City of Louisville
COLORADO • SINCE 1878

City Council

Agenda

Tuesday, October 19, 2021
Electronic Meeting
6:00 PM

This meeting will be held electronically. Residents interested in listening to the meeting or making public comments can join in one of two ways:

1) *You can call in to +1 408 638 0968 or 833 548 0282 (Toll Free), Webinar ID #814 0517 3371.*
2) *You can log in via your computer. Please visit the City's website here to link to the meeting: www.louisvilleco.gov/council*

The Council will accommodate public comments during the meeting. Anyone may also email comments to the Council prior to the meeting at Council@LouisvilleCO.gov.

1. CALL TO ORDER & ROLL CALL

2. APPROVAL OF AGENDA

3. PUBLIC COMMENTS ON ITEMS NOT ON THE AGENDA AND ITEMS ON THE CONSENT AGENDA

Council requests that public comments be limited to 3 minutes. When several people wish to speak on the same position on a given item, Council requests they select a spokesperson to state that position.

4. CONSENT AGENDA

The following items on the City Council Agenda are considered routine by the City Manager and shall be approved, adopted, accepted, etc., by motion of the City Council and roll call vote unless the Mayor or a City Council person specifically requests that such item be considered under "Regular Business." In such an event the item shall be removed from the "Consent Agenda" and Council action taken separately on said item in the order appearing on the Agenda. Those items so approved under the heading "Consent Agenda" will appear in the Council Minutes in their proper order.

A. Approval of Bills
B. Approval of Minutes: August 31, 2021
C. Approval of Council Meeting Schedule for Remainder of 2021
D. Louisville Chamber of Commerce 2021 Year End Report
E. Award Bid for 96th Street Bridge Repairs
F. Award Contracts for Engineering and Construction Services for Open Space Retaining Wall Replacement Project.

Citizen Information

If you wish to speak at the City Council meeting, please fill out a sign-up card and present it to the City Clerk.

Persons with disabilities planning to attend the meeting who need sign language interpretation, translation services, assisted listening systems, Braille, taped material, or special transportation, should contact the City Manager's Office at 303 335-4533. A forty-eight-hour notice is requested.

5. COUNCIL INFORMATIONAL COMMENTS ON PERTINENT ITEMS NOT ON THE AGENDA (Council general comments are scheduled at the end of the Agenda.)

6. CITY MANAGER'S REPORT

- Q3 2021 REVITALIZATION COMMISSION REPORT TO CITY COUNCIL

7. REGULAR BUSINESS

A. 501 JEFFERSON AVENUE LANDMARK & PRESERVATION GRANT

i. RESOLUTION NO. 71, SERIES 2021– A RESOLUTION APPROVING THE LESLIE HOUSE LOCATED AT 501 JEFFERSON AVENUE A HISTORIC LANDMARK

ii. RESOLUTION NO. 72, SERIES 2021 – A RESOLUTION APPROVING A HISTORIC PRESERVATION FUND GRANT FOR THE LESLIE HOUSE LOCATED AT 501 JEFFERSON AVENUE

- Mayor Opens Public Hearing
- Staff Presentation
- Public Comments (Please limit to three minutes each)
- Council Questions & Comments
- Mayor Closes Public Hearing
- Action

B. ORDINANCE NO. 1816, SERIES 2021 – AN ORDINANCE ADOPTING BY REFERENCE THE 2021 INTERNATIONAL ENERGY CONSERVATION CODE, WITH AMENDMENTS, REPEALING CHAPTER 15.60 OF THE LOUISVILLE MUNICIPAL CODE CONCERNING THE PRESCRIPTIVE ENERGY CODE AND DESIGN CRITERIA, AND AMENDING TITLE 17 OF THE LOUISVILLE MUNICIPAL CODE CONCERNING ELECTRIC VEHICLE CHARGING INFRASTRUCTURE – 2nd READING, PUBLIC HEARING (advertised *Daily Camera* 9/26/21)

- Mayor Opens Public Hearing
- Staff Presentation
- Public Comments (Please limit to three minutes each)
- Council Questions & Comments
- Additional Public Comments
- Mayor Closes Public Hearing
- Action

C. ORDINANCE NO. 1817, SERIES 2021 – AN ORDINANCE APPROVING THE VACATION OF A 125-FOOT BY 30.60-FOOT WIDE RIGHT-OF-WAY LYING SOUTH OF LOT 9, BLOCK 10, LOUISVILLE HEIGHTS SUBDIVISION IN THE CITY OF LOUISVILLE (601 MCKINLEY AVENUE) – 2nd READING, PUBLIC HEARING (advertised *Daily Camera* 10/10/21)

- Mayor Opens Public Hearing
- Staff Presentation
- Public Comments (Please limit to three minutes each)
- Council Questions & Comments
- Additional Public Comments
- Mayor Closes Public Hearing
- Action

D. REVISED RECOMMENDED BUDGET FOR 2022, INCLUDING UPDATED CAPITAL IMPROVEMENTS PLAN FOR 2021-2026 & UPDATED LONG-TERM FINANCIAL PLAN FOR 2021-2026 – PUBLIC HEARING (advertised *Daily Camera* 10/10/21)

- Mayor Opens Public Hearing
- Staff Presentation
- Public Comments (Please limit to three minutes each)
- Council Questions & Comments
- Mayor Closes Public Hearing
- Action

E. LOCAL LICENSING AUTHORITY FESTIVAL PERMITS

i. ORDINANCE NO. 1818, SERIES 2021 – AN ORDINANCE AMENDING CHAPTER 5.08 OF THE LOUISVILLE MUNICIPAL CODE TO AUTHORIZE THE LOCAL LICENSING AUTHORITY TO ISSUE FESTIVAL PERMITS AND TO UPDATE STATUTORY REFERENCES IN THE CHAPTER – 2nd READING, PUBLIC HEARING (advertised *Daily Camera* 10/10/21)

ii. RESOLUTION NO. 73, SERIES 2021 – A RESOLUTION APPROVING A FESTIVAL PERMIT FEE

- Mayor Opens Public Hearing
- Staff Presentation
- Public Comments (Please limit to three minutes each)
- Council Questions & Comments
- Additional Public Comments
- Mayor Closes Public Hearing
- Action

F. UPDATE ON CITY MANAGER RECRUITMENT PROCESS

- Council Presentation
- Public Comments (Please limit to three minutes each)
- Council Questions & Comments

8. CITY ATTORNEY'S REPORT

9. COUNCIL COMMENTS, COMMITTEE REPORTS, AND IDENTIFICATION OF FUTURE AGENDA ITEMS

10. ADJOURN

CASH ACCOUNT: 001000 101001 WARRANT: 093021 09/30/2021

VENDOR	VENDOR NAME	PURPOSE	AMOUNT
14154	ALLSTREAM	09/21/21-10/20/21 PHONE S	794.73
14164	ALPINE BANK	#5300089001 SOLAR PANEL L	3,729.33
14164	ALPINE BANK	#5300177601 SOLAR PANEL L	5,429.18
15142	BRANDON SHUPICK	GOLF INST REIM	140.00
14621	CHAD ROOT	REIMBURSEMENT TRAVEL EXPE	241.92
14801	CHRISTOPHER MELENDEZ	GOLF INSTR REIM	325.50
1115	COLONIAL LIFE INSURANCE	E9711888 SEP 2021 EMPLOYE	238.93
14938	INNOVISE BUSINESS CONSULTANTS	RENEWAL 2021/2022 FIDUCIA	7,400.00
2132	MEREDYTH MUTH	REIMBURSEMENT FOR ICE CRE	96.80
99999	MARIO & HENRIETTA BEEKES	UTILITY REFUND	78.51
99999	GEORGE BRANDON	UTILITY REFUND 508 LINCOL	106.03
15230	ROCKY MOUNTAIN OFFICIALS	FLAG FOOTBALL AND SOCCER	420.00
10884	WORD OF MOUTH CATERING INC	SENIOR MEAL REIM 9/23-9/2	3,005.55
3875	XCEL ENERGY	ELEC VEHICLE CHARGING STA	222.00
3875	XCEL ENERGY	SEPT 21 GROUP BILLING	83,651.48
15 INVOICES		WARRANT TOTAL	105,879.96

CASH ACCOUNT: 001000 101001 WARRANT: 100721 10/07/2021

VENDOR	VENDOR NAME	PURPOSE	AMOUNT
14923	CHOICE SCREENING INC	BACKGROUND CHECKS	460.50
14923	CHOICE SCREENING INC	BACKGROUND CHECKS	400.40
1115	COLONIAL LIFE INSURANCE	E9711888 OCT 2021 EMPLOYE	238.93
5255	FAMILY SUPPORT REGISTRY	Payroll Run 1 - Warrant 1	312.49
14603	KELLY ENTERPRISES LTD	LABOR DAY PARADE SUPPORT	325.00
10541	LITTLE VALLEY WHOLESALE NURSEY	FINANCE CHARGE	65.28
99999	MEGAN PIERCE	MILEAGE REIMBURSEMENT	100.73
99999	UNIVERSITY OF COLORADO	ARCHAEOLOGY CHILDREN PROG	195.00
99999	HELENE B MARTINEZ	REPLACE LOST CHECK#1178 P	459.06
15230	ROCKY MOUNTAIN OFFICIALS	FLAG FOOTBALL AND SOCCER	600.00
15213	RODNEY SAUER	LCC EVENT SILENT FILM JUN	300.00
10884	WORD OF MOUTH CATERING INC	SR MEAL PROGRAM 9/30-10/6	3,373.88
12 INVOICES		WARRANT TOTAL	6,831.27

CASH ACCOUNT: 001000 101001 WARRANT: 101421 10/14/2021

VENDOR	VENDOR NAME	PURPOSE	AMOUNT
15142	BRANDON SHUPICK	REIMB GOLF INSTR	294.00
15214	BT CONSTRUCTION INC	2021 Watermain Replacemen	38,016.15
15214	BT CONSTRUCTION INC	2021 Watermain Replacemen	425,345.40
11264	COLORADO DEPT OF PUBLIC HEALTH	MS4 PERMIT DUES FOR 2021	1,053.00
1205	COLORADO DEPT OF REVENUE	3Q 20201 REC CENTER AND G	11,908.11
15235	GRAVES CONSULTING LLC	1ST OF 3 INV FOR PAY EQUI	3,000.00
14306	KORBY LANDSCAPE LLC	PAY APP 1 Irrigation Main	47,180.62
14648	OCCUPATIONAL HEALTH CENTERS OF	DOT RECERT PHYS	377.00
11261	OFFICESCAPES	Cubicles for planning dep	13,822.33
99999	JOHN TUMASONIS	UTILITY REFUND 691 W ASPE	61.13
99999	HOMEWARD TITLE2	UTILITY REFUND 201 S MADI	118.86
9105	POSTMASTER	WINTER Postage for Commun	3,062.53
15230	ROCKY MOUNTAIN OFFICIALS	FLAG FOOTBALL AND SOCCER	330.00
10884	WORD OF MOUTH CATERING INC	SENIOR MEAL PROGRAM 10/7-	3,166.72
3875	XCEL ENERGY	SEPT 21 NON METERED	31,420.05
3875	XCEL ENERGY	SEPT 21 METERED	728.18
3875	XCEL ENERGY	SEPT 21 FLASHERS	17.62
	17 INVOICES	WARRANT TOTAL	579,901.70

CASH ACCOUNT: 001000 101001 WARRANT: 101921 10/19/2021

VENDOR	VENDOR NAME	PURPOSE	AMOUNT
13547	A G WASSENAAR INC	2021 Geotechnical Enginee	282.00
13547	A G WASSENAAR INC	2021 Geotechnical Enginee	3,458.50
14121	ACUSHNET COMPANY	2021 Resale Merchandise -	281.25
14121	ACUSHNET COMPANY	2021 Resale Merchandise -	122.67
14121	ACUSHNET COMPANY	2021 Resale Merchandise -	935.63
14121	ACUSHNET COMPANY	2021 Resale Merchandise -	83.23
14121	ACUSHNET COMPANY	2021 Resale Merchandise -	54.62
14121	ACUSHNET COMPANY	2021 Resale Merchandise -	981.26
12890	ADAMSON POLICE PRODUCTS	External Vest Carriers an	116.85
14547	ADIDAS AMERICA INC	2021 Resale Merchandise -	241.18
14547	ADIDAS AMERICA INC	CREDIT MEMO	-276.00
14547	ADIDAS AMERICA INC	2021 Resale Merchandise -	47.09
14547	ADIDAS AMERICA INC	2021 Resale Merchandise -	386.54
14547	ADIDAS AMERICA INC	2021 Resale Merchandise -	87.09
13959	AM SIGNAL INC	Portable Speed Radar	14,170.00
5001	BACKFLOW TECH	WWTP PLUMBING	942.82
5001	BACKFLOW TECH	PLUMBING	985.00
10801	BADGER METER INC	SEPT 21 CELLULAR SERVICES	106.80
500	BAKER AND TAYLOR	ADULT BOOKS AND MEDIA	22.00
500	BAKER AND TAYLOR	ADULT BOOKS AND MEDIA	13.74
500	BAKER AND TAYLOR	ADULT BOOKS AND MEDIA	24.74
500	BAKER AND TAYLOR	TEEN BOOKS AND MEDIA	15.94
10486	BERKELHAMMER TREE EXPERTS INC	PRUNING	1,260.00
14140	BLUE RIVER FORESTRY & TREE CAR	REMOVAL OF BRANCHES	2,250.00
640	BOULDER COUNTY	09/2021 BOULDER COUNTY US	11,717.62
8371	BOULDER VALLEY SCHOOL DISTRICT	6/9 LOVELAND LASER TAG	357.13
8371	BOULDER VALLEY SCHOOL DISTRICT	6/9 LOVELAND LASER TAG	342.34
8371	BOULDER VALLEY SCHOOL DISTRICT	6/16 GREAT OUTDOORS WATER	234.70
8371	BOULDER VALLEY SCHOOL DISTRICT	6/16 GREAT OUTDOORS WATER	141.48
8371	BOULDER VALLEY SCHOOL DISTRICT	6/23 COMM PARK LSVL	283.32
8371	BOULDER VALLEY SCHOOL DISTRICT	6/23 COMM PARK LSVL	275.78
8371	BOULDER VALLEY SCHOOL DISTRICT	6/30 ANDERSON FARMS	259.07
8371	BOULDER VALLEY SCHOOL DISTRICT	6/30 ANDERSON FARMS	259.98
8371	BOULDER VALLEY SCHOOL DISTRICT	7/7 DENVER MUSEUM	301.84
8371	BOULDER VALLEY SCHOOL DISTRICT	7/7 DENVER MUSEUM	337.20
8371	BOULDER VALLEY SCHOOL DISTRICT	7/14 COMM PARK LSVL	224.50
8371	BOULDER VALLEY SCHOOL DISTRICT	7/14 COMM PARK LSVL	224.50
8371	BOULDER VALLEY SCHOOL DISTRICT	7/21 LOVELAND LASER TAG	287.02
8371	BOULDER VALLEY SCHOOL DISTRICT	7/21 LOVELAND LASER TAG	280.78

CASH ACCOUNT: 001000 101001 WARRANT: 101921 10/19/2021

VENDOR	VENDOR NAME	PURPOSE	AMOUNT
8371	BOULDER VALLEY SCHOOL DISTRICT	7/28 DINOSAUR RIDGE	416.28
8371	BOULDER VALLEY SCHOOL DISTRICT	7/28 DINOSAUR RIDGE	387.77
8371	BOULDER VALLEY SCHOOL DISTRICT	8/4 COMM PARK LSVL	334.34
8371	BOULDER VALLEY SCHOOL DISTRICT	8/4 COMM PARK LSVL	333.30
7706	BRANNAN SAND & GRAVEL CO LLC	2021 Asphalt Hot Mix	284.83
7706	BRANNAN SAND & GRAVEL CO LLC	2021 Asphalt Hot Mix	232.96
7706	BRANNAN SAND & GRAVEL CO LLC	2021 Asphalt Hot Mix	288.02
14850	BRIDGEPAY NETWORK SOLUTIONS LL	SEPT 2021 CREDIT CARD FEE	23.10
9838	BRIGHTVIEW LANDSCAPE SERVICES	2021 Downtown Floral Disp	2,000.02
9838	BRIGHTVIEW LANDSCAPE SERVICES	Landscape Maintenance Ser	31,974.81
15236	BUILT 13 LLC	LABOE DAY RENTAL SETUP TE	1,750.00
10773	CENTRIC ELEVATOR CORP	c PC	289.66
10773	CENTRIC ELEVATOR CORP	OCT 21 ELEVATOR MAINT LI	566.91
10773	CENTRIC ELEVATOR CORP	OCT 21 ELEVATOR MAINT RSC	331.33
10773	CENTRIC ELEVATOR CORP	OCT 21 ELEVATOR MAINT CH	341.39
2220	CHEMTRADE CHEMICALS US LLC	Aluminum Sulfate for Wate	4,770.40
2220	CHEMTRADE CHEMICALS US LLC	Aluminum Sulfate for Wate	4,780.64
4785	CINTAS CORPORATION #66	UNIFORM SERVICE	262.96
4785	CINTAS CORPORATION #66	UNIFORM SERVICE	270.96
4785	CINTAS CORPORATION #66	UNIFORM SERVICE	329.38
4785	CINTAS CORPORATION #66	UNIFORM SERVICE	262.96
11467	CLEAR CREEK CONSULTANTS INC	AUDIT DATA REVIEW CELL SU	954.00
14118	CLUB PROPHET SYSTEMS	2021 Club Prophet Subscri	630.00
1120	COLORADO ANALYTICAL LABORATORI	TOTAL COLIFORM	162.50
1120	COLORADO ANALYTICAL LABORATORI	TOTAL COLIFORM	162.50
1120	COLORADO ANALYTICAL LABORATORI	FLUORIDE	26.20
1120	COLORADO ANALYTICAL LABORATORI	FLUORIDE	26.20
1120	COLORADO ANALYTICAL LABORATORI	DBP	796.00
1120	COLORADO ANALYTICAL LABORATORI	ANNUAL IPP SAMPLES	424.80
11353	COLORADO LIBRARY CONSORTIUM	EMAGAZINES OVERDRIVE	1,360.43
13162	CORE & MAIN LP	2021 Utility Parts	1,311.01
15036	DAVID J. THROWER	SEPT 21 JUDGE SERVICES	2,800.00
14529	DE NORA WATER TECHNOLOGIES INC	POWER SUPPLY	1,512.58
15149	DENALI WATER SOLUTIONS LLC	Biosolids Hauling- WWTP	716.77

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VENDOR	VENDOR NAME	PURPOSE	AMOUNT
13929	DHE COMPUTER SYSTEMS LLC	DOCKING STATION	186.31
14767	DIRECT DISCHARGE CONSULTING LL	Temporary Emergency Opera	4,000.00
14189	DON KING LANDSCAPING LLC	AUG 2021 IRRIGATION REPAI	2,400.00
14189	DON KING LANDSCAPING LLC	SEPT 2021 IRRIGATION REPA	2,400.00
1785	ECO-CYCLE INC	LABOR DAY SENIOR DINNER	435.79
14835	EDGE CONTRACTING INC	SH42 Underpass Landscape	3,875.00
13347	GLOBAL EQUIPMENT COMPANY INC	LIFT TRUCK FOR FLUORIDE	2,449.25
14936	GOLDEN AUTOMATION LLC	BACKWASH RECYCLE PUMP PRO	1,460.00
2310	GRAINGER	IPP SAMPLE BOTTLES	82.68
15157	GRAVES CIVIC SOLUTIONS LLC	EDI TASK FORCE NOVEMBER	6,944.44
2405	HACH COMPANY	DPD DISPENSER	140.90
2415	HARCROS CHEMICALS INC	WWTP SODIUM BICARBONATE	612.50
2475	HILL PETROLEUM	2021 Annual Fuel Purchase	14,763.72
15209	HOLLAR TREE CO LLC	ROW TREES	2,400.00
15212	HW HOUSTON CONSTRUCTION LLC	Arts Center Restoration C	28,700.00
9710	INDUSTRIAL CHEMICALS CORP	Sodium Silicate for Water	11,456.64
9710	INDUSTRIAL CHEMICALS CORP	SWTP HYDROCHLORIC ACID	238.50
9710	INDUSTRIAL CHEMICALS CORP	POTASSIUM PERMANGANATE	487.03
2615	INGRAM LIBRARY SERVICES INC	TEEN BOOKS AND MEDIA	83.25
2615	INGRAM LIBRARY SERVICES INC	TEEN BOOKS AND MEDIA	56.61
2615	INGRAM LIBRARY SERVICES INC	TEEN BOOKS AND MEDIA	20.88
2615	INGRAM LIBRARY SERVICES INC	TEEN BOOKS AND MEDIA	23.08
2615	INGRAM LIBRARY SERVICES INC	TEEN BOOKS AND MEDIA	111.75
2615	INGRAM LIBRARY SERVICES INC	TEEN BOOKS AND MEDIA	50.00
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	119.22
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	96.89
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	61.71
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	41.96
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	16.49
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	128.13
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	11.86
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	65.58
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	15.40
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	238.26
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	68.93

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VENDOR	VENDOR NAME	PURPOSE	AMOUNT
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	50.03
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	270.95
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	62.38
2615	INGRAM LIBRARY SERVICES INC	CHILDRENS BOOKS AND MEDIA	86.92
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	253.94
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	54.48
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	186.51
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	214.95
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	77.55
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	25.44
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	29.67
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	100.59
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	125.79
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	52.96
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	199.13
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	44.21
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	98.50
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	36.95
2615	INGRAM LIBRARY SERVICES INC	ADULT BOOKS AND MEDIA	223.75
15189	INNOVATIVE UTILITY SOLUTIONS L	Smart Meter Pilot Test Co	1,745.10
11267	INSIDE OUT HEALTH AND FITNESS	OUTDOOR PIYO 30027.1	490.00
13280	INSIGHT PUBLIC SECTOR INC	BLUEBEAM SOFTWARE ADDITIO	430.15
13280	INSIGHT PUBLIC SECTOR INC	ACCESS LICENSES FOR OPEN	314.25
14719	INTECONNECT INC	REPAIR OF CARD READER SWT	1,900.00
14719	INTECONNECT INC	WASHBAY DOOR ACCESS PANEL	807.50
13471	INTEGRATED CONTROL SYSTEMS INC	EMERG SRVCS TO HVAC RSC	1,160.00
10772	INTEGRATED SAFETY SERVICES LLC	GCC-HOOD AND FIRE ALARM I	436.03
13778	INVISION GIS LLC	SEPT 2021 GIS & AM Implem	6,386.25
15229	J KENT & ASSOCIATES INC	LABOR DAY SENIOR DINNER	348.00
15229	J KENT & ASSOCIATES INC	LABOR DAY PARADE STAFF	1,533.50
14904	JOANNA ALIDU	HISTORIC STRUCTURE ASSESS	4,000.00
14922	JOHN BRUNNER & COMPANY INC	POOL GAS VALVE REPLACEMEN	1,508.80
14922	JOHN BRUNNER & COMPANY INC	SERVICED SPLASH POOL	1,452.64
14922	JOHN BRUNNER & COMPANY INC	HOT GASKET LEAK	1,076.19
11289	JVA INC	AUG 2021 WWTP Solids Hand	15,253.12
11289	JVA INC	AUG 2021 WWTP FOG Design/	1,578.00
11289	JVA INC	Design Services for Fluor	2,520.00
2360	KELLY PC	SEPT 21 LEGAL SERVICES	32,991.00

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VENDOR	VENDOR NAME	PURPOSE	AMOUNT
14703	KEN CARYL GLASS INC	WINDOWS FOR DOORS	1,911.79
14703	KEN CARYL GLASS INC	Doors for Racqueball/Turf	3,147.30
14097	L.A.W.S.	Equipment for 3 patrol ve	17,201.95
5432	LOUISVILLE FIRE PROTECTION DIS	09/2021 FIRE PROTECTION D	6,274.00
12919	MARK WOZNY	JACKET	69.71
15240	MATTHEW AARON GOLDSTEIN	841 JEFFERSON HISTORIC ST	4,000.00
13525	MICHAEL BAKER JR INC	Wayfinding Design CIP (Ph	925.00
15225	MIDNIGHT METALS LLC	Museum HVAC Replacement C	36,636.00
14918	MIZUNO USA INC - NDC	2021 Resale Merchandise -	415.54
14768	MOJOS CLEANING SERVICES INC	SEPT 21 PARKS JANITORIAL	3,300.00
14768	MOJOS CLEANING SERVICES INC	OCT 21 JANITORIAL SERVICE	33,428.06
6168	MOTION & FLOW CONTROL PRODUCTS	#3296 EQUIP	156.34
6168	MOTION & FLOW CONTROL PRODUCTS	#3296 HYDR	200.51
6168	MOTION & FLOW CONTROL PRODUCTS	#3201	1,230.00
13565	MOTT MACDONALD LLC	SCWTP Disinfection - Cons	3,220.00
11061	MOUNTAIN PEAK CONTROLS INC	TROUBLESHOOT REUSE PROGRA	375.00
13597	NORTH LINE GIS LLC	2021 GIS Consulting Servi	1,140.00
99999	LESLIE RINGER	REC CENTER CREDIT BAL REF	199.00
99999	BLUE EARTH PRODUCTS	MEDIA TESTING	1,300.00
13649	OVERDRIVE INC	ADULT EMATERIALS	699.95
13649	OVERDRIVE INC	ADULT EMATERIALS	308.48
13649	OVERDRIVE INC	ADULT EMATERIALS	812.24
13649	OVERDRIVE INC	ADULT EMATERIALS	259.80
14144	PING INC	2021 Resale Merchandise -	882.00
14144	PING INC	2021 Resale Merchandise -	660.04
14160	PRECISE MRM LLC	AUG 21 POOLED DATA & MONT	280.00
13549	PUSH PEDAL PULL INC	FITNESS EQUIP MAINT	756.26
12840	QUALITY WATER BIOSYSTEMS INC	CUTRINE	1,155.00
14844	REPUBLIC SERVICES INC #535	SEPT 21 RESIDENTIAL WASTE	121,423.62
14844	REPUBLIC SERVICES INC #535	SEPT 21 SERVICES	4,235.59

CASH ACCOUNT: 001000 101001 WARRANT: 101921 10/19/2021

VENDOR	VENDOR NAME	PURPOSE	AMOUNT
14804	RESPEC COMPANY LLC	Environmental Compliance	6,845.00
14549	RICHARDSON SPORTS INC	2021 Resale Merchandise -	758.70
14549	RICHARDSON SPORTS INC	2021 Resale Merchandise -	168.00
14352	RIVISTAS SUBSCRIPTION SERVICES	PRINT PERIODICALS	3,965.85
15206	SMITH POWER PRODUCTS, INC	CO to include a new contr	4,708.56
14550	TAYLOR MADE GOLF COMPANY INC	2021 Resale Merchandise -	633.43
14550	TAYLOR MADE GOLF COMPANY INC	2021 Resale Merchandise -	424.80
14707	THATCHER COMPANY INC	Aluminum Chlorohydrate fo	13,448.73
1047	THE DAVEY TREE EXPERT COMPANY	TREE PRUNING	2,200.00
9481	THE HOME DEPOT	MISC SUPPLIES	960.02
9481	THE HOME DEPOT	MISC SUPPLIES	233.78
9481	THE HOME DEPOT	CREDIT MEMO MISC SUPPLIES	-24.80
14663	THE JUMP ROPE GROUP LLC	JUMP ROPE	249.20
15219	TJM SERVICES LLC	ATHLETIC FIELD STRIPING	2,104.00
15049	TODAY'S BUSINESS SOLUTIONS, IN	TBS	5,100.00
4765	UNCC	SEPT 21 LOCATES	512.16
14532	UNITED REFRIGERATION INC	TOOLS	219.99
11087	UNITED SITE SERVICES OF COLORA	TOILET RENTAL	251.60
11087	UNITED SITE SERVICES OF COLORA	TOILET RENTAL LABOR DAY	210.00
11087	UNITED SITE SERVICES OF COLORA	TOILET RENTAL LABOR DAY	210.00
11087	UNITED SITE SERVICES OF COLORA	TOILET RENTAL LABOR DAY	210.00
11087	UNITED SITE SERVICES OF COLORA	TOILET RENTAL LABOR DAY	210.00
11087	UNITED SITE SERVICES OF COLORA	TOILET RENTAL LABOR DAY	420.00
11087	UNITED SITE SERVICES OF COLORA	TOILET RENTAL LABOR DAY	403.06
11087	UNITED SITE SERVICES OF COLORA	TOILET RENTAL	283.70
6509	USA BLUEBOOK	DISTRO SUPPLIES	47.99
6509	USA BLUEBOOK	DISTRO SUPPLIES	678.60
14690	VELOCITY CONSTRUCTORS INC	BUILDING PERMIT FEE CITY	2,500.00
14690	VELOCITY CONSTRUCTORS INC	SEPT 2021 WWTP FOG Mitiga	26,790.00
11053	WATER TECHNOLOGY GROUP	WWTP Influent PS Electric	7,000.00
15014	WATTLE & DAUB CONTRACTORS	Provide historic structur	11,390.00

CASH ACCOUNT: 001000 101001 WARRANT: 101921 10/19/2021

VENDOR	VENDOR NAME	PURPOSE	AMOUNT
14821	WAYNES ELECTRIC INC	MS POOL PUMP PANEL REPLAC	2,415.00
14373	WEIFIELD GROUP CONTRACTING INC	JULY 2021 WWTP SERVICE CA	1,142.00
14373	WEIFIELD GROUP CONTRACTING INC	JUNE 2021 WWTP SERVICE CA	602.80
14373	WEIFIELD GROUP CONTRACTING INC	WWTP MAR APR MAY SERVICE	1,235.00
14373	WEIFIELD GROUP CONTRACTING INC	JUNE 2021 WWTP SERVICE CA	1,680.82
14373	WEIFIELD GROUP CONTRACTING INC	RECYCLE FLOW METER INSTAL	1,144.00
14373	WEIFIELD GROUP CONTRACTING INC	WWTP EMERG REPAIRS 5/3-6/	86,628.39
9511	WESTERN PAPER DISTRIBUTORS INC	BREAKROOM SUPPLIES RSC	144.55
9511	WESTERN PAPER DISTRIBUTORS INC	BREAKROOM SUPPLIES CS	144.55
9511	WESTERN PAPER DISTRIBUTORS INC	CUSTODIAL SUPPLIES RSC	76.05
3875	XCEL ENERGY	SEPT 21 SPRINKLERS	116.52
14050	YBA SHIRTS INC	YOUTH FLAG FOOTBALL JERSE	2,437.50
13790	ZAYO GROUP LLC	OCT 21 INTERNET SERVICE C	1,500.00
	220 INVOICES	WARRANT TOTAL	704,585.94

CITY OF LOUISVILLE

PURCHASE CARD SUMMARY

STATEMENT PERIOD 08/20/21- 09/21/21

SUPPLIER	SUPPLIER LOCATION	CARDHOLDER	DEPARTMENT	TRANS DATE	AMOUNT
4 RIVERS EQUIPMENT	GREELEY	AARON GRANT	PARKS	08/19/2021	28.70
AARP *MEMBERSHIP	888-687-2277	JILL SIEWERT	LIBRARY	09/15/2021	16.00
ABC-NV	913-8954600	DEVIN MADIGAN	WASTEWATER	08/19/2021	100.00
AIS INDUSTRIAL SUPPLY	DENVER	JACK MANIAN	OPERATIONS	08/30/2021	50.55
ALLDATA	800-859-3282	MASON THOMPSON	OPERATIONS	09/02/2021	125.00
AMAZON.COM*250CC9A91 A	AMZN.COM/BILL	JULIE SEYDEL	REC CENTER	08/27/2021	70.00
AMAZON.COM*252S22BM0 A	AMZN.COM/BILL	ELIZABETH SCHETTLER	PLANNING	09/01/2021	31.48
AMAZON.COM*256UQ0QD1 A	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	09/01/2021	27.11
AMAZON.COM*259AU3BY1 A	AMZN.COM/BILL	CATHERINE JEPSON	PARKS	08/31/2021	39.98
AMAZON.COM*259VT9CU1 A	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	08/23/2021	22.99
AMAZON.COM*2D3V21II0 A	AMZN.COM/BILL	BRIAN GARDUNO	OPERATIONS	08/23/2021	27.12
AMAZON.COM*2D5227182 A	AMZN.COM/BILL	BRIDGET BACON	LIBRARY	08/20/2021	17.11
AMAZON.COM*2D7YV0IL0 A	AMZN.COM/BILL	JESSE DEGRAW	REC CENTER	08/23/2021	558.00
AMAZON.COM*2D87J9V32 A	AMZN.COM/BILL	PEGGY NORRIS	LIBRARY	08/22/2021	69.00
AMAZON.COM*2D8SM2RT0 A	AMZN.COM/BILL	PEGGY NORRIS	LIBRARY	08/23/2021	17.98
AMAZON.COM*2D9YM45L2 A	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	08/23/2021	12.96
AMAZON.COM*2G0BA6NF1 A	AMZN.COM/BILL	SHARON SCHRAMM	PARKS	09/08/2021	114.89
AMAZON.COM*2G0UF54A2 A	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	09/15/2021	11.99
AMAZON.COM*2G1SW9HL0 A	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	09/15/2021	35.31
AMAZON.COM*2G2FZ49S0 A	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	09/19/2021	9.99
AMAZON.COM*2G3AO0FW2 A	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	09/15/2021	53.05
AMAZON.COM*2G5FZ4XT2 A	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	09/20/2021	9.99
AMAZON.COM*2G7QM8LM1 A	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	09/08/2021	15.31
AMAZON.COM*2G83E9VU0 A	AMZN.COM/BILL	ELIZABETH SCHETTLER	PLANNING	09/14/2021	49.99
AMBIENTE H2O INC	SHERIDAN	DEVIN MADIGAN	WASTEWATER	08/31/2021	315.08
AMERICAN RED CROSS	800-733-2767	DANIEL BIDLEMEN	REC CENTER	09/13/2021	96.00
AMERICAN RED CROSS	800-733-2767	DANNY WEIONSTOCK	REC CENTER	09/02/2021	224.00
AMERICAN RED CROSS	800-733-2767	DANIEL BIDLEMEN	REC CENTER	09/01/2021	40.00
AMERICAN RED CROSS	800-733-2767	KATIE MEYER	REC CENTER	08/30/2021	40.00
AMERICAN RED CROSS	800-733-2767	DANIEL BIDLEMEN	REC CENTER	08/24/2021	32.00
AMERICAN RED CROSS	800-733-2767	DANIEL BIDLEMEN	REC CENTER	08/24/2021	96.00
AMERICAN RED CROSS	800-733-2767	KATIE MEYER	REC CENTER	08/20/2021	312.00

AMERICAN SWING PRODUCT	8004332573	KATHLEEN D LORENZO	PARKS	09/14/2021	717.90
AMERLIBASSOC ECOMMERCE	866-746-7252	ERIN OWEN	LIBRARY	08/20/2021	148.00
AMZ*WATER TECH CORP	PAY.AMAZON.CO	EZRA VENO	REC CENTER	08/31/2021	146.26
AMZN MKTP US*255B25CQ2	AMZN.COM/BILL	ELIZABETH SCHETTLER	PLANNING	08/30/2021	59.99
AMZN MKTP US*255IE9H82	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	09/08/2021	57.89
AMZN MKTP US*2D5RI35D2	AMZN.COM/BILL	SHARON SCHRAMM	PARKS	08/23/2021	111.85
AMZN MKTP US*2G1V59581	AMZN.COM/BILL	GREG VENETTE	WATER	09/14/2021	35.98
AMZN MKTP US*2G49T3142	AMZN.COM/BILL	CATHERINE JEPSON	PARKS	09/19/2021	5.92
AMZN MKTP US*2G5TR4K50	AMZN.COM/BILL	CATHERINE JEPSON	PARKS	09/19/2021	23.69
AMZN MKTP US	AMZN.COM/BILL	KATIE TOFTE	REC CENTER	08/25/2021	6.98
AMZN MKTP US*251AI4L70	AMZN.COM/BILL	KATIE TOFTE	REC CENTER	08/25/2021	5.99
AMZN MKTP US*251I71HM1	AMZN.COM/BILL	PATRICIA MORGAN	REC CENTER	08/31/2021	14.99
AMZN MKTP US*251JH5PI1	AMZN.COM/BILL	LESLIE RINGER	HUMAN RESOURCES	08/29/2021	13.32
AMZN MKTP US*251PA8CI2	AMZN.COM/BILL	SANDRA ANDRETICH	OPERATIONS	08/30/2021	33.95
AMZN MKTP US*251Q91H91	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	08/31/2021	92.90
AMZN MKTP US*251U51RC1	AMZN.COM/BILL	SANDRA ANDRETICH	OPERATIONS	09/05/2021	6.91
AMZN MKTP US*252079850	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	09/01/2021	41.54
AMZN MKTP US*2525S8532	AMZN.COM/BILL	BRIDGET BACON	LIBRARY	09/08/2021	27.76
AMZN MKTP US*252GP3PV0	AMZN.COM/BILL	ERICA SCHMITT	LIBRARY	08/29/2021	6.90
AMZN MKTP US*252KH9IP1	AMZN.COM/BILL	RONDA HENGER	HUMAN RESOURCES	09/05/2021	50.36
AMZN MKTP US*253Q87GP2	AMZN.COM/BILL	DAVID BARIL	GOLF COURSE	09/06/2021	39.95
AMZN MKTP US*253Q89IS1	AMZN.COM/BILL	RONDA HENGER	HUMAN RESOURCES	09/05/2021	8.39
AMZN MKTP US*253Y09CQ0	AMZN.COM/BILL	GREG VENETTE	WATER	08/24/2021	315.96
AMZN MKTP US*254JU0C72	AMZN.COM/BILL	PATRICIA MORGAN	REC CENTER	08/30/2021	148.38
AMZN MKTP US*254S84LA2	AMZN.COM/BILL	PATRICIA MORGAN	REC CENTER	09/01/2021	9.98
AMZN MKTP US*2557O8CU2	AMZN.COM/BILL	BRIAN GARDUNO	OPERATIONS	08/30/2021	6.99
AMZN MKTP US*255B68RX2	AMZN.COM/BILL	PATRICIA MORGAN	REC CENTER	09/13/2021	101.85
AMZN MKTP US*255NN6VC0	AMZN.COM/BILL	JULIE SEYDEL	REC CENTER	08/30/2021	16.29
AMZN MKTP US*2564Y5WJ1	AMZN.COM/BILL	AMANDA PERERA	REC CENTER	09/06/2021	14.95
AMZN MKTP US*256UG1CM1	AMZN.COM/BILL	JULIE SEYDEL	REC CENTER	08/23/2021	449.70
AMZN MKTP US*256WP06O2	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	09/09/2021	239.99
AMZN MKTP US*2571N4CS0	AMZN.COM/BILL	JULIE SEYDEL	REC CENTER	08/24/2021	7.93
AMZN MKTP US*257237GZ1	AMZN.COM/BILL	LESLIE RINGER	HUMAN RESOURCES	08/29/2021	51.98
AMZN MKTP US*2573K2WT0	AMZN.COM/BILL	SANDRA ANDRETICH	OPERATIONS	09/06/2021	222.29
AMZN MKTP US*257GU3PR0	AMZN.COM/BILL	ERICA SCHMITT	LIBRARY	08/29/2021	27.99
AMZN MKTP US*257WF0TK1	AMZN.COM/BILL	DAVID DEAN	GOLF COURSE	08/26/2021	21.98
AMZN MKTP US*258293810	AMZN.COM/BILL	ERICA SCHMITT	LIBRARY	09/01/2021	59.21

AMZN MKTP US*258QX36G2	AMZN.COM/BILL	KRISTEN BODINE	LIBRARY	09/10/2021	39.85
AMZN MKTP US*258VJ3Z81	AMZN.COM/BILL	JULIE SEYDEL	REC CENTER	08/25/2021	16.99
AMZN MKTP US*258WH4D42	AMZN.COM/BILL	ELIZABETH SCHETTLER	PLANNING	09/10/2021	186.54
AMZN MKTP US*259657LE0	AMZN.COM/BILL	BRIDGET BACON	LIBRARY	08/25/2021	72.87
AMZN MKTP US*2599M59J2	AMZN.COM/BILL	GENEVIEVE KLINE	CITY CLERK	09/12/2021	12.99
AMZN MKTP US*259BX3HP0	AMZN.COM/BILL	SANDRA ANDRETICH	OPERATIONS	08/31/2021	75.98
AMZN MKTP US*259N95NJ2	AMZN.COM/BILL	BRIAN GARDUNO	OPERATIONS	09/01/2021	109.98
AMZN MKTP US*2D0DP3SY2	AMZN.COM/BILL	KERRY HOLLE	PUBLIC WORKS	08/25/2021	34.63
AMZN MKTP US*2D0Z979X0	AMZN.COM/BILL	KATIE TOFTE	REC CENTER	08/22/2021	6.98
AMZN MKTP US*2D1877X62	AMZN.COM/BILL	ERICA SCHMITT	LIBRARY	08/22/2021	41.95
AMZN MKTP US*2D1IF90G2	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	08/20/2021	33.13
AMZN MKTP US*2D1VX6AT2	AMZN.COM/BILL	BOBBIEJO TREGAY	FINANCE	08/19/2021	9.59
AMZN MKTP US*2D2G31SK2	AMZN.COM/BILL	DAVID DEAN	GOLF COURSE	08/25/2021	59.41
AMZN MKTP US*2D2P45DK0	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	08/20/2021	82.50
AMZN MKTP US*2D3KO4DO2	AMZN.COM/BILL	SHARON SCHRAMM	PARKS	08/25/2021	19.98
AMZN MKTP US*2D3SJ99U1	AMZN.COM/BILL	LINDSEY WITTY	REC CENTER	08/20/2021	603.95
AMZN MKTP US*2D3ZC5WS1	AMZN.COM/BILL	ERICA SCHMITT	LIBRARY	08/22/2021	176.28
AMZN MKTP US*2D5BL4P92	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	08/20/2021	146.55
AMZN MKTP US*2D5O68DF0	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	08/20/2021	30.15
AMZN MKTP US*2D66L4DO2	AMZN.COM/BILL	ALEX ABBOTT	IT	08/25/2021	26.98
AMZN MKTP US*2D68J3YU2	AMZN.COM/BILL	JULIE SEYDEL	REC CENTER	08/30/2021	88.92
AMZN MKTP US*2D6HQ88A0	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	08/19/2021	77.94
AMZN MKTP US*2D6YA5EP2	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	08/19/2021	75.98
AMZN MKTP US*2D7GG4RI1	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	08/22/2021	19.94
AMZN MKTP US*2D7NA4Q90	AMZN.COM/BILL	SANDRA ANDRETICH	OPERATIONS	08/19/2021	209.70
AMZN MKTP US*2D83G87J2	AMZN.COM/BILL	GLORIA HANDYSIDE	CITY MANAGER	08/27/2021	137.95
AMZN MKTP US*2D84C66R2	AMZN.COM/BILL	ALEX ABBOTT	IT	08/25/2021	53.96
AMZN MKTP US*2D8MD1HM2	AMZN.COM/BILL	AMANDA PERERA	REC CENTER	08/23/2021	84.18
AMZN MKTP US*2D8XS96P2	AMZN.COM/BILL	SANDRA ANDRETICH	OPERATIONS	08/25/2021	91.00
AMZN MKTP US*2G01N5FD2	AMZN.COM/BILL	PATRICIA MORGAN	REC CENTER	09/15/2021	43.30
AMZN MKTP US*2G03L2830	AMZN.COM/BILL	DAVID BARIL	GOLF COURSE	09/16/2021	7.49
AMZN MKTP US*2G06T6551	AMZN.COM/BILL	BOBBIEJO TREGAY	FINANCE	09/14/2021	28.59
AMZN MKTP US*2G0AW6RT1	AMZN.COM/BILL	PATRICIA MORGAN	REC CENTER	09/20/2021	16.99
AMZN MKTP US*2G0G90502	AMZN.COM/BILL	ERICA BERZINS	POLICE	09/21/2021	81.69
AMZN MKTP US*2G0JQ13F2	AMZN.COM/BILL	SANDRA ANDRETICH	OPERATIONS	09/17/2021	56.99
AMZN MKTP US*2G0LS8UO0	AMZN.COM/BILL	PATRICIA MORGAN	REC CENTER	09/20/2021	68.85
AMZN MKTP US*2G1775JC2	AMZN.COM/BILL	JEANETTE LONGORIA	SALES TAX	09/17/2021	19.07

AMZN MKTP US*2G1WB8VA1	AMZN.COM/BILL	KRISTEN BODINE	LIBRARY	09/13/2021	25.00
AMZN MKTP US*2G23M2QJ0	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	09/16/2021	196.05
AMZN MKTP US*2G35D8JY1	AMZN.COM/BILL	BRIAN GARDUNO	OPERATIONS	09/09/2021	181.08
AMZN MKTP US*2G42D3H90	AMZN.COM/BILL	PATRICIA MORGAN	REC CENTER	09/15/2021	63.81
AMZN MKTP US*2G4AK3DP0	AMZN.COM/BILL	ELIZABETH SCHETTLER	PLANNING	09/17/2021	75.00
AMZN MKTP US*2G52J42O1	AMZN.COM/BILL	ELIZABETH SCHETTLER	PLANNING	09/17/2021	75.00
AMZN MKTP US*2G5L19DU1	AMZN.COM/BILL	JEANETTE LONGORIA	SALES TAX	09/16/2021	58.26
AMZN MKTP US*2G5OC15T0	AMZN.COM/BILL	CATHERINE JEPSON	PARKS	09/15/2021	154.45
AMZN MKTP US*2G5Q27KV0	AMZN.COM/BILL	PATRICIA MORGAN	REC CENTER	09/19/2021	72.59
AMZN MKTP US*2G6FB2U31	AMZN.COM/BILL	GREG VENETTE	WATER	09/19/2021	29.96
AMZN MKTP US*2G6PS0KZ1	AMZN.COM/BILL	GLORIA HANDYSIDE	CITY MANAGER	09/17/2021	26.97
AMZN MKTP US*2G6PW9ZR1	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	09/08/2021	59.95
AMZN MKTP US*2G8RP8NE2	AMZN.COM/BILL	SANDRA ANDRETICH	OPERATIONS	09/16/2021	61.99
APWA CO CHPT	9704028620	VICKIE ILKO	OPERATIONS	08/26/2021	125.00
ARROWHEAD AWARDS	303-447-9407	DAWN BURGESS	CITY MANAGER	09/07/2021	70.00
ARROWHEAD AWARDS	BOULDER	DEAN JOHNSON	PARKS	08/30/2021	174.00
ATT*TECH SUPPORT 360	877-88TS360	CHRISTOPHER NEVES	IT	09/11/2021	10.00
ADOBE INC	8008336687	KURT KOWAR	PUBLIC WORKS	08/26/2021	29.98
AMAZON.COM*2500Z94J2	AMZN.COM/BILL	JESSE DEGRAW	REC CENTER	08/31/2021	93.24
AMAZON.COM*251IC8X20	AMZN.COM/BILL	JESSE DEGRAW	REC CENTER	08/30/2021	261.52
AMAZON.COM*252M98CZ2	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	08/30/2021	35.92
AMAZON.COM*254UR2QE2	AMZN.COM/BILL	BRIDGET BACON	LIBRARY	09/09/2021	147.98
AMAZON.COM*254XF1EZ2	AMZN.COM/BILL	CATHERINE JEPSON	PARKS	09/04/2021	109.90
AMAZON.COM*256A17YZ2	AMZN.COM/BILL	JEN KENNEY	POLICE	09/14/2021	171.96
AMAZON.COM*256NT4ZG0	AMZN.COM/BILL	JESSE DEGRAW	REC CENTER	08/26/2021	40.50
AMAZON.COM*2570N3382	AMZN.COM/BILL	AMANDA PERERA	REC CENTER	09/02/2021	5.99
AMAZON.COM*258IA8B22	AMZN.COM/BILL	KRISTEN BODINE	LIBRARY	09/08/2021	15.98
AMAZON.COM*258S27FK1	AMZN.COM/BILL	DEVIN MADIGAN	WASTEWATER	08/24/2021	155.00
AMAZON.COM*258Z65WT0	AMZN.COM/BILL	AMANDA PERERA	REC CENTER	09/06/2021	13.99
AMAZON.COM*259DD2TQ0	AMZN.COM/BILL	SANDRA ANDRETICH	OPERATIONS	08/27/2021	89.99
AMAZON.COM*2D4NV30D2	AMZN.COM/BILL	SANDRA ANDRETICH	OPERATIONS	08/20/2021	8.67
AMAZON.COM*2D52H6VU2	AMZN.COM/BILL	GREG VENETTE	WATER	08/22/2021	12.24
AMAZON.COM*2D62J82F2	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	08/26/2021	49.75
AMAZON.COM*2D7N14A82	AMZN.COM/BILL	SANDRA ANDRETICH	OPERATIONS	08/19/2021	8.67
AMAZON.COM*2D86C4H32	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	08/23/2021	13.99
AMAZON.COM*2D99N4QM0	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	08/19/2021	16.99
AMAZON.COM*2G0UI0GI1	AMZN.COM/BILL	SANDRA ANDRETICH	OPERATIONS	09/12/2021	17.34

AMAZON.COM*2G1HH9Q60	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	09/16/2021	20.98
AMAZON.COM*2G4781Z72	AMZN.COM/BILL	JEANETTE LONGORIA	SALES TAX	09/16/2021	48.13
AMAZON.COM*2G49O3240	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	09/18/2021	9.99
AMAZON.COM*2G4IX5F22	AMZN.COM/BILL	JOSH GILBERTSON	IT	09/15/2021	174.95
AMAZON.COM*2G4S92TB1	AMZN.COM/BILL	ELIZABETH SCHETTLER	PLANNING	09/10/2021	13.88
AMAZON.COM*2G6X06G71	AMZN.COM/BILL	ALEX ABBOTT	IT	09/12/2021	41.95
AMAZON.COM*2G7VG0721	AMZN.COM/BILL	JEANETTE LONGORIA	SALES TAX	09/18/2021	45.98
AMAZON.COM*2G8EL4IT1	AMZN.COM/BILL	JILL SIEWERT	LIBRARY	09/19/2021	35.98
AMAZON.COM*2G9OL8V22	AMZN.COM/BILL	LANCE PFEIFER	GOLF COURSE	09/20/2021	152.92
BEST BUY 00014167	DENVER	SHARON SCHRAMM	PARKS	09/08/2021	29.90
BEST BUY 00014167	DENVER	SANDRA ANDRETICH	OPERATIONS	08/21/2021	129.98
BEST WESTERN HOTELS	EAGLE	CHAD ROOT	BUILDING SAFETY	08/20/2021	302.40
BIZWEST-DIGITAL	FORT COLLINS	ROBERT ZUCCARO	PLANNING	09/12/2021	8.00
BIZWEST-PRINT-PLUS	FORT COLLINS	JILL SIEWERT	LIBRARY	09/14/2021	89.00
BK TIRE	FREDERICK	MASON THOMPSON	OPERATIONS	09/08/2021	689.12
BK TIRE	FREDERICK	MASON THOMPSON	OPERATIONS	08/19/2021	545.08
BLACKJACK PIZZA - CO 0	LOUISVILLE	ERICA SCHMITT	LIBRARY	09/04/2021	147.77
BOBCAT COMMERCE CITY	COMMERCE CITY	MASON THOMPSON	OPERATIONS	08/31/2021	531.52
BROADMOOR PARKING	COLORADO SPGS	MEGAN PIERCE	CITY MANAGER	08/25/2021	20.00
BROOMFIELD RENTALS INC	BROOMFIELD	KERRY KRAMER	PARKS	09/01/2021	65.70
BROOMFIELD RENTALS INC	BROOMFIELD	JACK MANIAN	OPERATIONS	08/26/2021	105.30
BROOMFIELD RENTALS INC	BROOMFIELD	DANIEL BIDLEMEN	REC CENTER	08/25/2021	840.40
CANVA* I03169-19662642	CAMDEN	GLORIA HANDYSIDE	CITY MANAGER	09/05/2021	12.95
CENTER COPY PRINTING	303-4406000	CONOR MCCORMICK	PARKS	09/09/2021	78.18
CENTER COPY PRINTING	303-4406000	ERIN OWEN	LIBRARY	09/07/2021	432.54
CENTER COPY PRINTING	303-4406000	RICHARD DZIOMBA	GOLF COURSE	09/01/2021	442.81
CENTER COPY PRINTING	303-4406000	JEANETTE LONGORIA	SALES TAX	08/31/2021	542.00
CENTER COPY PRINTING	303-4406000	ELIZABETH SCHETTLER	PLANNING	08/23/2021	662.40
CENTER COPY PRINTING	303-4406000	JEANETTE LONGORIA	SALES TAX	08/23/2021	55.00
CENTER COPY PRINTING	303-4406000	JEANETTE LONGORIA	SALES TAX	08/23/2021	573.42
CENTURYLINK/SPEEDPAY	800-244-1111	BOBBIEJO TREGAY	FINANCE	08/28/2021	2,567.06
CERTIFIED STAFFING SOL	8883306890	BENJAMIN FRANCISCO	OPERATIONS	08/25/2021	335.00
CGFOA	LITTLETON	BOBBIEJO TREGAY	FINANCE	09/17/2021	25.00
CGFOA	LITTLETON	BOBBIEJO TREGAY	FINANCE	09/07/2021	50.00
CGFOA	LITTLETON	DIANE M KREAGER	FINANCE	08/19/2021	25.00
CGFOA	LITTLETON	BOBBIEJO TREGAY	FINANCE	08/19/2021	50.00
CGRS INC	FORT COLLINS	DEVIN MADIGAN	WASTEWATER	08/31/2021	285.00

CHILDHEALTHCONNECTION	FORT COLLINS	AMANDA PERERA	REC CENTER	09/01/2021	109.00
COLORADO ASSOCIATION O	303-4636400	ERIN OWEN	LIBRARY	08/19/2021	95.00
COLORADO CWP	719-545-6748	DEVIN MADIGAN	WASTEWATER	09/08/2021	50.00
COLORADO CWP	719-545-6748	GREG VENETTE	WATER	09/03/2021	85.00
COLORADO CWP	719-545-6748	GREG VENETTE	WATER	09/03/2021	50.00
COLORADO CWP	719-545-6748	SANDRA ANDRETICH	OPERATIONS	09/02/2021	50.00
COLORADO CWP	719-545-6748	ZACH STEINBAUGH	WASTEWATER	09/01/2021	85.00
COLORADO CWP	719-545-6748	ROSS DAVIS	OPERATIONS	09/01/2021	85.00
COLORADO CWP	719-545-6748	ROSS DAVIS	OPERATIONS	09/01/2021	85.00
COLORADO CWP	719-545-6748	KEN MATHEWS	OPERATIONS	09/01/2021	50.00
COLORADO CWP	719-545-6748	GREG VENETTE	WATER	08/23/2021	50.00
COLORADO GOLF AND TURF	LITTLETON	LANCE PFEIFER	GOLF COURSE	09/03/2021	244.35
COLORADO GOLF AND TURF	LITTLETON	LANCE PFEIFER	GOLF COURSE	08/30/2021	65.24
COLORADO GOLF ASSN	303-3664653	RICHARD DZIOMBA	GOLF COURSE	08/31/2021	90.00
COLORADO MUNICIPAL LEA	303-8316411	DAWN BURGESS	CITY MANAGER	09/15/2021	99.00
COLORADO MUNICIPAL LEA	303-8316411	DAWN BURGESS	CITY MANAGER	09/02/2021	99.00
COLORADO MUNICIPAL LEA	303-8316411	RONDA HENGER	HUMAN RESOURCES	09/02/2021	45.00
COLORADO MUNICIPAL LEA	303-8316411	GLORIA HANDYSIDE	CITY MANAGER	08/26/2021	245.00
COLORADO OPEN SPACE	DENVER	CONOR MCCORMICK	PARKS	09/03/2021	200.00
COLORADO OPEN SPACE	DENVER	NICHOLAS POTOPCHUK	PARKS	09/02/2021	200.00
COLORADO OPEN SPACE	DENVER	STEVE ROELS	PARKS	08/26/2021	160.00
COLORADO OPEN SPACE	DENVER	DEBORAH AYERS	PARKS	08/25/2021	160.00
COLORADO OPEN SPACE	DENVER	BENJAMIN WHITE-PATARINO	PARKS	08/25/2021	160.00
COLORADO PARKS AND REC	DENVER	KATIE BEASLEY	REC CENTER	09/20/2021	10.00
COMCAST CABLE COMM	800-COMCAST	ERIN OWEN	LIBRARY	09/13/2021	109.95
COMCAST CABLE COMM	800-COMCAST	SHARON SCHRAMM	PARKS	08/28/2021	522.33
COMCAST DENVER	800-266-2278	JILL SIEWERT	LIBRARY	09/10/2021	298.02
CONNECTED SOLUTIONS GR	MECHANICSVILL	ALEX ABBOTT	IT	08/20/2021	5.67
CONOCO - UNITED PACIFI	LOUISVILLE	DAVID BARIL	GOLF COURSE	09/03/2021	17.27
COSTAR GROUP INC	8884141243	MEGAN PIERCE	CITY MANAGER	09/08/2021	395.00
CPS DISTRIBUTORS	BOULDER	BRADLEY AUSTIN	PARKS	09/17/2021	233.88
CPS DISTRIBUTORS	BOULDER	BRADLEY AUSTIN	PARKS	09/16/2021	589.20
CPS DISTRIBUTORS	BOULDER	KERRY KRAMER	PARKS	09/13/2021	97.43
CPS DISTRIBUTORS	ARVADA	DAVID DEAN	GOLF COURSE	09/13/2021	495.43
CPS DISTRIBUTORS	WESTMINSTER	MATT LOOMIS	PARKS	09/08/2021	220.76
CPS DISTRIBUTORS	WESTMINSTER	MATT LOOMIS	PARKS	09/08/2021	3.55
CPS DISTRIBUTORS	3033503236	NORMAN MERLO	GOLF COURSE	09/01/2021	241.57

CPS DISTRIBUTORS	BOULDER	VICKIE ILKO	OPERATIONS	08/31/2021	225.06
CPS DISTRIBUTORS	3033503236	DAVID DEAN	GOLF COURSE	08/30/2021	77.24
CPS DISTRIBUTORS	BOULDER	BRADLEY AUSTIN	PARKS	08/27/2021	168.84
CPS DISTRIBUTORS	BOULDER	MATT LOOMIS	PARKS	08/26/2021	9.10
CRAIGSLIST.ORG	415-399-5200	KIRSTIE AMBROSE-HARLEY	HUMAN RESOURCES	09/01/2021	45.00
CRAIGSLIST.ORG	415-399-5200	KIRSTIE AMBROSE-HARLEY	HUMAN RESOURCES	09/01/2021	45.00
CRAIGSLIST.ORG	415-399-5200	KIRSTIE AMBROSE-HARLEY	HUMAN RESOURCES	09/01/2021	50.00
CRAIGSLIST.ORG	415-399-5200	KIRSTIE AMBROSE-HARLEY	HUMAN RESOURCES	09/01/2021	25.00
CRAIGSLIST.ORG	415-399-5200	KIRSTIE AMBROSE-HARLEY	HUMAN RESOURCES	09/01/2021	50.00
CRAIGSLIST.ORG	415-399-5200	KIRSTIE AMBROSE-HARLEY	HUMAN RESOURCES	09/01/2021	25.00
CRAIGSLIST.ORG	415-399-5200	KIRSTIE AMBROSE-HARLEY	HUMAN RESOURCES	09/01/2021	25.00
CREATIVE FRAMING & ART	LOUISVILLE	DAWN BURGESS	CITY MANAGER	08/25/2021	329.76
CROWN AWARDS INC	8002271557	ERIN OWEN	LIBRARY	09/15/2021	17.45
CROWN AWARDS INC	8002271557	ERIN OWEN	LIBRARY	08/31/2021	26.61
CROWN AWARDS INC	8002271557	ERIN OWEN	LIBRARY	08/30/2021	401.98
DAILY CAMERA	3034443444	JILL SIEWERT	LIBRARY	09/14/2021	637.00
DBC IRRIGATION SUPPLY	BROOMFIELD	DAVID ALDERS	PARKS	09/15/2021	80.65
DBC IRRIGATION SUPPLY	BROOMFIELD	DAVID ALDERS	PARKS	09/14/2021	253.36
DBC IRRIGATION SUPPLY	BROOMFIELD	DAVID ALDERS	PARKS	09/10/2021	892.99
DBC IRRIGATION SUPPLY	BROOMFIELD	MATT LOOMIS	PARKS	09/08/2021	49.11
DBC IRRIGATION SUPPLY	BROOMFIELD	MATT LOOMIS	PARKS	08/24/2021	74.59
DEMCO INC	800-9624463	JILL SIEWERT	LIBRARY	09/13/2021	84.53
DEMCO INC	800-9624463	JILL SIEWERT	LIBRARY	09/02/2021	107.64
DISCOUNTCELL INC	PROVO	ALEX ABBOTT	IT	08/13/2021	359.10
DOMINO'S 6286	303-449-7101	ROSS DAVIS	OPERATIONS	08/23/2021	29.43
DROPBOX*FNB98DV8MC4X	DROPBOX.COM	KURT KOWAR	PUBLIC WORKS	09/09/2021	119.88
DROPBOX*SMH5PHTWMXZC	DROPBOX.COM	EMILY HOGAN	CITY MANAGER	09/18/2021	11.99
E 470 EXPRESS TOLLS	303-5373470	BOBBIEJO TREGAY	FINANCE	09/09/2021	27.20
EXPRESSO	SANTA CLARA	LINDSEY WITTY	REC CENTER	09/13/2021	275.00
FACEBK 4T6T37BG82	MENLO PARK	GLORIA HANDYSIDE	CITY MANAGER	09/20/2021	28.24
FACEBK RCX796FF82	MENLO PARK	GLORIA HANDYSIDE	CITY MANAGER	08/20/2021	171.72
FASTENAL COMPANY 01COB	LAFAYETTE	JESSE DEGRAW	REC CENTER	09/03/2021	19.80
FASTSIGNS BROOMFIELD	B	GLORIA HANDYSIDE	CITY MANAGER	08/23/2021	268.60
FEDEX 282742938477	MEMPHIS	DEVIN MADIGAN	WASTEWATER	08/20/2021	48.66
FEDEX 283256677810	MEMPHIS	DEVIN MADIGAN	WASTEWATER	09/03/2021	48.44
FEDEX 283498661386	MEMPHIS	DEVIN MADIGAN	WASTEWATER	09/10/2021	48.66
FEDEX 283629490740	MEMPHIS	DEVIN MADIGAN	WASTEWATER	09/14/2021	48.89

FEDEX 283779814816	MEMPHIS	DEVIN MADIGAN	WASTEWATER	09/17/2021	48.89
FEDEX OFFIC74200007427	LOUISVILLE	KATRINA KEHM	POLICE	09/15/2021	62.73
FEDEX OFFIC74200007427	LOUISVILLE	DAVID D HAYES	POLICE	09/11/2021	567.00
FEDEX OFFIC74200007427	LOUISVILLE	DAVID D HAYES	POLICE	09/11/2021	567.00
FEDEX OFFIC74200007427	LOUISVILLE	KATIE BAUM	CITY MANAGER	08/26/2021	141.88
FIRST CHOICE-BOYER S C	303-9649400	DAWN BURGESS	CITY MANAGER	09/09/2021	30.65
FIRST CHOICE-BOYER S C	303-9649400	DAWN BURGESS	CITY MANAGER	08/27/2021	86.31
FIRST CHOICE-BOYER S C	303-9649400	DAWN BURGESS	CITY MANAGER	08/27/2021	233.77
FREDPRYOR CAREERTRACK	800-5563012	SANDRA ANDRETICH	OPERATIONS	08/25/2021	249.00
GIH*GLOBALINDUSTRIALEQ	800-645-2986	GREG VENETTE	WATER	08/23/2021	324.88
GOLF SPORT SOLUTIONS L	LA SALLE	DAVID DEAN	GOLF COURSE	09/15/2021	900.85
GOLF SPORT SOLUTIONS L	LA SALLE	DAVID DEAN	GOLF COURSE	09/10/2021	449.02
GOLF SPORT SOLUTIONS L	LA SALLE	DAVID DEAN	GOLF COURSE	08/31/2021	349.42
GOVERNMENT FINANCE OFF	CHICAGO	DIANE M KREAGER	FINANCE	09/15/2021	135.00
GOVERNMENT FINANCE OFF	CHICAGO	DIANE M KREAGER	FINANCE	08/30/2021	150.00
GRAINGER	877-2022594	DAVID DEAN	GOLF COURSE	09/17/2021	93.42
GRAINGER	877-2022594	DAVID DEAN	GOLF COURSE	09/09/2021	50.93
GREEN CO2 SYSTEMS	970-482-0203	PAUL BORTH	REC CENTER	09/02/2021	131.74
GREENDISK INC	425-3928700	JILL SIEWERT	LIBRARY	08/24/2021	35.45
GROUPGREETING	SAN FRANCISCO	SHARON SCHRAMM	PARKS	09/09/2021	4.99
HACH COMPANY	LOVELAND	DEVIN MADIGAN	WASTEWATER	09/01/2021	284.50
HACH COMPANY	LOVELAND	DEVIN MADIGAN	WASTEWATER	08/19/2021	305.50
HILLYARD INC DENVER	3033211227	RICHARD DZIOMBA	GOLF COURSE	08/31/2021	183.70
HOBBY-LOBBY #0034	LONGMONT	LARISSA COX	REC CENTER	09/02/2021	85.44
ICMA ONLINE	2022894262	DAWN BURGESS	CITY MANAGER	08/26/2021	765.00
IN *1-2-1 MARKETING	407-3954701	SHARON SCHRAMM	PARKS	09/02/2021	199.00
IN *ARROWHEAD SCIENTIF	913-8948388	ERICA BERZINS	POLICE	09/20/2021	598.98
IN *BIOBAG USA	727-7891646	ERIK SWIATEK	PARKS	08/30/2021	822.00
IN *BIOCHAR NOW, LLC	970-4434896	GREG VENETTE	WATER	08/24/2021	576.00
IN *COMMUNITY LANGUAGE	720-3940126	MEREDYTH MUTH	CITY MANAGER	08/31/2021	130.00
IN *HIGH COUNTRY POOLS	FORT COLLINS	KATIE TOFTE	REC CENTER	08/25/2021	199.29
IN *ROSE SIGN LANGUAGE	720-2328370	MEREDYTH MUTH	CITY MANAGER	08/26/2021	174.00
IN *TRS INCORPORATED	303-4996722	AMANDA PERERA	REC CENTER	09/01/2021	750.00
INSTANT IMPRINTS LOUIS	LOUISVILLE	GINGER CROSS	GOLF COURSE	09/20/2021	146.33
INSTANT IMPRINTS LOUIS	LOUISVILLE	GINGER CROSS	GOLF COURSE	09/15/2021	81.90
INSTANT IMPRINTS LOUIS	LOUISVILLE	GENEVIEVE KLINE	CITY CLERK	09/02/2021	35.00
INTERMOUNTAIN SAFETY	3032782871	DEVIN MADIGAN	WASTEWATER	09/13/2021	148.36

JAX RANCH & HOME	LAFAYETTE	NICHOLAS POTOPCHUK	PARKS	09/14/2021	51.98
JIMMY JOHNS - 2668	LOUISVILLE	SCOTT MOORE	POLICE	09/20/2021	49.90
KEYSTONE RESV	KEYSTONE	ROBERT ZUCCARO	PLANNING	09/11/2021	22.98
KEYSTONE RESV	9704964971	ROBERT ZUCCARO	PLANNING	08/25/2021	335.28
KING SOOPERS #0013	LOUISVILLE	PATRICIA MORGAN	REC CENTER	09/08/2021	52.58
KING SOOPERS #0013	LOUISVILLE	KEVIN FREY	FACILITIES	09/01/2021	4.49
KING SOOPERS #0013	LOUISVILLE	MEAGAN BROWN	HUMAN RESOURCES	08/24/2021	33.37
KING SOOPERS #0013	LOUISVILLE	ZACH STEINBAUGH	WASTEWATER	08/19/2021	89.40
LAFAYETTE FLORIST GIFT	3036655552	DAWN BURGESS	CITY MANAGER	08/31/2021	17.00
LAFAYETTE LUMBER COMPA	LAFAYETTE	KERRY KRAMER	PARKS	08/19/2021	386.96
LANDS END BUS OUTFITTE	8003324700	JEN KENNEY	POLICE	08/20/2021	211.99
LES MILLS US TRADING	6308285949	LINDSEY WITTY	REC CENTER	09/03/2021	350.00
LEWAN TECHNOLOGY	CREDITCARDS@L	BOBBIEJO TREGAY	FINANCE	09/09/2021	368.00
LEWAN TECHNOLOGY	CREDITCARDS@L	BOBBIEJO TREGAY	FINANCE	09/09/2021	1,666.44
LEXISNEXIS EPIC	866-208-1420	KATRINA KEHM	POLICE	09/09/2021	322.50
LITTLE VALLEY WHOLESAL	BRIGHTON	BOB BERNHARDT	PARKS	08/30/2021	519.80
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	09/17/2021	154.88
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	09/17/2021	871.27
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	09/17/2021	105.62
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	09/17/2021	72.24
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	09/17/2021	349.24
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	09/17/2021	160.30
LL JOHNSON DIST CO	DENVER	DAVID DEAN	GOLF COURSE	08/30/2021	144.43
LL JOHNSON DIST CO	DENVER	DAVID DEAN	GOLF COURSE	08/30/2021	61.38
LL JOHNSON DIST CO	DENVER	DAVID DEAN	GOLF COURSE	08/30/2021	415.41
LL JOHNSON DIST CO	DENVER	DAVID DEAN	GOLF COURSE	08/30/2021	110.88
LL JOHNSON DIST CO	DENVER	DAVID DEAN	GOLF COURSE	08/30/2021	167.50
LL JOHNSON DIST CO	DENVER	DAVID DEAN	GOLF COURSE	08/30/2021	163.17
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	08/27/2021	277.02
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	08/27/2021	283.34
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	08/27/2021	32.92
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	08/27/2021	542.95
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	08/27/2021	160.30
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	08/27/2021	447.56
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	08/27/2021	100.28
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	08/27/2021	180.67
LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	08/27/2021	84.82

LL JOHNSON DIST CO	DENVER	LANCE PFEIFER	GOLF COURSE	08/27/2021	50.94
LONGMONT FORD	LONGMONT	MASON THOMPSON	OPERATIONS	09/14/2021	375.00
LOWES #00220*	LOUISVILLE	PHIL LIND	FACILITIES	09/20/2021	13.42
LOWES #00220*	LOUISVILLE	DAVID BARIL	GOLF COURSE	09/19/2021	25.96
LOWES #00220*	LOUISVILLE	RICHARD DZIOMBA	GOLF COURSE	09/18/2021	49.96
LOWES #00220*	LOUISVILLE	DAVID BARIL	GOLF COURSE	09/18/2021	2.07
LOWES #00220*	LOUISVILLE	PHIL LIND	FACILITIES	09/15/2021	21.97
LOWES #00220*	LOUISVILLE	KEVIN FREY	FACILITIES	09/15/2021	34.30
LOWES #00220*	LOUISVILLE	PHIL LIND	FACILITIES	09/14/2021	20.74
LOWES #00220*	LOUISVILLE	KEVIN FREY	FACILITIES	09/14/2021	36.48
LOWES #00220*	LOUISVILLE	GREG VENETTE	WATER	09/14/2021	165.88
LOWES #00220*	LOUISVILLE	KATHLEEN D LORENZO	PARKS	09/11/2021	16.44
LOWES #00220*	LOUISVILLE	PHIL LIND	FACILITIES	09/10/2021	21.96
LOWES #00220*	LOUISVILLE	PHIL LIND	FACILITIES	09/08/2021	16.06
LOWES #00220*	LOUISVILLE	DAVID BARIL	GOLF COURSE	09/03/2021	26.05
LOWES #00220*	LOUISVILLE	PHIL LIND	FACILITIES	09/02/2021	20.92
LOWES #00220*	LOUISVILLE	PHIL LIND	FACILITIES	08/30/2021	57.98
LOWES #00220*	LOUISVILLE	KATHLEEN D LORENZO	PARKS	08/29/2021	16.44
LOWES #00220*	LOUISVILLE	MARYANN DORNFELD	PARKS	08/27/2021	110.88
LOWES #00220*	LOUISVILLE	ERIK SWIATEK	PARKS	08/26/2021	8.96
LOWES #00220*	LOUISVILLE	DAVID BARIL	GOLF COURSE	08/26/2021	151.40
LOWES #00220*	LOUISVILLE	PHIL LIND	FACILITIES	08/25/2021	166.92
LOWES #00220*	LOUISVILLE	KEVIN FREY	FACILITIES	08/25/2021	5.94
LOWES #00220*	LOUISVILLE	JESSE DEGRAW	REC CENTER	08/25/2021	32.14
LOWES #00220*	LOUISVILLE	BRIAN GARDUNO	OPERATIONS	08/24/2021	97.41
LOWES #00220*	LOUISVILLE	REBECCA ST ORES	REC CENTER	08/23/2021	9.56
LOWES #00220*	LOUISVILLE	REBECCA ST ORES	REC CENTER	08/22/2021	19.12
LOWES #00220*	LOUISVILLE	KATHLEEN D LORENZO	PARKS	08/21/2021	24.64
LOWES #00220*	LOUISVILLE	LANA FAUVER	REC CENTER	08/19/2021	20.61
LOWES #00220*	LOUISVILLE	JACK MANIAN	OPERATIONS	08/19/2021	54.98
LOWES #00220*	LOUISVILLE	PHIL LIND	FACILITIES	08/19/2021	34.73
LOWES #00220*	LOUISVILLE	DAVID BARIL	GOLF COURSE	08/19/2021	77.70
LOWES #00907*	866-483-7521	DAVID BARIL	GOLF COURSE	09/05/2021	112.94
LS *BEYOND THE BLACKB	ARVADA	LANA FAUVER	REC CENTER	08/20/2021	9.96
MAC EQUIPMENT INC (LON	LONGMONT	MASON THOMPSON	OPERATIONS	09/14/2021	108.04
MAILCHIMP *MONTHLY	MAILCHIMP.COM	GLORIA HANDYSIDE	CITY MANAGER	09/18/2021	238.00
MEMENTO.COM	LONDON	MEAGAN BROWN	HUMAN RESOURCES	08/25/2021	19.99

MICHAELS #9490	800-642-4235	LANA FAUVER	REC CENTER	09/11/2021	122.45
MICHAELS #9490	800-642-4235	LANA FAUVER	REC CENTER	09/10/2021	17.99
MICHAELS #9490	800-642-4235	LANA FAUVER	REC CENTER	09/04/2021	75.95
MILE HIGH TURFGRASS LL	3039880969	DAVID DEAN	GOLF COURSE	09/15/2021	942.03
MSFT * E0500FNP0M	MSFT AZURE	CHRISTOPHER NEVES	IT	09/01/2021	118.47
NAME MAKER INC	800-241-2890	KATIE TOFTE	REC CENTER	09/13/2021	202.37
NAPA AUTO 0025122	BOULDER	BOBBIEJO TREGAY	FINANCE	09/09/2021	442.98
NAPA AUTO 0025122	BOULDER	BOBBIEJO TREGAY	FINANCE	09/09/2021	2,077.78
NAPA AUTO PARTS 138	3037759454	JULIAN CLARK	POLICE	09/08/2021	146.23
O MEARA FORD	NORTHGLENN	MASON THOMPSON	OPERATIONS	08/31/2021	554.07
OFFICE DEPOT #1080	800-463-3768	DAVID BARIL	GOLF COURSE	08/29/2021	55.78
OFFICE DEPOT #1080	800-463-3768	DAVID BARIL	GOLF COURSE	08/29/2021	20.58
OFFICE DEPOT #170	BOULDER	GINGER CROSS	GOLF COURSE	08/22/2021	24.99
OFFICEMAX/DEPOT 6554	800-463-3768	DAVID BARIL	GOLF COURSE	08/29/2021	25.98
OFFICEMAX/DEPOT 6616	SUPERIOR	RICHARD DZIOMBA	GOLF COURSE	09/16/2021	86.76
OFFICEMAX/DEPOT 6616	SUPERIOR	RICHARD DZIOMBA	GOLF COURSE	09/16/2021	12.99
OFFICEMAX/DEPOT 6616	SUPERIOR	RICHARD DZIOMBA	GOLF COURSE	08/31/2021	127.02
OFFICEMAX/DEPOT 6616	SUPERIOR	KERRY KRAMER	PARKS	08/30/2021	99.96
OFFICEMAX/DEPOT 6616	SUPERIOR	STEVE ROELS	PARKS	08/24/2021	9.99
OFFICEMAX/DEPOT 6616	SUPERIOR	GINGER CROSS	GOLF COURSE	08/22/2021	24.99
OLD SANTA FE MEXICAN G	LOUISVILLE	DAVID D HAYES	POLICE	08/26/2021	31.98
PARKER STORE LOUISVILL	LOUISVILLE	VICKIE ILKO	OPERATIONS	09/07/2021	26.96
PARKER STORE LOUISVILL	LOUISVILLE	VICKIE ILKO	OPERATIONS	09/07/2021	90.99
PARKER STORE LOUISVILL	LOUISVILLE	GREG VENETTE	WATER	09/03/2021	258.80
PARKER STORE LOUISVILL	LOUISVILLE	ROSS DAVIS	OPERATIONS	09/01/2021	78.71
PARKER STORE LOUISVILL	LOUISVILLE	VICKIE ILKO	OPERATIONS	08/31/2021	26.96
PARKER STORE LOUISVILL	LOUISVILLE	LANCE PFEIFER	GOLF COURSE	08/26/2021	402.51
PAYFLOW/PAYPAL	8888839770	BOBBIEJO TREGAY	FINANCE	09/02/2021	59.95
PAYFLOW/PAYPAL	8888839770	BOBBIEJO TREGAY	FINANCE	09/02/2021	19.95
PAYPAL *BOULDERCOUN	4029357733	DAWN BURGESS	CITY MANAGER	09/02/2021	127.38
PAYPAL *REGION8PRET	4029357733	JOCELYN BRINK	WASTEWATER	09/09/2021	225.00
PLUG N PAY TECHNOLOGIE	631-8707735	JULIE SEYDEL	REC CENTER	09/07/2021	174.90
POLYDYNE INC	9128843366	GREG VENETTE	WATER	09/03/2021	624.15
POWER SYSTEMS	TEL8003216975	LINDSEY WITTY	REC CENTER	08/24/2021	562.22
PRAIRIE MOUNTAIN MEDIA	8884549588	BOBBIEJO TREGAY	FINANCE	09/08/2021	1,400.96
PRESTIGE FLAG MFG CO I	800-5765155	DAVID DEAN	GOLF COURSE	09/15/2021	655.41
PET SCOOP	DENVER	SHARON SCHRAMM	PARKS	09/01/2021	540.00

RAINEDOUT	LEESBURG	KATIE MEYER	REC CENTER	08/19/2021	20.00
RMSAWWA* REG3LNMQKJO	CENTENNIAL	ZACH STEINBAUGH	WASTEWATER	08/23/2021	100.00
ROSATI S CHICAGO PIZZA	LOUISVILLE	KATIE MEYER	REC CENTER	09/17/2021	120.00
ROTO-ROOTER 10034	COMMERCE CITY	KATHY MARTIN	REC CENTER	08/30/2021	1,433.35
ROTO-ROOTER 10034	COMMERCE CITY	KATHY MARTIN	REC CENTER	08/24/2021	1,433.25
S&S WORLDWIDE, INC.	COLCHESTER	LANA FAUVER	REC CENTER	09/20/2021	33.59
SAFEWAY #2812	LOUISVILLE	KATHY MARTIN	REC CENTER	09/16/2021	74.95
SAFEWAY #2812	LOUISVILLE	PATRICIA MORGAN	REC CENTER	08/26/2021	13.45
SAFEWAY #2812	LOUISVILLE	GREG VENETTE	WATER	08/23/2021	54.89
SAFEWAY #2812	LOUISVILLE	KATRINA KEHM	POLICE	08/23/2021	312.98
SAMEDAY OFFICE SUPPLY	3037902777	ELIZABETH SCHETTLER	PLANNING	08/23/2021	250.00
SHRED-IT USA LLC	8666474733	KATRINA KEHM	POLICE	08/19/2021	60.00
SIMPLOT T&H DEN 1417	DENVER	DAVID DEAN	GOLF COURSE	08/30/2021	230.00
SITEONE LANDSCAPE SUPP	BROOMFIELD	BRADLEY AUSTIN	PARKS	09/17/2021	442.21
SITEONE LANDSCAPE SUPP	BROOMFIELD	DAVID DEAN	GOLF COURSE	09/15/2021	4.68
SITEONE LANDSCAPE SUPP	BROOMFIELD	NORMAN MERLO	GOLF COURSE	09/15/2021	95.22
SITEONE LANDSCAPE SUPP	BROOMFIELD	NORMAN MERLO	GOLF COURSE	08/17/2021	852.50
SITEONE LANDSCAPE SUPP	BROOMFIELD	NORMAN MERLO	GOLF COURSE	08/27/2021	10.86
SOURCE OFFICE - VITAL	GOLDEN	DAWN BURGESS	CITY MANAGER	09/02/2021	88.08
SP * GENESIS EDUCATION	3604226764	LANA FAUVER	REC CENTER	09/03/2021	36.50
SP * LION COUNTRY	8146847900	EZRA VENO	REC CENTER	08/27/2021	106.85
SPOTHERO 844-356-8054	CHICAGO	MEGAN PIERCE	CITY MANAGER	09/16/2021	5.75
SPOTHERO 844-356-8054	CHICAGO	MEGAN PIERCE	CITY MANAGER	09/15/2021	12.75
SQ *PICA'S LOUISVILLE	LOUISVILLE	MEGAN DAVIS	CITY MANAGER	09/13/2021	55.20
SQ *PRODUCT SOLUTIONS	GOSQ.COM	DAVID DEAN	GOLF COURSE	09/07/2021	185.00
STAPLS7337496384000001	877-8267755	KATRINA KEHM	POLICE	08/19/2021	10.65
STAPLS7337501215000001	877-8267755	KATRINA KEHM	POLICE	08/19/2021	44.99
STAPLS7338960883000001	877-8267755	DIANE M KREAGER	FINANCE	09/09/2021	163.24
STAPLS7338960883000002	877-8267755	DIANE M KREAGER	FINANCE	09/10/2021	578.76
STAPLS7339218436000001	877-8267755	BOBBIEJO TREGAY	FINANCE	09/14/2021	828.31
STAR CRANE & HOIST	6168925500	GREG VENETTE	WATER	08/19/2021	613.60
STK*SHUTTERSTOCK	8666633954	EMILY HOGAN	CITY MANAGER	09/17/2021	99.00
SUNBELT RENTALS # 746	LAKEWWOD	BOBBIEJO TREGAY	FINANCE	08/19/2021	1,981.14
SOCIETY FOR ECOLOGICAL	WASHINGTON	STEVE ROELS	PARKS	09/16/2021	50.00
TARGET SPECIALTY PROD	SANTA FE SPRI	DAVID DEAN	GOLF COURSE	08/31/2021	572.00
TARGET SPECIALTY PROD	SANTA FE SPRI	DAVID DEAN	GOLF COURSE	08/31/2021	208.00
THE GRILL AT COAL CREE	LOUISVILLE	DAVID BARIL	GOLF COURSE	09/19/2021	567.27

THE GRILL AT COAL CREE	LOUISVILLE	DAVID BARIL	GOLF COURSE	09/19/2021	800.00
THE GRILL AT COAL CREE	LOUISVILLE	DAVID BARIL	GOLF COURSE	09/17/2021	94.98
THE GRILL AT COAL CREE	LOUISVILLE	DAVID BARIL	GOLF COURSE	09/12/2021	487.21
THE GRILL AT COAL CREE	LOUISVILLE	DAVID BARIL	GOLF COURSE	09/12/2021	700.00
THE GRILL AT COAL CREE	LOUISVILLE	DAVID BARIL	GOLF COURSE	09/11/2021	154.80
THE GRILL AT COAL CREE	LOUISVILLE	DIANE M KREAGER	FINANCE	08/27/2021	1,254.00
THE HOME DEPOT #1506	LOUISVILLE	MATT LOOMIS	PARKS	09/17/2021	35.93
THE HOME DEPOT #1506	LOUISVILLE	NICHOLAS POTOPCHUK	PARKS	09/15/2021	71.81
THE HOME DEPOT #1506	LOUISVILLE	NICHOLAS POTOPCHUK	PARKS	09/14/2021	99.00
THE HOME DEPOT #1506	LOUISVILLE	GREG VENETTE	WATER	09/14/2021	217.44
THE HOME DEPOT #1506	LOUISVILLE	BRIAN GARDUNO	OPERATIONS	09/13/2021	7.30
THE HOME DEPOT #1506	LOUISVILLE	GREG VENETTE	WATER	09/13/2021	560.94
THE HOME DEPOT #1506	LOUISVILLE	AMANDA PERERA	REC CENTER	09/12/2021	3.96
THE HOME DEPOT #1506	LOUISVILLE	KERRY KRAMER	PARKS	09/10/2021	7.97
THE HOME DEPOT #1506	LOUISVILLE	JACK MANIAN	OPERATIONS	09/09/2021	23.04
THE HOME DEPOT #1506	LOUISVILLE	MICHAEL TOWERS	PARKS	09/09/2021	17.82
THE HOME DEPOT #1506	LOUISVILLE	BRADLEY AUSTIN	PARKS	09/09/2021	5.22
THE HOME DEPOT #1506	LOUISVILLE	PAUL BORTH	REC CENTER	09/08/2021	17.91
THE HOME DEPOT #1506	LOUISVILLE	PAUL BORTH	REC CENTER	09/08/2021	19.46
THE HOME DEPOT #1506	LOUISVILLE	STEVE ROELS	PARKS	09/08/2021	72.75
THE HOME DEPOT #1506	LOUISVILLE	MATT LOOMIS	PARKS	09/08/2021	23.62
THE HOME DEPOT #1506	LOUISVILLE	AARON GRANT	PARKS	09/07/2021	29.91
THE HOME DEPOT #1506	LOUISVILLE	JACK MANIAN	OPERATIONS	09/03/2021	29.97
THE HOME DEPOT #1506	LOUISVILLE	JACK MANIAN	OPERATIONS	09/02/2021	106.92
THE HOME DEPOT #1506	LOUISVILLE	CORY FREI	OPERATIONS	09/01/2021	19.97
THE HOME DEPOT #1506	LOUISVILLE	VICKIE ILKO	OPERATIONS	08/31/2021	5.98
THE HOME DEPOT #1506	LOUISVILLE	VICKIE ILKO	OPERATIONS	08/31/2021	5.98
THE HOME DEPOT #1506	LOUISVILLE	VICKIE ILKO	OPERATIONS	08/31/2021	37.85
THE HOME DEPOT #1506	LOUISVILLE	ROSS DAVIS	OPERATIONS	08/30/2021	43.36
THE HOME DEPOT #1506	LOUISVILLE	THOMAS CZAJKA	OPERATIONS	08/30/2021	7.94
THE HOME DEPOT #1506	LOUISVILLE	VICKIE ILKO	OPERATIONS	08/30/2021	77.64
THE HOME DEPOT #1506	LOUISVILLE	DEAN JOHNSON	PARKS	08/30/2021	67.40
THE HOME DEPOT #1506	LOUISVILLE	AMANDA PERERA	REC CENTER	08/25/2021	15.00
THE HOME DEPOT #1506	LOUISVILLE	GLORIA HANDYSIDE	CITY MANAGER	08/23/2021	26.47
THE HOME DEPOT #1506	LOUISVILLE	JACK MANIAN	OPERATIONS	08/23/2021	92.93
THE HOME DEPOT #1506	LOUISVILLE	KERRY KRAMER	PARKS	08/23/2021	14.94
THE HOME DEPOT #1506	LOUISVILLE	KERRY KRAMER	PARKS	08/23/2021	136.02

THE HOME DEPOT #1506	LOUISVILLE	AMANDA PERERA	REC CENTER	08/20/2021	3.96
THE HOME DEPOT #1506	LOUISVILLE	BRIAN GARDUNO	OPERATIONS	08/20/2021	83.08
THE HOME DEPOT #1506	LOUISVILLE	DEBORAH AYERS	PARKS	08/19/2021	3.12
THE HOME DEPOT #1506	LOUISVILLE	JACK MANIAN	OPERATIONS	08/18/2021	33.01
THE HOME DEPOT #1506	LOUISVILLE	BRIAN GARDUNO	OPERATIONS	08/18/2021	169.80
THE HOME DEPOT PRO	8565333261	KATHLEEN D LORENZO	PARKS	09/02/2021	907.91
THE UPS STORE 5183	LOUISVILLE	GREG VENETTE	WATER	08/30/2021	46.96
TOSHIBA BUSINESS SOLUT	LAKE FOREST	AMANDA PERERA	REC CENTER	09/14/2021	131.10
TOWN OF SUPERIOR	303-499-3677	BOBBIEJO TREGAY	FINANCE	09/16/2021	1,508.57
TRINITY SCS INC	3033718805	SANDRA ANDRETICH	OPERATIONS	09/07/2021	66.15
TST* THE HUCKLEBERRY	LOUISVILLE	MEGAN DAVIS	CITY MANAGER	09/11/2021	31.24
TST* THE HUCKLEBERRY	LOUISVILLE	DAWN BURGESS	CITY MANAGER	08/27/2021	136.00
US AUTOFORCE	920-730-7187	DAVID DEAN	GOLF COURSE	09/16/2021	148.54
US AUTOFORCE	920-730-7187	DAVID DEAN	GOLF COURSE	09/16/2021	363.90
USA BLUE BOOK	8004939876	ZACH STEINBAUGH	WASTEWATER	08/25/2021	75.10
USPS PO 0756700237	SUPERIOR	JILL SIEWERT	LIBRARY	08/30/2021	49.26
USPS PO 0756700237	SUPERIOR	JILL SIEWERT	LIBRARY	08/24/2021	8.40
USPS PO 0756700237	SUPERIOR	STEVE ROELS	PARKS	08/19/2021	11.50
USPS.COM CLICKNSHIP	800-782-6724	GENEVIEVE KLINE	CITY CLERK	08/26/2021	10.65
USPS.COM CLICKNSHIP	800-782-6724	GENEVIEVE KLINE	CITY CLERK	08/24/2021	7.95
VANCE BROTHERS DENVER	8169234325	THOMAS CZAJKA	OPERATIONS	09/15/2021	159.00
VAUGHN CONCRETE PRODUC	8778278255	BRIAN GARDUNO	OPERATIONS	08/25/2021	108.00
VENNGAGE.COM	TORONTO	EMILY HOGAN	CITY MANAGER	09/15/2021	19.00
VZWRLSS*MY VZ VB P	800-922-0204	BOBBIEJO TREGAY	FINANCE	08/26/2021	4,071.84
VZWRLSS*MY VZ VB P	800-922-0204	BOBBIEJO TREGAY	FINANCE	08/20/2021	1,521.72
VZWRLSS*MY VZ VB P	800-922-0204	BOBBIEJO TREGAY	FINANCE	08/20/2021	888.09
VZWRLSS*PRPAY AUTOPAY	888-294-6804	CRAIG DUFFIN	PUBLIC WORKS	09/08/2021	20.00
WAL-MART #2223	WESTMINSTER	LANA FAUVER	REC CENTER	09/05/2021	65.70
WALTON'S INC	3162620651	DEVIN MADIGAN	WASTEWATER	09/14/2021	403.91
WHENTOWORK INC	7143899695	LINDSEY WITTY	REC CENTER	09/14/2021	86.00
WHITEBOARDS ETC	5088426200	SANDRA ANDRETICH	OPERATIONS	08/20/2021	583.95
WWW.FLIPSNACK.COM	SAN FRANCISCO	GINGER CROSS	GOLF COURSE	08/26/2021	168.00
WWW.TABLEGROUP.COM	LAFAYETTE	CHRISTOPHER NEVES	IT	08/19/2021	25.00
YOURMEMBER-CAREERS	7274976565	KIRSTIE AMBROSE-HARLEY	HUMAN RESOURCES	08/23/2021	299.00
YOURMEMBER-CAREERS	7274976565	KIRSTIE AMBROSE-HARLEY	HUMAN RESOURCES	08/23/2021	299.00
YOURMEMBER-CAREERS	7274976565	KIRSTIE AMBROSE-HARLEY	HUMAN RESOURCES	08/23/2021	249.00
ZOOM.US 888-799-9666	SAN JOSE	ROBIN BROOKHART	HUMAN RESOURCES	09/19/2021	14.99

ZOOM.US 888-799-9666	SAN JOSE	ROBERT ZUCCARO	PLANNING	09/16/2021	59.73
ZOOM.US 888-799-9666	SAN JOSE	ERIN OWEN	LIBRARY	09/16/2021	112.42
ZOOM.US 888-799-9666	SAN JOSE	CHRISTOPHER NEVES	IT	09/14/2021	709.80
ZOOM.US 888-799-9666	SAN JOSE	KIRSTIE AMBROSE-HARLEY	HUMAN RESOURCES	09/09/2021	16.28
ZOOM.US 888-799-9666	SAN JOSE	KATIE BEASLEY	REC CENTER	09/02/2021	14.99
ZOOM.US 888-799-9666	SAN JOSE	DAVID D HAYES	POLICE	08/23/2021	154.98
ZOOM.US 888-799-9666	SAN JOSE	ROBIN BROOKHART	HUMAN RESOURCES	08/19/2021	14.99
EBAY O*25-07580-14202	SAN JOSE	DAVID BARIL	GOLF COURSE	09/09/2021	179.02
		CREDITS APPLIED & USED			45.85
TOTAL					
					93,780.06

CITY OF LOUISVILLE				
EXPENDITURE APPROVALS $25,000.00 - $99,999.99				
SEPTEMBER 2021				
DATE	**P.O. #**	**VENDOR**	**DESCRIPTION**	**AMOUNT**
9/9/2021	2021223	Midnight Metals LLC	*Museum HVAC replacement CIP. Received 2 bids, Midnight Metals*	$36,636.00
			being the lowest.	
9/24/2021	2021229	Conserve-A-Watt Lighting Inc	*Library project to replace all existing fluorescent lamps with LED*	$36,574.12
			tubes and occupancy sensors to improve energy efficiency. State	
			of Colorado price agreement.	
9/30/2021	2021230	Eco Cycle Inc	*Sole source vendor.Boulder based company taking recycling and*	$30,000.00
			composting materials from Operations.	

City of Louisville
COLORADO • SINCE 1878

City Council

Meeting Minutes

August 31, 2021
City Hall, Council Chambers
749 Main Street
6:00 PM

Call to Order – Mayor Stolzmann called the meeting to order at 6:00 p.m. **Roll Call** was taken and the following members were present:

City Council:	***Mayor Ashley Stolzmann***
	Mayor Pro Tem Dennis Maloney
	Councilmember Kyle Brown
	Councilmember J. Caleb Dickinson
	Councilmember Deborah Fahey
	Councilmember Chris Leh (arrived 6:02 pm)
	Councilmember Jeff Lipton
Staff Present:	***Megan Davis, Interim City Manager***
	Rob Zuccaro, Interim Deputy City Manager
	Kurt Kowar, Public Works Director
	Lisa Ritchie, Interim Planning & Building Safety Director
	Nathan Mosley
	Meredyth Muth, City Clerk
Others Present:	***Kathleen Kelly, City Attorney***

Mayor Stolzmann noted that because of the COVID-19 emergency the meeting is being held electronically. She gave information on how the meeting process will work and directions for those dialing in on how to participate when it is time for public comments.

APPROVAL OF THE CONSENT AGENDA

Mayor Stolzmann asked for changes to the consent agenda; hearing none she asked for a motion.

Mayor Pro Tem Maloney noted the Baker Tilly, LLC contract is for the recruitment of a new city manager. He stated there were many good proposals and he and Councilmember Fahey recommend this one and feel they will do a good job.

A. ***Approval of Contract with Baker Tilly, LLC for City Manager Recruitment Services***

Motion: Councilmember Fahey moved to approve the consent agenda, seconded by Mayor Pro Tem Maloney. **Vote:** All in favor**.**

ORDINANCE NO. 1811, SERIES 2021 – AN ORDINANCE APPROVING THE FIRST AMENDMENT TO CONOCOPHILLIPS CAMPUS GENERAL DEVELOPMENT PLAN (REDTAIL RIDGE MASTER PLAN) – 2ND READING, PUBLIC HEARING (advertised *Daily Camera* 7/18/21) *continued from 7/27/21, 8/3/21, & 8/17/21*

Mayor Stolzmann reopened the public hearing and asked for disclosures. Councilmember Dickinson stated he wanted to be clear he had not made up his mind on the application. He looks forward to more testimony and will take all the information into consideration in his decision.

Mayor Stolzmann reminded everyone where the application is in the process. She noted there will be one additional chance for public comments and applicant comments tonight.

Director Zuccaro reviewed the new information from the packet. It includes a proposal from the applicant with revisions to the open space dedication, a reduction in the maximum allowed building area, and a revision to the sustainability commitments.

City Attorney Kelly reminded everyone that the purpose of the meeting is for the Council to continue to listen to evidence and to consider the application and evidence with the applicable legal criteria from the municipal code. She noted that there is an additional set of criteria in the state statute that says the City Council can require additional public land dedications if additional factors are met (C.R.S. 29-20-201). It states that Council shall not require additional land dedication unless one of two criteria are met: 1) there is an essential nexus between the dedication and a legitimate City interest and 2) the dedication is roughly proportional both in nature and extent to the impact of the proposed use of the property. She reminded Council to apply the evidence and also to determine if the criteria have been met or not.

Geoff Baukol, applicant presentation, stated that in the earlier hearings there were requests for additional open space, more sustainability, and changes in density to protect the pond. In response to what they heard, the now present an updated application that increases the open space dedication by 20 acres, including areas that have not been previously developed; they added electric HVAC and hot water for all buildings and increased the solar installation minimum; they have reduced the building density around the pond in Parcel C; and they removed gas stations as a permitted use in any parcel.

Councilmember Leh asked for confirmation that the solar would be on the buildings not on the open spaces. Jordan Swisher stated the solar is not specifically depicted in the GDP other than it is an allowable use. The most cost-efficient way to do the solar is on the roofs but it may not be limited to that. That will be determined in the PUD process.

Mayor Stolzmann stated she prefers the alignment of Campus Drive be further north and connect to Paradise Lane. She is concerned the proposed location of the intersection of Campus Drive with 96th Street is too close to the Northwest Parkway and fire station entrance. She is concerned the traffic queuing will be extremely long and will impact travel times.

Bill Fox, applicant traffic engineer, stated that they have reviewed the queuing time and feel this alignment with the additional southbound through lane is preferred and it won't back up traffic back to the school.

Mayor Stolzmann stated she is concerned that at build out the roads in this area will not be able to maintain a Level of Service C as we want for this area.

Jordan Swisher noted their preference for the proposed alignment of Campus Drive as it maintains the buffer with Paradise Lane which is what is stipulated in the Northwest Parkway IGA. She also noted that the applicant does not control Paradise Lane so aligning Campus Drive with that would require the owners' consent.

Public Comments

Jill Sjong, 601 Dahlia Way, stated she feels the footprint is too large and the development should be limited to those areas that were previously developed. She does not think the City needs the development. She urged a no vote.

Sherry Sommer, 910 South Palisade Court, asked Council to consider the public sentiment and expertise that has been provided related to climate change in addition to the code in their decision.

Irfan Azeem, 631 West Street, stated he has many concerns about the development and is specifically concerned that adding new commercial space to the City will divert users from space that is already empty. He feels the development will have an adverse economic impact on the city.

Beth McQuie, 972 St. Andrews Lane, stated the current open space proposal is too small. She encouraged requiring all land north of Disc Drive be dedicated as open space to protect the areas that have not been previously developed. She asked for more trails in the dedicated open space. She asked the development be limited to 2.5M square feet.

Stephanie Rowe, 631 West Street, asked Council to consider the public comments they have received. She stated people are not against any development on this property but they feel this particular development is not appropriate and does not meet the Comp Plan. She supports making all of the area north of Disc Drive as open space.

Michiko Christiansen, speaking through an ASL interpreter, 543 Adams Avenue, asked Council to deny the application and asked council to use this area as a buffer with

Broomfield. She feels there is no need for additional developed space as there is room in CTC and Centennial Valley. She encouraged Council to make better use of the existing buildings and transportation network in town before approving this.

Scott (no last name given), stated he supports the application for its steps towards sustainability. The applicant has gone above and beyond the requirements and will be one of the most sustainability developments in town.

Allison Torbik, stated she supports the application. This is not undeveloped land, and it needs to be used for the betterment of the community. This application has offered more open space than is required and has made a commitment to sustainability. We need jobs locally to keep people from driving to Denver to work. She urged approval.

Jan Prokop, 637 West Street, stated she doesn't support additional square footage over the already allowed 2.5M. She encouraged requiring everything north of Disc Drive to be open space, and she feels the environmental impact is too big. She urged a no vote.

Cindy Bedell, 662 West Willow Street, urged the Council to consider the overall need for open space and trails; additional open space and trails would benefit the entire community. She stated the municipal code allows for a larger dedication and urged requiring everything north of Disc Drive as open space and keeping the square footage to 2.5M.

Bryan Boonstra, 9555 Paradise Lane, urged a yes vote stating this proposal does a good job of balancing economic development and the need to protect open space. The connection of Campus Drive with 96th street is much needed.

Audrey Debarros, 839 West Mulberry Street, urged approval of the project. The GDP is consistent with the Comp Plan and the multimodal and transportation improvements would help build local and regional connections. The applicant has gone above and beyond with the sustainability requirements. She stated the City needs to be open to business and this application is a benefit to the community.

Matt Jones, 265 Dahlia Drive, asked the Council to listen to the environmentalists in town, to require 30% open space, to save the pond, and to fully electrify the site. He urged keeping the site to 2.5M square feet.

Tamar Krantz, 691 West Street, stated the statute and municipal code allow the Council to require a larger open space dedication and urged Council to do that for the health and safety of the community. She urged saving all land north of Disc Drive and urged a no vote.

Jennifer Singer-Rupp, 466 Muirfield Circle, stated a single user campus is preferable to this application. She stated this property will compete with existing vacant space and is not in the best interest of the community. She urged a no vote.

Maxine Most, 640 West Linden Street, stated this application is not consistent with the Comp Plan or the values of this community. She stated the applicant does not have the needs of the community in mind and in only out to maximize profit. She urged a no vote.

MOTION: Councilmember Brown moved to approve the ordinance but noted that depending on the discussion he may or may not vote for it; the motion died for lack of a second.

Councilmember Lipton stated this application has been going on for more than a year. He stated there is unlikely any plan that will satisfy everyone's interests and opinions. We need to find compromise and common ground that balances a number of key interests. Those interests include ensuring environmentally sustainable land and buildings; providing strong stewardship to our open space program and our ecological interests; supporting the City's economic vitality and financial sustainability; being lawful in the application of our municipal code; respecting private property rights; trying to agree on a plan that has a reasonably high probability of financial success; and providing additional incentives to the developer to exceed the minimum GDP requirements to encourage additional open space dedications and to help achieve a zero carbon development.

He stated his had created a motion with 9 approval conditions for Council to discuss and see if the group can find common ground.

MOTION: Councilmember Lipton moved the Council approve Ordinance 1811, Series 2021, approving the ConocoPhillips Campus GDP, 1st Amendment, Redtail Ridge Master Plan, and that prior to final execution and recordation of the GDP, the following conditions be included in the GDP:

1) The GDP be revised to allow a maximum of 3.0 million gross square feet of building development subject to the other conditions below.
2) The permitted uses on the site excludes gasoline service stations.
3) The applicant shall revise the Sustainability Commitment Plan to not that all commercial development above 10,000 square feet shall meet the LEED Silver rating.
4) The public land dedication shall be increased to 83.7 acres of land with the recently added 20.3 acres of publicly dedicated Open Space be located around the pond in Parcel C and contiguous to currently identified Open Space in Parcel A.
5) The applicant shall be provided an additional (43,560 X FAR of .27) 11,761 square feet of building space development for every additional acre of Open Space dedicated to the City above the required 83.7 acres in locations and amounts approved by the City up to a total Public Open Space dedication of 100 acres.
6) All buildings shall be heated, cooled and provided hot water by electric power and that the use of natural gas will be limited to providing back up emergency electrical generation power and only for the process uses where the best available technology cannot rely on electrical power or if electrical power is deemed impractical or infeasible.

7) The applicant will be required to raise its commitment for rooftop or ground mounted solar generated electricity from the originally proposed 2 MW of power to a minimum of 3MW and that solar power be installed in proportion to the square footage of the overall project buildout.
8) The applicant shall make all parking lots and structured parking EV-ready and provide Level 2 charging stations for 3% of all parking spaces. The applicant shall also provide Level 3 Fast Charging stations in sufficient quantities necessary to meet occupant demand.
9) The applicant shall be permitted to increase its approved building space in each parcel by up to 10% as a “density bonus” if requested by the applicant and if the City determines that the proposed development in the respective parcel qualifies as fully “Net Zero” facilities without the use of purchased renewable energy credits (RECs) and if the additional density does not present other materially consequential impacts that cannot be accommodated and/or mitigated in the development plan.

Seconded by Mayor Pro Tem Maloney.

Mayor Stolzmann stated Council will need to discuss each of the conditions and she noted others may want to introduce conditions of their own as well during the discussion. She asked Councilmember Lipton to speak to the motion.

Councilmember Lipton stated he is looking for a balance of how much development potential could be allowed and also meet our open space needs while trying to have an environmentally sustainable development. This would also provide incentives to the developer to be able to accomplish this in an economically feasible manner. He stated he supports heating and cooling the buildings without natural gas and adding additional solar ready capacity. He feels this meets the goals and needs of the community.

Mayor Stolzmann recommend that whatever is decided tonight would then go back to staff so the conditions can be put in the ordinance and Council can review that and vote at a later meeting. This way everyone will know exactly what is in the ordinance and have time to review it before a vote. It would not be to extend the public hearing, but just to make sure the conditions are as Council wants them in the ordinance.

Mayor Stolzmann asked for discussion on the conditions point by point to see which ones have consensus.

Councilmember Leh asked for some clarity from the City Attorney on her earlier comments to make sure everyone understood how public comments are evaluated in the land use process.

City Attorney Kelly stated the Council takes public comments on these applications to assist in applying the criteria in the municipal code. She noted the public comments that relate to the criteria can and should be taken into consideration, however the comments

that do not relate to the criteria cannot be taken into consideration. She reminded the Council that the decision tonight must be guided by the legal requirements in the code and state statute and comments should specifically address the criteria in the code.

Councilmember Leh noted the Council is acting in a quasi-judicial role here and has to make a decision based on the evidence presented in the hearing. The Council has to follow due process.

Mayor Pro Tem Maloney stated he thinks there is merit in the application and if the Council can work through some good conditions we can make it a good fit for the community. He noted the application has been shaped over time by this process and the public comments.

Condition #1 The GDP be revised to allow a maximum of 3.0 million gross square feet of building development subject to the other conditions below.

MOTION: Councilmember Brown moved to replace the 3M square foot limit with 1.6M square feet. Mayor Stolzmann seconded.

Councilmember Brown stated he supports 1.6M sf as it is the foot print of the original StorageTek campus on this site. He stated this provides for a sufficient sized campus and preserves open space.

Mayor Stolzmann stated she supports this as it is what was allowed for StorageTek on the property. The ConocoPhilips plan that was approved for 2.5M sf was never built and the additional density never implemented so she feels between 1.6 and 2.5M sf can be reasonably argued as use by right on the site. She doesn't feel there is any reason to give additional entitlements when the applicant has not shown the proposed use will bring economic stability to the community.

Councilmember Leh asked staff if this is how the use by right should be interpreted. Director Zuccaro noted the ConocoPhilips GDP approved the rezoning of the property to PCZD zoning and allowed up to 2.5M sf of development. GDPs do not expire so that 2.5M sf is the current entitlement on the property.

Councilmember Lipton reviewed the history of the site approvals. He noted that if the Council wants to have a sustainable development on the site it will need to have density; more density that when it was StorageTek, and more than what ConocoPhillips asked for.

There was no consensus to reduce the square footage to 1.6M sf.

Mayor Stolzmann asked that the condition be revised to 2.5M sf. She stated she saw no need to go above what was in the previous GDP and it will only be a larger environmental impact on the site. Councilmember Brown supported the 2.5M sf. There was no consensus to move this forward.

Majority consensus was to leave the condition as originally proposed.

Condition #2 The permitted uses on the site excludes gasoline service stations.

All were in agreement to remove this use on the site.

#3 The applicant shall revise the Sustainability Commitment Plan to note that all commercial development above 10,000 square feet shall meet the LEED Silver rating.

Councilmember Brown proposed that all industrial buildings must be Silver and commercial must meet LEED Gold standard. He stated he feels this is needed given the environmental impact of this development and he would like to see additional transportation options included in the proposal.

Councilmember Dickinson asked staff if the City has required this in other GDPs. Director Zuccaro stated this has not been a requirement in other GDPs.

Mayor Stolzmann asked if the applicant had proposed LEED certification in their application. Director Zuccaro stated yes, the applicant proposed LEED Certified for industrial uses and LEED Silver for all other buildings.

Councilmember Lipton stated there are no LEED Gold buildings in town, not even City buildings, so he is uncomfortable requiring this in the application. He stated he wants to propose something that is feasible and can be done and Silver for industrial buildings may not be feasible.

Councilmember Dickinson stated this condition as proposed is already a higher standard than other buildings in town he supports it if reaching something higher is not possible.

Mayor Stolzmann asked the applicant if this proposal was feasible. Geoff Baukol stated they feel LEED Certified for industrial and LEED Silver for the other buildings is feasible, but moving to Gold would not be.

Mayor Pro Tem Maloney agreed with Councilmember Dickinson that we want what is feasible and that we are applying these rules equally noting Council approved an industrial building just a few weeks ago without this requirement. He stated he would like to make these types of things requirements in the code and would like to see Council address that in the code.

Mayor Stolzmann stated she feels that as the applicant is asking for changes to the GDP to allow new uses, she feels that the Council has the right to ask for a higher level of sustainability commitment. She feels that if the applicant wants new use groups than the new industrial use group should meet the standards of the other use groups.

Councilmember Leh supported Councilmember Brown's suggestion

Councilmember Fahey stated she supported the condition as written as there are other things in the conditions such as requiring electrification and EV charging station that will get us to where we want to be on sustainability.

The consensus of the majority was to keep the condition as proposed.

Condition #4 The Public land dedication shall be increased to 83.7 acres of land with the recently added 20.3 acres of publicly dedicated Open Space be located around the pond in Parcel C and contiguous to currently identified Open Space in Parcel A.

Mayor Stolzmann asked to include "land intended to be open natural land to be zoned as Open Space on dedication."

Councilmember Brown proposed requiring everything north of Disc Drive as open space.

Councilmember Leh stated he does not support everything north of Disc Drive as open space but he does feel additional land should be dedicated as open space due to the impact of this development.

Mayor Pro Tem Maloney stated the 83.7 acres currently proposed is a good compromise and the area represents purposeful open space including the pond. He supports this.

Councilmember Dickinson stated that asking for 160 acres is probably not reasonable as it is 52% of the property. 83 acres is 25% of the area and when you add the undeveloped areas of the property that are not a part of the public dedication it is close to the 30%. He stated he would like to get to 93 acres which would be about 30%.

Mayor Stolzmann supported 93 acres as it relates to the public dedication and impact on the community. She would like to see the development clustered together south of Disc Drive to keep the area north of Disc Drive undeveloped so as to keep this area feeling rural like its rural designation. That would also make the land dedication meaningful and protect the view corridor. Without that clustering and keeping the area north of Disc Drive open she stated she can't support this condition.

Councilmember Brown agreed with Mayor Stolzmann that this would protect the area the best. He suggested a proposal that no building be allowed north of Disc Drive.

Councilmember Lipton stated he doesn't think the Executive Order for 30% open spaces applies to local land use decisions and it is a Federal Order and an intrusion on local land use decisions. The municipal code requires 12% public land dedication and the applicant is offering twice that. He is concerned about setting precedents for other property owners. However, he is interested in clustering the building to optimize the undeveloped areas and meet some of our other goals.

Councilmember Fahey stated she likes the idea of clustering. Even if all of the property is not designated as City Open Space it will still feel like open space. She is willing to give concessions such as another story on their buildings to encourage such clustering

Mayor Pro Tem Maloney also likes that idea and suggested there may need to be some flexibility on density and height in the PUD process to make that happen.

Councilmember Dickinson asked the applicant if it is possible to put all 3M sf south of Disc Drive. Baukol stated that such clustering would require the building to go higher which might then eliminate some uses such as research and development so that will be a challenge. He stated if it was all office it could be done, but it will require more work to see if it is possible.

Councilmember Dickinson state he would like to see the development as far south as possible but using the Disc Drive line may not make sense.

Councilmember Lipton stated if this is the requirement it would mean this is an office park not a mixed use park.

The consensus of the majority was to change the condition to require 93 acres to be dedicated and as Open Space and zoned on dedication.

There was also consensus that the intent is for the buildings to be clustered on the south of the property, preferably south of Disc Drive, so the open land is as contiguous as possible with Parcels C and A. Director Zuccaro stated this may have to be a note on the GDP rather than a condition in the ordinance.

Condition #5 The applicant shall be provided an additional (43,560 X FAR of .27) 11,761 square feet of building space development for every additional acre of Open Space dedicated to the City above the required 83.7 acres in locations and amounts approved by the City up to a total Public Open Space dedication of 100 acres.

The consensus was to strike this condition as this issue was basically addressed in the previous condition.

Condition #6 All buildings shall be heated, cooled and provided hot water by electric power and that the use of natural gas will be limited to providing back up emergency electrical generation power and only for the process uses where the best available technology cannot rely on electrical power or if electrical power is deemed impractical or infeasible.

Mayor Stolzmann stated she prefers to stay with the applicant's proposal rather than this condition. Councilmembers Dickinson and Brown agreed.

Mayor Pro Tem Maloney stated he likes the condition as written so there is practical back up capability on the site. Councilmember Lipton stated not having a practical back up will limit the types of uses on this property. Councilmember Fahey agreed.

Councilmember Brown stated he could not support this condition as he feels it is a step backward.

Mayor Stolzmann stated she supports removing natural gas from the site. If that means there cannot be industrial uses on the site than we should change the uses on the site.

Mayor Pro Tem Maloney stated a reliable back up power source is not just needed for industrial uses, it can be needed for heavy computer use and biomedical uses. He wants to make sure this is a location that will invite the type of employers and industries we want in the community.

Councilmember Leh stated he would like to find language that would allow natural gas only in very limited ways on the site.

Councilmember Brown stated that build out is not for 20 years and he would prefer to look forward knowing there will be alternatives to natural gas by the build out.

Councilmember Lipton stated that at this time there are no good solutions and for now we need to attract companies that will build here. He asked Baukol if full electrification was feasible on the site. Baukol stated that for right now to be feasible they need to include some options for redundancies. The long-term goal would be full electrification.

Mayor Pro Tem Maloney agreed that in 20 years there will likely be options other than natural gas, but for now the only back up would be diesel which is worse than natural gas. Eventually we all hope the entire site is fully electric but that is not feasible right now.

Councilmember Dickinson stated his very much supports full electrification, but at this time he is concerned that if there is no option for at least some use of natural gas the development will fail. He supports the language as proposed.

The consensus of the majority was to keep the proposed condition as written.

Condition #7 The applicant will be required to raise its commitment for rooftop or ground mounted solar generated electricity from the originally proposed 2MW of power to a minimum of 3MW and that solar power be installed in proportion to the square footage of the overall project buildout.

The consensus was to accept the condition as written.

Condition #8 The applicant shall make all parking lots and structured parking EV-ready and provide Level 2 charging stations for 3% of all parking spaces. The applicant shall

also provide Level 3 Fast Charging stations in sufficient quantities necessary to meet occupant demand.

The consensus was to strike the first sentence as it is already in the applicant's sustainability plan and keep the second sentence as proposed.

Condition #9 The applicant shall be permitted to increase its approved building space in each parcel by up to 10% as a "density bonus" if requested by the applicant and if the City determines that the proposed development in the respective parcel qualifies as fully "Net Zero" facilities without the use of purchased renewable energy credits (RECs) and if the additional density does not present other materially consequential impacts that cannot be accommodated and/or mitigated in the development plan.

Councilmember Lipton stated he presented this in an effort to encourage the applicant to reach the goal of Net Zero which we all want and is important to the community.

Mayor Pro Tem Maloney supports a density bonus if a building can be Net Zero.

Mayor Stolzmann stated she doesn't support this because the density bonus would need to be provided when building and there is no way to know how much energy use a tenant will be using at the time of building core and shell. Councilmember Dickinson agreed.

Councilmember Lipton stated he supports this as a way to encourage density on the site to give the Council options at the time of PUD.

The consensus of the majority was to keep the proposed condition as written.

Additional conditions

Mayor Stolzmann proposed a condition or note on the GDP requiring construction access for the site be limited to access from the NW Parkway. Members agreed to that condition.

Mayor Stolzmann proposed deleting the section of the note on the GDP that reads "Any such PUD approval shall be in compliance with the amended and restated planned community zone district zoning agreement including the requirement for clustering and provision of common open space for the areas noted in this GDP." These decisions need to be made when the PUD is submitted and it is clear what is being proposed.

Councilmember Dickinson agreed this should be done at the time of PUD. Mayor Pro Tem Maloney agreed.

Members agreed to deleting the full note and replacing it with language related to condition #4.

Mayor Stolzmann proposed a condition that offsite traffic improvements and trails will be paid for by the applicant and will be noted in the subdivision agreement.

Mayor Stolzmann stated that as the improvements will be needed due to this development, she would like guarantees the developer pays for needed improvements.

Councilmember Lipton stated he wanted to be sure the developer is only paying for their proportional impact on these improvements as some of them are impacted by development form outside of Louisville.

Councilmember Brown agreed with Mayor Stolzmann, noting the developer created a metro district that can help pay for these improvements.

Mayor Pro Tem Maloney stated this development will have a significant impact on traffic and they should pay their portion of the improvements, but not the entire cost.

Councilmember Brown suggested adding language that the developer will pay their proportionate share of their impact on the offsite traffic improvements

There was consensus of the majority was to add the condition with the proportional language.

Mayor Stolzmann proposed a condition to realign Campus Drive with Paradise Lane.

Mayor Stolzmann stated this would be a better location for the intersection with 96th Street and eliminate a queuing problem. She feels having Paradise Lane, Campus Drive, and the NW Parkway so close together on 96th Street will be problematic and cause more traffic issues. She feels the traffic plan in inadequate as presented and the level of service will be lower than what is presented.

There was no consensus to add this condition.

Councilmember Brown proposed a condition that the development may only proceed when the City has secured sufficient water rights.

Director Kowar stated the tap fees are charged for each development and that money is used to purchase water rights. The City buys water rights with that tap fee money as they rights become available. The site does already have a six-inch water tap to cover some of their use. This site is already built into the City's long-range water plan and there is water available to purchase.

Councilmember Brown asked if the water can be purchased before the development proceeds. Director Kowar stated water would generally be purchased over the years of development and would be coordinated with other water purchases the City is making.

After discussion Councilmember Brown withdrew the proposal.

Councilmember Brown proposed a condition that the developer submit a wildlife plan showing how wildlife would be relocated or terminated on the site and that the plan be approved by Council before the GDP is finalized and recorded.

Director Zuccaro stated there is no requirement in the development process for approval of a wildlife plan. He asked if this would be a condition of finalizing and recording the GDP.

Councilmember Brown stated he would like information on how wildlife will be handled and the community is interested in what the plan is.

Mayor Pro Tem Maloney noted the applicant will have to follow all State rules and regulations related to wildlife management.

There was no consensus to add this condition.

Mayor Stolzmann asked the applicant for closing comments.

Baukol thanked Council and the residents for the process. He noted that if approved, this will be the most sustainable development in Louisville's history. They hope it will be a great blend of nature and employment to the benefit of the community.

Mayor Stolzmann closed public hearing.

City Attorney Kelly noted that as the public hearing is now closed. Staff will bring back draft language on the conditions based on what was discussed tonight. No new public testimony or evidence will be taken on the application unless the public hearing is reopened and proper notice given.

MOTION: Mayor Stolzmann moved to continue the item to September 21 at 6 pm, Mayor Pro Tem Maloney seconded the motion. All in favor.

ADJOURN

Members adjourned at 11:30 pm.

_____
Ashley Stolzmann, Mayor

_____
Meredyth Muth, City Clerk

City of Louisville
COLORADO • SINCE 1878

CITY COUNCIL COMMUNICATION
AGENDA ITEM 4C

SUBJECT: **APPROVAL OF COUNCIL MEETING SCHEDULE FOR REMAINDER OF 2021**

DATE: **OCTOBER 19, 2021**

PRESENTED BY: **MEREDYTH MUTH, CITY CLERK**

SUMMARY:
Staff recommends the following meeting schedule changes and additions for the remainder of 2021. If any of these meetings are not needed they will be cancelled.

- October 26 Study Session (5 pm) with BVSD School Board
- October 26 Special Meeting (6 pm) for executive session
- Monday, November 1 Regular Meeting (6 pm) moved from November 2
- November 9 Study Session (6 pm) City Council Orientation
- November 16 Regular Meeting (6 pm)
- November 23 Study Session Cancelled
- December 7 Regular Meeting (6 pm)
- Monday, December 13 Special Meeting (6 pm) Board & Commission Interviews
- December 14 Special Meeting (6 pm) Work Plan Discussion
- December 21 Regular Meeting (6 pm)
- December 28 Study Session Cancelled

Additional meetings are expected in November for the City Manager interviews and Board and Commission application review. Those will be approved at a later date when the schedule is confirmed.

FISCAL IMPACT:
None

RECOMMENDATION:
Approve meeting schedule.

ATTACHMENT(S):
None

SUBJECT: **LOUISVILLE CHAMBER OF COMMERCE – 2021 YEAR END REPORT**

DATE: **OCTOBER 19, 2021**

PRESENTED BY: **MEGAN E. PIERCE, ECONOMIC VITALITY DIRECTOR**

SUMMARY:
In 2020, the Louisville Chamber of Commerce made a request to City Council to increase the City funding to the Chamber. City Council concurred with the request and new funding was incorporated in fiscal year 2021. In 2021, the Chamber received $25,000 for business retention and promotion activities. The Chamber will additionally receive $2,000 in support of the Parade of Lights later this year. Prior to 2021, the Chamber received $5,000 annually for business retention support and $2,000 for the Parade of Lights.

As part of the increased funding, staff and the Chamber agreed-to an annual report on the Chamber's activities—outlining what business activities the funding specifically helped to support. *Attachment #1* is the Chamber's 2021 annual funding report. Shelley Angell, the recently retired Chamber Executive Director, oversaw the funding increase request and prepared the attached report. Economic vitality staff greatly appreciates Shelley's contributions and the partnership the City and the Chamber have established under her leadership.

Staff is currently working with the Chamber of Commerce's new Executive Director, Amber Thiel, on the planned funding for next year and what activities the dollars will support. The fiscal year 2022 budget includes $32,000 in Chamber funding ($30,000 for business retention and promotion and $2,000 for the Parade).

FISCAL IMPACT:
In 2021, the total fiscal impact of the City's support to the Chamber of Commerce is $27,000. In 2022, the anticipated fiscal impact is expected to increase to $32,000. No specific funding request has yet been made for 2023.

PROGRAM/SUB-PROGRAM IMPACT:
Collaboration with and financial support of the Louisville Chamber of Commerce relates to the Economic Prosperity Program Goal to promote a thriving business climate that provides job opportunities, facilitates investment, and produces reliable revenue to support City services.

RECOMMENDATION:
Information only report.

ATTACHMENTS:

1. Louisville Chamber of Commerce 2021 Annual Funding Report

STRATEGIC PLAN IMPACT:

☒	**Financial Stewardship & Asset Management**	☐	**Reliable Core Services**
☒	**Vibrant Economic Climate**	☐	**Quality Programs & Amenities**
☐	**Engaged Community**	☐	**Healthy Workforce**
☐	**Supportive Technology**	☐	**Collaborative Regional Partner**

LOUISVILLE
CHAMBER

Dear Honorable Mayor and Council Members,

On behalf of the Louisville Chamber, I would like to thank you for the generous $27,000 funding you provided the Chamber for 2021, which included $25,000 for business retention and promotion activities and $2,000 for the Parade of Lights. This funding has helped the Chamber and business community stay strong and work together through these unprecedented times.

Here are several things the funding allowed us to accomplish:

- We produced a Business Directory and Community Guide that we direct mailed to 11,000 households. The directory not only includes business listings, but it also has several pages dedicated to community information as well as city information. We also provided a free half page ad in the directory for PACE and Louisville Sustainability Green Business Program.
- We sponsored a Taste of Louisville weekend that included a community 5K Fun Run and promotions for our local businesses to encourage people to shop and dine local. As an incentive, we did drawings for $50 gift cards that we purchased from local businesses for people that sent us their receipts from the Taste weekend. We also gave out over 500 t-shirts to restaurants and retailers for their customers.
- We promoted and hosted a State of the City Zoom presented by Mayor Stolzmann.
- We reached out to over ten businesses a month to see how they were doing and how we could help them.
- We sent out well over 100 emails to our business community keeping them informed on all city, county, and state information, including all the changes with covid regulations.
- We partnered with the city for a Shop Small Campaign. This took place the months of January, February, and March. People would send us their receipts from local businesses and every two weeks we would do a drawing for a $100 gift card to a business of their choice. At the end of the promotion, we did a drawing for a $500 gift card grand prize.
- We gave grants to 24 businesses that were struggling to help pay their membership dues.
- Shelley Angell met monthly with both Heather Balser and Megan Pierce to discuss and provide input on new programs for the businesses.

Moving forward, the new Executive Director, Amber Thiel will oversee the funding. It is our understanding that in 2022 the Chamber is budgeted to receive $30,000 for business retention and $2,000 for Parade of Lights.

The Chamber truly appreciates the city's partnership and all the support you have given us throughout the years.

If you have any questions, please contact me anytime.

Sincerely,

Shelley Angell

Shelley Angell
Louisville Chamber of Commerce

SUBJECT: **AWARD BID FOR 2021 96TH STREET BRIDGE REPAIRS**

DATE: **OCTOBER 19, 2021**

PRESENTED BY: **KURT KOWAR, PUBLIC WORKS DEPARTMENT**

SUMMARY:

Approval of Bridge Repairs – Slab Raising

Staff recommends City Council award the Bridge Repairs – Slab Raising to Uretek USA, Inc. for $104,593.00, authorize staff to execute change orders up to $10,459.30 for additional work and project contingency, and authorize the Mayor, Public Works Director and City Clerk to sign and execute contract documents on behalf of the City.

On September 23, 2021 staff performed a Request for Qualifications (RFQ) with contractors for the Bridge Repairs – Slab Raising project. The pricing received through the RFQ is listed below:

Contractor	Total
Uretek USA, Inc.	**$104,593.00**
Concrete Stabilization Technologies, Inc	$109,500.00

The work shall consist of soil densification to strengthen base and sub-base soils under the bridge approaches for the Coal Creek Bridge on 96th Street, by furnishing and injecting expansive polyurethane material into the foundation soils beneath the pavement through holes or injection tubes while monitoring for movement at the surface. Void space located at the southern slab of the Coal Creek Bridge will be filled. In addition, for the BNSF Bridge on 96th Street, a gap between the slope and abutment on the north side shall be filled. These repairs are based on the maintenance recommendations from the Colorado Department of Transportation Off System Bridge Inspections which occurred in January and February of 2021.

Staff recommends award of the project to Uretek USA, Inc. for the base bid.

The contract work will begin in November 2021 and finish in December 2021.

A map of the project location is attached.

FISCAL IMPACT
The breakdown of estimated project costs that includes construction, soft costs such as engineering and material testing and contingency are listed below:

301312-660064 Bridge Repairs

Budget	$204,957.32
Contract	$104,593.00
Contingency	$10,459.30
Remaining Budget	$89,905.03

PROGRAM/SUB-PROGRAM IMPACT:
The recommended contract supports the Transportation-Infrastructure Maintenance goal of providing a safe, well-maintained effective and efficient multimodal transportation system at a reasonable cost.

RECOMMENDATION:
Staff recommends City Council award the Bridge Repairs – Slab Raising Project to Uretek USA, Inc for $104,593.00, authorize staff to execute change orders up to $10,459.30 for additional work and project contingency, and authorize the Mayor, Public Works Director and City Clerk to sign and execute contract documents on behalf of the City.

ATTACHMENT(S):
1. Contract Agreement
2. Map of Location

STRATEGIC PLAN IMPACT:

☒	**Financial Stewardship & Asset Management**	☒	**Reliable Core Services**
☐	**Vibrant Economic Climate**	☐	**Quality Programs & Amenities**
☐	**Engaged Community**	☐	**Healthy Workforce**
☐	**Supportive Technology**	☐	**Collaborative Regional Partner**

INDEPENDENT CONTRACTOR AGREEMENT
BY AND BETWEEN THE CITY OF LOUISVILLE
AND URETEK USA, INC
FOR BRIDGE REPAIRS – SLAB RAISING SERVICES

1.0 PARTIES

This INDEPENDENT CONTRACTOR AGREEMENT (this "Agreement") is made and entered into this _____ day of _____, 2021 (the "Effective Date"), by and between the **City of Louisville**, a Colorado home rule municipal corporation, hereinafter referred to as the "City", and _____, Uretek USA, Inc. a Iowa Corporation, hereinafter referred to as the "Contractor".

2.0 RECITALS AND PURPOSE

2.1 The City desires to engage the Contractor for the purpose of providing Bridge Repair – Slab Raising services as further set forth in the Contractor's Scope of Services (which services are hereinafter referred to as the "Services").

2.2 The Contractor represents that it has the special expertise, qualifications and background necessary to complete the Services.

3.0 SCOPE OF SERVICES

The Contractor agrees to provide the City with the specific Services and to perform the specific tasks, duties and responsibilities set forth in Scope of Services attached hereto as Exhibit "A" and incorporated herein by reference. Contractor shall furnish all tools, labor and supplies in such quantities and of the proper quality as are necessary to professionally and timely perform the Services. Contractor acknowledges that this Agreement does not grant any exclusive privilege or right to supply Services to the City.

4.0 COMPENSATION

4.1 The City shall pay the Contractor for Services under this Agreement a total not to exceed the amounts set forth in Exhibit "A" attached hereto and incorporated herein by this reference. For Services compensated at hourly or per unit rates, or on a per-task basis, such rates or costs per task shall not exceed the amounts set forth in Exhibit A. The City shall not pay mileage and other reimbursable expenses (such as meals, parking, travel expenses, necessary memberships, etc.), unless such expenses are (1) clearly set forth in the Scope of Services, and (2) necessary for performance of the Services ("Pre-Approved Expenses"). The foregoing amounts of compensation shall be inclusive of all costs of whatsoever nature associated with the Contractor's efforts, including but not limited to salaries, benefits, overhead, administration, profits, expenses, and outside Contractor fees. The Scope of Services and payment therefor shall only be changed by a properly authorized amendment to this Agreement. No City employee has the authority to bind the City with regard to any payment for any Services which exceeds the amount payable under the terms of this Agreement.

4.2 The Contractor shall submit monthly an invoice to the City for Services rendered and a detailed expense report for Pre-Approved Expenses incurred during the previous month. The invoice shall document the Services provided during the preceding month, identifying

by work category and subcategory the work and tasks performed and such other information as may be required by the City. The Contractor shall provide such additional backup documentation as may be required by the City. The City shall pay the invoice within thirty (30) days of receipt unless the Services or the documentation therefor are unsatisfactory. Payments made after thirty (30) days may be assessed an interest charge of one percent (1%) per month unless the delay in payment resulted from unsatisfactory work or documentation therefor.

5.0 PROJECT REPRESENTATION

5.1 The City designates Kevin Trott as the responsible City staff to provide direction to the Contractor during the conduct of the Services. The Contractor shall comply with the directions given by Kevin Trott and such person's designees.

5.2 The Contractor designates Christa Wickland as its project manager and as the principal in charge who shall be providing the Services under this Agreement. Should any of the representatives be replaced, particularly Christa Wickland, and such replacement require the City or the Contractor to undertake additional reevaluations, coordination, orientations, etc., the Contractor shall be fully responsible for all such additional costs and services.

6.0 TERM

6.1 The term of this Agreement shall be from the Effective Date to October 20, 2021, unless sooner terminated pursuant to Section 13, below. The Contractor's Services under this Agreement shall commence on November 1, 2021 and Contractor shall proceed with diligence and promptness so that the Services are completed in a timely fashion consistent with the City's requirements.

6.2 Nothing in this Agreement is intended or shall be deemed or construed as creating any multiple-fiscal year direct or indirect debt or financial obligation on the part of the City within the meaning of Colorado Constitution Article X, Section 20 or any other constitutional or statutory provision. All financial obligations of the City under this Agreement are subject to annual budgeting and appropriation by the Louisville City Council, in its sole discretion. Notwithstanding anything in this Agreement to the contrary, in the event of non-appropriation, this Agreement shall terminate effective December 31 of the then-current fiscal year.

7.0 INSURANCE

7.1 The Contractor agrees to procure and maintain, at its own cost, the policies of insurance set forth in Subsections 7.1.1 through 7.1.4. The Contractor shall not be relieved of any liability, claims, demands, or other obligations assumed pursuant to this Agreement by reason of its failure to procure or maintain insurance, or by reason of its failure to procure or maintain insurance in sufficient amounts, durations, or types. The coverages required below shall be procured and maintained with forms and insurers acceptable to the City. All coverages shall be continuously maintained from the date of commencement of Services hereunder. The required coverages are:

7.1.1 Workers' Compensation insurance as required by the Labor Code of the State of Colorado and Employers Liability Insurance. Evidence of qualified self-insured status may be substituted.

7.1.2 General Liability insurance with minimum combined single limits of $1,000,000 each occurrence and $2,000,000 aggregate. The policy shall include the City of Louisville, its officers and its employees, as additional insureds, with primary coverage as respects the City of Louisville, its officers and its employees, and shall contain a severability of interests provision.

7.1.3 Comprehensive Automobile Liability insurance with minimum combined single limits for bodily injury and property damage of not less than $400,000 per person in any one occurrence and $1,000,000 for two or more persons in any one occurrence, and auto property damage insurance of at least $50,000 per occurrence, with respect to each of Contractor's owned, hired or non-owned vehicles assigned to or used in performance of the Services. If the Contractor has no owned automobiles, the requirements of this paragraph shall be met by each officer or employee of the Contractor providing services to the City of Louisville under this contract.

7.2 The Contractor's general liability insurance and automobile liability and physical damage insurance shall be endorsed to include the City, and its elected and appointed officers and employees, as additional insureds, unless the City in its sole discretion waives such requirement. Every policy required above shall be primary insurance, and any insurance carried by the City, its officers, or its employees, shall be excess and not contributory insurance to that provided by the Contractor. Such policies shall contain a severability of interests provision. The Contractor shall be solely responsible for any deductible losses under each of the policies required above.

7.3 Certificates of insurance shall be provided by the Contractor as evidence that policies providing the required coverages, conditions, and minimum limits are in full force and effect, and shall be subject to review and approval by the City. No required coverage shall be cancelled, terminated or materially changed until at least 30 days prior written notice has been given to the City. The City reserves the right to request and receive a certified copy of any policy and any endorsement thereto.

7.4 Failure on the part of the Contractor to procure or maintain policies providing the required coverages, conditions, and minimum limits shall constitute a material breach of contract upon which the City may immediately terminate this Agreement, or at its discretion may procure or renew any such policy or any extended reporting period thereto and may pay any and all premiums in connection therewith, and all monies so paid by the City shall be repaid by Contractor to the City upon demand, or the City may offset the cost of the premiums against any monies due to Contractor from the City.

7.5 The parties understand and agree that the City is relying on, and does not waive or intend to waive by any provision of this contract, the monetary limitations or any other rights, immunities, and protections provided by the Colorado Governmental Immunity Act, § 24-10-101 et seq., C.R.S., as from time to time amended, or otherwise available to the City, its officers, or its employees.

8.0 INDEMNIFICATION

To the fullest extent permitted by law, the Contractor agrees to indemnify and hold harmless the City, and its elected and appointed officers and its employees, from and against all liability, claims, and demands, on account of any injury, loss, or damage, which arise out of or are connected with the Services hereunder, if such injury, loss, or damage is caused by the negligent act, omission, or other fault of the Contractor or any subcontractor of the Contractor, or any officer, employee, or agent of the Contractor or any subcontractor, or any other person for whom Contractor is responsible. The Contractor shall investigate, handle, respond to, and provide defense for and defend against any such liability, claims, and demands. The Contractor shall further bear all other costs and expenses incurred by the City or Contractor and related to any such liability, claims and demands, including but not limited to court costs, expert witness fees and attorneys' fees if the court determines that these incurred costs and expenses are related to such negligent acts, errors, and omissions or other fault of the Contractor. The City shall be entitled to its costs and attorneys' fees incurred in any action to enforce the provisions of this Section 8.0. The Contractor's indemnification obligation shall not be construed to extend to any injury, loss, or damage which is caused by the act, omission, or other fault of the City.

9.0 QUALITY OF WORK

Contractor's Services shall be performed in accordance with the highest professional workmanship and service standards in the field to the satisfaction of the City.

10.0 INDEPENDENT CONTRACTOR

It is the expressed intent of the parties that the Contractor is an independent contractor and not the agent, employee or servant of the City, and that:

10.1. **CONTRACTOR SHALL SATISFY ALL TAX AND OTHER GOVERNMENTALLY IMPOSE RESPONSIBILITIES INCLUDING, BUT NOT LIMITED TO, PAYMENT OF STATE, FEDERAL AND SOCIAL SECURITY TAXES, UNEMPLOYMENT TAXES, WORKERS' COMPENSATION AND SELF-EMPLOYMENT TAXES. NO STATE, FEDERAL OR LOCAL TAXES OF ANY KIND SHALL BE WITHHELD OR PAID BY THE CITY.**

10.2. **CONTRACTOR IS NOT ENTITLED TO WORKERS' COMPENSATION BENEFITS EXCEPT AS MAY BE PROVIDED BY THE INDEPENDENT CONTRACTOR NOR TO UNEMPLOYMENT INSURANCE BENEFITS UNLESS UNEMPLOYMENT COMPENSATION COVERAGE IS PROVIDED BY THE INDEPENDENT CONTRACTOR OR SOME ENTITY OTHER THAN THE CITY.**

10.3. Contractor does not have the authority to act for the City, or to bind the City in any respect whatsoever, or to incur any debts or liabilities in the name of or on behalf of the City.

10.4. Contractor has and retains control of and supervision over the performance of Contractor's obligations hereunder and control over any persons employed by Contractor for performing the Services hereunder.

10.5. The City will not provide training or instruction to Contractor or any of its employees regarding the performance of the Services hereunder.

10.6. Neither the Contractor nor any of its officers or employees will receive benefits of any type from the City.

10.7. Contractor represents that it is engaged in providing similar services to other clients and/or the general public and is not required to work exclusively for the City.

10.8. All Services are to be performed solely at the risk of Contractor and Contractor shall take all precautions necessary for the proper and sole performance thereof.

10.9. Contractor will not combine its business operations in any way with the City's business operations and each party shall maintain their operations as separate and distinct.

11.0 ASSIGNMENT

Contractor shall not assign or delegate this Agreement or any portion thereof, or any monies due to or become due hereunder without the City's prior written consent.

12.0 DEFAULT

Each and every term and condition hereof shall be deemed to be a material element of this Agreement. In the event either party should fail or refuse to perform according to the terms of this Agreement, such party may be declared in default.

13.0 TERMINATION

13.1 This Agreement may be terminated by either party for material breach or default of this Agreement by the other party not caused by any action or omission of the other party by giving the other party written notice at least thirty (30) days in advance of the termination date. Termination pursuant to this subsection shall not prevent either party from exercising any other legal remedies which may be available to it.

13.2 In addition to the foregoing, this Agreement may be terminated by the City for its convenience and without cause of any nature by giving written notice at least fifteen (15) days in advance of the termination date. In the event of such termination, the Contractor will be paid for the reasonable value of the Services rendered to the date of termination, not to exceed a pro-rated daily rate, for the Services rendered to the date of termination, and upon such payment, all obligations of the City to the Contractor under this Agreement will cease. Termination pursuant to this Subsection shall not prevent either party from exercising any other legal remedies which may be available to it.

14.0 INSPECTION AND AUDIT

The City and its duly authorized representatives shall have access to any books, documents, papers, and records of the Contractor that are related to this Agreement for the purpose of making audits, examinations, excerpts, and transcriptions.

15.0 DOCUMENTS

All computer input and output, analyses, plans, documents photographic images, tests, maps, surveys, electronic files and written material of any kind generated in the performance of this Agreement or developed for the City in performance of the Services are and shall remain the sole

and exclusive property of the City. All such materials shall be promptly provided to the City upon request therefor and at the time of termination of this Agreement, without further charge or expense to the City and in hardcopy or an electronic format acceptable to the City, or both, as the City shall determine. Contractor shall not provide copies of any such material to any other party without the prior written consent of the City. Contractor shall not use or disclose confidential information of the City for purposes unrelated to performance of this Agreement without the City's written consent.

16.0 ENFORCEMENT

16.1 In the event that suit is brought upon this Agreement to enforce its terms, the parties shall each bear and be responsible for their own attorneys' fees and court costs.

16.2 This Agreement shall be deemed entered into in Boulder County, Colorado, and shall be governed by and interpreted under the laws of the State of Colorado. Any action arising out of, in connection with, or relating to this Agreement shall be filed in the courts of Boulder County or the federal district court for the District of Colorado, and in no other court. Contractor hereby waives its right to challenge the personal jurisdiction of the courts of Boulder County and the federal district court for the District of Colorado over it. Colorado law shall apply to the construction and enforcement of this Agreement.

17.0 COMPLIANCE WITH LAWS; WORK BY ILLEGAL ALIENS PROHIBITED

17.1 Contractor shall be solely responsible for compliance with all applicable federal, state, and local laws, including the ordinances, resolutions, rules, and regulations of the City; for payment of all applicable taxes; and obtaining and keeping in force all applicable permits and approvals.

17.2 Exhibit B, the "City of Louisville Public Services Contract Addendum-Prohibition Against Employing Illegal Aliens", is attached hereto and incorporated herein by reference. There is also attached hereto a copy of Contractor's Pre-Contract Certification which Contractor has executed and delivered to the City prior to Contractor's execution of this Agreement. The City is constrained by a Colorado statute, C.R.S. § 8-17.5-101, et seq., requiring the City to use the term "illegal alien" in City contracts. In the spirit of the Parties' contractual relationship and the Services to be provided by Consultant under this Agreement, the Parties acknowledge the term "illegal alien" is outdated, brands humans—as opposed to actions—as illegal, and may have an isolating, disorienting, dehumanizing, and denigrating effect on immigrants.

18.0 INTEGRATION AND AMENDMENT

This Agreement represents the entire Agreement between the parties and there are no oral or collateral agreements or understandings. This Agreement may be amended only by an instrument in writing signed by the parties.

19.0 NOTICES

All notices required or permitted under this Agreement shall be in writing and shall be given by hand delivery, by United States first class mail, postage prepaid, registered or certified, return receipt requested, by national overnight carrier, or by email transmission, addressed to the party for whom it is intended at the following address:

If to the City:

City of Louisville
Attn: Kevin Trott
749 Main Street
Louisville, CO 80027
e-mail: ktrott@louisvilleco.gov

If to the Contractor:

Uretek USA, Inc.
Attn:Theresa Uhlmann
PO Box 1929
Tomball, TX 77377

Except for notices by email transmission, any notice required or permitted under this Agreement shall be effective when received as indicated on the delivery receipt, if by hand delivery or overnight carrier; on the United States mail return receipt, if by United States mail. Notices by email transmission shall be effective on transmission, so long as no message of error or non-receipt is received by the party giving notice. Either party may by similar notice given, change the address to which future notices or other communications shall be sent.

20.0 EQUAL OPPORTUNITY EMPLOYER

a) Contractor will not discriminate against any employee or applicant for employment because of age 40 and over, race, sex, color, religion, national origin, disability, genetic information, sexual orientation, veteran status, or any other applicable status protected by state or local law. Contractor will take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to any status set forth in the preceding sentence. Such action shall include but not be limited to the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notice to be provided by an agency of the federal government, setting forth the provisions of the Equal Opportunity Laws.

b) Contractor shall be in compliance with the applicable provisions of the American with Disabilities Act as enacted and from time to time amended and any other applicable federal, state, or local laws and regulations. A signed, written certificate stating compliance with the Americans with Disabilities Act may be requested at any time during the life of this Agreement or any renewal thereof.

21.0 NO THIRD PARTY BENEFICIARIES

It is expressly understood and agreed that enforcement of the terms and conditions of this Agreement, and all rights of action relating to such enforcement, shall be strictly reserved to City and Contractor, and nothing contained in this Agreement shall give or allow any such claim or right of action by any other third party on such Agreement. It is the express intention of the parties

that any person other than City or Contractor receiving services or benefits under this Agreement shall be deemed to be an incidental beneficiary only.

22.0 SUBCONTRACTORS

Contractor may utilize subcontractors identified in its qualifications submittal to assist with non-specialized works as necessary to complete projects. Contractor will submit any proposed subcontractor and the description of its services to the City for approval. The City will not work directly with subcontractors.

23.0 AUTHORITY TO BIND

Each of the persons signing below on behalf of any party hereby represents and warrants that such person is signing with full and complete authority to bind the party on whose behalf of whom such person is signing, to each and every term of this Agreement.

In witness whereof, the parties have executed this Agreement to be effective as of the day and year first above written.

CITY OF LOUISVILLE

By:_____
Mayor

Attest:_____
City Clerk

CONTRACTOR:
_____

By:_____
Title:_____

Exhibit A – Scope of Services

[See Following Page(s)]

URETEK

PROPOSAL FOR SERVICES

Bid Information:
Project: Bridge Repairs – Slab Raising
Project Number: 301312-660064
Owner: City of Louisville, Colorado

Prepared by:
Christa Wickland
Regional Project Manager

URETEK USA, Inc.
(720) 601-7469
cwickland@uretekusa.com
www.uretekusa.com

Proposal date:
September 21, 2021

Proposed Cost:

Bid Line Item 1: Mobilization LS $0.00

Bid Line Item 2A: Coal Creek Bridge - Repair settled approach slabs (North and South approach slabs): 15,000lbs @$4.75/lb = $71,250.00

Bid Line Item 2B: Coal Creek Bridge - Fill Void underneath slab at south corners: 1,000lbs @$4.75/lb = 4,750.00

Bid Line Item 3: BNSF Bridge - Seal gap between slope and paving abutment: 4,000lbs @ $4.75/lb = $19,000.00

Bid Line Item 4: Traffic Control 6 Days Incl Tax LS: $9,593.00

Total Bid Price: $104,593.00

Items not Included in Quote:

Bonding/Bond Participation, Saw Cutting, Joint/Crack Sealing, Milling of Existing Asphalt Wedges (if required), Sales Tax

Submittals Included: See Attachments

Indemnification & Hold Harmless:

To the fullest extent permitted by law, the Subcontractor shall indemnify and hold harmless the Contractor, the Contractor's other subcontractors, the Architect, the Owner and their agents, consultants and employees (the Indemnities) from all claims for bodily injury and property damage other than to the Work itself that may arise from the performance of the Subcontract Work, including reasonable attorneys' fees, costs and expenses, that arise from the performance of the Work, but only to the extent caused by the negligent acts or omissions of the Subcontractor, the Subcontractor's Sub Subcontractors or anyone employed directly or indirectly by any of them or by anyone for whose acts any of them may be liable . This indemnity includes if the Subcontractor or any of its agents, employees, suppliers, or lower-tier Subcontractors utilize any machinery, equipment, tools, scaffolding, hoists, lifts, or similar items owned, leased, or under the control of the Contractor. The Subcontractor shall be entitled to reimbursement of any defense cost paid above Subcontractor's percentage of liability for the underlying claim to the extent attributable to the negligent acts or omissions of the Indemnities.

Merit Shop Contractor:

URETEK USA, Inc. is a merit shop contractor and all services provided by this proposal will be on a merit shop basis. All reference to labor agreement of any kind, or alluded to, in a principle contract or a sub-contract, are set aside, and not part of this proposal.

Operating Classification:

URETEK USA, Inc. is a self-performing, SBA designated, Small Business Entity.

Primary NAICS:
237310 - Highway, Street, and Bridge Construction

Secondary NAICS:
237110 - Water and Sewer Line and Related Structures Construction
237990 - Railroad Construction & Other Heavy and Civil Engineering Construction
236118 - Remodeling Construction
236210 - Industrial Building Construction
236220 - Construction (including new work, additions, alterations, maintenance, and repairs) of Commercial and Institutional Buildings and Related Structures
238190 - Other Foundation, Structure, and Building Exterior Contractors
238990 - Specialized Trade and Site Preparation

DUNS #: 556910990

CAGE code: 1T9Y9

URETEK USA, Inc. is an Equal Opportunity Employer hiring minority, disadvantaged, disabled, and veteran personnel.

Exhibit B

City of Louisville Public Services Contract Addendum
Prohibition Against Employing Illegal Aliens

Prohibition Against Employing Illegal Aliens. Contractor shall not knowingly employ or contract with an illegal alien to perform work under this contract. Contractor shall not enter into a contract with a subcontractor that fails to certify to the Contractor that the subcontractor shall not knowingly employ or contract with an illegal alien to perform work under this contract.

Contractor will participate in either the E-verify program or the Department program, as defined in C.R.S. § § 8-17.5-101(3.3) and 8-17.5-101(3.7), respectively, in order to confirm the employment eligibility of all employees who are newly hired for employment to perform work under the public contract for services. Contractor is prohibited from using the E-verify program or the Department program procedures to undertake pre-employment screening of job applicants while this contract is being performed.

If Contractor obtains actual knowledge that a subcontractor performing work under this contract for services knowingly employs or contracts with an illegal alien, Contractor shall:

a. Notify the subcontractor and the City within three days that the Contractor has actual knowledge that the subcontractor is employing or contracting with an illegal alien; and

b. Terminate the subcontract with the subcontractor if within three days of receiving the notice required pursuant to this paragraph the subcontractor does not stop employing or contracting with the illegal alien; except that the Contractor shall not terminate the contract with the subcontractor if during such three days the subcontractor provides information to establish that the subcontractor has not knowingly employed or contracted with an illegal alien.

Contractor shall comply with any reasonable request by the Department of Labor and Employment made in the course of an investigation that the Department is undertaking pursuant to the authority established in C.R.S. § 8-17.5-102(5).

If Contractor violates a provision of this Contract required pursuant to C.R.S. § 8-17.5-102, City may terminate the contract for breach of contract. If the contract is so terminated, the Contractor shall be liable for actual and consequential damages to the City.

Pre-Contract Certification in Compliance with C.R.S. Section 8-17.5-102(1)

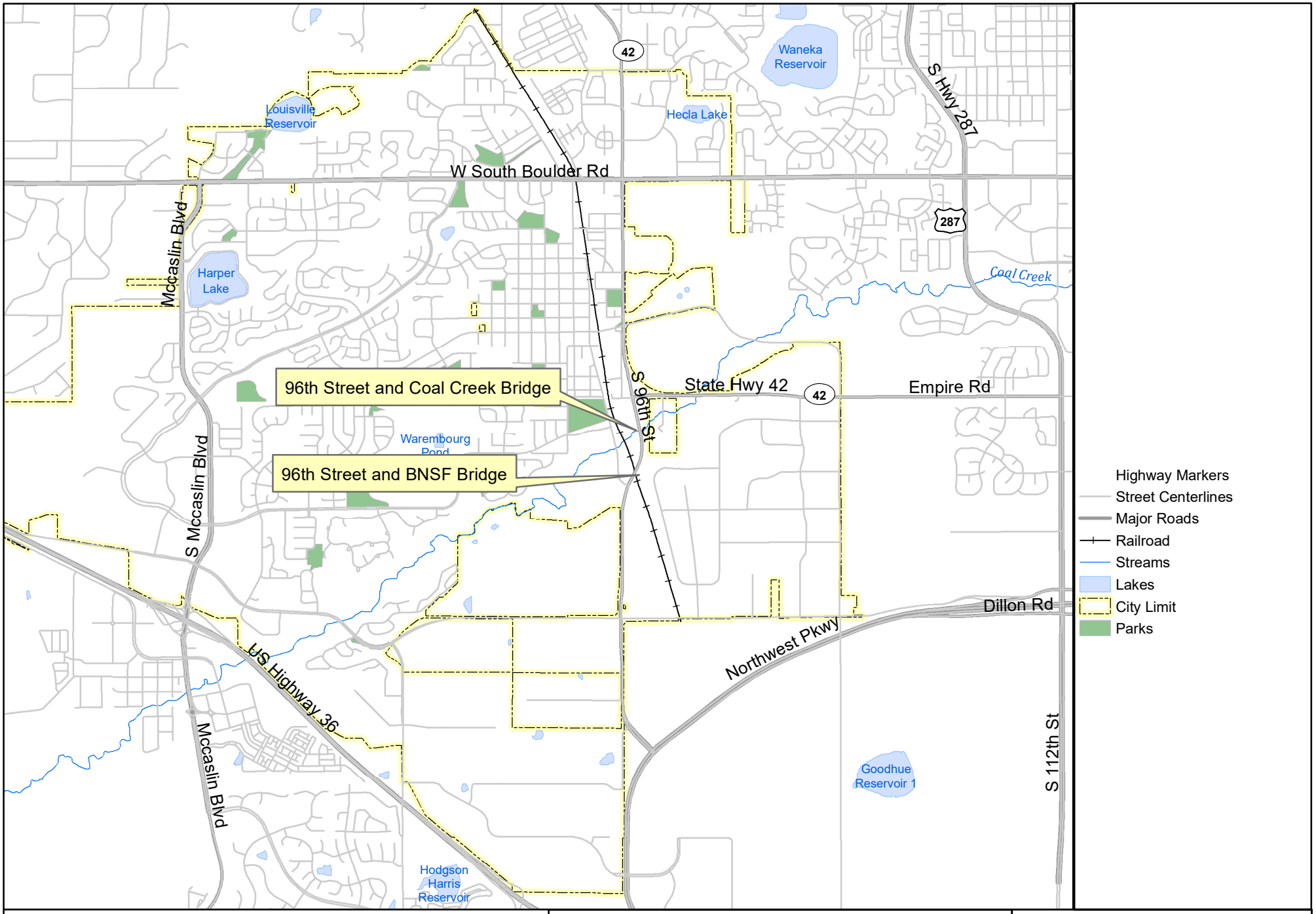
The undersigned hereby certifies as follows:

That at the time of providing this certification, the undersigned does not knowingly employ or contract with an illegal alien; and that the undersigned will participate in the E-Verify program or the Department program, as defined in C.R.S. § § 8-17.5-101(3.3) and 8-17.5-101(3.7), respectively, in order to confirm the employment eligibility of all employees who are newly hired for employment to perform under the public contract for services.

Proposer:
_____

By_____
Title:_____

_____
Date



City of Louisville
COLORADO • SINCE 1878

Vicinity Map
Bridge Repairs
Slab Raising

0 1,300 2,600 Feet

0 0.35 0.7 Mile

Updated: 10/13/2021
File: Vicinity Map1.mxd

This draft document was prepared for internal use by the City of Louisville, CO. The City makes no claim as to the accuracy or completeness of the data contained hereon. Due to security concerns, The City requests that you do not post this document on the internet or otherwise make it available to persons unknown to you.

SUBJECT: **AWARD CONTRACTS FOR ENGINEERING & CONSTRUCTION SERVICES FOR THE OPEN SPACE RETAINING WALL REPLACEMENT PROJECT**

DATE: **OCTOBER 19, 2021**

PRESENTED BY: **NATHAN MOSLEY, DIRECTOR OF PARKS, RECREATION AND OPEN SPACE**
ALLAN GILL, PARKS PROJECT MANAGER

SUMMARY:
The Parks Department solicited proposals from qualified design/build firms to work with City staff for project specific engineering and construction services for the removal and replacement of wood retaining walls in the City. Two areas are set for replacement: 1) across from the Louisville Recreation Center in the Hillside Open Space and 2) near the intersection of Washington Ave. and Tyler Ave. in the Coyote Run Open Space.

An invitation to bid was posted in the *Daily Camera* and on the Rocky Mountain E-Purchasing system with bids due July 7th. No bids were submitted in response to the RFP. Staff has pursued a sole source agreement to complete this work with two vendors with whom the City is currently contracted for other projects, Otak and Green Landscape Solutions.

FISCAL IMPACT:
This project was initially funded through the Open Space and Parks Fund at $100,000. Otak Engineering has provided a proposal for engineering services for $7,000.00 and Green Landscape Solutions has provided a proposal for removal and replacement of the retaining walls for construction services for $134,385. Adding 10% contingency brings the total project budget to $155,523.

If the contract is approved, a budget amendment will be brought forward at a later time to address the increased project costs.

PROGRAM/SUB-PROGRAM IMPACT:
The recommended contracts supports objectives of the Parks Program by replacing and improving facilities, and helps to maintain levels of service for residents.

RECOMMENDATION:
Approve contract with Otak Engineering for $7,000 for engineering services and to Green Landscape Solutions for replacement of the retaining walls for $134,385.

ATTACHMENT(S):
1. Otak Engineering proposal for engineering services
2. Green Landscape Solutions proposal for replacement of the retaining walls
3. Otak Contract
4. Green Landscaping Solutions Contract

STRATEGIC PLAN IMPACT:

☒	**Financial Stewardship & Asset Management**	☐	**Reliable Core Services**
☐	**Vibrant Economic Climate**	☐	**Quality Programs & Amenities**
☐	**Engaged Community**	☐	**Healthy Workforce**
☐	**Supportive Technology**	☐	**Collaborative Regional Partner**

September 10, 2021

Mr. Allan Gill
Parks Project Manager
City of Louisville
749 Main Street
Louisville, CO 80027

Reference: **Coyote Run Wall Replacements**
Otak Proposal

Dear Allan:

Thanks for your interest in working with Otak on this project. This proposal is based on the site meeting held on September 10th with yourself and Green Landscapes LLC, and previous correspondence.

There are three existing timber walls that will be replaced in-kind. Some of the walls will be shortened at the ends where the area can be regraded. Our proposed scope of work consists of the following:

Services

- Perform a site walk to measure the length and height of the walls (completed on September 10th).
- Develop three (3) wall sections outlined below. The taller two sections will include deadmen.
  - Wall height = 2-timbers
  - Wall height = 3-timbers
  - 3-timbers < Wall height < 7-timbers (max recorded wall height = 6-timbers)
- Coordinate wall sectional requirements with Louisville and Green Landscapes LLC.
- Respond to miscellaneous RFI's and construction issues as they arise.
- Perform up to three (3) construction site visits to ensure compliance with plan requirements.

Schedule

- Submit wall sections within 2-weeks from Notice to Proceed.
- Construction site visits and coordination will be as requested.

Meetings

- Up to three (3) construction site visits.
- Virtual coordination calls via Teams as required.

Services Not Included

- Topographic Survey
- Utility Coordination
- Drainage Analysis
- Geotechnical Engineering
- Erosion Control
- Maintenance of Traffic

- Public Engagement

We propose to perform these services on an hourly basis with a not-to-exceed fee of $7,000, in accordance with attached 2021 Fee Worksheet, under the City of Louisville Standard Terms of Agreement. Please feel free to contact me if you have any questions, otherwise I look forward to your response at your earliest convenience.

Sincerely,

The Office of
Otak, Inc.

Dan Beltzer, PE,
Structures Group Manager

COLORADO REGION 2021 FEE SCHEDULE
EFFECTIVE 01/01/2021

CATEGORY NAME	BILLING RATE
Engineering	
Sr. PIC/Sr. PM Civil	$285
PIC/Sr. PM Civil	$248
Civil Engineer X	$209
Civil Engineer IX	$193
Civil Engineer VIII	$173
Civil Engineer VII	$157
Civil Engineer VI	$149
Civil Engineer V	$139
Civil Engineer IV	$128
Civil Engineer III	$113
Civil Engineer II	$104
Civil Engineer I	$95
Engineering Designer V	$124
Engineering Designer IV	$112
Engineering Designer III	$98
Engineering Designer II	$92
Engineering Designer I	$82
Engineering Tech VIII	$180
Engineering Tech VII	$152
Engineering Tech VI	$131
Engineering Tech V	$120
Engineering Tech IV	$101
Engineering Tech III	$86
Engineering Tech II	$75
Engineering Tech I	$67
Construction Management	
PIC/Sr. CM	$216
Construction Manager VI	$202
Construction Manager V	$180
Construction Manager IV	$166
Construction Manager III	$151
Construction Manager II	$139
Construction Manager I	$123
Field Representative VII	$166
Field Representative VI	$145
Field Representative V	$133
Field Representative IV	$109

Field Representative III	$101
Field Representative II	$89
Field Representative I	$83
CM Documentation Specialist III	$120
CM Documentation Specialist II	$109
CM Documentation Specialist I	$94
Planning & Design	
Sr. PIC/Sr. PM LA/Mst Pln	$246
PIC/Sr. PM LA/Master Plan	$216
Landscape Architect VI	$159
Landscape Architect V	$141
Landscape Architect IV	$128
Landscape Architect III	$120
Landscape Architect II	$109
Landscape Architect I	$95
Landscape Technician III	$99
Landscape Technician II	$87
Landscape Technician I	$73
PIC/Sr. PM Urban Design	$200
Urban Designer V	$185
Urban Designer IV	$166
Urban Designer III	$141
Urban Designer II	$124
Urban Designer I	$108
PIC/Sr. PM Planner	$250
Sr. PM – Planner II	$183
Sr.PM – Planner I	$168
Planner IV	$151
Planner III	$142
Planner II	$128
Planner I	$101
Planner Associate IV	$132
Planner Associate III	$102
Planner Associate II	$89
Planner Associate I	$73
Sr. GIS Specialist Planner	$124
GIS Specialist - Planner	$110
Planning/GIS Intern	$86
Science	
PIC/Scientist	$222
Scientist VI	$200

Scientist V	**$161**
Scientist IV	**$145**
Scientist III	**$126**
Scientist II	**$98**
Scientist I	**$88**
Environmental Specialist	**$136**
Other	
Contract Administrator	**$116**
Project Coordinator	**$122**
Project Admin. Asst	**$83**
Graphics Specialist	**$116**

Mileage	**Per the IRS Allowable**	
Copies	**Color 81/2 x 11 = $0.50** **Color 11 x 17 = $1.00**	**B/W 81/2 x 11 = $0.10** **B/W 11 x 17 = $0.20**
Plots for Submittals (per sqft)	**$5.50 bond Color | $0.25 Bond B/W | $3.50 mylar**	

Retaining Wall Budget

Green Landscape Solutions

Client Name:	City of Louisville		
Project Name:	Timber Retaining Walls		
Jobsite Address:	Via Appia Way Louisville, Colorado 80027	**Billing Address:**	749 Main Street Louisville, Colorado 80027
Estimate ID:	EST2778971		
Date:	Sep 16, 2021		

Thank you for the opportunity to participate in your landscaping project. If you have any questions about the proposal please feel free to call or email to discuss.

Mobilization — $600.00

10	Hours	Mobilization (C)	Loading trucks with equipment needed for the job

Timber Retaining Wall 668 LF #1 — $80,452.14

Demolition and removal of Timber wall. Installation of new timber wall with Deadmen every 8' for any area 3 tiers or higher. Deadmen to be anchored with concrete and rebar. Installation of a perforated pipe and gravel behind wall to alleviate pressure. Disturbed area will be layered with an 1" of top soil and reseeded then covered with straw mat.

***WOOD PRICING MAY VAIRY AT TIME OF PURCHASE. COST WILL FLUCTUATE*

ESTIMATE DOES NOT INCLUDE REPAIR TO CONCRETE IN THE EVENT THAT CONCRETE IS DAMAGED DURING CONSTRUCTION

11	Each	Disposal/Recycle Fee > Wood/Rock/Concrete
67.5	Hours	Equipment > Skid Loader Demolition
97	Hours	Residential Landscape Crew Demolition
316	Each	Timber, Timbers, 6" x 6" x 8' Cedar Tone Treated
501	LF	Concrete, Rebar #4-60 (1/2")
841	ea	Hardware, 10" Timber Loc Screw/ea.
47	Ton	Gravel, Local River Rock 3/4" or 1-1/2"
668	LF	Drain, 4" Corrugated Pipe-Perforated(C) - 4"
13.5	Hours	Tools > Plate Tamper
3	Each	Delivery > 1 to 15 tons

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501	Hours	Residential Landscape Crew Construct Wall
78	Each	Timber, Timbers, 6" x 6" x 8' Cedar Tone Treated for Deadmans
156	ea	Hardware, 10" Timber Loc Screw/ea. - 10 for Deadmans
312	Bags	Masonry, Quikrete 80 lbs concrete mix (yellow)
312	LF	Concrete, Rebar #4-60 (1/2")
78	Hours	Equipment > Bobcat Mini X
156	Hours	Residential Landscape Crew
12.5	CY	Soil, Amended Topsoil (C)
17	LB	Buffalo Grass Seed Per Pound - Avg. cost per pound-verify pricing
4086	SF	Erosion Control Double Straw Blanket
818	Each	Fabric Pins
12.5	Hours	Equipment > Skid Loader
12.5	Hours	Residential Landscape Crew - Rake Off
9.5	Hours	Residential Landscape Crew Straw Mat

Timber Retaining Wall 147 LF #2 — $18,201.06

Demolition and removal of Timber wall. Installation of new timber wall with Deadmen every 8' for any area 3 tiers or higher. Deadmen to be anchored with concrete and rebar. Installation of a perforated pipe and gravel behind wall to alleviate pressure. Disturbed area will be layered with an 1" of top soil and reseeded then covered with straw mat. Disturbed crusher fine path to be top dressed and regraded to fix any damage caused by machinery.

***WOOD PRICING MAY VAIRY AT TIME OF PURCHASE. COST WILL FLUCTUATE*

3	Each	Disposal/Recycle Fee > Wood/Rock/Concrete
19.5	Hours	Equipment > Skid Loader Demolition
29.5	Hours	Residential Landscape Crew Demolition
70	Each	Timber, Timbers, 6" x 6" x 8' Cedar Tone Treated
110	LF	Concrete, Rebar #4-60 (1/2")
185	ea	Hardware, 10" Timber Loc Screw/ea.
10.5	Ton	Gravel, Local River Rock 3/4" or 1-1/2"
147	LF	Drain, 4" Corrugated Pipe-Perforated(C) - 4"
3	Hours	Tools > Plate Tamper

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1	Each	Delivery > 1 to 15 tons
110	Hours	Residential Landscape Crew Construct Wall
13	Each	Timber, Timbers, 6" x 6" x 8' Cedar Tone Treated for Deadmans
25	ea	Hardware, 10" Timber Loc Screw/ea. - 10 for Deadmans
50	Bags	Masonry, Quikrete 80 lbs concrete mix (yellow)
50	LF	Concrete, Rebar #4-60 (1/2")
12.5	Hours	Equipment > Bobcat Mini X
25	Hours	Residential Landscape Crew
2	CY	Soil, Amended Topsoil (C)
3	LB	Buffalo Grass Seed Per Pound - Avg. cost per pound-verify pricing
588	SF	Erosion Control Double Straw Blanket
118	Each	Fabric Pins
2	Hours	Equipment > Skid Loader
2	Hours	Residential Landscape Crew - Rake Off
2	Hours	Residential Landscape Crew Straw Mat
4	Ton	Gravel, Crusher Fines Gray Breeze/Ton (C)
4	Hours	Equipment > Skid Loader
8	Hours	Residential Landscape Crew Crusher Fine Repair

Timber Retaining Wall 381 LF #3 **$34,321.23**

Demolition and removal of Timber wall. Installation of new timber wall with Deadmen every 8' for any area 3 tiers or higher. Deadmen to be anchored with concrete and rebar. Installation of a perforated pipe and gravel behind wall to alleviate pressure. Disturbed area will be layered with an 1" of top soil and reseeded then covered with straw mat. Disturbed crusher fine path to be top dressed and regraded to fix any damage caused by machinery.

***WOOD PRICING MAY VAIRY AT TIME OF PURCHASE. COST WILL FLUCTUATE*

5	Each	Disposal/Recycle Fee > Wood/Rock/Concrete
49.5	Hours	Equipment > Skid Loader Demolition
69.5	Hours	Residential Landscape Crew Demolition
128	Each	Timber, Timbers, 6" x 6" x 8' Cedar Tone Treated
286	LF	Concrete, Rebar #4-60 (1/2")
339	ea	Hardware, 10" Timber Loc Screw/ea.
19	Ton	Gravel, Local River Rock 3/4" or

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		1-1/2"
381	LF	Drain, 4" Corrugated Pipe-Perforated(C) - 4"
7.5	Hours	Tools > Plate Tamper
1	Each	Delivery > 1 to 15 tons
209	Hours	Residential Landscape Crew Construct Wall
17	Each	Timber, Timbers, 6" x 6" x 8' Cedar Tone Treated for Deadmans
34	ea	Hardware, 10" Timber Loc Screw/ea. - 10 for Deadmans
68	Bags	Masonry, Quikrete 80 lbs concrete mix (yellow)
68	LF	Concrete, Rebar #4-60 (1/2")
17	Hours	Equipment > Bobcat Mini X
34	Hours	Residential Landscape Crew
7	LB	Buffalo Grass Seed Per Pound - Avg. cost per pound-verify pricing
1524	SF	Erosion Control Double Straw Blanket
306	Each	Fabric Pins
2	Hours	Residential Landscape Crew - Rake Off
5	Hours	Residential Landscape Crew Straw Mat
9.5	Ton	Gravel, Crusher Fines Gray Breeze/Ton (C)
9.5	Hours	Equipment > Skid Loader
19	Hours	Residential Landscape Crew

Construction Signage			**$810.60**
60	Days	Construction Signage Rental	

Subtotal	$134,385.03
Taxes	$0.00
Estimate Total	**$134,385.03**

Notes:

•Green Landscape Solutions does not use weed control agent prior to installation of mulch and weed fabric

Exclusions:

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•Soil Prep for planting areas unless specified above

•Meter, tap, or related fees

•Private utility locates

•Walls, signs, fencing, or documentation unless specified above

•Temporary irrigation to seed

•Site furnishings unless stated above

•Coring, boring, potholing or cut and patch

•Tree protection

•Special insurances such as Vicarious, Subsidence, etc

•Permit fees

•Demolition except what's noted above

•Prevailing wages or special wages unless stated in inclusions

•Erosion control devices unless stated above

•Import, export or spreading of soils other than compost for soil prep unless specifically stated above

•Prices are based on existing conditions on site at the beginning of September 2021

•No addenda has been received

Clarifications:

•Water service to location of backflows, wet tap, water tap fee, water meter, sub water meter, vault and associated plumbing is to be by others prior to mobilization to site. All water lines are to be stubbed at location of backflows by others. If the backflow device is in the interior of the building, the water line is to be brought through the building and stubbed out in a landscape area, by others

•Sleeving is by others

•This proposal includes mobilizations to complete the landscape

•All plant material is subject to availability and sustainability within climate

•All construction repairs or treatments for areas outside the contract limits of this project are by other or by Change Order, site will be returned to owner in the condition it was given

•Improperly located private utilities are not the responsibility of Green Landscape Solutions

•Overtime due to the General Contractor/Customer not making the site totally available to Green Landscape Solutions will be billed out at the full time and half rate. All OT required due to Green Landscape Solutions not meeting schedule is the responsibility of Green Landscape Solutions

•Retainage to be released to Green Landscape Solutions within 90 days of final acceptance of work completion

Warranties:

•All work performed hereunder shall be completed in a neat, skillful and workmanlike manner. All materials furnished by Contractor shall

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be as specified herein unless changed by the Customer. Contractor provides a one-year warranty on all original installations, as further limited below. Mechanical parts (such as pumps/clocks) come with their own specific product warranties, which will be made available upon request.

Specific Warranty on Concrete:

•The highest quality concrete available will be used for your project. All concrete will be formed and poured with the highest standard of workmanship possible. Appropriate reinforcement will be used and score lines will be used to provide crack control joints with the proper spacing to minimize random cracking. However, even with all these preventive measures, we cannot guarantee that a hairline crack will not develop out of the control joint. Please be aware that with the reinforcement used, any such crack will remain hairline. WE DO guarantee against structural defects and we will replace any such defect at no charge for a period of one year.

Plant Warranty:

•Green Landscape Solutions warrants plants to be true to name and in healthy growing condition when installed. It is then the responsibility of the owner to supply them with sufficient water and fertilizer to keep them healthy. Newly planted trees and shrubs must be watered year-round, including the dormant season. Newly installed landscape plants will suffer transplant shock, particularly during the hot summer months. It is imperative that plants receive proper care, so as to minimize stress.

•Trees and shrubs are warranted for one year from date of installation, and will be replaced once within the warranty period, should they die. Annuals, perennials, bulbs, and ground cover are NOT warranted. Green Landscape Solutions will make warranty replacements during the optimum planting seasons; spring and fall. Typically, replacements will take place between May 1st through June 30th and September 1st through November 15th. These time frames are subject to change only at the discretion of Green Landscape Solutions.

•Green Landscape Solutions assumes no liability for replacement of plants killed or damaged by improper care, pests, insect infestation, abnormal weather conditions, or other conditions beyond our control, nor will we replace plants experiencing "seasonal die-back", when pruning and proper care will restore them to health. Moving landscape plants from their original location will void the warranty.

•All orders for landscape plants are accepted under the foregoing conditions, and no other warranty, whether expressed or implied, will apply.

Seeding-Revegetation Warranty:

•Green Landscape Solutions warrants seeding re-vegetation to be installed properly using the seed type and amounts specified. Due to environmental factors, we cannot warrant seed germination, growth or potential soil erosion. Weeds will germinate along with the seed mix and we do not warranty against this weed growth. Some grass or native seed may take up to 21 days to germinate and will require frequent watering during germination and supplemental watering until vegetation is established which may take up to 3 years.

Stone and Natural Materials:

•Please note that stone and other natural materials vary in color and texture by nature. The Contractor will make reasonable effort to match the color and texture to any samples shown but exact matches cannot be guaranteed. As well, the Contractor cannot guarantee the performance of any natural product.

The Warranties are limited as follows:

•To repair or replacement of the defective materials, or to correct defects in installation or construction. Labor costs of replacing defective materials are not included in the warranty work.

•To repair or replace the Work on the Property only as long as it remains in the possession of the Customer named above.

•To Work that has not been subject to accident, misuse or abuse.

•To Work that has not been modified, altered, defaced, or had repairs made or attempted by others.

•That Contractor be immediately notified in writing within ten (10) days of first knowledge of defect by Customer or his agent.

•That Contractor shall be given first opportunity to make any repairs, replacements or corrections to the defective Work at no cost to owner within a reasonable period of time.

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•Under no circumstances shall Contractor be liable by virtue of this warranty or otherwise for damage to any person or property whatsoever for any special, indirect, secondary or consequential damages (including, but not limited to, damages for loss of business, loss of profit, or the like of any nature however arising out of the use or inability to use because of the construction defect.

•Any damages for breach of warranty of any kind shall not exceed the contract price paid by the Customer.

•All grading work per plan related to settling and/or drainage work after the project is completed and approved by Green Landscape and Customer will be billable (not covered under warranty).

Estimate authorized by: _____

Company Representative

Signature Date: _____

Estimate approved by: _____

Customer Representative

Signature Date: _____

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AN AGREEMENT BY AND BETWEEN THE CITY OF LOUISVILLE AND OTAK FOR CONSULTING SERVICES

1.0 PARTIES

This AGREEMENT FOR CONSULTING SERVICES (this "Agreement") is made and entered into this 19th day of October, 2021 (the "Effective Date"), by and between the **City of Louisville**, a Colorado home rule municipal corporation, hereinafter referred to as the "City", and OTAK [Name of Contractor], a Colorado Company hereinafter referred to as the "Consultant".

2.0 RECITALS AND PURPOSE

2.1 The City desires to engage the Consultant for the purpose of providing Engineering design services as further set forth in the Consultant's Scope of Services (which services are hereinafter referred to as the "Services").

2.2 The Consultant represents that it has the special expertise, qualifications and background necessary to complete the Services.

3.0 SCOPE OF SERVICES

The Consultant agrees to provide the City with the specific Services and to perform the specific tasks, duties and responsibilities set forth in Scope of Services attached hereto as Exhibit "B" and incorporated herein by reference.

4.0 COMPENSATION

4.1 The City shall pay the Consultant for services under this agreement a total not to exceed the amounts set forth in Exhibit "C" attached hereto and incorporated herein by this reference. [Further revise as needed to reflect whether contract is hourly of flat amount]. The City shall not pay mileage and other reimbursable expenses (such as meals, parking, travel expenses, necessary memberships, etc.), unless such expenses are (1) clearly set forth in the Scope of Services, and (2) necessary for performance of the Services ("Pre-Approved Expenses"). The foregoing amounts of compensation shall be inclusive of all costs of whatsoever nature associated with the Consultant's efforts, including but not limited to salaries, benefits, overhead, administration, profits, expenses, and outside consultant fees. The Scope of Services and payment therefor shall only be changed by a properly authorized amendment to this Agreement. No City employee has the authority to bind the City with regard to any payment for any services which exceeds the amount payable under the terms of this Agreement.

4.2 The Consultant shall submit monthly an invoice to the City for Services rendered and a detailed expense report for Pre-Approved Expenses incurred during the previous month.

The invoice shall document the Services provided during the preceding month, identifying by work category and subcategory the work and tasks performed and such other information as may be required by the City. The Consultant shall provide such additional backup documentation as may be required by the City. The City shall pay the invoice within thirty (30) days of receipt unless the Services or the documentation therefor are unsatisfactory. Payments made after thirty (30) days may be assessed an interest charge of one percent (1%) per month unless the delay in payment resulted from unsatisfactory work or documentation therefor.

5.0 PROJECT REPRESENTATION

5.1 The City designates Allan Gill as the responsible City staff to provide direction to the Consultant during the conduct of the Services. The Consultant shall comply with the directions given by Allan Gill and such person's designees.

5.2 The Consultant designates Dan Beltzer as its project manager and as the principal in charge who shall be providing the Services under this Agreement. [The Services shall not be provided by persons other than Dan Beltzer.] [or] [Should any of the representatives be replaced, particularly _____, and such replacement require the City or the Consultant to undertake additional reevaluations, coordination, orientations, etc., the Consultant shall be fully responsible for all such additional costs and services.]

6.0 TERM

6.1 The term of this Agreement shall be from the Effective Date to December 31, 2021, unless sooner terminated pursuant to Section 13, below. The Consultant's Services under this Agreement shall commence on [(the Effective Date) or (on another date desired by the City, after the Effective Date)] and Consultant shall proceed with diligence and promptness so that the Services are completed in a timely fashion consistent with the City's requirements.

6.2 Nothing in this Agreement is intended or shall be deemed or construed as creating any multiple-fiscal year direct or indirect debt or financial obligation on the part of the City within the meaning of Colorado Constitution Article X, Section 20 or any other constitutional or statutory provision. All financial obligations of the City under this Agreement are subject to annual budgeting and appropriation by the Louisville City Council, in its sole discretion. Notwithstanding anything in this Agreement to the contrary, in the event of non-appropriation, this Agreement shall terminate effective December 31 of the then-current fiscal year.

7.0 INSURANCE

7.1 The Consultant agrees to procure and maintain, at its own cost, the policies of insurance set forth in Subsections 7.1.1 through 7.1.4. The Consultant shall not be relieved of any liability, claims, demands, or other obligations assumed pursuant to this Agreement by reason of its failure to procure or maintain insurance, or by reason of its failure to procure

or maintain insurance in sufficient amounts, durations, or types. The coverages required below shall be procured and maintained with forms and insurers acceptable to the City. All coverages shall be continuously maintained from the date of commencement of services hereunder. The required coverages are:

7.1.1 Workers' Compensation insurance as required by the Labor Code of the State of Colorado and Employers Liability Insurance. Evidence of qualified self-insured status may be substituted.

7.1.2 General Liability insurance with minimum combined single limits of ONE MILLION DOLLARS ($1,000,000) each occurrence and TWO MILLION DOLLARS ($2,000,000) aggregate. The policy shall include the City of Louisville, its officers and its employees, as additional insureds, with primary coverage as respects the City of Louisville, its officers and its employees, and shall contain a severability of interests provision.

7.1.3 Comprehensive Automobile Liability insurance with minimum combined single limits for bodily injury and property damage of not less than FOUR HUNDRED THOUSAND DOLLARS ($400,000) per person in any one occurrence and ONE MILLION DOLLARS ($1,000,000) for two or more persons in any one occurrence, and auto property damage insurance of at least FIFTY THOUSAND DOLLARS ($50,000) per occurrence, with respect to each of Consultant's owned, hired or non-owned vehicles assigned to or used in performance of the services. The policy shall contain a severability of interests provision. If the Consultant has no owned automobiles, the requirements of this paragraph shall be met by each employee of the Consultant providing services to the City of Louisville under this Agreement.

7.1.4 Professional Liability coverage with minimum combined single limits of ONE MILLION DOLLARS ($1,000,000) each occurrence and ONE MILLION DOLLARS ($1,000,000) aggregate.

7.2 The Consultant's general liability insurance, automobile liability and physical damage insurance, and professional liability insurance shall be endorsed to include the City, and its elected and appointed officers and employees, as additional insureds, unless the City in its sole discretion waives such requirement. Every policy required above shall be primary insurance, and any insurance carried by the City, its officers, or its employees, shall be excess and not contributory insurance to that provided by the Consultant. Such policies shall contain a severability of interests provision. The Consultant shall be solely responsible for any deductible losses under each of the policies required above.

7.3 Certificates of insurance shall be provided by the Consultant as evidence that policies providing the required coverages, conditions, and minimum limits are in full force and effect, and shall be subject to review and approval by the City. No required coverage shall be cancelled, terminated or materially changed until at least 30 days' prior written notice has been given to the City. The City reserves the right to request and receive a certified copy of any policy and any endorsement thereto.

7.4 Failure on the part of the Consultant to procure or maintain policies providing the required coverages, conditions, and minimum limits shall constitute a material breach of contract upon which the City may immediately terminate this Agreement, or at its discretion may procure or renew any such policy or any extended reporting period thereto and may pay any and all premiums in connection therewith, and all monies so paid by the City shall be repaid by Consultant to the City upon demand, or the City may offset the cost of the premiums against any monies due to Consultant from the City.

7.5 The parties understand and agree that the City is relying on, and does not waive or intend to waive by any provision of this Agreement, the monetary limitations or any other rights, immunities, and protections provided by the Colorado Governmental Immunity Act, § 24-10-101 et seq., C.R.S., as from time to time amended, or otherwise available to the City, its officers, or its employees.

8.0 INDEMNIFICATION

To the fullest extent permitted by law, the Consultant agrees to indemnify and hold harmless the City, and its elected and appointed officers and its employees, from and against all liability, claims, and demands, on account of any injury, loss, or damage, which arise out of or are connected with the services hereunder, if and to the extent such injury, loss, or damage is caused by the negligent act, omission, or other fault of the Consultant or any subcontractor of the Consultant, or any officer, employee, or agent of the Consultant or any subcontractor, or any other person for whom Consultant is responsible. The Consultant shall investigate, handle, respond to, and provide defense for and defend against any such liability, claims, and demands. The Consultant shall further bear all other costs and expenses incurred by the City or Consultant and related to any such liability, claims and demands, including but not limited to court costs, expert witness fees and attorneys' fees if the court determines that these incurred costs and expenses are related to such negligent acts, errors, and omissions or other fault of the Consultant. Notwithstanding the foregoing, Consultant's duty to defend, indemnify and hold harmless the City, and its elected and appointed officials and employees as set forth in this section shall only arise upon determination, by adjudication, alternative dispute resolution, or mutual agreement between Consultant and the City, of the Consultant's liability or fault. The City shall be entitled to its costs and attorneys' fees incurred in any action to enforce the provisions of this Section 8.0. The Consultant's indemnification obligation shall not be construed to extend to any injury, loss, or damage which is caused by the act, omission, or other fault of the City.

9.0 QUALITY OF WORK

Consultant's professional services shall be in accordance with the prevailing standard of practice normally exercised in the performance of services of a similar nature in the Denver metropolitan area.

10.0 INDEPENDENT CONTRACTOR

It is the expressed intent of the parties that the Consultant is an independent contractor and not the agent, employee or servant of the City, and that:

10.1. Consultant shall satisfy all tax and other governmentally imposed responsibilities including but not limited to, payment of state, federal, and social security taxes, unemployment taxes, worker's compensation and self-employment taxes. No state, federal or local taxes of any kind shall be withheld or paid by the City.

10.2. **Consultant is not entitled to worker's compensation benefits except as may be provided by the Consultant nor to unemployment insurance benefits unless unemployment compensation coverage is provided by the Consultant or some entity other than the City.**

10.3. Consultant does not have the authority to act for the City, or to bind the City in any respect whatsoever, or to incur any debts or liabilities in the name of or on behalf of the City.

10.4. Consultant has and retains control of and supervision over the performance of Consultant's obligations hereunder and control over any persons employed by Consultant for performing the Services hereunder.

10.5. The City will not provide training or instruction to Consultant or any of its employees regarding the performance of the Services hereunder.

10.6. Neither the Consultant nor any of its officers or employees will receive benefits of any type from the City.

10.7. Consultant represents that it is engaged in providing similar services to other clients and/or the general public and is not required to work exclusively for the City.

10.8. All Services are to be performed solely at the risk of Consultant and Consultant shall take all precautions necessary for the proper and sole performance thereof.

10.9. Consultant will not combine its business operations in any way with the City's business operations and each party shall maintain their operations as separate and distinct.

11.0 ASSIGNMENT

Except as provided in section 22.0 hereof, Consultant shall not assign or delegate this Agreement or any portion thereof, or any monies due or to become due hereunder without the City's prior written consent.

12.0 DEFAULT

Each and every term and condition hereof shall be deemed to be a material element of this Agreement. In the event either party should fail or refuse to perform according to the terms of this Agreement, such party may be declared in default.

13.0 TERMINATION

13.1 This Agreement may be terminated by either party for material breach or default of this Agreement by the other party not caused by any action or omission of the other party by giving the other party written notice at least thirty (30) days in advance of the termination date. Termination pursuant to this subsection shall not prevent either party from exercising any other legal remedies which may be available to it.

13.2 In addition to the foregoing, this Agreement may be terminated by the City for its convenience and without cause of any nature by giving written notice at least fifteen (15) days in advance of the termination date. In the event of such termination, the Consultant will be paid for the reasonable value of the services rendered to the date of termination, not to exceed a pro-rated daily rate, for the services rendered to the date of termination, and upon such payment, all obligations of the City to the Consultant under this Agreement will cease. Termination pursuant to this subsection shall not prevent either party from exercising any other legal remedies which may be available to it.

14.0 INSPECTION AND AUDIT

The City and its duly authorized representatives shall have access to any books, documents, papers, and records of the Consultant that are related to this Agreement for the purpose of making audits, examinations, excerpts, and transcriptions.

15.0 DOCUMENTS

All computer input and output, analyses, plans, documents photographic images, tests, maps, surveys, electronic files and written material of any kind generated in the performance of this Agreement or developed for the City in performance of the Services are and shall remain the sole and exclusive property of the City. All such materials shall be promptly provided to the City upon request therefor and at the time of termination of this Agreement, without further charge or expense to the City. Consultant shall not provide copies of any such material to any other party without the prior written consent of the City.

16.0 ENFORCEMENT

16.1 In the event that suit is brought upon this Agreement to enforce its terms, the prevailing party shall be entitled to its reasonable attorneys' fees and related court costs.

16.2 This Agreement shall be deemed entered into in Boulder County, Colorado, and shall be governed by and interpreted under the laws of the State of Colorado. Any action arising out of, in connection with, or relating to this Agreement shall be filed in the District Court of Boulder County of the State of Colorado, and in no other court. Consultant hereby

waives its right to challenge the personal jurisdiction of the District Court of Boulder County of the State of Colorado over it.

17.0 COMPLIANCE WITH LAWS; WORK BY ILLEGAL ALIENS PROHIBITED

17.1 Consultant shall be solely responsible for compliance with all applicable federal, state, and local laws, including the ordinances, resolutions, rules, and regulations of the City; for payment of all applicable taxes; and obtaining and keeping in force all applicable permits and approvals.

17.2 Exhibit A, the "City of Louisville Public Services Contract Addendum-Prohibition Against Employing Illegal Aliens", is attached hereto and incorporated herein by reference. There is also attached hereto a copy of Consultant's Pre-Contract Certification which Consultant has executed and delivered to the City prior to Consultant's execution of this Agreement.

17.3 Consultant acknowledges that the City of Louisville Code of Ethics provides that independent contractors who perform official actions on behalf of the City which involve the use of discretionary authority shall not receive any gifts seeking to influence their official actions on behalf of the City, and that City officers and employees similarly shall not receive such gifts. Consultant agrees to abide by the gift restrictions of the City's Code of Ethics.

18.0 INTEGRATION AND AMENDMENT

This Agreement represents the entire Agreement between the parties and there are no oral or collateral agreements or understandings. This Agreement may be amended only by an instrument in writing signed by the parties.

19.0 NOTICES

All notices required or permitted under this Agreement shall be in writing and shall be given by hand delivery, by United States first class mail, postage prepaid, registered or certified, return receipt requested, by national overnight carrier, or by facsimile transmission, addressed to the party for whom it is intended at the following address:

If to the City:

City of Louisville
Attn: City Manager
749 Main Street
Louisville, Colorado 80027
Telephone: (303) 335-4533
Fax: (303) 335-4550

If to the Consultant:

OTAK
Attn. Dan Beltzer
371 Centennial Parkway, Suite 210,
Louisville, CO 80027
Telephone: (303) 444-2073
Otak.com

Any such notice or other communication shall be effective when received as indicated on the delivery receipt, if by hand delivery or overnight carrier; on the United States mail return receipt, if by United States mail; or on facsimile transmission receipt. Either party may by similar notice given, change the address to which future notices or other communications shall be sent.

20.0 EQUAL OPPORTUNITY EMPLOYER

20.1 Consultant will not discriminate against any employee or applicant for employment because of race, color, religion, age, sex, disability or national origin. Consultant will take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, color, religion, age, sex, disability, or national origin. Such action shall include but not be limited to the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. Consultant agrees to post in conspicuous places, available to employees and applicants for employment, notice to be provided by an agency of the federal government, setting forth the provisions of the Equal Opportunity Laws.

20.2 Consultant shall be in compliance with the applicable provisions of the American with Disabilities Act of 1990 as enacted and from time to time amended and any other applicable federal, state, or local laws and regulations. A signed, written certificate stating compliance with the Americans with Disabilities Act may be requested at any time during the life of this Agreement or any renewal thereof.

21.0 NO THIRD PARTY BENEFICIARIES

It is expressly understood and agreed that enforcement of the terms and conditions of this Agreement, and all rights of action relating to such enforcement, shall be strictly reserved to City and Consultant, and nothing contained in this Agreement shall give or allow any such claim or right of action by any other third party on such Agreement. It is the express intention of the parties that any person other than City or Consultant receiving services or benefits under this Agreement shall be deemed to be an incidental beneficiary only.

22.0 SUBCONTRACTORS

Consultant may utilize subcontractors identified in its qualifications submittal to assist with non-specialized works as necessary to complete projects. Consultant will submit any

proposed subcontractor and the description of its services to the City for approval. The City will not work directly with subcontractors.

23.0 AUTHORITY TO BIND

Each of the persons signing below on behalf of any party hereby represents and warrants that such person is signing with full and complete authority to bind the party on whose behalf of whom such person is signing, to each and every term of this Agreement.

In witness whereof, the parties have executed this Agreement to be effective on the date first above written.

CITY OF LOUISVILLE,
a Colorado Municipal Corporation

By:_____
Ashley Stolzmann, Mayor

Attest:_____
Meredyth Muth, City Clerk

CONSULTANT:
_____

By:_____

Title:_____

Exhibit A

City of Louisville Public Services Contract Addendum
Prohibition Against Employing Illegal Aliens

Prohibition Against Employing Illegal Aliens. Contractor shall not knowingly employ or contract with an illegal alien to perform work under this Agreement. Contractor shall not enter into a contract with a subcontractor that fails to certify to the Contractor that the subcontractor shall not knowingly employ or contract with an illegal alien to perform work under this Agreement.

Contractor will participate in either the E-verify program or the Department program, as defined in C.R.S. § § 8-17.5-101(3.3) and 8-17.5-101(3.7), respectively, in order to confirm the employment eligibility of all employees who are newly hired for employment to perform work under the public contract for services. Contractor is prohibited from using the E-verify program or the Department program procedures to undertake pre-employment screening of job applicants while this Agreement is being performed.

If Contractor obtains actual knowledge that a subcontractor performing work under this Agreement for services knowingly employs or contracts with an illegal alien, Contractor shall:

a. Notify the subcontractor and the City within three days that the Contractor has actual knowledge that the subcontractor is employing or contracting with an illegal alien; and

b. Terminate the subcontract with the subcontractor if within three days of receiving the notice required pursuant to this paragraph the subcontractor does not stop employing or contracting with the illegal alien; except that the Contractor shall not terminate the contract with the subcontractor if during such three days the subcontractor provides information to establish that the subcontractor has not knowingly employed or contracted with an illegal alien.

Contractor shall comply with any reasonable request by the Department of Labor and Employment made in the course of an investigation that the Department is undertaking pursuant to the authority established in C.R.S. § 8-17.5-102(5).

If Contractor violates a provision of this Agreement required pursuant to C.R.S. § 8-17.5-102, City may terminate the Agreement for breach of contract. If the Agreement is so terminated, the Contractor shall be liable for actual and consequential damages to the City.

Pre-Contract Certification in Compliance with C.R.S. Section 8-17.5-102(1)

The undersigned hereby certifies as follows:

That at the time of providing this certification, the undersigned does not knowingly employ or contract with an illegal alien; and that the undersigned will participate in the E-Verify program or the Department program, as defined in C.R.S. § § 8-17.5-101(3.3) and 8-17.5-101(3.7), respectively, in order to confirm the employment eligibility of all employees who are newly hired for employment to perform under the public contract for services.

Proposer:
_____

By_____

Title:_____

_____
Date

September 10, 2021

Mr. Allan Gill
Parks Project Manager
City of Louisville
749 Main Street
Louisville, CO 80027

Reference: **Coyote Run Wall Replacements**
Otak Proposal

Dear Allan:

Thanks for your interest in working with Otak on this project. This proposal is based on the site meeting held on September 10th with yourself and Green Landscapes LLC, and previous correspondence.

There are three existing timber walls that will be replaced in-kind. Some of the walls will be shortened at the ends where the area can be regraded. Our proposed scope of work consists of the following:

Services

- Perform a site walk to measure the length and height of the walls (completed on September 10th).
- Develop three (3) wall sections outlined below. The taller two sections will include deadmen.
  - Wall height = 2-timbers
  - Wall height = 3-timbers
  - 3-timbers < Wall height < 7-timbers (max recorded wall height = 6-timbers)
- Coordinate wall sectional requirements with Louisville and Green Landscapes LLC.
- Respond to miscellaneous RFI's and construction issues as they arise.
- Perform up to three (3) construction site visits to ensure compliance with plan requirements.

Schedule

- Submit wall sections within 2-weeks from Notice to Proceed.
- Construction site visits and coordination will be as requested.

Meetings

- Up to three (3) construction site visits.
- Virtual coordination calls via Teams as required.

Services Not Included

- Topographic Survey
- Utility Coordination
- Drainage Analysis
- Geotechnical Engineering
- Erosion Control
- Maintenance of Traffic

- Public Engagement

We propose to perform these services on an hourly basis with a not-to-exceed fee of $7,000, in accordance with attached 2021 Fee Worksheet, under the City of Louisville Standard Terms of Agreement. Please feel free to contact me if you have any questions, otherwise I look forward to your response at your earliest convenience.

Sincerely,

The Office of
Otak, Inc.

Dan Beltzer, PE,
Structures Group Manager

COLORADO REGION 2021 FEE SCHEDULE

EFFECTIVE 01/01/2021

CATEGORY NAME	BILLING RATE
Engineering	
Sr. PIC/Sr. PM Civil	$285
PIC/Sr. PM Civil	$248
Civil Engineer X	$209
Civil Engineer IX	$193
Civil Engineer VIII	$173
Civil Engineer VII	$157
Civil Engineer VI	$149
Civil Engineer V	$139
Civil Engineer IV	$128
Civil Engineer III	$113
Civil Engineer II	$104
Civil Engineer I	$95
Engineering Designer V	$124
Engineering Designer IV	$112
Engineering Designer III	$98
Engineering Designer II	$92
Engineering Designer I	$82
Engineering Tech VIII	$180
Engineering Tech VII	$152
Engineering Tech VI	$131
Engineering Tech V	$120
Engineering Tech IV	$101
Engineering Tech III	$86
Engineering Tech II	$75
Engineering Tech I	$67
Construction Management	
PIC/Sr. CM	$216
Construction Manager VI	$202
Construction Manager V	$180
Construction Manager IV	$166
Construction Manager III	$151
Construction Manager II	$139
Construction Manager I	$123
Field Representative VII	$166
Field Representative VI	$145
Field Representative V	$133
Field Representative IV	$109

Field Representative III	$101
Field Representative II	$89
Field Representative I	$83
CM Documentation Specialist III	$120
CM Documentation Specialist II	$109
CM Documentation Specialist I	$94
Planning & Design	
Sr. PIC/Sr. PM LA/Mst Pln	$246
PIC/Sr. PM LA/Master Plan	$216
Landscape Architect VI	$159
Landscape Architect V	$141
Landscape Architect IV	$128
Landscape Architect III	$120
Landscape Architect II	$109
Landscape Architect I	$95
Landscape Technician III	$99
Landscape Technician II	$87
Landscape Technician I	$73
PIC/Sr. PM Urban Design	$200
Urban Designer V	$185
Urban Designer IV	$166
Urban Designer III	$141
Urban Designer II	$124
Urban Designer I	$108
PIC/Sr. PM Planner	$250
Sr. PM – Planner II	$183
Sr.PM – Planner I	$168
Planner IV	$151
Planner III	$142
Planner II	$128
Planner I	$101
Planner Associate IV	$132
Planner Associate III	$102
Planner Associate II	$89
Planner Associate I	$73
Sr. GIS Specialist Planner	$124
GIS Specialist - Planner	$110
Planning/GIS Intern	$86
Science	
PIC/Scientist	$222
Scientist VI	$200

Scientist V	**$161**
Scientist IV	**$145**
Scientist III	**$126**
Scientist II	**$98**
Scientist I	**$88**
Environmental Specialist	**$136**
Other	
Contract Administrator	**$116**
Project Coordinator	**$122**
Project Admin. Asst	**$83**
Graphics Specialist	**$116**

Mileage	**Per the IRS Allowable**	
Copies	**Color 81/2 x 11 = $0.50** **Color 11 x 17 = $1.00**	**B/W 81/2 x 11 = $0.10** **B/W 11 x 17 = $0.20**
Plots for Submittals (per sqft)	**$5.50 bond Color | $0.25 Bond B/W | $3.50 mylar**	

INDEPENDENT CONTRACTOR AGREEMENT
BY AND BETWEEN THE CITY OF LOUISVILLE
AND GREEN LANDSCAPE SOLUTIONS
FOR CONSTRUCTION SERVICES

1.0 PARTIES

This INDEPENDENT CONTRACTOR AGREEMENT (this "Agreement") is made and entered into this 19TH day of October, 2021 (the "Effective Date"), by and between the **City of Louisville**, a Colorado home rule municipal corporation, hereinafter referred to as the "City", and Green Landscape Solutions, a Colorado Company, hereinafter referred to as the "Contractor".

2.0 RECITALS AND PURPOSE

2.1 The City desires to engage the Contractor for the purpose of providing Construction services as further set forth in the Contractor's Scope of Services (which services are hereinafter referred to as the "Services").

2.2 The Contractor represents that it has the special expertise, qualifications and background necessary to complete the Services.

3.0 SCOPE OF SERVICES

The Contractor agrees to provide the City with the specific Services and to perform the specific tasks, duties and responsibilities set forth in Scope of Services attached hereto as Exhibit "A" and incorporated herein by reference. Contractor shall furnish all tools, labor and supplies in such quantities and of the proper quality as are necessary to professionally and timely perform the Services. Contractor acknowledges that this Agreement does not grant any exclusive privilege or right to supply Services to the City.

4.0 COMPENSATION

4.1 The City shall pay the Contractor for Services under this Agreement a total not to exceed the amounts set forth in Exhibit "A" attached hereto and incorporated herein by this reference. For Services compensated at hourly or per unit rates, or on a per-task basis, such rates or costs per task shall not exceed the amounts set forth in Exhibit A. The City shall not pay mileage and other reimbursable expenses (such as meals, parking, travel expenses, necessary memberships, etc.), unless such expenses are (1) clearly set forth in the Scope of Services, and (2) necessary for performance of the Services ("Pre-Approved Expenses"). The foregoing amounts of compensation shall be inclusive of all costs of whatsoever nature associated with the Contractor's efforts, including but not limited to salaries, benefits, overhead, administration, profits, expenses, and outside Contractor fees. The Scope of Services and payment therefor shall only be changed by a properly authorized amendment to this Agreement. No City employee has the authority to bind the City with regard to any payment for any Services which exceeds the amount payable under the terms of this Agreement.

4.2 The Contractor shall submit monthly an invoice to the City for Services rendered and a detailed expense report for Pre-Approved Expenses incurred during the previous month. The invoice shall document the Services provided during the preceding month, identifying by work category and subcategory the work and tasks performed and such other

information as may be required by the City. The Contractor shall provide such additional backup documentation as may be required by the City. The City shall pay the invoice within thirty (30) days of receipt unless the Services or the documentation therefor are unsatisfactory. Payments made after thirty (30) days may be assessed an interest charge of one percent (1%) per month unless the delay in payment resulted from unsatisfactory work or documentation therefor.

5.0 PROJECT REPRESENTATION

5.1 The City designates Allan Gill as the responsible City staff to provide direction to the Contractor during the conduct of the Services. The Contractor shall comply with the directions given by Allan Gill and such person's designees.

5.2 The Contractor designates _____ as its project manager and as the principal in charge who shall be providing the Services under this Agreement. Should any of the representatives be replaced, particularly _____, and such replacement require the City or the Contractor to undertake additional reevaluations, coordination, orientations, etc., the Contractor shall be fully responsible for all such additional costs and services.

6.0 TERM

6.1 The term of this Agreement shall be from the Effective Date to December 31, 2021, unless sooner terminated pursuant to Section 13, below. The Contractor's Services under this Agreement shall commence on [(the Effective Date) or (on another date desired by the City, after the Effective Date)] and Contractor shall proceed with diligence and promptness so that the Services are completed in a timely fashion consistent with the City's requirements.

6.2 Nothing in this Agreement is intended or shall be deemed or construed as creating any multiple-fiscal year direct or indirect debt or financial obligation on the part of the City within the meaning of Colorado Constitution Article X, Section 20 or any other constitutional or statutory provision. All financial obligations of the City under this Agreement are subject to annual budgeting and appropriation by the Louisville City Council, in its sole discretion. Notwithstanding anything in this Agreement to the contrary, in the event of non-appropriation, this Agreement shall terminate effective December 31 of the then-current fiscal year.

7.0 INSURANCE

7.1 The Contractor agrees to procure and maintain, at its own cost, the policies of insurance set forth in Subsections 7.1.1 through 7.1.4. The Contractor shall not be relieved of any liability, claims, demands, or other obligations assumed pursuant to this Agreement by reason of its failure to procure or maintain insurance, or by reason of its failure to procure or maintain insurance in sufficient amounts, durations, or types. The coverages required below shall be procured and maintained with forms and insurers acceptable to the City. All coverages shall be continuously maintained from the date of commencement of Services hereunder. The required coverages are:

7.1.1 Workers' Compensation insurance as required by the Labor Code of the State of Colorado and Employers Liability Insurance. Evidence of qualified self-insured status may be substituted.

7.1.2 General Liability insurance with minimum combined single limits of $1,000,000 each occurrence and $2,000,000 aggregate. The policy shall include the City of Louisville, its officers and its employees, as additional insureds, with primary coverage as respects the City of Louisville, its officers and its employees, and shall contain a severability of interests provision.

7.1.3 Comprehensive Automobile Liability insurance with minimum combined single limits for bodily injury and property damage of not less than $400,000 per person in any one occurrence and $1,000,000 for two or more persons in any one occurrence, and auto property damage insurance of at least $50,000 per occurrence, with respect to each of Contractor's owned, hired or non-owned vehicles assigned to or used in performance of the Services. If the Contractor has no owned automobiles, the requirements of this paragraph shall be met by each officer or employee of the Contractor providing services to the City of Louisville under this contract.

7.2 The Contractor's general liability insurance and automobile liability and physical damage insurance shall be endorsed to include the City, and its elected and appointed officers and employees, as additional insureds, unless the City in its sole discretion waives such requirement. Every policy required above shall be primary insurance, and any insurance carried by the City, its officers, or its employees, shall be excess and not contributory insurance to that provided by the Contractor. Such policies shall contain a severability of interests provision. The Contractor shall be solely responsible for any deductible losses under each of the policies required above.

7.3 Certificates of insurance shall be provided by the Contractor as evidence that policies providing the required coverages, conditions, and minimum limits are in full force and effect, and shall be subject to review and approval by the City. No required coverage shall be cancelled, terminated or materially changed until at least 30 days prior written notice has been given to the City. The City reserves the right to request and receive a certified copy of any policy and any endorsement thereto.

7.4 Failure on the part of the Contractor to procure or maintain policies providing the required coverages, conditions, and minimum limits shall constitute a material breach of contract upon which the City may immediately terminate this Agreement, or at its discretion may procure or renew any such policy or any extended reporting period thereto and may pay any and all premiums in connection therewith, and all monies so paid by the City shall be repaid by Contractor to the City upon demand, or the City may offset the cost of the premiums against any monies due to Contractor from the City.

7.5 The parties understand and agree that the City is relying on, and does not waive or intend to waive by any provision of this contract, the monetary limitations or any other rights, immunities, and protections provided by the Colorado Governmental Immunity Act, § 24-10-101 et seq., C.R.S., as from time to time amended, or otherwise available to the City, its officers, or its employees.

8.0 INDEMNIFICATION

To the fullest extent permitted by law, the Contractor agrees to indemnify and hold harmless the City, and its elected and appointed officers and its employees, from and against all liability, claims, and demands, on account of any injury, loss, or damage, which arise out of or are connected with the Services hereunder, if such injury, loss, or damage is caused by the negligent act, omission, or other fault of the Contractor or any subcontractor of the Contractor, or any officer, employee, or agent of the Contractor or any subcontractor, or any other person for whom Contractor is responsible. The Contractor shall investigate, handle, respond to, and provide defense for and defend against any such liability, claims, and demands. The Contractor shall further bear all other costs and expenses incurred by the City or Contractor and related to any such liability, claims and demands, including but not limited to court costs, expert witness fees and attorneys' fees if the court determines that these incurred costs and expenses are related to such negligent acts, errors, and omissions or other fault of the Contractor. The City shall be entitled to its costs and attorneys' fees incurred in any action to enforce the provisions of this Section 8.0. The Contractor's indemnification obligation shall not be construed to extend to any injury, loss, or damage which is caused by the act, omission, or other fault of the City.

9.0 QUALITY OF WORK

Contractor's Services shall be performed in accordance with the highest professional workmanship and service standards in the field to the satisfaction of the City.

10.0 INDEPENDENT CONTRACTOR

It is the expressed intent of the parties that the Contractor is an independent contractor and not the agent, employee or servant of the City, and that:

10.1. **CONTRACTOR SHALL SATISFY ALL TAX AND OTHER GOVERNMENTALLY IMPOSE RESPONSIBILITIES INCLUDING, BUT NOT LIMITED TO, PAYMENT OF STATE, FEDERAL AND SOCIAL SECURITY TAXES, UNEMPLOYMENT TAXES, WORKERS' COMPENSATION AND SELF-EMPLOYMENT TAXES. NO STATE, FEDERAL OR LOCAL TAXES OF ANY KIND SHALL BE WITHHELD OR PAID BY THE CITY.**

10.2. **CONTRACTOR IS NOT ENTITLED TO WORKERS' COMPENSATION BENEFITS EXCEPT AS MAY BE PROVIDED BY THE INDEPENDENT CONTRACTOR NOR TO UNEMPLOYMENT INSURANCE BENEFITS UNLESS UNEMPLOYMENT COMPENSATION COVERAGE IS PROVIDED BY THE INDEPENDENT CONTRACTOR OR SOME ENTITY OTHER THAN THE CITY.**

10.3. Contractor does not have the authority to act for the City, or to bind the City in any respect whatsoever, or to incur any debts or liabilities in the name of or on behalf of the City.

10.4. Contractor has and retains control of and supervision over the performance of Contractor's obligations hereunder and control over any persons employed by Contractor for performing the Services hereunder.

10.5. The City will not provide training or instruction to Contractor or any of its employees regarding the performance of the Services hereunder.

10.6. Neither the Contractor nor any of its officers or employees will receive benefits of any type from the City.

10.7. Contractor represents that it is engaged in providing similar services to other clients and/or the general public and is not required to work exclusively for the City.

10.8. All Services are to be performed solely at the risk of Contractor and Contractor shall take all precautions necessary for the proper and sole performance thereof.

10.9. Contractor will not combine its business operations in any way with the City's business operations and each party shall maintain their operations as separate and distinct.

11.0 ASSIGNMENT

Contractor shall not assign or delegate this Agreement or any portion thereof, or any monies due to or become due hereunder without the City's prior written consent.

12.0 DEFAULT

Each and every term and condition hereof shall be deemed to be a material element of this Agreement. In the event either party should fail or refuse to perform according to the terms of this Agreement, such party may be declared in default.

13.0 TERMINATION

13.1 This Agreement may be terminated by either party for material breach or default of this Agreement by the other party not caused by any action or omission of the other party by giving the other party written notice at least thirty (30) days in advance of the termination date. Termination pursuant to this subsection shall not prevent either party from exercising any other legal remedies which may be available to it.

13.2 In addition to the foregoing, this Agreement may be terminated by the City for its convenience and without cause of any nature by giving written notice at least fifteen (15) days in advance of the termination date. In the event of such termination, the Contractor will be paid for the reasonable value of the Services rendered to the date of termination, not to exceed a pro-rated daily rate, for the Services rendered to the date of termination, and upon such payment, all obligations of the City to the Contractor under this Agreement will cease. Termination pursuant to this Subsection shall not prevent either party from exercising any other legal remedies which may be available to it.

14.0 INSPECTION AND AUDIT

The City and its duly authorized representatives shall have access to any books, documents, papers, and records of the Contractor that are related to this Agreement for the purpose of making audits, examinations, excerpts, and transcriptions.

15.0 DOCUMENTS

All computer input and output, analyses, plans, documents photographic images, tests, maps, surveys, electronic files and written material of any kind generated in the performance of this Agreement or developed for the City in performance of the Services are and shall remain the sole

and exclusive property of the City. All such materials shall be promptly provided to the City upon request therefor and at the time of termination of this Agreement, without further charge or expense to the City and in hardcopy or an electronic format acceptable to the City, or both, as the City shall determine. Contractor shall not provide copies of any such material to any other party without the prior written consent of the City. Contractor shall not use or disclose confidential information of the City for purposes unrelated to performance of this Agreement without the City's written consent.

16.0 ENFORCEMENT

16.1 In the event that suit is brought upon this Agreement to enforce its terms, the parties shall each bear and be responsible for their own attorneys' fees and court costs.

16.2 This Agreement shall be deemed entered into in Boulder County, Colorado, and shall be governed by and interpreted under the laws of the State of Colorado. Any action arising out of, in connection with, or relating to this Agreement shall be filed in the courts of Boulder County or the federal district court for the District of Colorado, and in no other court. [If out of state contractor: Contractor hereby waives its right to challenge the personal jurisdiction of the courts of Boulder County and the federal district court for the District of Colorado over it.] Colorado law shall apply to the construction and enforcement of this Agreement.

17.0 COMPLIANCE WITH LAWS; WORK BY ILLEGAL ALIENS PROHIBITED

17.1 Contractor shall be solely responsible for compliance with all applicable federal, state, and local laws, including the ordinances, resolutions, rules, and regulations of the City; for payment of all applicable taxes; and obtaining and keeping in force all applicable permits and approvals.

17.2 Exhibit B, the "City of Louisville Public Services Contract Addendum-Prohibition Against Employing Illegal Aliens", is attached hereto and incorporated herein by reference. There is also attached hereto a copy of Contractor's Pre-Contract Certification which Contractor has executed and delivered to the City prior to Contractor's execution of this Agreement.

18.0 INTEGRATION AND AMENDMENT

This Agreement represents the entire Agreement between the parties and there are no oral or collateral agreements or understandings. This Agreement may be amended only by an instrument in writing signed by the parties.

19.0 NOTICES

All notices required or permitted under this Agreement shall be in writing and shall be given by hand delivery, by United States first class mail, postage prepaid, registered or certified, return receipt requested, by national overnight carrier, or by email transmission, addressed to the party for whom it is intended at the following address:

If to the City:

City of Louisville
Attn: _____
749 Main Street
Louisville, CO 80027
e-mail: _____

If to the Contractor:

_____
_____
_____

_____

Except for notices by email transmission, any notice required or permitted under this Agreement shall be effective when received as indicated on the delivery receipt, if by hand delivery or overnight carrier; on the United States mail return receipt, if by United States mail. Notices by email transmission shall be effective on transmission, so long as no message of error or non-receipt is received by the party giving notice. Either party may by similar notice given, change the address to which future notices or other communications shall be sent.

20.0 EQUAL OPPORTUNITY EMPLOYER

a) Contractor will not discriminate against any employee or applicant for employment because of age 40 and over, race, sex, color, religion, national origin, disability, genetic information, sexual orientation, veteran status, or any other applicable status protected by state or local law. Contractor will take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to any status set forth in the preceding sentence. Such action shall include but not be limited to the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notice to be provided by an agency of the federal government, setting forth the provisions of the Equal Opportunity Laws.

b) Contractor shall be in compliance with the applicable provisions of the American with Disabilities Act as enacted and from time to time amended and any other applicable federal, state, or local laws and regulations. A signed, written certificate stating compliance with the Americans with Disabilities Act may be requested at any time during the life of this Agreement or any renewal thereof.

21.0 NO THIRD PARTY BENEFICIARIES

It is expressly understood and agreed that enforcement of the terms and conditions of this Agreement, and all rights of action relating to such enforcement, shall be strictly reserved to City and Contractor, and nothing contained in this Agreement shall give or allow any such claim or right of action by any other third party on such Agreement. It is the express intention of the parties

that any person other than City or Contractor receiving services or benefits under this Agreement shall be deemed to be an incidental beneficiary only.

22.0 SUBCONTRACTORS

Contractor may utilize subcontractors identified in its qualifications submittal to assist with non-specialized works as necessary to complete projects. Contractor will submit any proposed subcontractor and the description of its services to the City for approval. The City will not work directly with subcontractors.

23.0 AUTHORITY TO BIND

Each of the persons signing below on behalf of any party hereby represents and warrants that such person is signing with full and complete authority to bind the party on whose behalf of whom such person is signing, to each and every term of this Agreement.

In witness whereof, the parties have executed this Agreement to be effective as of the day and year first above written.

CITY OF LOUISVILLE

By:_____
Mayor

Attest:_____
City Clerk

CONTRACTOR:
_____

By:
_____

Title:_____

Retaining Wall Budget

Green Landscape Solutions

Client Name:	City of Louisville		
Project Name:	Timber Retaining Walls		
Jobsite Address:	Via Appia Way Louisville, Colorado 80027	**Billing Address:**	749 Main Street Louisville, Colorado 80027
Estimate ID:	EST2778971		
Date:	Sep 16, 2021		

Thank you for the opportunity to participate in your landscaping project. If you have any questions about the proposal please feel free to call or email to discuss.

Mobilization — $600.00

10	Hours	Mobilization (C)	Loading trucks with equipment needed for the job

Timber Retaining Wall 668 LF #1 — $80,452.14

Demolition and removal of Timber wall. Installation of new timber wall with Deadmen every 8' for any area 3 tiers or higher. Deadmen to be anchored with concrete and rebar. Installation of a perforated pipe and gravel behind wall to alleviate pressure. Disturbed area will be layered with an 1" of top soil and reseeded then covered with straw mat.

***WOOD PRICING MAY VAIRY AT TIME OF PURCHASE. COST WILL FLUCTUATE*

ESTIMATE DOES NOT INCLUDE REPAIR TO CONCRETE IN THE EVENT THAT CONCRETE IS DAMAGED DURING CONSTRUCTION

11	Each	Disposal/Recycle Fee > Wood/Rock/Concrete
67.5	Hours	Equipment > Skid Loader Demolition
97	Hours	Residential Landscape Crew Demolition
316	Each	Timber, Timbers, 6" x 6" x 8' Cedar Tone Treated
501	LF	Concrete, Rebar #4-60 (1/2")
841	ea	Hardware, 10" Timber Loc Screw/ea.
47	Ton	Gravel, Local River Rock 3/4" or 1-1/2"
668	LF	Drain, 4" Corrugated Pipe-Perforated(C) - 4"
13.5	Hours	Tools > Plate Tamper
3	Each	Delivery > 1 to 15 tons

4100 N. 119th Street
Lafayette, CO 80026
p. 720-468-0987
www.greenlandscapellc.com
email: tim@greenlandscapellc.com

501	Hours	Residential Landscape Crew Construct Wall
78	Each	Timber, Timbers, 6" x 6" x 8' Cedar Tone Treated for Deadmans
156	ea	Hardware, 10" Timber Loc Screw/ea. - 10 for Deadmans
312	Bags	Masonry, Quikrete 80 lbs concrete mix (yellow)
312	LF	Concrete, Rebar #4-60 (1/2")
78	Hours	Equipment > Bobcat Mini X
156	Hours	Residential Landscape Crew
12.5	CY	Soil, Amended Topsoil (C)
17	LB	Buffalo Grass Seed Per Pound - Avg. cost per pound-verify pricing
4086	SF	Erosion Control Double Straw Blanket
818	Each	Fabric Pins
12.5	Hours	Equipment > Skid Loader
12.5	Hours	Residential Landscape Crew - Rake Off
9.5	Hours	Residential Landscape Crew Straw Mat

Timber Retaining Wall 147 LF #2 — $18,201.06

Demolition and removal of Timber wall. Installation of new timber wall with Deadmen every 8' for any area 3 tiers or higher. Deadmen to be anchored with concrete and rebar. Installation of a perforated pipe and gravel behind wall to alleviate pressure. Disturbed area will be layered with an 1" of top soil and reseeded then covered with straw mat. Disturbed crusher fine path to be top dressed and regraded to fix any damage caused by machinery.

***WOOD PRICING MAY VAIRY AT TIME OF PURCHASE. COST WILL FLUCTUATE*

3	Each	Disposal/Recycle Fee > Wood/Rock/Concrete
19.5	Hours	Equipment > Skid Loader Demolition
29.5	Hours	Residential Landscape Crew Demolition
70	Each	Timber, Timbers, 6" x 6" x 8' Cedar Tone Treated
110	LF	Concrete, Rebar #4-60 (1/2")
185	ea	Hardware, 10" Timber Loc Screw/ea.
10.5	Ton	Gravel, Local River Rock 3/4" or 1-1/2"
147	LF	Drain, 4" Corrugated Pipe-Perforated(C) - 4"
3	Hours	Tools > Plate Tamper

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1	Each	Delivery > 1 to 15 tons
110	Hours	Residential Landscape Crew Construct Wall
13	Each	Timber, Timbers, 6" x 6" x 8' Cedar Tone Treated for Deadmans
25	ea	Hardware, 10" Timber Loc Screw/ea. - 10 for Deadmans
50	Bags	Masonry, Quikrete 80 lbs concrete mix (yellow)
50	LF	Concrete, Rebar #4-60 (1/2")
12.5	Hours	Equipment > Bobcat Mini X
25	Hours	Residential Landscape Crew
2	CY	Soil, Amended Topsoil (C)
3	LB	Buffalo Grass Seed Per Pound - Avg. cost per pound-verify pricing
588	SF	Erosion Control Double Straw Blanket
118	Each	Fabric Pins
2	Hours	Equipment > Skid Loader
2	Hours	Residential Landscape Crew - Rake Off
2	Hours	Residential Landscape Crew Straw Mat
4	Ton	Gravel, Crusher Fines Gray Breeze/Ton (C)
4	Hours	Equipment > Skid Loader
8	Hours	Residential Landscape Crew Crusher Fine Repair

Timber Retaining Wall 381 LF #3 **$34,321.23**

Demolition and removal of Timber wall. Installation of new timber wall with Deadmen every 8' for any area 3 tiers or higher. Deadmen to be anchored with concrete and rebar. Installation of a perforated pipe and gravel behind wall to alleviate pressure. Disturbed area will be layered with an 1" of top soil and reseeded then covered with straw mat. Disturbed crusher fine path to be top dressed and regraded to fix any damage caused by machinery.

***WOOD PRICING MAY VAIRY AT TIME OF PURCHASE. COST WILL FLUCTUATE*

5	Each	Disposal/Recycle Fee > Wood/Rock/Concrete
49.5	Hours	Equipment > Skid Loader Demolition
69.5	Hours	Residential Landscape Crew Demolition
128	Each	Timber, Timbers, 6" x 6" x 8' Cedar Tone Treated
286	LF	Concrete, Rebar #4-60 (1/2")
339	ea	Hardware, 10" Timber Loc Screw/ea.
19	Ton	Gravel, Local River Rock 3/4" or

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		1-1/2"
381	LF	Drain, 4" Corrugated Pipe-Perforated(C) - 4"
7.5	Hours	Tools > Plate Tamper
1	Each	Delivery > 1 to 15 tons
209	Hours	Residential Landscape Crew Construct Wall
17	Each	Timber, Timbers, 6" x 6" x 8' Cedar Tone Treated for Deadmans
34	ea	Hardware, 10" Timber Loc Screw/ea. - 10 for Deadmans
68	Bags	Masonry, Quikrete 80 lbs concrete mix (yellow)
68	LF	Concrete, Rebar #4-60 (1/2")
17	Hours	Equipment > Bobcat Mini X
34	Hours	Residential Landscape Crew
7	LB	Buffalo Grass Seed Per Pound - Avg. cost per pound-verify pricing
1524	SF	Erosion Control Double Straw Blanket
306	Each	Fabric Pins
2	Hours	Residential Landscape Crew - Rake Off
5	Hours	Residential Landscape Crew Straw Mat
9.5	Ton	Gravel, Crusher Fines Gray Breeze/Ton (C)
9.5	Hours	Equipment > Skid Loader
19	Hours	Residential Landscape Crew

Construction Signage			**$810.60**
60	Days	Construction Signage Rental	

Subtotal	$134,385.03
Taxes	$0.00
Estimate Total	**$134,385.03**

Notes:

•Green Landscape Solutions does not use weed control agent prior to installation of mulch and weed fabric

Exclusions:

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•Soil Prep for planting areas unless specified above

•Meter, tap, or related fees

•Private utility locates

•Walls, signs, fencing, or documentation unless specified above

•Temporary irrigation to seed

•Site furnishings unless stated above

•Coring, boring, potholing or cut and patch

•Tree protection

•Special insurances such as Vicarious, Subsidence, etc

•Permit fees

•Demolition except what's noted above

•Prevailing wages or special wages unless stated in inclusions

•Erosion control devices unless stated above

•Import, export or spreading of soils other than compost for soil prep unless specifically stated above

•Prices are based on existing conditions on site at the beginning of September 2021

•No addenda has been received

Clarifications:

•Water service to location of backflows, wet tap, water tap fee, water meter, sub water meter, vault and associated plumbing is to be by others prior to mobilization to site. All water lines are to be stubbed at location of backflows by others. If the backflow device is in the interior of the building, the water line is to be brought through the building and stubbed out in a landscape area, by others

•Sleeving is by others

•This proposal includes mobilizations to complete the landscape

•All plant material is subject to availability and sustainability within climate

•All construction repairs or treatments for areas outside the contract limits of this project are by other or by Change Order, site will be returned to owner in the condition it was given

•Improperly located private utilities are not the responsibility of Green Landscape Solutions

•Overtime due to the General Contractor/Customer not making the site totally available to Green Landscape Solutions will be billed out at the full time and half rate. All OT required due to Green Landscape Solutions not meeting schedule is the responsibility of Green Landscape Solutions

•Retainage to be released to Green Landscape Solutions within 90 days of final acceptance of work completion

Warranties:

•All work performed hereunder shall be completed in a neat, skillful and workmanlike manner. All materials furnished by Contractor shall

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be as specified herein unless changed by the Customer. Contractor provides a one-year warranty on all original installations, as further limited below. Mechanical parts (such as pumps/clocks) come with their own specific product warranties, which will be made available upon request.

Specific Warranty on Concrete:

•The highest quality concrete available will be used for your project. All concrete will be formed and poured with the highest standard of workmanship possible. Appropriate reinforcement will be used and score lines will be used to provide crack control joints with the proper spacing to minimize random cracking. However, even with all these preventive measures, we cannot guarantee that a hairline crack will not develop out of the control joint. Please be aware that with the reinforcement used, any such crack will remain hairline. WE DO guarantee against structural defects and we will replace any such defect at no charge for a period of one year.

Plant Warranty:

•Green Landscape Solutions warrants plants to be true to name and in healthy growing condition when installed. It is then the responsibility of the owner to supply them with sufficient water and fertilizer to keep them healthy. Newly planted trees and shrubs must be watered year-round, including the dormant season. Newly installed landscape plants will suffer transplant shock, particularly during the hot summer months. It is imperative that plants receive proper care, so as to minimize stress.

•Trees and shrubs are warranted for one year from date of installation, and will be replaced once within the warranty period, should they die. Annuals, perennials, bulbs, and ground cover are NOT warranted. Green Landscape Solutions will make warranty replacements during the optimum planting seasons; spring and fall. Typically, replacements will take place between May 1st through June 30th and September 1st through November 15th. These time frames are subject to change only at the discretion of Green Landscape Solutions.

•Green Landscape Solutions assumes no liability for replacement of plants killed or damaged by improper care, pests, insect infestation, abnormal weather conditions, or other conditions beyond our control, nor will we replace plants experiencing "seasonal die-back", when pruning and proper care will restore them to health. Moving landscape plants from their original location will void the warranty.

•All orders for landscape plants are accepted under the foregoing conditions, and no other warranty, whether expressed or implied, will apply.

Seeding-Revegetation Warranty:

•Green Landscape Solutions warrants seeding re-vegetation to be installed properly using the seed type and amounts specified. Due to environmental factors, we cannot warrant seed germination, growth or potential soil erosion. Weeds will germinate along with the seed mix and we do not warranty against this weed growth. Some grass or native seed may take up to 21 days to germinate and will require frequent watering during germination and supplemental watering until vegetation is established which may take up to 3 years.

Stone and Natural Materials:

•Please note that stone and other natural materials vary in color and texture by nature. The Contractor will make reasonable effort to match the color and texture to any samples shown but exact matches cannot be guaranteed. As well, the Contractor cannot guarantee the performance of any natural product.

The Warranties are limited as follows:

•To repair or replacement of the defective materials, or to correct defects in installation or construction. Labor costs of replacing defective materials are not included in the warranty work.

•To repair or replace the Work on the Property only as long as it remains in the possession of the Customer named above.

•To Work that has not been subject to accident, misuse or abuse.

•To Work that has not been modified, altered, defaced, or had repairs made or attempted by others.

•That Contractor be immediately notified in writing within ten (10) days of first knowledge of defect by Customer or his agent.

•That Contractor shall be given first opportunity to make any repairs, replacements or corrections to the defective Work at no cost to owner within a reasonable period of time.

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•Under no circumstances shall Contractor be liable by virtue of this warranty or otherwise for damage to any person or property whatsoever for any special, indirect, secondary or consequential damages (including, but not limited to, damages for loss of business, loss of profit, or the like of any nature however arising out of the use or inability to use because of the construction defect.

•Any damages for breach of warranty of any kind shall not exceed the contract price paid by the Customer.

•All grading work per plan related to settling and/or drainage work after the project is completed and approved by Green Landscape and Customer will be billable (not covered under warranty).

Estimate authorized by: _____ Estimate approved by: _____

Company Representative Customer Representative

Signature Date: _____ Signature Date: _____

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Exhibit B

City of Louisville Public Services Contract Addendum
Prohibition Against Employing Illegal Aliens

Prohibition Against Employing Illegal Aliens. Contractor shall not knowingly employ or contract with an illegal alien to perform work under this contract. Contractor shall not enter into a contract with a subcontractor that fails to certify to the Contractor that the subcontractor shall not knowingly employ or contract with an illegal alien to perform work under this contract.

Contractor will participate in either the E-verify program or the Department program, as defined in C.R.S. § § 8-17.5-101(3.3) and 8-17.5-101(3.7), respectively, in order to confirm the employment eligibility of all employees who are newly hired for employment to perform work under the public contract for services. Contractor is prohibited from using the E-verify program or the Department program procedures to undertake pre-employment screening of job applicants while this contract is being performed.

If Contractor obtains actual knowledge that a subcontractor performing work under this contract for services knowingly employs or contracts with an illegal alien, Contractor shall:

a. Notify the subcontractor and the City within three days that the Contractor has actual knowledge that the subcontractor is employing or contracting with an illegal alien; and

b. Terminate the subcontract with the subcontractor if within three days of receiving the notice required pursuant to this paragraph the subcontractor does not stop employing or contracting with the illegal alien; except that the Contractor shall not terminate the contract with the subcontractor if during such three days the subcontractor provides information to establish that the subcontractor has not knowingly employed or contracted with an illegal alien.

Contractor shall comply with any reasonable request by the Department of Labor and Employment made in the course of an investigation that the Department is undertaking pursuant to the authority established in C.R.S. § 8-17.5-102(5).

If Contractor violates a provision of this Contract required pursuant to C.R.S. § 8-17.5-102, City may terminate the contract for breach of contract. If the contract is so terminated, the Contractor shall be liable for actual and consequential damages to the City.

Pre-Contract Certification in Compliance with C.R.S. Section 8-17.5-102(1)

The undersigned hereby certifies as follows:

That at the time of providing this certification, the undersigned does not knowingly employ or contract with an illegal alien; and that the undersigned will participate in the E-Verify program or the Department program, as defined in C.R.S. § § 8-17.5-101(3.3) and 8-17.5-101(3.7), respectively, in order to confirm the employment eligibility of all employees who are newly hired for employment to perform under the public contract for services.

Proposer:

_____

By_____

Title:_____

_____

Date

City of Louisville
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CITY COUNCIL COMMUNICATION
AGENDA ITEM 6

SUBJECT: **Q3 2021 REVITALIZATION COMMISSION REPORT TO CITY COUNCIL**

DATE: **OCTOBER 19, 2021**

PRESENTED BY: **MEGAN E. PIERCE, ECONOMIC VITALITY DIRECTOR**

SUMMARY:
This report summarizes the Louisville Revitalization Commission's (LRC) meetings and significant activities for Q3 2021. The LRC met three times; minutes for each meeting are included here as *Attachment #1*. In addition, the LRC continues to review its Work Plan document at each meeting; a copy of the most current version is included as *Attachment #2*.

DISCUSSION:
The LRC had two meetings in July 2021: July 7 and July 14. Both meetings focused on the LRC's potential participation in the Transportation Master Plan Underpass Improvements, which are now scheduled as a ballot item for November 2021. On July 7, the LRC considered a draft Cooperation Agreement to outline their financial participation in potential underpass improvements at Main Street/South Boulder Road and Hwy 42/South Street. At this meeting, Commissioners agreed-to a funding structure that they hoped would incentivize underpass improvements to be built in the Urban Renewal Area.

On July 14, the LRC considered final adoption of the Cooperation Agreement for Transportation Master Plan Improvements, which had been approved by City Council on July 13. Commissioners unanimously adopted the Agreement. Also on July 14, the LRC also agreed to advance a Cooperation Agreement for Funding Underground Project at State Highway 42 & Griffith Street. The LRC included this item in its 2021 budget, but the Agreement serves to formalize the funding arrangement. The Agreement was subsequently approved by City Council on July 27, 2021 and given final approval by LRC on September 8, 2021.

Outside of the Cooperation Agreement, LRC's September 8 meeting focused on budget—including a public hearing to amend the 2021 budget for the Urban Revitalization District as well as proposed projects for a 2022 budget. The LRC agreed-to advance the 2021 budget amendment to City Council, which approved the item on September 21, 2021. The LRC gave the amendment final approval at its October 13, 2021 meeting. Commissioners provided input for the proposed 2022 budget through dialogue with staff as well as review of its current Work Plan. The LRC held a public hearing on the 2022 proposed budget on October 13, 2021.

Agenda packets for the LRC's 2021 meetings are available at:
https://www.louisvilleco.gov/government/boards-commissions/revitalization-commission.

FISCAL IMPACT:
Adoption of the Cooperation Agreement for Transportation Master Plan Improvements does not have an immediate impact on the LRC's budget, but if the projects come to fruition, the impact would first appear in the Commission's 2023 budget. Other fiscal impacts of recent LRC matters are captured in the 2021 amended budget document.

PROGRAM/SUB-PROGRAM IMPACT:
The LRC's work facilitates investment in the City's approved Urban Renewal Areas.

RECOMMENDATION:
This report is for informational purposes.

ATTACHMENTS:
1. Attachment #1: LRC Meeting Minutes for Q3 2021
2. Attachment #2: LRC Work Plan

STRATEGIC PLAN IMPACT:

☐	**Financial Stewardship & Asset Management**	☐	**Reliable Core Services**
☒	**Vibrant Economic Climate**	☐	**Quality Programs & Amenities**
☐	**Engaged Community**	☐	**Healthy Workforce**
☐	**Supportive Technology**	☐	**Collaborative Regional Partner**

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Louisville Revitalization Commission

Minutes

Wednesday, July 7, 2021
8:00 am
Special Electronic Meeting

Call to Order – Chair Adler called the meeting to order at 8:02 am and took roll call.

Commissioners Present:	Alexis Adler Mark Gambale Alex Gorsevski Council member Chris Leh Graham Smith Bob Tofte Corrie Williams
Staff Present:	Heather Balser, City Manager Megan Pierce, Economic Vitality Director Kim Bauer, Historic Preservation Planner Nick Cotton-Baez, Attorney to the City of Louisville Lisa Ritchie, Principal Planner Dawn Burgess, Executive Administrator
Others Present:	Mike Kranzdorf, Mark Cathcart, Deb Fahey

Approval of Agenda:
Council member Leh moved the agenda be approved. Commissioner Tofte seconded. Approved.

Public Comments on Items Not on the Agenda:
None.

Reports of Commission:
In response to a Commissioner question, Attorney Cotton-Baez said today's process related to the motion from the June 30th meeting and that will be clarified during the staff presentation.

Business Matters of Commission:

- **<u>Discussion/Direction – Draft Cooperation Agreement for Transportation Master Plan Underpass Improvements</u>**
  Economic Vitality Director Megan Pierce began by noting that at the end of the June 30th meeting, there was a motion made my Commissioner Gambale and seconded by Commissioner Tofte; the motion was continued to today. There will be discussion and if there is a desire to change direction, a friendly amendment to the continued motion can be made and discussed.

  Option #1 in the packet is a recap of the continued motion. Two other options are presented in the packet. Option #2 is simplified: the same amount of money as in Option #1, but without a split between projects. Option #3 aligns more closely with Option #1 in that it provides for a funding split, but would allocate more toward the Main Street/South Boulder Road project if only one underpass is constructed.

  Attorney Cotton-Baez confirmed it is legal for the LRC to present stipulations in the Cooperation Agreement. The LRC can make its prioritization clear to Council, understanding that there is still much work to be done to develop the project concepts. Staff and Commissioners discussed bond counsel's input that stipulations on projects would not have an adverse effect on a future bond issuance.

  Director Pierce also briefly reviewed the updated financial information in the packet and reiterated the process timeline. If there is clear direction from LRC, the goal remains to take a Cooperation Agreement to City Council on July 13.

  Council member Leh discussed Council's rationale for prioritizing and how this linked with potential LRC contributions. He noted that Council has indicated a prioritization, but that it is a snapshot of where projects are now and that things could certainly change.

  Commissioner Gambale is confident Option #1 provides what the LRC wants to accomplish and highlights the Commission's priorities.

  Commissioner Tofte asked staff for further explanation about bond counsel's input and impact prioritization could have on the City's future bonding. City

Manager Balser said that by the time bonds are issued, projects would be much more advanced and Council will be able to make decisions based on priorities and costs. Commissioner Tofte indicated he also prefers Option #1 to incentivize City Council.

Commissioner Smith agreed with Commissioner Tofte and likes Option #1. He noted his review of the financials shows even with conservative estimates, the LRC still will have a lot of money to be spent by 2032. Chair Adler also said she was most comfortable with Option #1 because it leaves room for future projects. Commissioners iterated additional funds could be pledged toward the underpass improvements in the future.

Commissioner Gorsevski likes all options but thinks Option #1 gives more surety. He said there is a lot of work to be done on Hwy 42 and the LRC may be able to partner with CDOT on Hwy 42.

Commissioner Tofte asked if anything would preclude future LRC contributions toward enhancing more basic underpass designs. Director Pierce said the LRC is not precluded from either allocating funds to such improvements in the Cooperation Agreement or through a separate Agreement at a later date, when there is more specificity about what is needed on the particular project. She also described the LRC's right to review and approve significant project changes, as outlined in the Cooperation Agreement.

Council member Leh said costs will be reduced as much as possible and that there will be more public process for input. He said there are a number of projects on the horizon that the LRC may be able to contribute to. He feels the Comprehensive Plan update could result in substantial changes that may spur more interest in LRC assistance. He supports Option #1.

Chair Adler confirmed she is in favor with Option #1 to show priorities and leaving room for future projects. She likes the idea of being able to make future contributions if needed. Commissioner Williams also expressed support for Option #1.

Chair Adler asked for public comments. Mike Kranzdorf supports Option #1. He said changes could arise and that Hwy 42 will present opportunities for LRC expenditures.

Commissioner Gambale moved we accept Option #1 as presented in the packet. Director Pierce clarified that the motion was continued from the prior meeting, so as long as there is clarity on the motion and no suggested amendments, there can simply be a vote on the motion.

Council member Leh provided a friendly amendment to utilize the language presented as Option #1 for the motion to enhance clarity. Commissioner Gambale and Commissioner Tofte accepted the friendly amendment. Director Pierce said the draft Cooperation Agreement would utilize the language from Option #1 since everyone agrees it reflects the intent of the motion.

Roll call vote:
Commissioner Gambale – yes
Commissioner Tofte – yes
Chair Adler - yes
Commissioner Smith - yes
Council member Leh - yes
Commissioner Gorsevski - yes
Commissioner Williams – yes

Motion passes.

Items for Next Regular Meeting: July 14, 2021:

- Resolution No. 21-07: Underpass Improvements Cooperation Agreement
- Cooperation Agreement, Funding for Undergrounding Project at State Highway 42 & Griffith Street
- Work Plan

Commissioners Comments:

Council member Leh expressed appreciation for the LRC work and contribution to the project.

Adjourn: The meeting adjourned at 9:09 am.

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Louisville Revitalization Commission

Minutes

Wednesday, July 14, 2021
8:00 am
Special Electronic Meeting

Call to Order – Chair Adler called the meeting to order at 8:02 am and took roll call.

Commissioners Present:	Alexis Adler Mark Gambale Alex Gorsevski Council member Chris Leh Graham Smith Bob Tofte Corrie Williams - absent
Staff Present:	Heather Balser, City Manager Megan Pierce, Economic Vitality Director Kim Bauer, Historic Preservation Planner Nick Cotton-Baez, Attorney to the City of Louisville Lisa Ritchie, Principal Planner Dawn Burgess, Executive Administrator
Others Present:	Deb Fahey, Mike Kranzdorf

Approval of Agenda:
Commissioner Tofte moved the agenda be approved. Commissioner Smith seconded. Approved.

Approval of June 16, 2021, June 30, 2021 and July 7, 2021 minutes:
Council member Leh made a motion to approve the minutes. Commissioner Tofte seconded. Approved.

Public Comments on Items Not on the Agenda:
None.

Reports of Commission:
None.

Business Matters of Commission:

- **Resolution 21-07: Cooperation Agreement for Transportation Master Plan Underpass Improvements**

  Economic Vitality Director Megan Pierce stated City Council approved this Cooperation Agreement at its July 13 meeting. This resolution is before the LRC is for final adoption. She highlighted the agreement summary in the agenda packet, as well as the funding structure that is outlined.

  Council member Leh questioned clarity of the language in Section 4.b.iii. of the Cooperation Agreement. Director Pierce clarified item 4.b.iii. of the agreement, on page 27 of the packet, which shows the contributions based on which projects the City ultimately may construct. If the City only constructs an underpass at Main Street/South Boulder Road, it receives $7.75M in contributions. If the City constructions that underpass as well as one at Hwy 42/South Street, it receives a total of $18.75M in contributions, which can be spent on either of the two projects. Attorney Cotton-Baez pointed to Section 2, Pledged Revenue, which more clearly defines the either/or funding.

  Commissioners Tofte and Smith also discussed whether the legal terms provided enough clarity for the future on the LRC's intent. It was agreed that when read in totality, and with the support of the minutes, the LRC's desires would be clear over the long-term.

  Chair Adler called for public comment. There was none.

  Commissioner Tofte made a motion to approve the Cooperation Agreement in Resolution 21-07. Council member Leh seconded.

  Roll Call vote:
  Commissioner Tofte - yes
  Council member Leh - yes
  Chair Adler - yes
  Commissioner Smith – yes
  Commissioner Gambale - yes
  Commissioner Gorsevski - yes

  Motion passes.

- **Discussion/Direction – Cooperation Agreement for Funding Underground Project at State Highway 42 & Griffith Street**
  Director Pierce said this is a budgeted item for 2021. The City is using its 1% fund to underground Xcel utility lines, but this funding source cannot be used for other telecommunications, including Comcast and CenturyLink lines. The LRC contribution helps the City complete the project. Commissioner Smith wants to make sure City has oversight of Xcel's work.

  Director Pierce confirmed that the City has direct involvement and that the City Engineer provides project oversight.

  Chair Adler called for public comment. There was none.

  By show of hands, all Commissioners are in favor of advancing the Cooperation Agreement for City Council approval. Once approved by Council, it will come back to the LRC for final approval.

- **Discussion/Direction – Work Plan**
  Director Pierce will update the Work Plan to reflect recent action on the underpasses and Cooperation Agreements. She advised the LRC will still need to revisit the priority of Work Plan items, which will assist in preparing the 2022 Budget.

  Commissioner Smith asked Director Pierce to re-organize the Work Plan to highlight the areas where the LRC needs to focus at the next meeting.

  Chair Adler called for public comment. There was none.

Items for Next Regular Meeting:

- Resolution No. 21-08: Undergrounding Project Cooperation Agreement
- Wayfinding Signage Update
- Work Plan

Commissioners Comments:
Commissioner Tofte commended Director Pierce for her excellent work on the many LRC items.

Director Pierce provided an update on the potential future meeting schedule for the LRC, including the ability to return to in-person meetings. Although this item was not specifically listed on the agenda, Attorney Cotton-Baez said discussion of the schedule is administrative and that the dialogue could proceed.

Council member Leh made a motion that the LRC not meet in August and resume meeting in September. Commissioner Smith seconded.

Roll call vote:

Council member Leh - yes
Commissioner Smith - yes
Chair Adler - yes
Commissioner Gambale - yes
Commissioner Gorsevski - yes
Commissioner Tofte - yes

Motion passes.

Commissioners were in agreement to resume in person meetings. The LRC provided input about meeting date and time as well as potential meeting locations, including the Art Center, Recreation Center, and Library Meeting Room. There was generally a preference to continue meeting on the 2nd Wednesday at 8 AM. Council member Deb Fahey suggested the Senior Center as a potential meeting location. Staff will research available meeting rooms and will follow-up with the Commission to confirm ahead of the September 8 meeting.

Commissioners asked for an update on the public art project at the South Street Gateway Underpass. Director Pierce noted staff is working with BNSF and that the art still needs to go through the public approval process. She said she would gather more information to share.

Chair Adler attended last night's City Council meeting and asked Director Pierce to provide an update on the approved Business Assistance Package for the Louisville Beer Garden. Director Pierce said the business is negotiating a lease in the space Growler USA previously occupied. They are eligible for approximately $191,000 in incentives agreed-to by the City if they execute the lease and begin operations.

Council member Leh thanked the LRC for the Cooperation Agreements.

Commissioner Tofte would like an update on Coal Creek Station at the next meeting.

Adjourn: The meeting adjourned at 9:02 am.

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Louisville Revitalization Commission

Minutes

Wednesday, September 8, 2021
8:00 am
Special Electronic Meeting

Call to Order – Chair Adler called the meeting to order at 8:04 AM and took roll call.

Commissioners Present:	Alexis Adler Mark Gambale Alex Gorsevski Council member Chris Leh Graham Smith - absent Bob Tofte Corrie Williams
Staff Present:	Megan Davis, Interim City Manager Megan Pierce, Economic Vitality Director Austin Brown, Economic Vitality Specialist Nick Cotton-Baez, Attorney to the City of Louisville Lisa Ritchie, Interim Planning and Building Safety Director Dawn Burgess, Executive Administrator
Others Present:	Council member Deb Fahey

Approval of Agenda:
Commissioner Tofte moved the agenda be approved. Council member Leh seconded. Approved.

Approval of July 14, 2021 Minutes:
Commissioner Tofte made a motion to approve the minutes. Council member Leh seconded. Approved.

Public Comments on Items Not on the Agenda:
None.

Reports of Commission:

- Interim Planning Director Lisa Ritchie provided an update on the status of the Coal Creek Village property, formerly called Coal Creek Station. Markel Homes submitted an application for a Preliminary PUD and Plat earlier this summer to allow redevelopment on the property. They propose 185 residential units in a mix of product type along with commercial development along South Boulder Road. Public hearings may occur later this fall or winter.

  Chair Adler inquired as to whether tenants have been identified for the project. Ritchie replied that staff had not yet heard of any tenants and assume that the applicant will continue to work on that as the project moves forward.

  Commissioner Tofte inquired about the amount commercial space in the development. Commissioner Leh noted that as a Councilmember, he is recusing himself from the meeting due to quasi-judicial limitations on discussions of pending applications. Council member Fahey, an attendee of the meeting, also recused herself. Ritchie replied that the applicant and staff are looking at additional options to expand commercial square footage along South Boulder Road, including shared parking and parking reductions.

- Economic Vitality Director Megan Pierce introduced Austin Brown, Economic Vitality Specialist, saying he will be a great addition to the Department.

Business Matters of Commission:

- **Resolution 21-08: Cooperation Agreement for Funding Utility Undergrounding at State Highway 42 and Griffith Street**

  Director Pierce noted this item is before the LRC for final approval. A $170,000 contribution for undergrounding at Hwy 42 and Griffith Street is in the 2021 budget. She noted staff recommends a slightly higher amount than what was in the budget to allow for contingencies: a not-to-exceed amount of $187,000. The Cooperation Agreement was approved by City Council on July 27. Commissioner Smith submitted a comment noting his approval of a 10% contingency. Councilmember Leh indicated the item will also come before Council again on October 21.

  Chair Adler called for Public Comment – none.

  Commissioner Tofte asked if there is a timeline for the project. Director Pierce said they are working on easements but that she has been told this fall is feasible for the project.

Commissioner Tofte made a motion to approve Resolution 21-08. Commissioner Gambale seconded.

Roll call vote:
Commissioner Tofte - yes
Commissioner Gambale - yes
Chair Adler - yes
Commissioner Williams - yes
Commissioner Gorsevski - yes
Council member Leh - yes
Motion passed

- **Resolution 21-09: Amending the Annual Budget for Fiscal Year 2021 for the Urban Revitalization District**

  Director Pierce noted this is the start of 2022 budget process. This amendment reflects what has changed in the 2021 budget. This is an opportunity for the LRC to provide input; the Resolution will come before the LRC for final approval in October.

  Chair Adler opened the Public Hearing – no public comments.

  Director Pierce presented a summary of the items in red, which are the anticipated changes from the adopted 2021 budget. She also reviewed a proposed change to the cost of Support Services paid to the City of Louisville, which she recommended decrease from $60,000 to $45,000. Several Commissioners inquired about the reason for the change and confirmed there would not be any reduction to the level of service. Director Pierce said the amount does not reflect hours and staff costs at this time.

  Commissioner Smith submitted a question regarding the $17,940 payment from the DELO Construction Account. Director Pierce noted that this was an approved pay request from the developer related to some of the minor improvements still being completed.

  Chair Adler closed the public hearing.

  Commissioner Gorsevski made a motion to forward Resolution 21-09 to Council for approval. Commissioner Gambale seconded.

Roll Call vote:
Commissioner Gorsevski - yes
Commissioner Tofte - yes
Chair Adler - yes
Commissioner Williams - yes
Commissioner Gambale - yes
Council member Leh - yes
Motion passed

- **Discussion/Direction – Work Plan**

  Director Pierce noted that for development of a proposed 2022 budget, staff will require input about the LRC's highest priorities or any new projects they are interested in undertaking. Commissioners reviewed Work Plan items where the priority was highlighted in "yellow"—meaning it had not been updated since committing to the Transportation Master Plan underpass improvements.

  Commissioners asked questions about combining the two phases of the Wayfinding Signage Program, implementation of bike connectivity improvements, scope of streetscape and street furniture project, and areas of sidewalk improvements. Staff gathered feedback to revise the prioritization.

  Due to time, Commissioners did not review the entire Work Plan. Commissioners will send comments on priorities to Director Pierce to incorporate ahead of the next meeting date.

- **Discussion/ Direction – Preliminary 2022 Budget**

  Director Pierce reviewed the budget process timeline. She requested direction from Commissioners to be able to bring back a proposed budget in October. She then reviewed several projects that staff felt the LRC may wish to consider for next year's budget, including: expanded wayfinding signage, bike parking amenities, public infrastructure assistance, marketing strategy and implementation, and façade improvement program.

  Councilmember Leh inquired about how a façade improvement program would interact with the existing historic preservation program. Director Pierce said this will require more detail and consideration in the structure of the program. She said it is feasible to get a program into place by early next year and then start awarding funds. Commissioner Smith submitted a comment that he is in support of façade improvements. Chair Adler is also in agreement.

Chair Adler and other Commissioners noted their support for additional wayfinding signage funds. There may be some cost savings by mobilizing once and installing all desired signs under one bid process.

Commissioners discussed whether the amount of public infrastructure assistance currently approved for Corvus Nidus LLC ($134,760) should be carried forward into 2022. The agreement expires in December 2021, so Director Pierce explained there would be no legal obligation to the amount after this year, but a carry forward could represent a desire to still support the project. Commissioners felt it did not set a good precedent to carry the amount, but that the applicant could seek an amendment to the existing agreement or a new agreement if the project is able to continue.

Commissioner Gambale noted his interest in a marketing program for the Urban Renewal Area, similar to what the urban renewal authority in Lafayette has undertaken. Director Pierce said she would explore the idea with the City Attorney to confirm this appropriately matches with the goals of the Hwy 42 Urban Renewal Plan.

With the input received, staff will prepare a proposed 2022 Budget for LRC consideration in October.

Items for Next Regular Meeting, October 13, 2021:

- Resolution No. 21-09: 2021 Budget Amendment (final approval)
- Public Hearing for 2022 Budget
- Work Plan
- Wayfinding Signage

Commissioners Comments:

Commissioner Tofte commented about the growth of Duda in DeLo, which recently acquired another company.

Commissioner Gorsevski asked about the projects at 809 Main Street and 824 South Street. He also commented about Lafayette's success in cleaning-up Public Road and inquired about the future sports complex off of Hwy 42 that could be supported by the desired underpass improvements.

Councilmember Leh noted that the 809 Main building had recently been recognized by the Historic Preservation Commission. He also suggested an opportunity for a joint meeting with the LRC and Economic Vitality Committee as well as for Public Works Director Kurt Kowar to attend an LRC meeting.

Adjourn: The meeting adjourned at 9:51 AM.

Louisville Revitalization Commission
Work Plan

LRC Goals

1. *Reduce, eliminate, and prevent the spread of blight by funding projects that help to redevelop or rehabilitate the Urban Renewal Area.*

2. *Participate in funding public infrastructure improvements that will provide community benefit.*

3. *Form public-private collaborations to provide financial assistance that stimulates growth and reinvestment in the Urban Renewal Area.*

Project Areas & Actions	Owner	Timeframe	Funding	Priority
1. *Streetscape & Connectivity for Downtown*				
a. Implement Wayfinding Signage Program (includes secondary & tertiary monument signs, directory kiosks, pedestrian pole mounted signs, vehicular pole mounted signs, interpretive signs, district directional signs, and parking directional signs)	Pierce	ST	$$ $130,000*	HIGH **(In Process)**
b. Consider Enhancing Downtown Patio Parklets (additional patio purchases and canopy systems)	Pierce	ST	$ $81,000*	HIGH **(In Process)**
c. Evaluate Plans for Improving On-Street Bike Networks; Consider Implementation of Bike Parking Amenities as well as Community Resources (maps, signage, etc.)	Pierce	MT	$$	HIGH
d. Evaluate Needs for Street Furniture and Fixtures to Enhance Pedestrian & Visitor Experience (benches, trash/recycling bins, bollards, street trees, etc.)	Pierce	LT	$$$	LOW

Project Areas & Actions	Owner	Timeframe	Funding	Priority
e. Evaluate Needs for Sidewalk Improvements for Pedestrian Connectivity (brick banding, crosswalks, etc.)	Pierce	LT	$$$	MEDIUM
f. Explore Year-Round Festive Lighting (e.g. over the street, alleys)	Pierce	MT	$$$	TBD
Notes:	*Advancing any project in this area requires outcomes from the City's Downtown Streetlight Study and potential separation from Xcel.*			
g. Consider incentives for placement of EV charging stations through developers and Applications for Assistance	LRC/Pierce	ST	$	TBD
Notes:	*City currently evaluating Code requirements in 2021 that could impact requirements to provide charging infrastructure or stations. Recommend making a policy decision after the Code language is developed.*			
2. *Highway 42 Area*				
a. Fund sidewalk improvement for Griffith and Pine Streets @ Rail crossing (part of Quiet Zone projects)- SW3 and SW4 (TMP)	LRC	ST	$ $16,500*	HIGH **(In Process)**
b. Participate in funding the undergrounding of overhead utility lines on west Hwy 42 and west Griffith Street	City/LRC	ST	$$ $187,000*	HIGH **(In Process)**
c. Executed Cooperation Agreement to contribute funding for underpass improvements at Hwy 42 & South Street- GS2 (TMP)	City/LRC	LT	$$$ $8.9M	HIGH **(In Process)**
d. Contribute funding for construction of Underpass at Hwy 42 Regional Trail & South Boulder Road- GS5 (TMP)	City/LRC	LT	$$$ $5.3M	LOW

Project Areas & Actions	Owner	Timeframe	Funding	Priority
Notes:	*This underpass improvement has not been given a high priority by City Council nor LRC for the current TMP implementation projects. So the LRC should determine how to reflect it in its Work Plan priorities.*			
e. Fund sidewalk improvement for Hwy 42 from South Street to Pine Street (TMP)	LRC	LT	$$ $700,000	TBD
Notes:	*This project will be delayed until the broader Hwy 42 Corridor improvements are advanced, and the estimated project costs will likely changed based on required infrastructure.*			
f. Improve East Side parking lots @ Sports Complex/Hwy 42 to provide expanded downtown parking availability	LRC	LT	$$	TBD
Notes:	*This project is not feasible until after Hwy 42 Corridor improvements have been completed.*			
3. *Downtown & DeLo*				
a. Evaluate potential Wi-Fi connectivity project for Steinbaugh Pavilion and for cell carriers to add 5G Downtown	City/LRC	MT	$$	LOW
b. Consider connectivity improvements between Downtown and Coal Creek Village	LRC	LT	$$$	LOW
c. Evaluate funding participation in overhead utility undergrounding in Downtown alley (between Main Street and LaFarge Avenue from Pine Street to South Street)	City/LRC	ST	$$	TBD
Notes:	*City conducted site visit with Xcel in late April. Given outlined challenges and complexities raised by Xcel, the City has decided not to pursue the project at this time. City still discussing with Tebo Properties and looking at alternatives that may assist with line height & reliability.*			
d. ~~Secure placement of public art for DeLo underpass~~	~~Louisville Cultural Council/LRC~~	~~ST~~	~~$$~~	~~LOW~~ **(Completed February 2021)**

Louisville Revitalization Commission
Work Plan

Project Areas & Actions	Owner	Timeframe	Funding	Priority
4. *South Boulder Road Area*				
a. Contribute funding for construction of Underpass at South Boulder Road & Main Street- GS1 (TMP)	City/LRC	LT	$$$ $19.8M	HIGH **(In Process)**
b. Explore connectivity between Village Square & residential to the north (via ditch and creation of public space @ rear)	LRC	MT	$$$	LOW
c. Discuss public improvements for funding, such as landscaping, pedestrian scale lighting, and connectivity in Village Square	LRC	MT	$$	MEDIUM
d. Consider façade improvement program to incentivize maintenance and improvements on private property	LRC	ST	$$ $150,000*	HIGH
e. Widen North side sidewalk on South Boulder Road (Garfield, Jefferson) to 10' where possible; coordinate w/underpass construction- SW1 (TMP)	LRC	MT	$$ $81,000	TBD
Notes:	*This project may be coordinated with the GS1 underpass. It was removed from the budget thru the 2021 amendment. Funding in future years will likely change.*			
5. *TIF Requests and Property Tax Rebate Agreements*				
~~a. Consider fee to off-set costs of independent financial analysis for TIF requests~~	~~LRC~~	~~ST~~	~~N/A~~	~~HIGH~~ **(Completed September 2020)**
~~b. Evaluate request for assistance from 824 South, Inc.~~	~~LRC~~	~~ST~~	~~$$~~	~~HIGH~~ **(Completed April 2020)**
~~c. Evaluate potential request for assistance from 511 East South Boulder Road (The Rose and Raven)~~	~~LRC~~	~~ST~~	~~$$~~	~~HIGH~~ **(Completed February 2021)**

Louisville Revitalization Commission
Work Plan

Project Areas & Actions	Owner	Timeframe	Funding	Priority
6. Business Support Related to Impacts of COVID-19 Pandemic				
a. Develop Marketing or Communication materials to represent the LRC	Pierce/LRC	ST	$	MEDIUM
b. Consider Consultant-Led Marketing Strategy for Urban Renewal Area	Pierce/LRC	ST	$$	HIGH
~~c. Participate in City's Emergency Solutions Grant Program to assist small businesses within the Urban Renewal Area & prevent blight~~	~~LRC/CC~~	~~ST~~	~~$100,000~~	~~HIGH~~ **(Completed May 2020)**
~~d. Participate in City's Small Business Preservation Grant program~~	~~LRC/CC~~	~~ST~~	~~$88,000*~~	~~HIGH~~ **(Completed March 2021)**

"Parking Lot":

- Assist in identifying funding opportunities for remediation of environmental hazards preventing development/redevelopment of commercial sites
- Revisit or identify small parking lot projects as opportunities arise
- Evaluate additional opportunities for trail connectivity to Downtown

Matrix Definitions:

- *Project Areas & Actions*: Every item should have an associated project area; we recommend each action should start with a verb to clarify the intent of the work to be accomplished. Notation such as "SW1" is a reference to the Transportation Master Plan
- *Owner*: Every action should have an assigned owner to assist with accountability. This area can also be used to indicate when resources might be required from an outside group
- *Timeframe*: Each action has a timeframe to accomplish of either short-term (three months to one year), mid-term (one to three years), and long-term (anything longer than three years)
- *Funding*: A single "$" indicates little to no financial investment; two "$" indicate some financial investment; and three "$" indicate major project or expense

- "*" Next to specific dollar amount means this has been allocated for funding in the 2021 Budget

- *Priority*: Every action should have a rating of low, medium, or high. Completed items are notated with stricken text

City of Louisville
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CITY COUNCIL COMMUNICATION
AGENDA ITEM 7A

SUBJECT: 501 JEFFERSON AVENUE LANDMARK & GRANT

RESOLUTION NO. 71 SERIES 2021– A RESOLUTION APPROVING THE LESLIE HOUSE LOCATED AT 501 JEFFERSON AVENUE A HISTORIC LANDMARK

RESOLUTION NO. 72, SERIES 2021 – A RESOLUTION APPROVING A HISTORIC PRESERVATION FUND GRANT FOR THE LESLIE HOUSE LOCATED AT 501 JEFFERSON AVENUE

DATE: OCTOBER 19, 2021

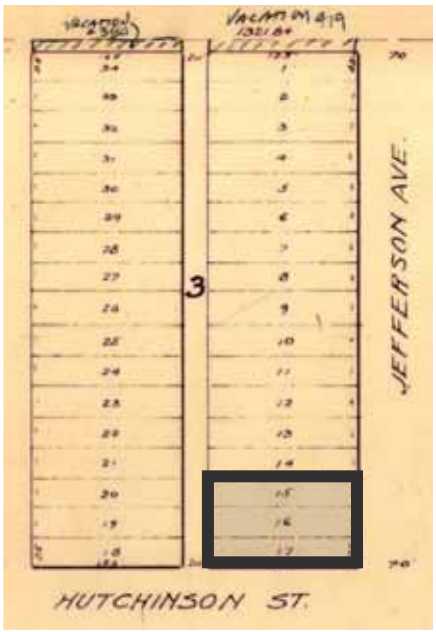
PRESENTED BY: KIM BAUER, HISTORIC PRESERVATION PLANNER
PLANNING & BUILDING SAFETY DEPARTMENT

LOCATION:

REQUEST:
The applicant requests the following:
Landmark Designation: Landmark designation for 501 Jefferson Avenue, to be known as the Leslie House, and accompanying $5,000 Landmark Bonus

Grant Request: A Historic Preservation Fund matching grant of $7,436 for preservation, rehabilitation and restoration work on the structure. This the first grant request for the property.

HISTORICAL BACKGROUND:
Information from Bridget Bacon, Louisville Historical Museum



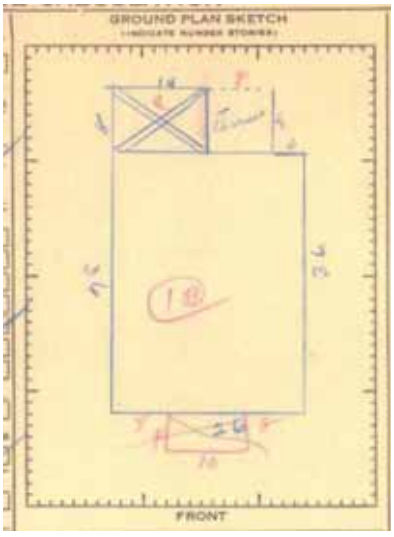
Lots 15-17, Acme Place

In 1893, John Connell, who had helped to establish the Acme Mine, platted the subdivision of Acme Place. It established the 500 blocks of Lincoln, Grant, Jefferson, and LaFarge Avenues. The Acme Place subdivision was the fourth addition to original Louisville and developed due to its proximity to the Acme Mine.

The lots where 501 Jefferson Avenue is now located were originally owned by the Acme Mining Company and later the Rocky Mountain Fuel Company. In 1948, these lots were sold to William and Ruth Leslie. The Assessor Card for 501 Jefferson, dated 1948, does not contain a date of construction, but states that the house was relocated from the Columbine Mine in 1948.

William “Bill” Leslie was born in Louisville in 1897. In 1926, he married Ruth Wellerd and they eventually had four children: Donald, William, John, and Gilbert. Bill worked at the Matchless Mine and retired from mining in 1941. Following that, he worked as a marshal/patrolman from 1947-1964 and monitored Louisville for “speeders, drunk driving cases, traffic accidents, illegal gambling, teenager pranks, and unruly conduct at the town’s taverns.” The property sold in 1974 following his death.

Columbine Mine – Date unknown



501 Jefferson Avenue, Boulder County Assessor's Card, 1948

501 Jefferson Avenue, east view – Current Photo

501 Jefferson Avenue, northeast view – Current Photo

ARCHITECTURAL INTEGRITY:
The historic structure located at 501 Jefferson Avenue was constructed at an unknown date and relocated to Jefferson Avenue in 1948. The primary façade faces east to Jefferson Avenue. By its size, shape, and style – Craftsman-type Bungalow – it was likely built c. 1905-1930, when that style was at its height of popularity. The style fell out of favor relatively quickly after 1930, making it fairly unlikely the house was built after the beginning of that decade. Character defining features of the Craftsman are present throughout, including a low-pitched, front gabled roof with wide, unenclosed eave overhangs, which are often exposed as they are here. Typical of the Craftsman style, the front façade exhibits a partial-width front porch with squared columns. It is also one and one-half stories tall. While this is not a high-styled example of the Craftsman-style bungalow, many occurrences outside of Southern California where the style first originated, are similar to this example. The bungalow style proliferated in large part because of their relatively smaller size and lesser ornamentation as compared to many Victorian styles of the contemporaneous era, and the more vernacular-presenting bungalows could be made with modest means and materials.

The current footprint of the house includes a 4'x14' rear addition built in 1975. The windows were replaced in 2008 but the window placements appear to be original.

Primary changes occurred over time:
- Cinder block garage built (post-1948);
- Stucco added (unknown)
- Rear addition (1975);
- Window replacement (2008);
- Roof-mounted solar (2009, 2018).

HISTORICAL SIGNIFICANCE ANALYSIS AND CRITERIA FOR LISTING AS LOCAL LANDMARK:
In order to receive a City landmark designation, landmarks must be at least 50 years old and meet one or more of the criteria for architectural, social or geographic/environmental significance as described in Louisville Municipal Code (LMC) Section 15.36.050(A).

Staff finds that this application complies with the above criterion by the following:

Sec. 15.36.050. - Criteria for Designation

Criteria	Meets Criteria?	Evaluation
A. Landmarks must be at least 50 years old and meet one or more of the criteria for architectural, social or	**Yes**	The principal structure at 501 Jefferson Avenue was constructed at an unknown date and relocated to Louisville in 1948.

geographic/environmental significance as described in this chapter.		It has been located at its current site for 72 years.
1. a. Architectural. ***1) Exemplifies specific elements of an architectural style or period.*** *2) Example of the work of an architect or builder who is recognized for expertise nationally, statewide, regionally, or locally.* *3) Demonstrates superior craftsmanship or high artistic value.* *4) Represents an innovation in construction, materials or design.* ***5) Style particularly associated with the Louisville area.*** ***6) Represents a built environment of a group of people in an era of history that is culturally significant to Louisville.*** *7) Pattern or grouping of elements representing at least one of the above criteria.* *8) Significant historic remodel.*	**Yes**	This house is associated with the historic development of Louisville. Often, houses were moved from a mine camp into towns such as Louisville, Lafayette, and Superior following a mine closure. In this case, the Columbine Mine closed in 1946 and the house was relocated in 1948. The historic structure located at 501 Jefferson Avenue was constructed at an unknown date and relocated to Jefferson Avenue in 1948. The primary façade faces east to Jefferson Avenue. By its size, shape, and style – Craftsman-type Bungalow – it was likely built c. 1905-1930, when that style was at its height of popularity. . Character defining features of the Craftsman are present throughout, including a low-pitched, front gabled roof with wide, unenclosed eave overhangs which are often exposed as they are here. Typical of the Craftsman style, the front façade exhibits a partial-width front porch with squared columns.
1. b. Social. *1) Site of historic event that had an effect upon society.* ***2) Exemplifies cultural, political, economic or social heritage of the community.*** ***3) Association with a notable person or the work of a notable person.***	**Yes**	The lots where 501 Jefferson Avenue is now located were originally owned by the Acme Mining Company and later the Rocky Mountain Fuel Company, prior to being sold and developed in 1948. William “Bill” Leslie was born in Louisville in 1897. Bill worked at the Matchless Mine and retired from mining in 1941. Following that, he worked as a marshal/patrolman from 1947-1964 and monitored Louisville for “speeders, drunk driving

		cases, traffic accidents, illegal gambling, teenager pranks, and unruly conduct at the town's taverns."
1. c. Geographic/environmental. *1) Enhances sense of identity of the community.* *2) An established and familiar natural setting or visual feature that is culturally significant to the history of Louisville.*	**Yes**	Not only were many homes and structures moved in Louisville historically, but also smaller bungalows like this would have been typical to what those who worked in a mine would have been able to afford. Because it was moved to Acme Place in the late 1940s, it is also representative of Old Town's growth.
3. All properties will be evaluated for physical integrity and shall meet one or more of the following criteria: ***a. Shows character, interest or value as part of the development, heritage or cultural characteristics of the community, region, state, or nation.*** ***b. Retains original design features, materials and/or character.*** ***c. Remains in its original location, has the same historic context after having been moved, or was moved more than 50 years ago.*** *d. Has been accurately reconstructed or restored based on historic documentation.*	**Yes**	This structure adds character and value to Old Town Louisville and represents a pattern of relocating structures to town from various area mining camps. The property has integrity of location, design, workmanship, feeling, and setting. Integrity of association with the Acme Place subdivision is intact. A small rear addition was added in 1975. Following its relocation in 1948, the structure retains its overall form and appearance from the street and exhibits a high level of physical integrity.

GRANT REQUEST:
The applicant is requesting approval of a Preservation and Restoration Grant for rehabilitation and restoration work on the structure at 501 Jefferson Avenue. The total grant request is $7,436. This grant would be in addition to the $5,000 signing bonus for landmarking the structure and the $4,000 grant for the Historic Structure Assessment previously approved for the property.

A Historic Structure Assessment was previously done for the property, completed by Stewart Architecture & Planning and paid for by the Historic Preservation Fund. The assessment (attached) makes several recommendations including: repairing the window storm seals. The applicants received a cost estimate from Signature Windows + Doors. The proposed total cost for all of the work on the historic structure is $14,872.

The accompanying Alteration Certificate authorizing the work was approved by Historic Preservation Commission on September 20, 2021.

> **Preservation** *is the act or process of applying measures necessary to sustain the existing form, integrity, and materials of an historic property as they now exist. Approved work focuses upon the repair of exterior historic materials and features rather than extensive replacement and new construction.*
>
> **Rehabilitation** *is the act or process of making possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural, or architectural values. Rehabilitation acknowledges the need to alter or add to a historic property to meet continuing or changing uses while retaining the property's historic character. The limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate.*
>
> **Restoration** *is the act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time. Approved work focuses on exterior work and includes the removal of features from other periods in its history and reconstruction of missing features from the restoration period.*
>
> - Window replacement

Work proposed with total cost:

- Window replacement: $14,872

COST ESTIMATE OF PROPOSED WORK: $14,872
MATCHING GRANT REQUESTED: $7,436 (matching grant maximum $40,000)

HISTORIC PRESERVATION COMMISSION ACTION:
The Historic Preservation Commission (HPC) held a public hearing on the application on September 20, 2021. The HPC voted to recommend approval of both the local landmark designation and the Historic Preservation Fund grant request. In addition, the HPC approved an alternation certificate for the restoration work associated with the grant request. The HPC determined the rehabilitation work restores the architectural integrity and qualifies for matching grant funds.

PUBLIC COMMENT:
Staff has not received any public comments regarding the request.

FISCAL IMPACT:
Approval of this grant request allows for a grant total of up to $7,436 from the Historic Preservation Fund: a $7,436 Preservation Grant (matching). The current balance of the fund is approximately $2.9 million.

PROGRAM/SUB-PROGRAM IMPACT:
The application meets the Community Design program goals and sub-program objectives by providing incentives to preserve the historic character of Old Town and to encourage the promotion and preservation of Louisville's history and cultural heritage.

RECOMMENDATION:
Staff recommends approval of Resolution 71, Series 2021 and Resolution 72, Series 2021, approval the local landmark designation for 501 Jefferson Avenue and naming the property the Leslie House, and approving the Historic Preservation Grant request of $7,436.

ATTACHMENTS:
1. Resolution No. 71, Series 2021
2. Resolution No. 72, Series 2021
3. Application Materials
4. Historic Structure Assessment
5. Historic Preservation Commission Resolution No. 6
6. Historic Preservation Commission Resolution No. 8
7. Historic Preservation Commission Minutes, September 20, 2021
8. Presentation

STRATEGIC PLAN IMPACT:

☐	**Financial Stewardship & Asset Management**	☐	**Reliable Core Services**
☐	**Vibrant Economic Climate**	☒	**Quality Programs & Amenities**
☒	**Engaged Community**	☐	**Healthy Workforce**
☐	**Supportive Technology**	☐	**Collaborative Regional Partner**

RESOLUTION NO. 71
SERIES 2021

A RESOLUTION DESIGNATING THE LESLIE HOUSE LOCATED AT 501 JEFFERSON AVENUE A HISTORIC LANDMARK

WHEREAS, there has been submitted to the City Council an application requesting a landmark eligibility determination for a historical residential property located at 501 Jefferson Avenue, on property legally described as Lots 15-17, Block 3, Acme Place, City of Louisville, State of Colorado; and

WHEREAS, the City Staff and the Louisville Historic Preservation Commission have reviewed the application and found it to be in compliance with Chapter 15.36 of the Louisville Municipal Code; and

WHEREAS, the Louisville Historic Preservation Commission held a properly noticed public hearing on the proposed landmark application and has forwarded to the City Council a recommendation of approval; and

WHEREAS, the City Council has duly considered the proposed landmark application and the Commission's recommendation and report, and has held a properly noticed public hearing on the application; and

WHEREAS, the Leslie House has architectural significance because it is a vernacular structure that is representative of the built environment in early 20th century Louisville; and

WHEREAS, the property 501 Jefferson Avenue (Leslie House) has social significance because it exemplifies the cultural, political, economic or social heritage of the community considering its association with Louisville families and cultural heritage; and

WHEREAS, the City Council finds that these and other characteristics specific to the individual structure are of both architectural and social significance as described in Section 15.36.050 (A) of the Louisville Municipal Code and justify the approval of the historic landmark application.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF LOUISVILLE, COLORADO:

1. The proposed historic landmark application for the Leslie House is hereby approved and is hereby designated a historic landmark to be preserved as such and is eligible for a $5,000 landmark incentive grant.

2. The City Clerk shall provide written notification of such designation to the property owners and cause a copy of this resolution to be recorded with the Boulder County Clerk and Recorder.

PASSED AND ADOPTED this 19th day of October, 2021.

_____
Ashley Stolzmann, Mayor

ATTEST:

_____
Meredyth Muth, City Clerk

RESOLUTION NO. 72
SERIES 2021

A RESOLUTION APPROVING A PRESERVATION AND RESTORATION GRANT FOR THE LESLIE HOUSE LOCATED AT 501 JEFFERSON AVENUE

WHEREAS, there has been submitted to the Louisville Historic Preservation Commission (HPC) an application requesting a preservation and restoration grant for the Leslie House, a historic residential structure located at 501 Jefferson Avenue, on property legally described as the Lots 15-17, Block 3, Acme Place, City of Louisville, State of Colorado; and

WHEREAS, the Staff and the Louisville Historic Preservation Commission have reviewed the application and found it to be in compliance with Chapter 3.20.605.D and Section 15.36.120 of the Louisville Municipal Code; and

WHEREAS, the Louisville Historic Preservation Commission has held a properly noticed public hearing on the proposed grant application and has recommended the request be forwarded to the Louisville City Council with a recommendation of approval; and

WHEREAS, the City Council has duly considered the proposed grant application and the Commission's recommendation and report, and has held a properly noticed public hearing on the application; and

WHEREAS, the City Council finds the proposed improvements will assist in the preservation of the Leslie House, a local historic landmark.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF LOUISVILLE, COLORADO:

Section 1. The City Council hereby approves the Preservation and Restoration Grant application for work at the Leslie House located 501 Jefferson Avenue, subject to the following:

1. Approved preservation items are those in the proposed scope of work presented to City Council totaling $14,872.
2. There is approved a total grant amount of $**7,436**.

PASSED AND ADOPTED this 19th day of October, 2021.

_____
Ashley Stolzmann, Mayor

ATTEST:

_____
Meredyth Muth, City Clerk

City of Louisville
COLORADO · SINCE 1878

Department of Planning and Building Safety

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HISTORIC PRESERVATION APPLICATION

CASE NO. _____

PROPERTY INFORMATION

Address: 501 Jefferson Ave

Date of construction (if known): 1948

Legal Description: Lot 15, 16, 17 Blk 3

Subdivision Acme Place

If Applicable: Landmark Name/Resolution

_____

Res. No. _____ Year _____

TYPE (S) OF APPLICATION

- ☐ Historic Structure Assessment
- ☒ Landmark
- ☒ Historic Preservation Fund Grant
- ☐ Historic Preservation Fund Loan
- ☒ Alteration Certificate
- ☐ Demolition Review
- ☐ Pre-filing Conference with Historic Preservation Commission

APPLICANT INFORMATION

Name: Carolyn Ford + Christopher Behm

Company: _____

Address: 501 Jefferson Ave
Louisville, CO 80027

Telephone: 303 888 9094

Email: behmford@gmail.com

PROJECT INFORMATION

(Attach additional pages if necessary)

Summary: _____

Historic Designation

Window replacement

OWNER INFORMATION *(if not applicant)*

Name: _____

Company: _____

Address: _____

_____

Telephone: _____

Email: _____

SIGNATURES & DATE

Applicant Name (please print): S Ford Chris Behm

Applicant Signature: Carolyn Ford CHRIS BEHM

Owner Name (please print): Carolyn FORD CHRIS BEHM

Owner Signature: S Ford Ch Beh

City of Louisville
COLORADO • SINCE 1882

3. REQUEST SUMMARY HISTORIC DESIGNATION
WINDOW REPLACEMENT

4. PROJECT DESCRIPTION (Please do not exceed space provided below.)

a. Provide a brief description of the proposed scope of work.

REPLACE WINDOWS IN ORIGINAL PORTION OF HOUSE

b. Describe how the work will be carried out and by whom. Include a description of elements to be rehabilitated or replaced and describe preservation work techniques that will be used.

ENTIRE WINDOWS WILL BE REPLACE IN ORIGINAL OPENINGS. WORK WILL BE DONE BY SIGNATURE WINDOWS

c. Explain why the project needs historic preservation funds. Include a description of community support and/or community benefits, if any.

CURRENT WINDOW HAVE FAILED SEALS AFFECTING THE LOOK OF HOUSE

City of Louisville
COLORADO • SINCE 1882

5. DESCRIPTION OF REHABILITATION *(Attach additional pages as necessary.)*

Name of Architectural Feature:

Describe feature and its condition:	Describe proposed work on feature:
WINDOWS IN ORIGINAL OPENING HAVE FAILED SEAL AND ARE CLOUDED	DIRECT REPLACE-MENT OF WINDOWS

Name of Architectural Feature:

Describe feature and its condition:	Describe proposed work on feature:

Name of Architectural Feature:

Describe feature and its condition:	Describe proposed work on feature:

Name of Architectural Feature:

Describe feature and its condition:	Describe proposed work on feature:

City of Louisville
COLORADO · SINCE 1882

6. COST ESTIMATE OF PROPOSED WORK

*Provide a budget that includes accurate estimated costs of your project. Include an **itemized breakdown** of work to be funded by the incentives and the work to be funded by the applicant. Include only eligible work elements. Use additional sheets as necessary. When possible, include quotes for the proposed work.*

Type of Incentive: ■ GRANT ☐ LOAN ☐ BOTH

Feature	Proposed Work to be Funded	Fund Request	Match (M)	Total
A.	WINDOW REPLACEMENT	$ 7436	$ 7436	$ 14872
B.		$	$	$
C.		$	$	$
D.		$	$	$
E.		$	$	$
F.		$	$	$
G.		$	$	$
H.		$	$	$
I.		$	$	$
J.		$	$	$
K.		$	$	$
	Total Proposed Work	$	$	$

For loan requests, indicate total loan request here:	$

If partial incentive funding were awarded, would you complete your project? ☒ YES ☐ NO

City of Louisville
COLORADO · SINCE 1882

7. ADDITIONAL MATERIALS REQUIRED

The following items must be submitted along with this application:

- [x] One set of photographs for each feature as described in Item 4 "Description of Rehabilitation". Digital is preferred.
- [x] A construction bid if one has been completed for your project (recommended).
- [ ] Working or scaled drawings, spec sheets, or materials of the proposed work, if applicable to your project.

8. ASSURANCES

The Applicant hereby agrees and acknowledges that:

A. Funds received as a result of this application will be expended solely on described projects, and must be completed within established timelines.

B. Awards from the Historic Preservation Fund may differ in type and amount from those requested on an application.

C. Recipients must submit their project for any required design review by the Historic Preservation Commission and acquire any required building permits before work has started.

D. All work approved for grant funding must be completed even if only partially funded through this incentives program.

E. Unless the conditions of approval otherwise provide, disbursement of grant or rebate funds will occur after completion of the project.

F. The incentive funds may be considered taxable income and Applicant should consult a tax professional if he or she has questions.

G. If this has not already occurred, Applicant will submit an application to landmark the property to the Historic Preservation Commission. If landmarking is not possible for whatever reason, Applicant will enter into a preservation easement agreement with the City of Louisville. Any destruction or obscuring of the visibility of projects funded by this grant program may result in the City seeking reimbursement.

H. The Historic Preservation Fund was approved by the voters and City Council of Louisville for the purpose of retaining the city's historic character, so all work completed with these funds should remain visible to the public.

Signature of Applicant/Owner — Date: 7/10/2021

Signature of Applicant/Owner — Date: 7/10/2021

City of Louisville
COLORADO · SINCE 1882

Historic Preservation Application

The following information must be provided to ensure adequate review of your proposal. Please type or print answers to each question. Please keep your responses brief but thorough. If you have any questions about the application or application process, please reach out to the Historic Preservation Planner.

TYPE(S) OF APPLICATION

- ☐ Probable Cause Hearing/Historic Structure Assessment
- ☒ Landmark Designation
- ☒ Historic Preservation Fund Grant
- ☐ Historic Preservation Fund Loan
- ☒ Landmark Alteration Certificate
- ☐ Demolition Review
- ☐ Other: _____

1. OWNER/APPLICANT INFORMATION

Owner or Organization

Name(s): Carolyn Ford & Chris Behm
Mailing Address: 501 Jefferson Ave Louisville
Telephone: 303 888 9094
Email: behmford@gmail.com

Applicant/Contact Person (if different than owner)

Name: _____
Company: _____
Mailing Address: _____
Telephone: _____
Email: _____

2. PROPERTY INFORMATION

Address: 501 Jefferson Ave
Legal Description: Lots 15, 16 & 17 Block 3 Acme Place
Parcel Number: _____ Year of construction (if known): 1948
Landmark Name and Resolution (if applicable): _____
Primary Use of Property: Residence

501 Jefferson Ave., L-Ville
Chris Behm

Quote #: ZFPJDX4

A Proposal for Window and Door Products prepared for:
Job Site:
80027

Shipping Address:
SIGNATURE WINDOWS-BOULDER
14309 E 35th Pl Ste 105
Aurora, CO 80011-1247

SIGNATURE WINDOWS + DOORS
INNOVATION | IMAGINATION | INSTALLATION
KIB DELORRAINE
SIGNATURE WINDOWS-BOULDER
14309 E 35TH PL STE 105
AURORA, CO 80011-1247
Phone: (303) 442-4277 109

Email: kdelorraine@signaturewindows.co

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Featuring products from:

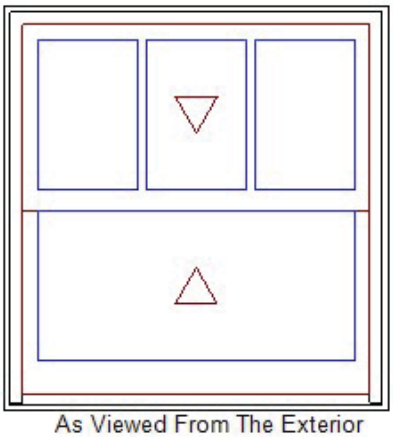
MARVIN

LINE ITEM QUOTES

The following is a schedule of the windows and doors for this project. For additional unit details, please see Line Item Quotes. Additional charges, tax or Terms and Conditions may apply. Detail pricing is per unit.

Line #1 Qty: 1	Mark Unit: A-KITCHEN WEST	Net Price: Ext. Net Price:	 USD	805.60 805.60

MARVIN



As Viewed From The Exterior

Entered As: FS
FS 37" X 39"
Egress Information
Width: 33 13/32" Height: 14 7/16"
Net Clear Opening: 3.35 SqFt
Performance Information
U-Factor: 0.33
Solar Heat Gain Coefficient: 0.27
Visible Light Transmittance: 0.46
Condensation Resistance: 55
CPD Number: MAR-N-425-17179-00001
Performance Grade
Licensee #1127
AAMA/WDMA/CSA/101/ I.S.2/A440-08
LC-PG50 1149X2223 mm (45.3X87.5 in)
LC-PG50 DP +50/-50
FL17635

Bronze Clad Exterior
Bare Pine Interior
Ultimate Double Hung G2
Frame Size 37" X 39"
Rough Opening 38" X 39 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG
Low E2
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W1H
Bronze Clad Ext - Bare Pine Int
Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E2
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Aluminum Screen
Bronze Surround
Charcoal Fiberglass Mesh
***Screen/Combo Ship Loose
4 9/16" Jambs
Nailing Fin
***Note: Units with Capillary tubes will not have Argon gas.
***Note: Unit Availability and Price is Subject to Change

Initials required

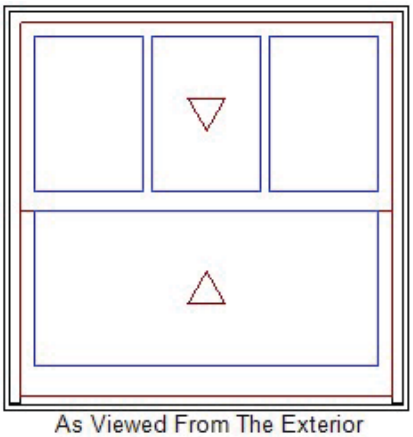
Seller: _____

Buyer: _____

Line #2 Qty: 1	Mark Unit: B-KITCHEN WEST	Net Price: Ext. Net Price:	 USD	884.00 884.00

MARVIN

Bronze Clad Exterior
Bare Pine Interior
Ultimate Double Hung G2
Frame Size 43" X 43"
Rough Opening 44" X 43 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG



As Viewed From The Exterior

Entered As: FS
FS 43" X 43"
Egress Information
Width: 39 13/32" Height: 16 7/16"
Net Clear Opening: 4.50 SqFt
Performance Information
U-Factor: 0.33
Solar Heat Gain Coefficient: 0.27
Visible Light Transmittance: 0.46
Condensation Resistance: 55
CPD Number: MAR-N-425-17179-00001
Performance Grade
Licensee #1127
AAMA/WDMA/CSA/101/ I.S.2/A440-08
LC-PG50 1149X2223 mm (45.3X87.5 in)
LC-PG50 DP +50/-50
FL17635

Low E2
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W1H
Bronze Clad Ext - Bare Pine Int
Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E2
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Aluminum Screen
Bronze Surround
Charcoal Fiberglass Mesh
***Screen/Combo Ship Loose
4 9/16" Jambs
Nailing Fin
***Note: Units with Capillary tubes will not have Argon gas.
***Note: Unit Availability and Price is Subject to Change

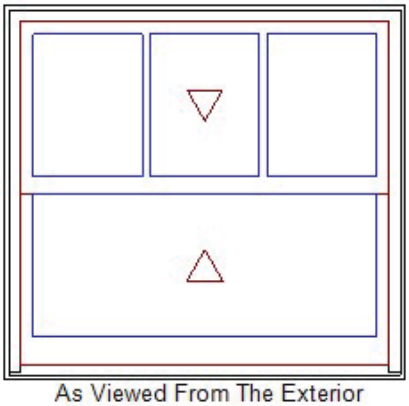
Initials required

Seller: _____

Buyer: _____

Line #3 Qty: 1	Mark Unit: C-LVF S.E./366 GLS/HALF SCRN	Net Price: Ext. Net Price:	USD	960.00 960.00

MARVIN



As Viewed From The Exterior

Entered As: FS
FS 45" X 42"
Egress Information
Width: 41 13/32" Height: 15 15/16"
Net Clear Opening: 4.58 SqFt
Performance Information
U-Factor: 0.33
Solar Heat Gain Coefficient: 0.18
Visible Light Transmittance: 0.41
Condensation Resistance: 55

Bronze Clad Exterior
Bare Pine Interior
Ultimate Double Hung G2
Frame Size 45" X 42"
Rough Opening 46" X 42 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG
Low E3
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W1H
Bronze Clad Ext - Bare Pine Int
Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E3
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Half Screen
Bronze Surround

CPD Number: MAR-N-425-17183-00001
ENERGY STAR: S
Performance Grade
Licensee #1127
AAMA/WDMA/CSA/101/ I.S.2/A440-08
LC-PG50 1149X2223 mm (45.3X87.5 in)
LC-PG50 DP +50/-50
FL17635

Charcoal Fiberglass Mesh
***Screen/Combo Ship Loose
4 9/16" Jambs
Nailing Fin
***Note: Units with Capillary tubes will not have Argon gas.
***Note: Unit Availability and Price is Subject to Change

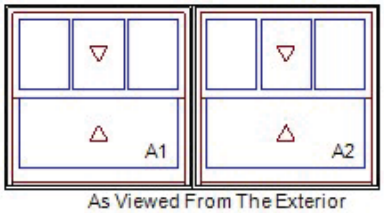
Initials required

Seller: _____

Buyer: _____

Line #4 Qty: 1	Mark Unit: D-LVG S TWIN DH/366/HALF SCN	Net Price: Ext. Net Price:	 USD	1,824.80 1,824.80

MARVIN



As Viewed From The Exterior

Entered As: Size by Units
FS 86" X 42"
Egress Information A1, A2
Width: 39 13/32" Height: 15 15/16"
Net Clear Opening: 4.36 SqFt
Performance Information A1, A2
Product Performance Information is currently unavailable in the OMS for this product and glazing option. To request product performance information not in the OMS, contact your Marvin representative or submit an Assistance Request.
Performance Grade A1, A2
Licensee #1127
AAMA/WDMA/CSA/101/ I.S.2/A440-08
LC-PG50 1149X2223 mm (45.3X87.5 in)
LC-PG50 DP +50/-50
FL17635
Performance Grade Mull
Licensee #1127
AAMA 450-10
LC-65 1149X1613 mm (45.26X63.51 in)
LC-65 DP 65
Performance Grade Overall Assembly
LC-PG50 DP +50/-50

Bronze Clad Exterior
Bare Pine Interior
2W1H - Rectangle Assembly
Assembly Rough Opening
87" X 42 1/2"

Unit: A1
Ultimate Double Hung G2
Basic Frame 43" X 42"
Rough Opening 44" X 42 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG
Low E3
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W1H
Bronze Clad Ext - Bare Pine Int
Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E2
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Half Screen
Bronze Surround
Charcoal Fiberglass Mesh
***Screen/Combo Ship Loose

Unit: A2
Ultimate Double Hung G2
Basic Frame 43" X 42"
Rough Opening 44" X 42 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG
Low E3
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W1H
Bronze Clad Ext - Bare Pine Int

Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E2
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Half Screen
Bronze Surround
Charcoal Fiberglass Mesh
***Screen/Combo Ship Loose
Standard Mull Charge
4 9/16" Jambs
Nailing Fin
***Note: This configuration meets a minimum structural performance of DP 20 through either physical testing or calculations in accordance with AAMA 450 and building code requirements. Mull certification ratings may vary from individual unit certification ratings. Reference the mulling chapter of the ADM for additional information.
***Note: Units with Capillary tubes will not have Argon gas.
***Note: Unit Availability and Price is Subject to Change

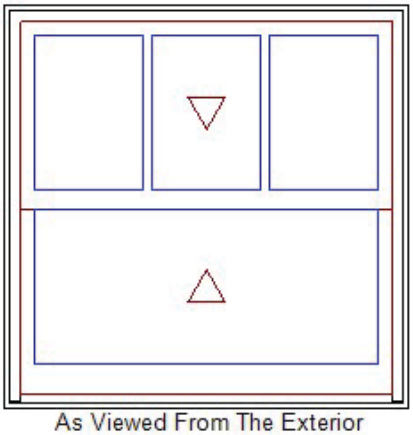
Initials required

Seller: _____

Buyer: _____

Line #5 Qty: 2	Mark Unit: E-LVG E./HALF SCRN	Net Price: Ext. Net Price:	USD	884.00 1,768.00

MARVIN



As Viewed From The Exterior

Entered As: FS
FS 43" X 43"
Egress Information
Width: 39 13/32" Height: 16 7/16"
Net Clear Opening: 4.50 SqFt
Performance Information
U-Factor: 0.33
Solar Heat Gain Coefficient: 0.27
Visible Light Transmittance: 0.46
Condensation Resistance: 55

Bronze Clad Exterior
Bare Pine Interior
Ultimate Double Hung G2
Frame Size 43" X 43"
Rough Opening 44" X 43 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG
Low E2
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W1H
Bronze Clad Ext - Bare Pine Int
Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E2
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Half Screen
Bronze Surround
Charcoal Fiberglass Mesh

CPD Number: MAR-N-425-17179-00001
Performance Grade
Licensee #1127
AAMA/WDMA/CSA/101/ I.S.2/A440-08
LC-PG50 1149X2223 mm (45.3X87.5 in)
LC-PG50 DP +50/-50
FL17635

***Screen/Combo Ship Loose
4 9/16" Jambs
Nailing Fin
***Note: Units with Capillary tubes will not have Argon gas.
***Note: Unit Availability and Price is Subject to Change

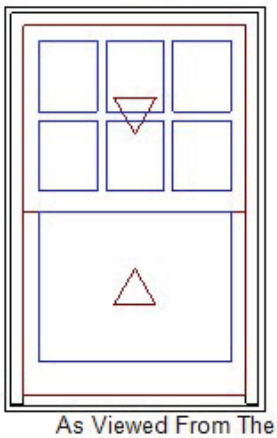
Initials required

Seller: _____

Buyer: _____

Line #6 Qty: 3	Mark Unit: F-DRESSING & BR	Net Price: Ext. Net Price:	 USD	808.80 2,426.40

MARVIN



As Viewed From The Exterior

Entered As: FS
FS 25" X 39"
Egress Information
Width: 21 13/32" Height: 14 7/16"
Net Clear Opening: 2.15 SqFt
Performance Information
U-Factor: 0.33
Solar Heat Gain Coefficient: 0.27
Visible Light Transmittance: 0.46
Condensation Resistance: 55
CPD Number: MAR-N-425-17179-00001
Performance Grade
Licensee #1127
AAMA/WDMA/CSA/101/ I.S.2/A440-08
LC-PG50 1149X2223 mm (45.3X87.5 in)
LC-PG50 DP +50/-50
FL17635

Bronze Clad Exterior
Bare Pine Interior
Ultimate Double Hung G2
Frame Size 25" X 39"
Rough Opening 26" X 39 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG
Low E2
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W2H
Bronze Clad Ext - Bare Pine Int
Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E2
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Half Screen
Bronze Surround
Charcoal Fiberglass Mesh
***Screen/Combo Ship Loose
4 9/16" Jambs
Nailing Fin
***Note: Units with Capillary tubes will not have Argon gas.
***Note: Unit Availability and Price is Subject to Change

Initials required

Seller: _____

Buyer: _____

Line #7 Qty: 1	Mark Unit: INSTALLATION	Net Price: Ext. Net Price:	 USD	5,454.36 5,454.36

Labor *Removal and disposal of existing, installation of new windows, 10-year labor warranty

Initials required

Seller: _____

Buyer: _____

Project Subtotal Net Price: USD	8,668.80
Non-Taxable Labor: USD	5,454.36
8.635% Sales Tax: USD	748.55
Project Total Net Price: USD	14,871.71

TERMS AND CONDITIONS

Quotations are subject to correction at any time, and to price revision after 30-days. All window and door options and specifications as entered are approved by you. You are responsible for windows meeting egress and safety glass code requirements. Immediately upon submitting approved orders with Signature Window + Door's vendors, change requests will be subject to scrap charges and order change fees.

Payment terms are 1/2-Deposit, Balance-COD except with prior approval. Past due accounts are subject to reasonable collection costs, including attorney's fees and interest. Should we hold any part of your order more than 30-days at your request, you agree to process our invoice for payment as if your order had been delivered complete. Signature Windows + Doors is not responsible for delivery delays beyond its control.

Signature Windows + Door's builder/contractor pricing program includes services such as discounted delivery, discount for paying by cash or check, pre-installation workshops and post-installation walk through inspections when requested.

Thank you for your business!

PRODUCT AND PERFORMANCE INFORMATION

NFRC energy ratings and values may vary depending on the exact configuration of glass thickness used on the unit. This data may change over time due to ongoing product changes or updated test results or requirements.

The National Fenestration Rating Council (NFRC) has developed and operates a uniform national rating system for the energy performance of fenestration products, including windows and doors. For additional information regarding this rating system, see www.nfrc.org.

NFRC energy values and ratings may change over time due to ongoing product changes, updated test results or requirements.

PURCHASE APPROVAL/SIGN OFF

Project Subtotal Net Price: USD	8,668.80
Non-Taxable Labor: USD	5,454.36
8.635% Sales Tax: USD	748.55
Project Total Net Price: USD	14,871.71

I have reviewed all line item quotes in detail and agree that the product specifications and pricing are accurate, and I approve the project for order. I acknowledge that additional charges, tax or Terms and Conditions may apply.

Seller: _____

Buyer: _____

501 Jefferson Ave., L-Ville
Chris Behm

Quote #: ZFPJDX4

A Proposal for Window and Door Products prepared for:
Job Site:
80027

Shipping Address:
SIGNATURE WINDOWS-BOULDER
14309 E 35th Pl Ste 105
Aurora, CO 80011-1247

SIGNATURE WINDOWS + DOORS
INNOVATION | IMAGINATION | INSTALLATION
KIB DELORRAINE
SIGNATURE WINDOWS-BOULDER
14309 E 35TH PL STE 105
AURORA, CO 80011-1247
Phone: (303) 442-4277 109

Email: kdelorraine@signaturewindows.co

This report was generated on 5/14/2021 11:13:38 AM using the Marvin Order Management System, version 0003.08.01 (Current). Price in USD. Unit availability and price are subject to change. Dealer terms and conditions may apply.

Featuring products from:

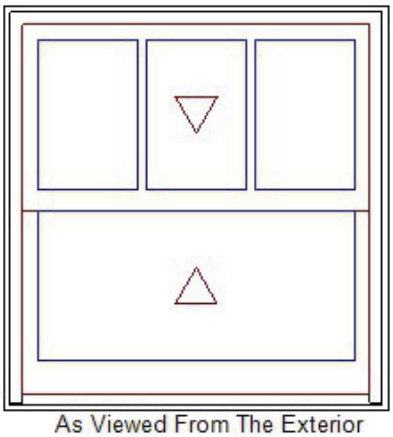
MARVIN

LINE ITEM QUOTES

The following is a schedule of the windows and doors for this project. For additional unit details, please see Line Item Quotes. Additional charges, tax or Terms and Conditions may apply. Detail pricing is per unit.

Line #1 Qty: 1	Mark Unit: A-KITCHEN WEST	Net Price: Ext. Net Price:	 USD	805.60 805.60

MARVIN



As Viewed From The Exterior

Entered As: FS
FS 37" X 39"
Egress Information
Width: 33 13/32" Height: 14 7/16"
Net Clear Opening: 3.35 SqFt
Performance Information
U-Factor: 0.33
Solar Heat Gain Coefficient: 0.27
Visible Light Transmittance: 0.46
Condensation Resistance: 55
CPD Number: MAR-N-425-17179-00001
Performance Grade
Licensee #1127
AAMA/WDMA/CSA/101/ I.S.2/A440-08
LC-PG50 1149X2223 mm (45.3X87.5 in)
LC-PG50 DP +50/-50
FL17635

Bronze Clad Exterior
Bare Pine Interior
Ultimate Double Hung G2
Frame Size 37" X 39"
Rough Opening 38" X 39 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG
Low E2
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W1H
Bronze Clad Ext - Bare Pine Int
Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E2
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Aluminum Screen
Bronze Surround
Charcoal Fiberglass Mesh
***Screen/Combo Ship Loose
4 9/16" Jambs
Nailing Fin
***Note: Units with Capillary tubes will not have Argon gas.
***Note: Unit Availability and Price is Subject to Change

7

Initials required

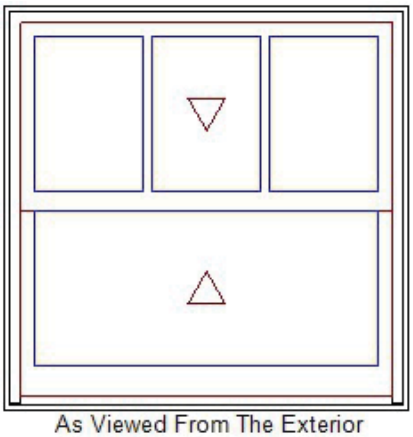
Seller: _____

Buyer: _____

Line #2 Qty: 1	Mark Unit: B-KITCHEN WEST	Net Price: Ext. Net Price:	 USD	884.00 884.00

MARVIN

Bronze Clad Exterior
Bare Pine Interior
Ultimate Double Hung G2
Frame Size 43" X 43"
Rough Opening 44" X 43 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG



As Viewed From The Exterior

Entered As: FS
FS 43" X 43"
Egress Information
Width: 39 13/32" Height: 16 7/16"
Net Clear Opening: 4.50 SqFt
Performance Information
U-Factor: 0.33
Solar Heat Gain Coefficient: 0.27
Visible Light Transmittance: 0.46
Condensation Resistance: 55
CPD Number: MAR-N-425-17179-00001
Performance Grade
Licensee #1127
AAMA/WDMA/CSA/101/ I.S.2/A440-08
LC-PG50 1149X2223 mm (45.3X87.5 in)
LC-PG50 DP +50/-50
FL17635

Low E2
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W1H
Bronze Clad Ext - Bare Pine Int
Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E2
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Aluminum Screen
Bronze Surround
Charcoal Fiberglass Mesh
***Screen/Combo Ship Loose
4 9/16" Jambs
Nailing Fin
***Note: Units with Capillary tubes will not have Argon gas.
***Note: Unit Availability and Price is Subject to Change

6

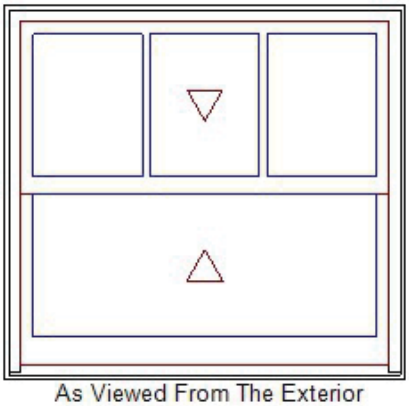
Initials required

Seller: _____

Buyer: _____

Line #3 Qty: 1	Mark Unit: C-LVF S.E./366 GLS/HALF SCRN	Net Price: Ext. Net Price:	USD	960.00 960.00

MARVIN



As Viewed From The Exterior

Entered As: FS
FS 45" X 42"
Egress Information
Width: 41 13/32" Height: 15 15/16"
Net Clear Opening: 4.58 SqFt
Performance Information
U-Factor: 0.33
Solar Heat Gain Coefficient: 0.18
Visible Light Transmittance: 0.41
Condensation Resistance: 55

Bronze Clad Exterior
Bare Pine Interior
Ultimate Double Hung G2
Frame Size 45" X 42"
Rough Opening 46" X 42 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG
Low E3
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W1H
Bronze Clad Ext - Bare Pine Int
Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E3
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Half Screen
Bronze Surround

5

CPD Number: MAR-N-425-17183-00001
ENERGY STAR: S
Performance Grade
Licensee #1127
AAMA/WDMA/CSA/101/ I.S.2/A440-08
LC-PG50 1149X2223 mm (45.3X87.5 in)
LC-PG50 DP +50/-50
FL17635

Charcoal Fiberglass Mesh
***Screen/Combo Ship Loose
4 9/16" Jambs
Nailing Fin
***Note: Units with Capillary tubes will not have Argon gas.
***Note: Unit Availability and Price is Subject to Change

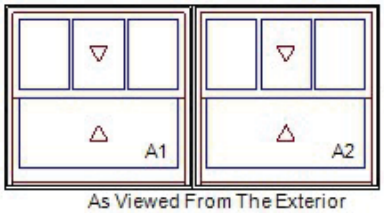
Initials required

Seller: _____

Buyer: _____

Line #4	Mark Unit: D-LVG S TWIN DH/366/HALF SCN	Net Price:		1,824.80
Qty: 1		Ext. Net Price:	USD	1,824.80

MARVIN



As Viewed From The Exterior

Entered As: Size by Units
FS 86" X 42"
Egress Information A1, A2
Width: 39 13/32" Height: 15 15/16"
Net Clear Opening: 4.36 SqFt
Performance Information A1, A2
Product Performance Information is currently unavailable in the OMS for this product and glazing option. To request product performance information not in the OMS, contact your Marvin representative or submit an Assistance Request.
Performance Grade A1, A2
Licensee #1127
AAMA/WDMA/CSA/101/ I.S.2/A440-08
LC-PG50 1149X2223 mm (45.3X87.5 in)
LC-PG50 DP +50/-50
FL17635
Performance Grade Mull
Licensee #1127
AAMA 450-10
LC-65 1149X1613 mm (45.26X63.51 in)
LC-65 DP 65
Performance Grade Overall Assembly
LC-PG50 DP +50/-50

Bronze Clad Exterior
Bare Pine Interior
2W1H - Rectangle Assembly
Assembly Rough Opening
87" X 42 1/2"

Unit: A1
Ultimate Double Hung G2
Basic Frame 43" X 42"
Rough Opening 44" X 42 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG
Low E3
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W1H
Bronze Clad Ext - Bare Pine Int
Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E2
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Half Screen
Bronze Surround
Charcoal Fiberglass Mesh
***Screen/Combo Ship Loose

3

4

Unit: A2
Ultimate Double Hung G2
Basic Frame 43" X 42"
Rough Opening 44" X 42 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG
Low E3
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W1H
Bronze Clad Ext - Bare Pine Int

Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E2
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Half Screen
Bronze Surround
Charcoal Fiberglass Mesh
***Screen/Combo Ship Loose
Standard Mull Charge
4 9/16" Jambs
Nailing Fin
***Note: This configuration meets a minimum structural performance of DP 20 through either physical testing or calculations in accordance with AAMA 450 and building code requirements. Mull certification ratings may vary from individual unit certification ratings. Reference the mulling chapter of the ADM for additional information.
***Note: Units with Capillary tubes will not have Argon gas.
***Note: Unit Availability and Price is Subject to Change

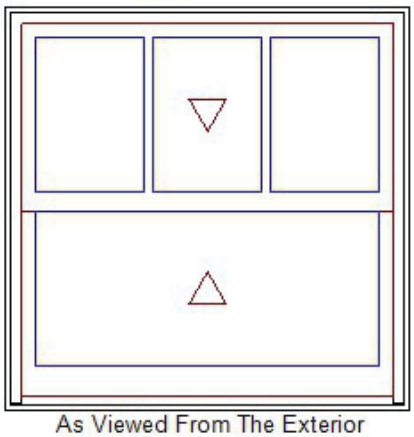
Initials required

Seller: _____

Buyer: _____

Line #5 Qty: 2	Mark Unit: E-LVG E./HALF SCRN	Net Price: Ext. Net Price:	USD	884.00 1,768.00

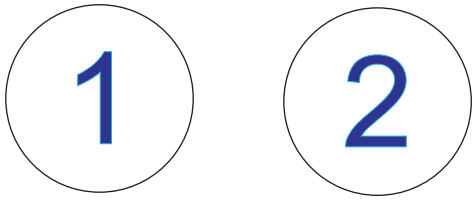
MARVIN



As Viewed From The Exterior

Entered As: FS
FS 43" X 43"
Egress Information
Width: 39 13/32" Height: 16 7/16"
Net Clear Opening: 4.50 SqFt
Performance Information
U-Factor: 0.33
Solar Heat Gain Coefficient: 0.27
Visible Light Transmittance: 0.46
Condensation Resistance: 55

Bronze Clad Exterior
Bare Pine Interior
Ultimate Double Hung G2
Frame Size 43" X 43"
Rough Opening 44" X 43 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG
Low E2
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W1H
Bronze Clad Ext - Bare Pine Int
Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E2
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Half Screen
Bronze Surround
Charcoal Fiberglass Mesh



CPD Number: MAR-N-425-17179-00001
Performance Grade
Licensee #1127
AAMA/WDMA/CSA/101/ I.S.2/A440-08
LC-PG50 1149X2223 mm (45.3X87.5 in)
LC-PG50 DP +50/-50
FL17635

***Screen/Combo Ship Loose
4 9/16" Jambs
Nailing Fin
***Note: Units with Capillary tubes will not have Argon gas.
***Note: Unit Availability and Price is Subject to Change

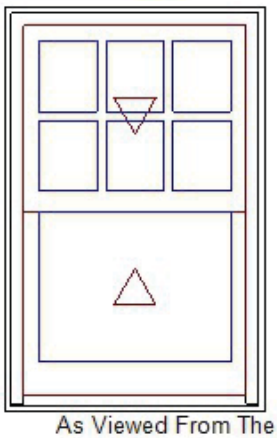
Initials required

Seller: _____

Buyer: _____

Line #6 Qty: 3	Mark Unit: F-DRESSING & BR	Net Price: Ext. Net Price:	 USD	808.80 2,426.40

MARVIN



As Viewed From The Exterior

Entered As: FS
FS 25" X 39"
Egress Information
Width: 21 13/32" Height: 14 7/16"
Net Clear Opening: 2.15 SqFt
Performance Information
U-Factor: 0.33
Solar Heat Gain Coefficient: 0.27
Visible Light Transmittance: 0.46
Condensation Resistance: 55
CPD Number: MAR-N-425-17179-00001
Performance Grade
Licensee #1127
AAMA/WDMA/CSA/101/ I.S.2/A440-08
LC-PG50 1149X2223 mm (45.3X87.5 in)
LC-PG50 DP +50/-50
FL17635

Bronze Clad Exterior
Bare Pine Interior
Ultimate Double Hung G2
Frame Size 25" X 39"
Rough Opening 26" X 39 1/2"
Top Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG
Low E2
Black Perimeter and Spacer Bar
7/8" SDL - With Spacer Bar - Black
Rectangular - Special Cut 3W2H
Bronze Clad Ext - Bare Pine Int
Ogee Interior Glazing Profile
Bottom Sash
Bronze Clad Sash Exterior
Bare Pine Sash Interior
IG - 1 Lite
Low E2
Black Perimeter Bar
Ogee Interior Glazing Profile
Beige Interior Weather Strip Package
Black Exterior Weather Strip Package
Bronze Sash Lock
Bronze Top Sash Strike Plate Assembly Color
Half Screen
Bronze Surround
Charcoal Fiberglass Mesh
***Screen/Combo Ship Loose
4 9/16" Jambs
Nailing Fin
***Note: Units with Capillary tubes will not have Argon gas.
***Note: Unit Availability and Price is Subject to Change

8

9

10

Initials required

Seller: _____

Buyer: _____

Line #7 Qty: 1	Mark Unit: INSTALLATION	Net Price: Ext. Net Price:	 USD	5,454.36 5,454.36

Labor *Removal and disposal of existing, installation of new windows, 10-year labor warranty

Initials required

Seller: _____

Buyer: _____

Project Subtotal Net Price: USD	8,668.80
Non-Taxable Labor: USD	5,454.36
8.635% Sales Tax: USD	748.55
Project Total Net Price: USD	14,871.71

TERMS AND CONDITIONS

Quotations are subject to correction at any time, and to price revision after 30-days. All window and door options and specifications as entered are approved by you. You are responsible for windows meeting egress and safety glass code requirements. Immediately upon submitting approved orders with Signature Window + Door's vendors, change requests will be subject to scrap charges and order change fees.

Payment terms are 1/2-Deposit, Balance-COD except with prior approval. Past due accounts are subject to reasonable collection costs, including attorney's fees and interest. Should we hold any part of your order more than 30-days at your request, you agree to process our invoice for payment as if your order had been delivered complete. Signature Windows + Doors is not responsible for delivery delays beyond its control.

Signature Windows + Door's builder/contractor pricing program includes services such as discounted delivery, discount for paying by cash or check, pre-installation workshops and post-installation walk through inspections when requested.

Thank you for your business!

PRODUCT AND PERFORMANCE INFORMATION

NFRC energy ratings and values may vary depending on the exact configuration of glass thickness used on the unit. This data may change over time due to ongoing product changes or updated test results or requirements.

The National Fenestration Rating Council (NFRC) has developed and operates a uniform national rating system for the energy performance of fenestration products, including windows and doors. For additional information regarding this rating system, see www.nfrc.org.

NFRC energy values and ratings may change over time due to ongoing product changes, updated test results or requirements.

PURCHASE APPROVAL/SIGN OFF

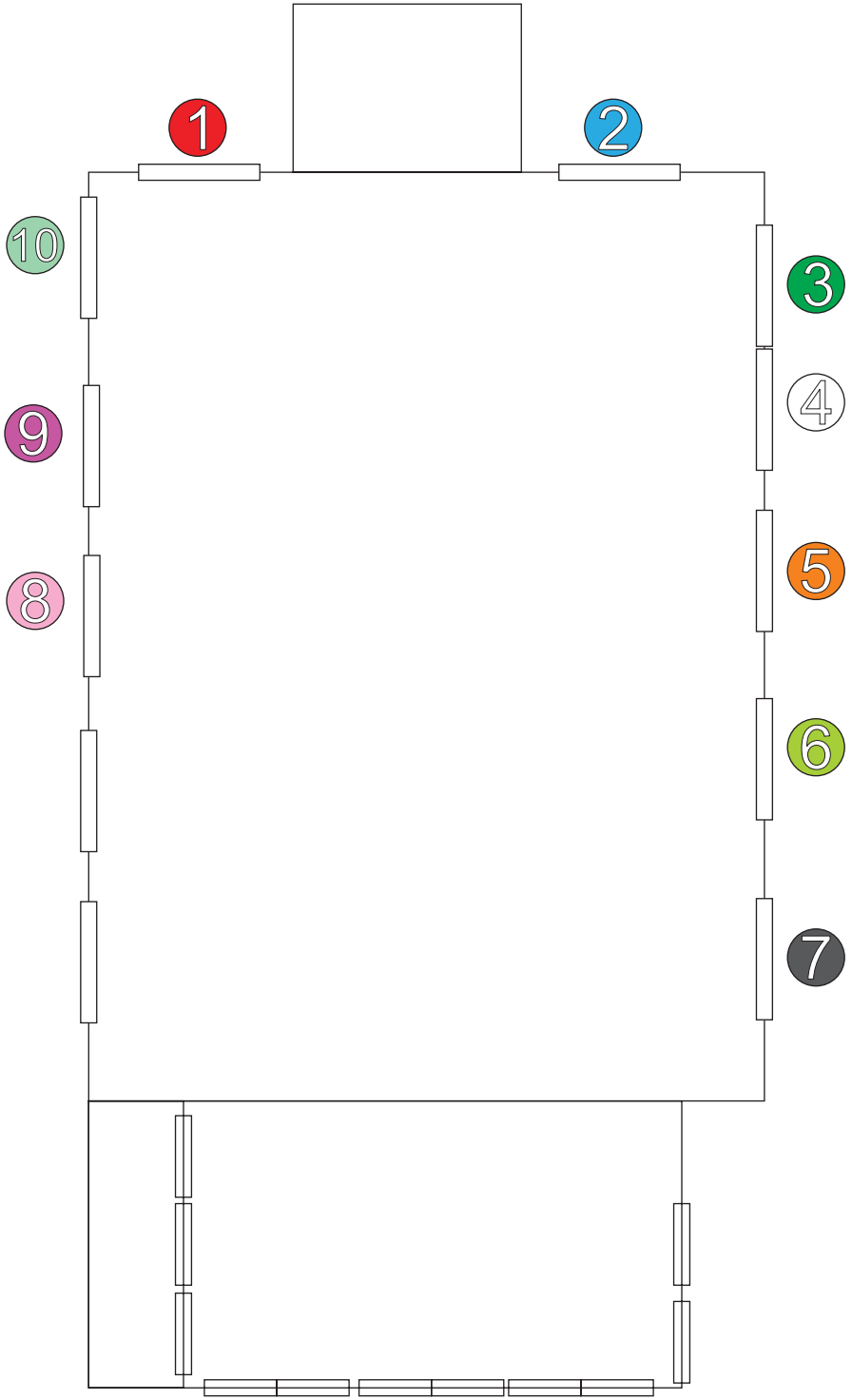
Project Subtotal Net Price: USD	**8,668.80**
Non-Taxable Labor: USD	**5,454.36**
8.635% Sales Tax: USD	**748.55**
Project Total Net Price: USD	**14,871.71**

I have reviewed all line item quotes in detail and agree that the product specifications and pricing are accurate, and I approve the project for order. I acknowledge that additional charges, tax or Terms and Conditions may apply.

Seller: _____

Buyer: _____

New window map corresponding with bid window list

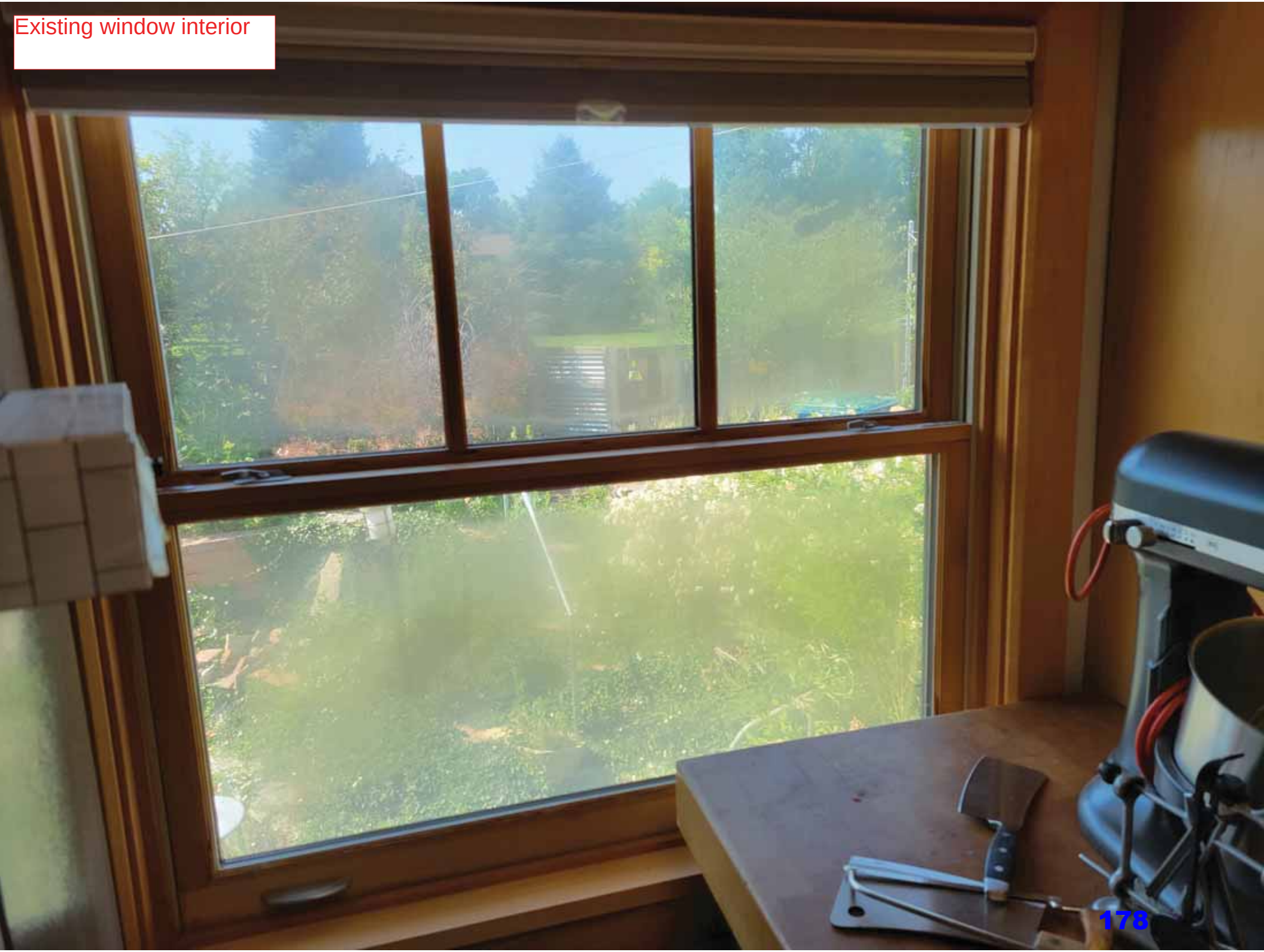


1
2

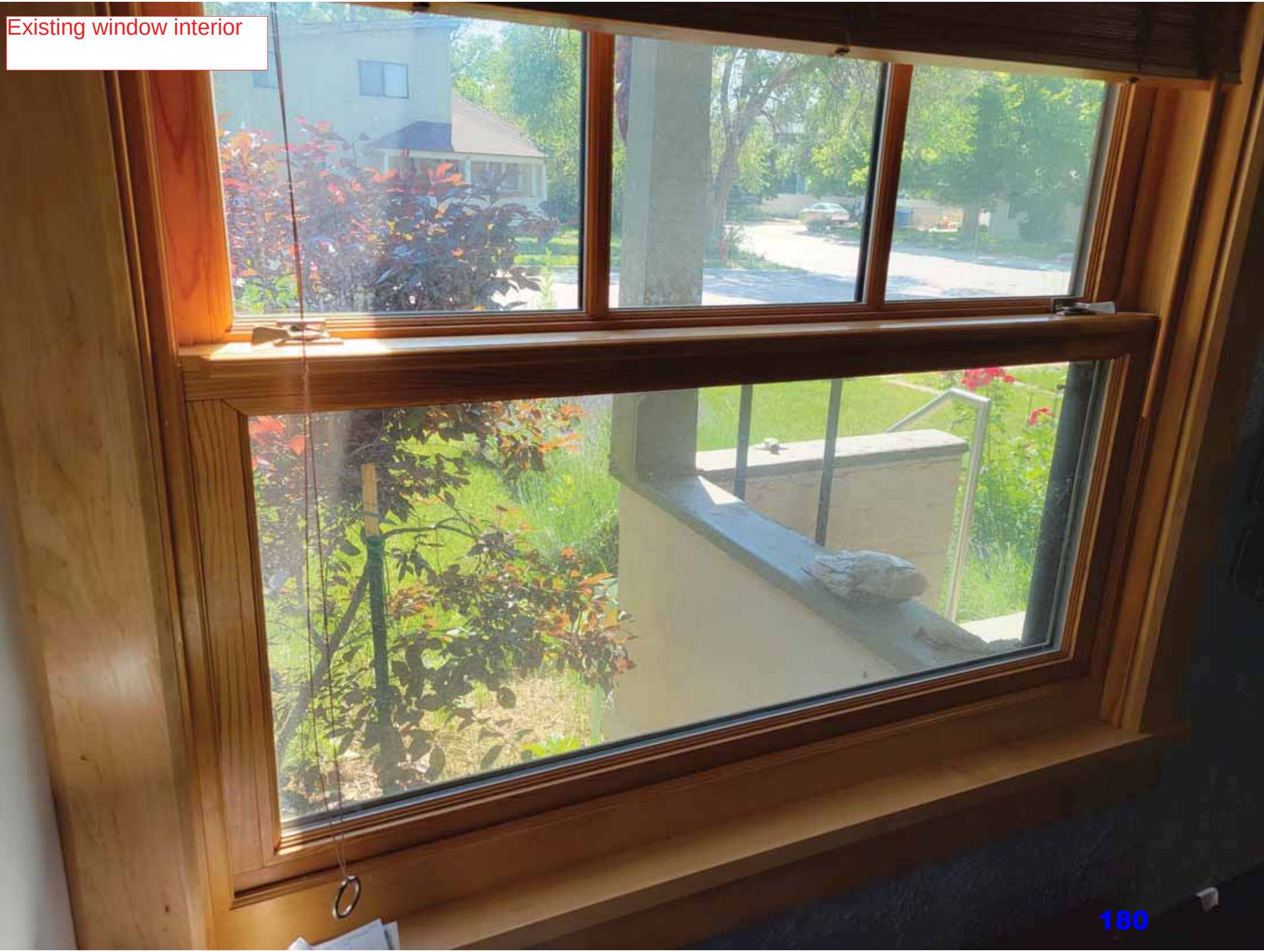
10
9
8

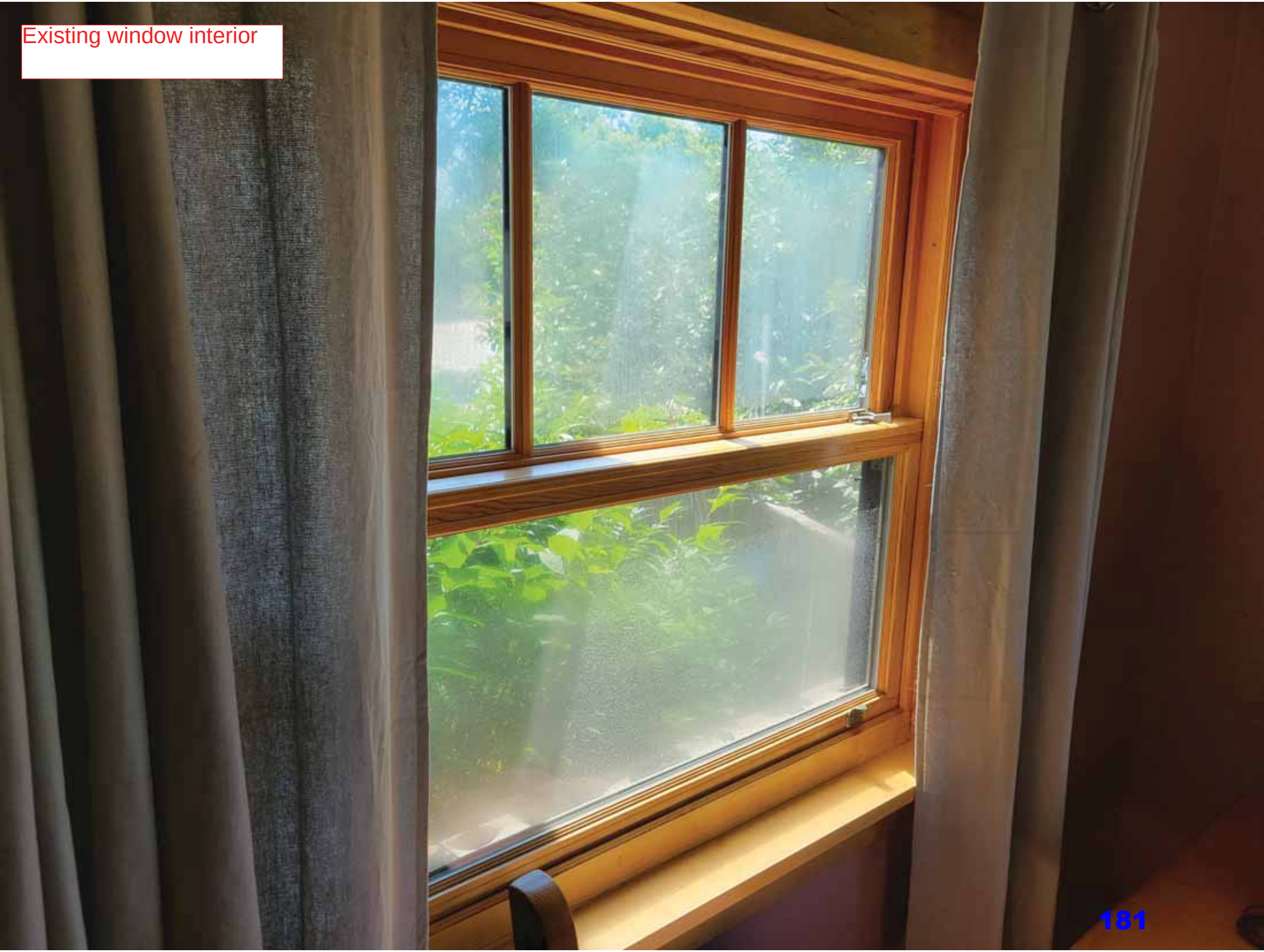
5
4
3
7
6

Existing window interior

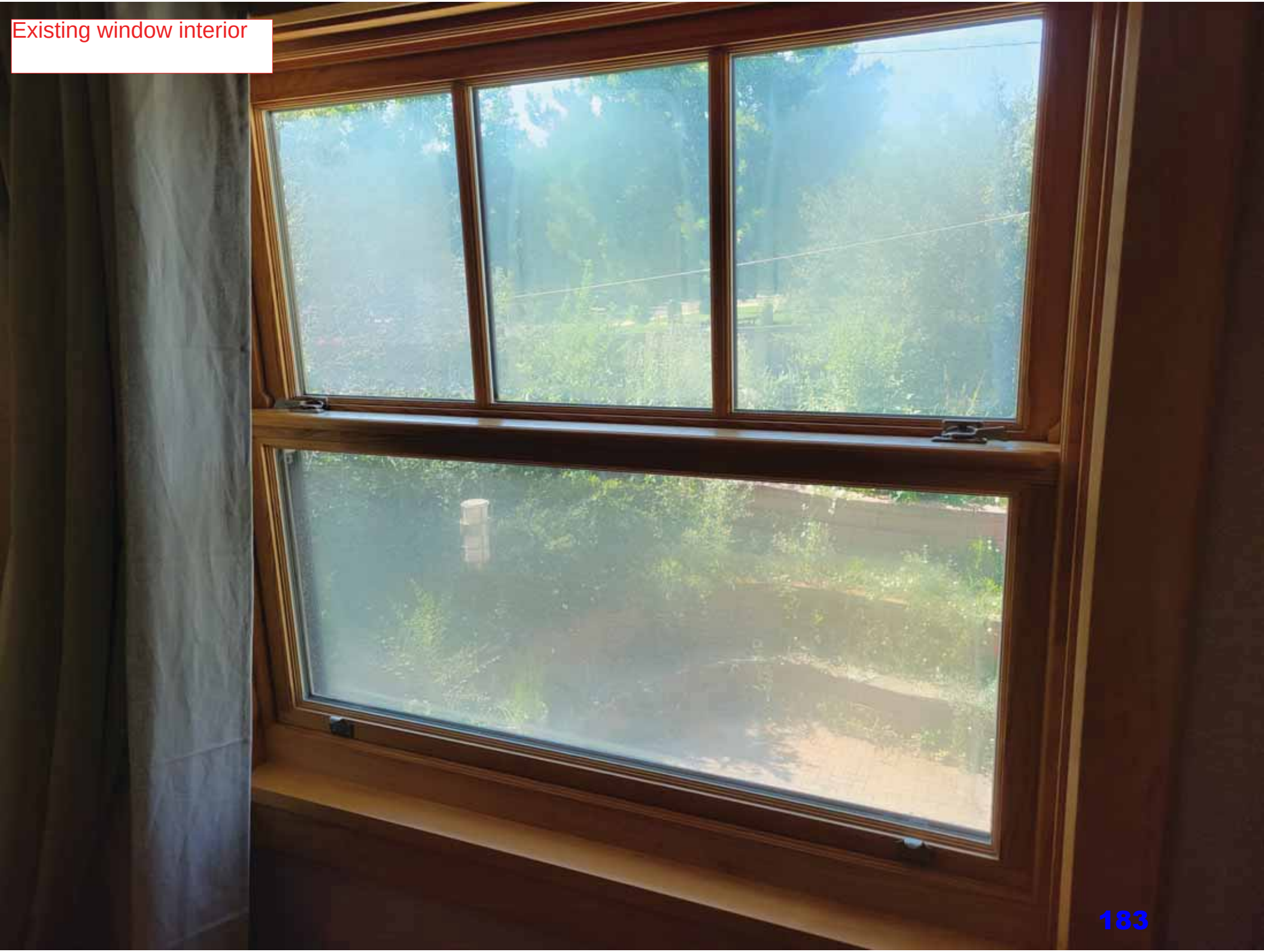

Existing window interior

Existing window interior


Existing window interior


Existing window interior

Existing window interior


Existing window interior

501 Jefferson Avenue
Historic Structure Assessment

Prepared by:
Stewart Architecture & Planning
1132 Jefferson Avenue
Louisville, CO 80027
(303) 665-6668

Prepared for:
Carolyn Ford & Chris Behm

March 2021

CREDITS

FUNDING:
This project was partially paid for by the Louisville Historic Preservation Fund.

PARTICIPANTS:

Stewart Architecture
Peter J. Stewart
Kelsey Tessier

Photo and Map Credits
Stewart Architecture
Louisville Historical Museum, Department of Library & Museum Services

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Structural Condition Assessment, November 16, 2020

1.0 Introduction

1.1 Research Background/Participants

This report was researched and prepared by Stewart Architecture and Planning for Chris Behm & Carolyn Ford. The primary focus of this report is the house and not the accessory garage building.

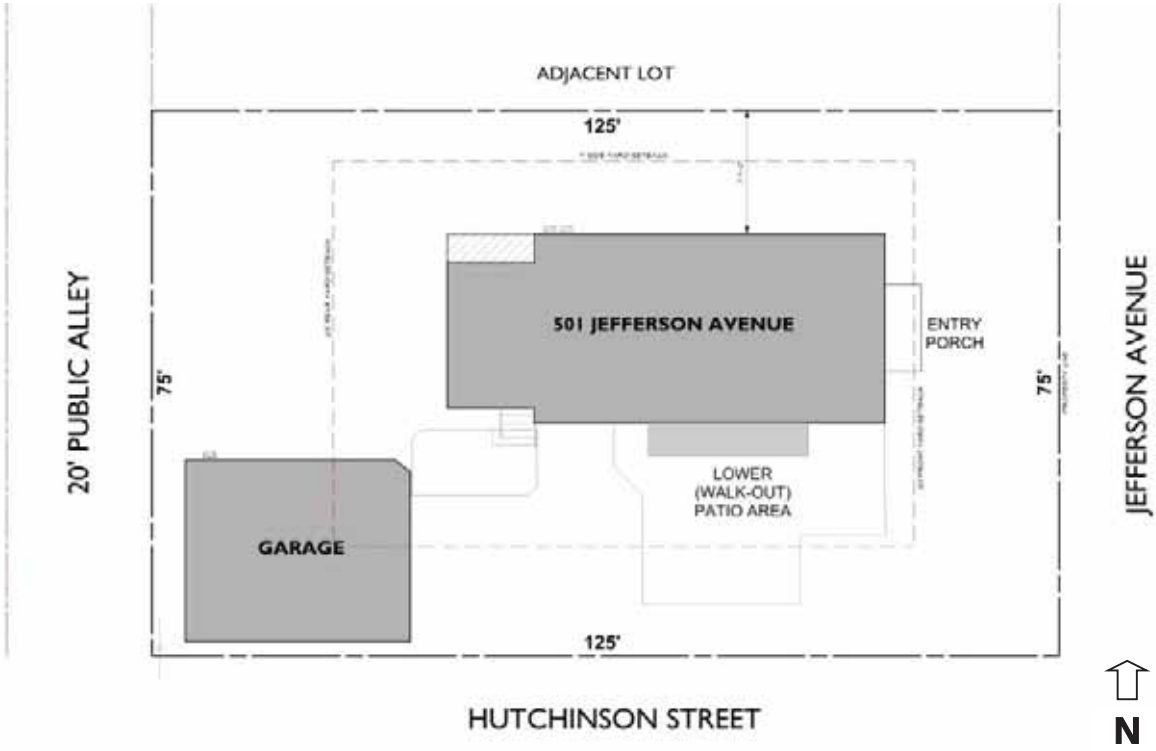
Information was provided by Stewart Architecture and Planning consultants and the City of Louisville. The project was partially funded by a Louisville Historic Preservation Fund grant.

1.2 Building Location

Building Address:	501 Jefferson Avenue, Louisville, Colorado.
Legal Description:	Lots 15,16, & 17, Block 3, Acme Place, City of Louisville, Colorado
Boundary:	This legally defined parcel encompasses but does not exceed the land historically associated with this property.

Vicinity Map

Site Plan



Site Plan- Existing Conditions
Not to scale

2.0 History and Use

2.0 Building History

Information from Bridget Bacon, City of Louisville Museum Coordinator

Summary: This house was relocated from the Columbine Mine camp in 1948. Its original construction date is unknown. It was the home of the family of William and Ruth Leslie from 1948 until 1974.

Development of the Acme Place Addition

In 1893, John Connell, who had helped to establish the Acme Mine at what is now the corner of Roosevelt and Hutchinson, platted the subdivision of Acme Place. It covered what are now the 500 blocks of Lincoln, Grant, Jefferson, and La Farge Avenues. The Acme Place subdivision was only the fourth addition to Original Louisville and was likely developed due to its proximity to the Acme Mine that was started in 1888. The 1909 Drumm's Wall Map of Louisville shows that the 500 blocks of Lincoln and Grant were well populated with houses by 1909, but the 500 blocks of Jefferson and La Farge, which were located quite close to the Acme Mine and parts of which were within the Mine's fenced enclosure, had few houses at that time. Boulder County Property records indicate that the land that Connell used to establish Acme Place had been acquired directly from the Acme Coal Mining Company.

In 1911, Rocky Mountain Fuel Company acquired the mine and was the owner/operator of the Acme Mine until it closed in 1928. Rocky Mountain Fuel Company for many years continued to own the property, including the lots that make up 501 Jefferson.

Leslie Family Ownership of Property, 1946-1974; Discussion of Date of Construction

In 1946, Rocky Mountain Fuel Company sold these lots, plus two adjoining lots, to William J. and Ruth Leslie. (The next year, the Leslies sold the adjoining lots, which became 515 Jefferson. The house at 515 Jefferson was also identified on its Assessor Card has having been relocated, and other information indicates that it also came from a mine camp.)

The Assessor Card for 501 Jefferson, dated 1948, does not contain a date of construction, but states that the house was relocated from the Columbine Mine in 1948. This date is repeated on the Boulder County website, which is generally thought to have adopted the information from the Assessor Cards, at least for Louisville properties. However, on the County website it is instead given as the date of construction. Boulder County has sometimes been found to be in error with respect to the date of construction of Louisville buildings, so it is important to look to other evidence of the construction year.

It appears that the date of construction of the house at the Columbine Mine camp is not known. The Assessor Card states that the house was relocated and remodeled in 1948, not constructed in that year. Specifically, the field for the "Date of Construction" is empty and there is a handwritten notation on the card under the field for "Major Alterations or

Additions." This notation states the date of 1948 and says "Old House moved in + Remodeled." Underneath that, an additional handwritten notation states: "House moved from Columbine mine a remodel job."

For these reasons, the date of 1948 is not accurate as a date of construction, but is accurate as a date of relocation and remodel. The original date of construction is not known, but according to a USGS map of mines in the area (USGS i-2735 produced in 2000, viewable here: https://pubs.usgs.gov/imap/i-2735/), the Columbine Mine was in operation from 1920 to 1946. It was located in Serene, Weld County, Colorado. Some Louisville residents worked as miners there.

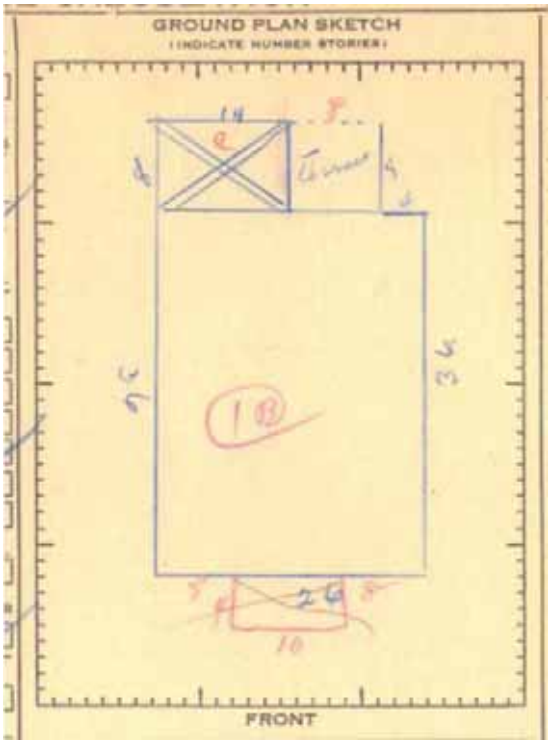
The following two undated photos from the collection of the Louisville Historical Museum show the mine camp at the Columbine Mine.

The history of relocated buildings in Louisville was summarized in the following article in *The Louisville Historian*: https://www.louisvilleco.gov/Home/ShowDocument?id=1114 . Often, houses were moved from a mine camp into towns such as Louisville, Lafayette, and Superior on the occasion of that particular mine closing. In this case, it appears that that was what was happening here, as the Columbine Mine closed in 1946 and the house was relocated in 1948.

William J. “Bill” Leslie (1897-1973) was born in Louisville. As a young man, he worked as a coal miner at Louisville’s Matchless Mine that was located near today’s Louisville Recreation Center. After his father died when Bill was about 14, he helped support his mother while she operated a Louisville hotel. He married Ruth Wellerd (1905-1971) in Golden in 1926. She was born in Ohio and came to Colorado as a young child. Their children were four sons: Donald, William, John, and Gilbert.

After many years of working as a coal miner and retiring from that in 1941, Bill Leslie worked for the town of Louisville as a marshal or deputy marshal, and later as a “patrolman,” from 1947 until 1964. In the 1940s, the town’s lack of funding placed a particular burden on the marshal, who essentially was on call seven days a week, 24 hours a day. According to an article in the *Louisville Times* on April 22, 1948, the town board “favored putting three men . . . on eight-hour shifts, but have no money and don’t know how it can be done.” A few weeks later, the board voted to have Bill Leslie continue as marshal with the help of one deputy marshal. As reported in the *Louisville Times*, some of the law enforcement issues Bill Leslie handled over the years concerned speeders, drunk driving cases, traffic accidents, illegal gambling, teenager pranks, and unruly conduct at the town’s taverns, especially at night. By 1959, there was more funding for law enforcement, and Bill Leslie’s job was as a patrolman was for the 3 PM to 11 PM shift.

The following 1948 photo of the house and a ground layout sketch are from the Boulder County Assessor card:



In 1974, the year after Bill Leslie's death, the executor for his estate sold 501 Jefferson.

Later Owners, 1974-present

In 1974, Allan and Rachel Farber purchased 501 Jefferson. In 1975, they sold the house to Greg and Nancy Coleman. One or both of them owned the house until 1997. They were

followed as owners by Jill Midgley, Charles Schmidt, and Jill Midgley again. In 2006, Carolyn Ford Gaye and Christopher Joseph Behm purchased 501 Jefferson, and they are still the current owners of record. Sources

The preceding research is based on a review of relevant and available online County property records, census records, oral history interviews, Louisville directories, and Louisville Historical Museum maps, files, and obituary records.

ARCHITECTURAL INTEGRITY:

The historic structure located at 501 Jefferson Avenue was constructed at an unknown date and relocated to Jefferson Avenue in 1948. It is an early twentieth century wood frame vernacular house with a front gable roof. The primary façade faces east to Jefferson Avenue. A dormer is located on the north surface of the roof. There is a porch with a front gable roof on the front façade. The front porch has a solid railing covered in stucco with wood support posts. The structure has a rectangular plan. The current footprint of the house includes a 4'x14' rear addition built in 1975. The windows were replaced in 2008 but the window placement appears to be original.

End of Bridget Bacon's report

2.1 Architectural Significance and Construction History

Architectural Description:

This 1-story wood-framed house is situated on a large lot (75' x 125'), on the west side of Jefferson Avenue, south of downtown Louisville.

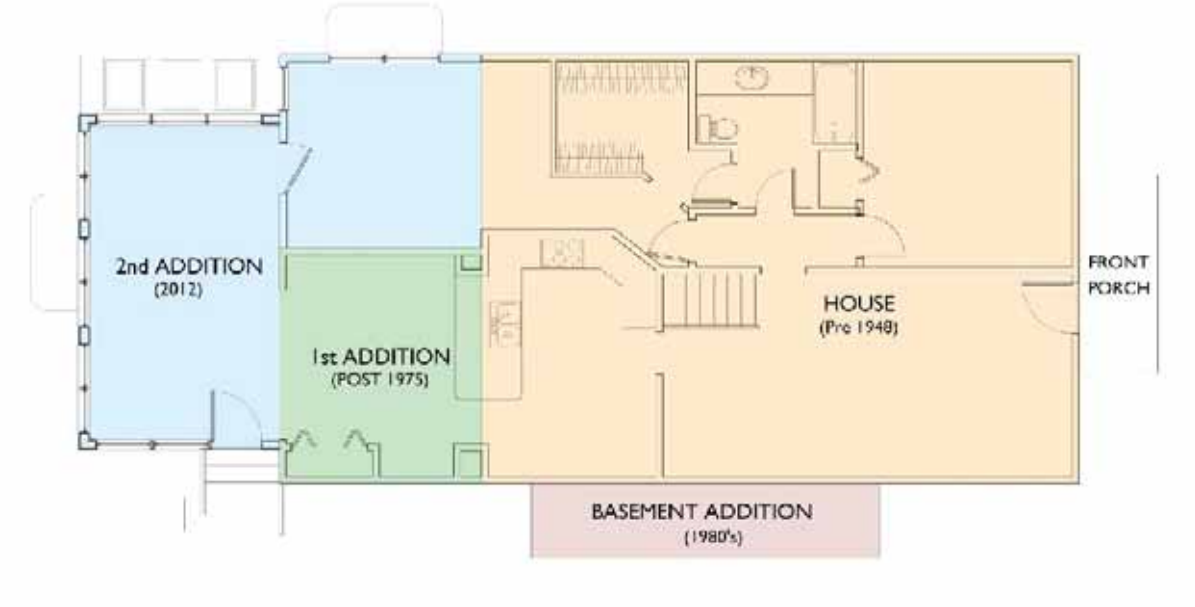
The building is a simple rectangular shape with front gable roof of moderate pitch. A shed dormer is on the north side of the roof. A rectangular entry porch is located on the east side (facing Jefferson Ave) covered with a gable roof, set lower than the main roof, and supported by wood trimmed columns. The siding is stucco and windows are predominately double hung type trimmed with wood casing.

Construction History:

The building was relocated to 501 Jefferson from the Columbine Mine camp sometime between 1946 and 1948. The date of its original construction is unknown. The original, relocated house, a 1 story side-gabled structure measured 26' N-S by 36' E-W. Three single-story additions to the west (rear) elevation date 1975 and 2012. The first addition (1975), with a gable roof measures 14' N-S by 12' E-W; the other addition (2012), with a gable roof, measures 20' N-S by 24' E-W.

Chronology:

- Pre-1946 Columbine Mine camp building
- 1946 – 1948 Relocated from the Columbine Mine camp
- Post 1948 Cinder block garage built
- Post 1948 Stucco added (date unknown)
- 1975 First Rear addition
- 2012 Second addition
- 1980's Lower level excavated for walk-out with bay addition
- 2008 Window replacement
- 2009,2018 Roof-mounted solar
- 2012 Second addition
- 2015 2nd Floor addition to the garage



Building History Plan
Not to scale

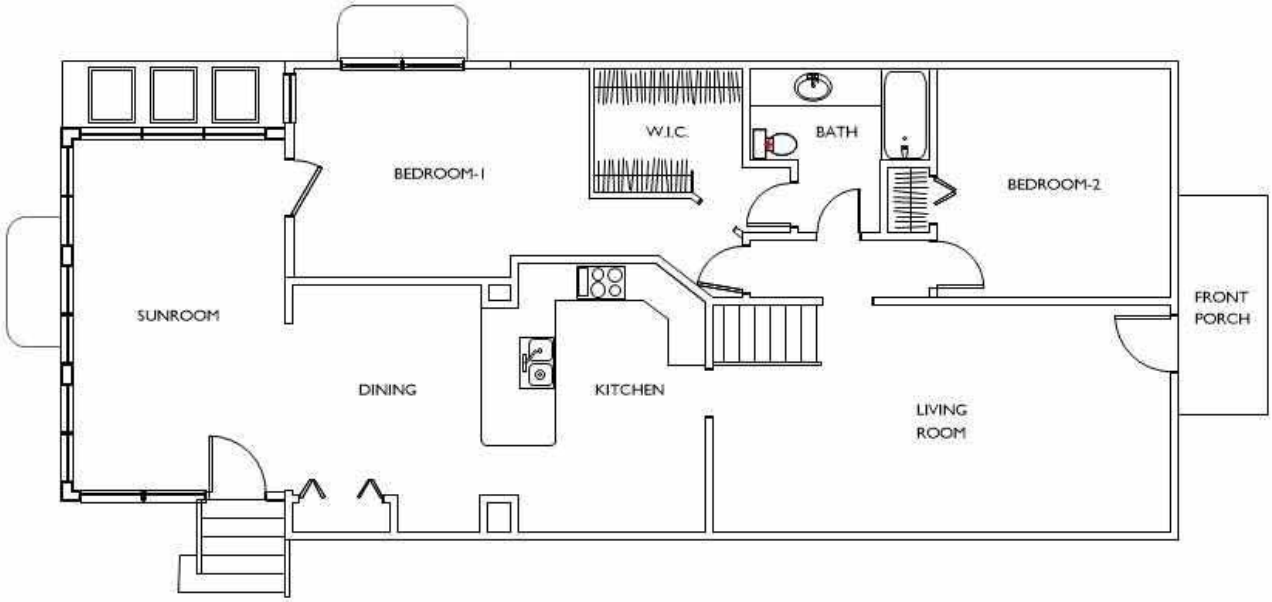
N

Significance:
This house is historically significant, relative to the National Register Criterion A, for its associations with the Acme Mining Company and the Leslie family, and with both commercial and residential development in Louisville during the first half of the twentieth century. Relative to the National Register Criterion B, The building is architecturally significant because of its simple form typical of both mine-camp structures and well as residential structures.

Criteria A: Associated with events that have made a significant contribution to the broad patterns of our history.

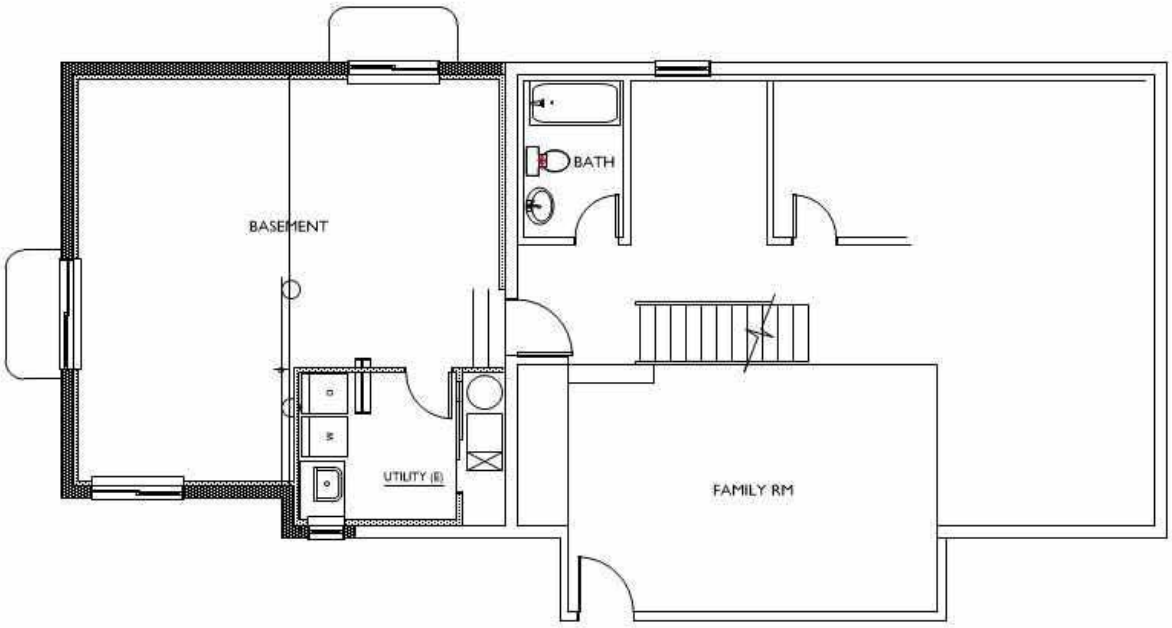
Criteria C: Embodies the distinctive characteristics of a type, period, or method of construction, or represents the work of a master, or that possess high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.

2.2 Floor Plans



Main Floor Plan- Existing Conditions
Not to scale

N



Basement Plan- Existing Conditions
Not to scale

N

2.3 Proposed Use

The historic use as a residence use is anticipated to continue.

3.0 Structure Condition Assessment

3.0 Condition Assessment

This site and building assessment represents the first critical phase to the historic preservation project. The report is based on comprehensive field inspections and research conducted by a number of professionals, including a preservation specialist, an archaeologist, architect and engineer. The assessment recommends, where necessary, appropriate treatments consistent to the *Secretary of Interior's Standards for the Treatment of Historic Properties*.

The users of this assessment will find a description of each feature, element, or space followed by a condition evaluation and finally recommendations for the appropriate treatment of each.

The following condition evaluation rating system is used in this section to evaluate the condition of each feature, element, or space:

GOOD CONDITION: An element, feature, or space is evaluated in good condition when it meets the following criteria:

- It is intact, structurally sound, and performing its intended purpose.
- There are few or no cosmetic imperfections.
- It needs no repair and only minor or routine maintenance.

FAIR CONDITION: An element, feature, or space is evaluated in fair condition when one or more the following are evident:

- There are early signs of wear, failure, or deterioration, although the feature or element is generally structurally sound and performing its intended purpose.
- There is failure of a sub-component of the feature or element.
- Replacement of up to 25% of the feature or element is required.
- Replacement of a defective sub-component of the feature or element is required.

POOR CONDITION: An element, feature, or space is evaluated in poor condition when the following is evident:

- It is no longer performing its intended purpose.
- It is missing.
- It shows signs of imminent failure or breakdown.
- Deterioration/damage affects more than 25% of the feature/element and cannot be adjusted or repaired.
- It requires major repair or replacement.

3.1 Site

Element	*Description & Condition*	*Evaluation*	*Treatment Recommendation*
Landscape	Existing trees and shrubs are in good conditioned and not damaging the existing structures	Good	None
Fencing	6' cedar fence along southern property line. 4' fence along northern property line.	Good	None
Grading	The grade drains toward the structure on the north side	Fair	Correct drainage to carry storm water toward the street in a swale
Parking	Existing accessory structure which allows parking for 3 vehicles, Cinder block garage built (post-1948), Garage second story built (2015)	Good	None
Associated Structures	Detached garage located in the south west portion of the property.	Good	None

Garage (South Elevation)

Garage (South Elevation)

Cedar Fence along South Property Line

Lower patio- South side of structure

3.2 Structural Systems

Element	*Description & Condition*	*Evaluation*	*Treatment Recommendation*
Structural System	Wood framed structure on concrete foundation	Good	
Foundation System	The foundation is concrete basement walls with some interior concrete walls	Good (Based on performance)	See Structural Assessment in Appendix
Floor & Ceiling Systems	Basement floors are concrete slab on grade. Main level floor joists are rough sawn 2 x 8s on piled dimensional lumber beams. Western additions are framed with engineered I-Joists.	Good	See Structural Assessment in Appendix
Roof Framing System	Original House: Rafters are 2"x3 ½" dimensional lumber rafters, spliced. Additions are likely framed with 2 x 10 rafters:	Fair Good	Inadequate Roof Framing at original house: Reinforce roof rafters with new framing. See Structural Assessment in Appendix
Entry Porch	Concrete stoop – sloping downward to the east	Fair	Mud-jack the stoop to level and reduce gap at house. Re-anchor the handrail to the stoop.

See Structural Assessment in Appendix for additional information and photographs of the structural systems.

3.3 Envelope- Exterior Walls

Element	*Description & Condition*	*Evaluation*	*Treatment Recommendation*
Exterior Wall	Wood framed stud wall with exterior stucco. Walls are generally straight and plumb.	Good	None
Exterior Finishes	Stucco siding (likely more than 50 years old)	Good	None. However, the stucco was added over the original wood clapboards at an unknown date. If the period of significance pre-dates the stucco, consider removing an restoring the wood siding
Exterior Masonry	None	N/A	None
Front Porch	Entry Stoop floor is concrete. Ceiling is stucco. The original ceiling has likely been covered.	Fair Good	See structural systems above Consider restoring to original ceiling material.

Exposed wood rafter tails

South façade of house

Entry porch ceiling & exposed roof rafters

South façade with lower level walk-out

3.4 Envelope- Roofing and Waterproofing

Element	*Description & Condition*	*Evaluation*	*Treatment Recommendation*
Roofing Systems	Roofing is asphalt shingles.	Good	The roof is in good condition and should serve the building for 25 + years. When reroofing is undertaken consider sawn wood shingles to match the historic material
Sheet Metal Flashing	Galvanized at side walls.	Good	None
Foundation Drain	Unknown		None
Drainage Systems	There is painted metal K-shaped gutters on the house.	Poor, broken from snow	Replace with half-round gutters & add snow guards on the south side

		sliding off roof	

3.5 Windows & Doors

Element	*Description & Condition*	*Evaluation*	*Treatment Recommendation*
Doors	Main entry door is not original and has been replaced.	Good	Consider replacing with panel door with rectangular glazing to better fit with this vintage house
Windows	All the windows in the original house are replacement wood double hung windows in original openings. Historic photos show wood DH windows with divided lites. Windows in the rear additions are DH windows of similar style to the replacement windows in the original house.	Fair. The glazing seals have failed and fog up Good	Replace the glazing and reseal. None

New Window in original openings

Interior window sill

3.6 Interior Finishes

Element	*Description & Condition*	*Evaluation*	*Treatment Recommendation*
Wall Finish Material	Walls are plaster on lath & gypsum board	Good	None
Ceiling Finish	Plaster on lath & gypsum board at additions	Good	None
Floor Finish	Main Level floors are strip oak on the main level and carpet over concrete in the basement	Good	None
Trim & Built-Ins	Door and window casing is stained wood. It appears the original woodwork has been replaced	Good	None
Stairs to basement	1970's vintage wood stairs with closed stringer and open risers. Guard railings are missing	Fair	Stairs do not meet current code. Recommend adding guard railings both sides for safety

Living room (looking east)

Typical replaced window

Stairs lacking guardrails

3.7 Mechanical Systems

Element	*Description & Condition*	*Evaluation*	*Treatment Recommendation*
Heating and AC	*A gas fired forced air furnace is located in the basement which serves the house. It is a recent model, and appears to be in good condition. Galvanized duct distribution system is utilized*	Good	None
Water Service, Plumbing & Sewer Utilities	Bathroom plumbing fixtures have been replaced in recent years.	Good	None
Fire Suppression	None		None

3.8 Electrical Systems

Element	*Description & Condition*	*Evaluation*	*Treatment Recommendation*
Electrical Service	Overhead service lines feed the meter and panel located on the NE corner of the garage. From there an underground line is feed to the house.	Good	None
Electrical Distribution	Lighting, switches and outlets were installed or updated in recent years.	Good	None
Smoke Detection	Existing- Appears to be code compliant	Good	
Security Systems	None	None	None

4.0 Analysis and Compliance

4.1 Hazardous Materials

A hazardous material investigation was not conducted as part of this report. It is recommended to conduct such investigation prior to any construction or remodel work on the building.

4.2 Building Code Compliance

As an existing residence the building code allows continued use of the building, even though all elements may not meet current building codes. Except in cases where dangerous or hazardous structural issues are identified.

The following are some items that do not meet current code but may be used as a continued use:

- Structural systems: Roof Loads
- Stair to basement missing guardrails

Any new construction (additions or alterations) will be required to meet current building codes at the time of construction. In addition, any new work will trigger a requirement for smoke and carbon monoxide detectors to be installed in or near sleeping rooms.

4.3 Zoning Code Compliance

The property is located in the medium density, RM, zone district and is within the Old Town Overlay. The 75 x 125-foot lot meets the minimum lot size. Residential use is an allowed use. The garage does not meet the minimum side street setback. Its 2nd floor addition received a variance from the City of Louisville for its construction.

5.0 Preservation Plan

5.1 Prioritized Work

Prioritized Work

The following identifies two categories of prioritized work:

High Priority is work necessary to stabilize the structure and assure it is weather tight. This work may also include other Items which fall within the Critical or Serious Deficiency categories (see definitions below)

- Reinforce roof rafters over original house.

Medium to Low priority work includes Minor Deficiencies and preservation work, and reconstruction work for interpretive purposes.

- Repair or reinforce entry porch stoop
- Replace windows glazing units which have failed.
- Install guardrails at basement stairs for safety
- Improve drainage along the north side of the structure
- Repair or replace broken gutters

DEFINITIONS

- **CRITICAL DEFICIENCY:** One or more of the following indicate a critical deficiency:

1. Advanced deterioration has resulted in failure of the building element, feature, or space, or will result in its failure if not corrected within two years.
2. Accelerated deterioration of adjacent or related building materials has occurred as a result of the feature or element's deficiency.
3. The feature or element poses a threat to the health and/or safety of the user.
4. The feature or element fails to meet a code/compliance requirement.

- **SERIOUS DEFICIENCY:** One or more of the following indicate a serious deficiency:

1. Deterioration, if not corrected within two to five years, will result in failure of the feature or element.
2. Deterioration of a feature or element, if not corrected within two to five years, may pose a threat to the health and/or safety of the user.
3. Deterioration of adjacent or related building materials and/or systems will occur as a result of the deficiency of the feature or element.

- **MINOR DEFICIENCY:** One or more of the following indicate a minor deficiency:

1. Standard preventive maintenance practices and building conservation methods have not been followed.
2. A reduced life expectancy of affected or related building materials and/or systems will result.
3. A condition exists with long-term impact beyond five years.

5.2 Estimate of Probable Costs of Construction

Since the Architect has no control over the cost of labor, materials, equipment, the contractor's method of determining prices, or market conditions, opinions of probable costs, as provided herein, are made on the basis of our experience with similar project types and represent our best judgment as design professionals familiar with the rehabilitation/ construction industry. The Architect cannot and does not guarantee that proposals, bids or the construction costs will not vary from our opinions of probable costs.

Notes:

The allowance for general conditions provides for the General Contractor's mobilization, temporary facilities, builders risk insurance, and contingencies.

General Contractor overhead includes indirect costs such as permits, Workers' Compensation, insurances and supervision.

Contingency (for construction) provides for uncovered existing conditions, weather delays and other unforeseen conditions.

Abbreviations

ea	lump sum
sf	square feet
lf	lineal feet
sq	square

Estimate of Probable Costs Worksheet

Feature/Task	*Quantity*	*Unit*	*Unit Cost*	*Total*
A. Site				
Site Grading- drainage swail at north side	1	EA	$ 1,500.00	$ 1,500
Subtotal				$ 1,500
B. Foundations				
Repair to front stoop (mudjacking)	1	EA	$ 2,500.00	$ 2,500
Subtotal				$ 2,500
C. Structural System				
Reinforce roof framing system (rafters)	1	EA	$ 12,000.00	$ 12,000
Subtotal				$ 12,000
D. Exterior - Siding				
E. Appurtenances				
(Entry porch- see Foundation above)				
F. Envelope- Roofing and Waterproofing				
Gutters and downspouts (replace with 1/2 round)	1	EA	$ 2,500.00	$ 2,500
Snow Guards (south side)	1	EA	$ 1,500.00	$ 1,500
				$ 4,000
G. Envelope- Insulation				
H. Windows and Doors				
Window - Reglaze or replace	10	EA	$ 900.00	$ 9,000
Subtotal				$ 9,000
I. Interior Finishes				
Stair - guardrails	1	EA	$ 2,200.00	$ 2,200
J. Mechanical Systems				
K. Electrical Systems				
Subtotal Construction Costs				**$ 31,200**
Other				
Permits	1	EA	$ 800.00	$ 800
Contingency	20%			$ 6,240
Total Costs				**$ 38,240**

6.0 Bibliography

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Bianchina, Paul. *Illustrated Dictionary of Building Materials and Techniques*. John Wiley & Sons, Inc., 1993.

Weeks, Kay D. and Anne E. Grimmer. *Secretary of Interior's Standards for the Treatment of Historic Properties.* Washington, D.C.: Library of Congress Cataloging-in-Publication, 1995.

Online sources

"SHF Historic Structure Assessment Grants." *History Colorado.* http://www.historycolorado.org/grants/shf-historic-structure-assessment-grants

USGS Mine maps in Boulder and Weld County's Colorado: https://pubs.usgs.gov/imap/i-2735/

7.0 Appendix

- Structural Condition Assessment, JVA Engineering, Dated November 16, 2020

JVA, Incorporated
1319 Spruce Street
Boulder, CO 80302
303.444.1951
info@jvajva.com

www.jvajva.com

November 16, 2020

Peter Stewart
Stewart Architecture
1132 Jefferson Avenue
Louisville, CO 80027

RE: 501 Jefferson Avenue – Structural Condition Observations and Recommendations
JVA Job Number 20619

Dear Mr. Stewart:

PURPOSE
The homeowners of 501 Jefferson Avenue in Louisville, CO are working with Stewart Architecture to produce a historic structures assessment of their house. JVA was contacted by Stewart Architecture to prepare structural input. JVA visited the site on October 13, 2020 to perform a visual condition assessment and limited review of accessible framing and foundation elements.

No material testing or invasive probes were performed. The information contained in this report is intended to describe our observations of the structural systems and their conditions, as well as recommend repair concepts. No structural design has been completed at this stage; recommendations have been made based on our experience and our preliminary analysis.

DESCRIPTION
The house at 501 Jefferson Avenue was constructed in several phases: the original building that faces east has been added onto several times to the west. The original structure was constructed at an unknown date, however it was moved to the current location in 1948. In 1975 a 4'x14' addition was added to the west. This addition was expanded at an unknown date into the dining room. In 2012, the sunroom and bedroom 1 portions of the residence were added. There is also a detached garage to the west of the house that was constructed sometime after 1948 to which a second story was added in 2015. Generally, each of the building sections was built with wood floor, wall, and roof framing founded on concrete foundations with a full height basement. The garage was constructed of CMU walls and the second floor addition is framed with steel and wood roof and floor framing. Refer to the architectural floor plans for further information.

Foundation
The house is founded on concrete basement foundation walls around the perimeter of the structure and interior concrete walls. At some framing bearing locations, concrete pilasters extend from the wall to support the framing. Reinforced concrete pads support interior load-bearing columns at the western additions.

The steel columns of the upper story of the garage addition are founded on reinforced concrete pads. The original CMU walls are founded on a continuous concrete footing.

Condition:
The foundations are in good condition and seem to be performing structurally. Most of the walls are covered in finishes and could not be directly assessed, however, there are no indications that the building is settling (i.e. cracks in the walls and wall finishes above).

Floor Framing
The basement floor is a concrete slab on grade. The first floor of the residence is framed with dimensional lumber. In the original building, 2x8 joists span in the north-south direction between the exterior walls, interior dropped and plied dimensional lumber beams, and interior concrete walls. The joists are sheathed with 1x horizontal sheathing.

At the front/east entrance to the house, a concrete stoop provides access to the entry door of the structure.

The drawings for the western additions indicate that the floors are framed with 9 1/2" TJI joists or equivalent spaced at 16" spanning in the east-west direction between the foundation walls, plied LVL beams, and steel beams. Under the dining room, the existing 2x8 floor joists were sistered with 2x8s as indicated on the 2012 drawings.

The garage first floor is a concrete slab on grade. The upper floor is framed with a mix of wood I joists at the interior portion of the addition and dimensional lumber joists at the balcony at the south end of the structure. Both framing systems span between a steel frame that was inset inside the original walls of the structure.

Condition:
The floor framing is in good condition. The slabs show no signs of distress and although only small areas of the framing were visible during the visit due to finishes, there are no signs of widespread deterioration. Preliminary analyses indicate that the first floor framing is adequate for the Code required loading of a residence (40 pounds per square foot).

In the southeast corner of the original house structure, there is some charring visible on the wood joists and underside of the sheathing. Again, due to concealment by ceiling finishes not much of this area is visible. However, in the areas that were visible, the charring observed does not affect the structural integrity of the members.

The concrete stoop at the main entry is sloping downwards to the east, away from the building approximately 1" over the 5' it extends from the building. This 1/4" over 1' slope may have been intentional to allow the stoop to drain, or the foundation under the eastern edge of the stoop has settled. Additionally, the steel stair handrail leading up the stairs to the stoop is quite loose.

Roof Framing
The gable roof of the original building is framed with 2" by 3 1/2" dimensional lumber rafters spaced at 24". These 2x rafters have butt joints around the midpoint of their span where they are spliced with a 1' ± length of 1x4 nailed to either side of the splice. Some rafters adjacent to skylight openings in the roof have been sistered with 2x8 members. At the peak of the gable roof is a 2"x6" ridge board. The roof is sheathed with a layer of 1x horizontal skip sheathing and a

layer of panel sheathing. The 2"x4" ceilings joists are also spaced at 24". 2x diagonal struts extending from the rafters to the ceiling joists appear to have been added after the original construction of the structure. There are solar panels installed on the south aspect of this original roof.

The rest of the roof framing of the newer portions of the house was not visible at the time of the visit. The framing of the roof over the dining room is not visible. However, based on the construction documents for the westernmost addition (encompassing the sun room and bedroom 1), the gable roof is framed with 2x10 rafters spanning up to LVL ridge beams.

The roof framing of the garage was installed when the top was popped in 2015. Although not visible during the visit, this roof is framed with 2x10 rafters spaced at 16" per the 2015 construction drawings.

Condition:
Where observed, the roof framing of the original house is in good physical condition with no signs of water leaks, deteriorating members, or distressed members. However, preliminary analyses indicate that the rafters are overstressed, even without the added weight of the solar panels. This overstress is exacerbated where the rafters are spliced.

The roof framing systems of the western additions and the garage were not observable during the site visit, however, the framing depicted on the 2012 and 2015 construction drawings is adequate for the loads on the roof.

Wall Framing
Although not observable at the time of the visit, the walls of the house above grade are framed with dimensional lumber.

At the garage, the first floor walls are constructed of CMU. The second floor walls are construction of dimensional lumber.

Condition:
Although not visible during the time of the observation visit because concealed with finishes, the walls appear to be performing structurally.

STRUCTURAL RECOMMENDATIONS

Inadequate Roof Framing: The existing roof framing of the original structure is inadequate for the Code required loads for a residential roof even without the addition weight of the solar panels. With the weight of the solar panels, it stresses the framing even further.

Recommendations: Sister the rafters of the original house with 7 1/4" LVL members.

Sloping Entry Stoop: As mentioned above, the stoop is sloping east approximately 1" over the 5' dimension out from the structure. This could have been intentional to allow the stoop to drain away from the structure, or the east foundation has settled slightly. Also, the guardrail connection to the stoop is loose and not safe.

Recommendations: Monitor the slope of the stoop. If it continues to move and the movement is a nuisance to the owners, reconstruct the stoop. Reattach the handrail to the stoop.

Please reach out if there are any questions and if you would like us to move forward with any of the recommendations by preparing construction documents. We look forward to working with you on this project.

Sincerely,
JVA, INCORPORATED

By: _____
Christine Britton, PE
Project Engineer

Reviewed By: Ian Glaser, PE
Principal

Enclosure: Report Figures

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Photographs:

Figure 1: 501 Jefferson viewed from the northeast

Figure 2: Western additions to the back of the house

Figure 3: Garage with popped top at the rear/west portion of the property

Figure 4: Exterior of concrete stoop at main/east entry viewed from the north

Figure 5: Concrete stoop slab as viewed from underneath

Figure 6: Slight charring on first floor joists under the living room, not of structural concern

Figure 7: Roof framing of original portion of the house. Note the spliced rafters and the diagonal struts

Figure 8: Roof framing of the original portion of the house. Note the 1x horizontal sheathing, the panel sheathing atop, and the several sistered rafters a the skylight opening

Figure 9: Solar panels installed on the roof of the original structure

RESOLUTION NO. 6
SERIES 2021

A RESOLUTION MAKING FINDINGS AND RECOMMENDATIONS REGARDING THE LANDMARK DESIGNATION FOR A HISTORICAL RESIDENTIAL PROPERTY LOCATED 501 JEFFERSON AVENUE

WHEREAS, there has been submitted to the Louisville Historic Preservation Commission (HPC) an application requesting a landmark eligibility determination for a historical property located at 501 Jefferson Avenue, legally described as Lots 15-17, Block 3, Acme Place; and

WHEREAS, the HPC have reviewed the application and found it to be in compliance with Chapter 15.36 of the Louisville Municipal Code, including Section 15.36.050.A, establishing criteria for landmark designation; and

WHEREAS, the HPC has held a properly noticed public hearing on the proposed landmark application; and

WHEREAS, 501 Jefferson Avenue (Leslie House) has social significance because it exemplifies the cultural, political, economic, or social heritage of the community considering its association with various Louisville families and Louisville's mining heritage; and

WHEREAS, the Leslie House has architectural significance because it has architectural integrity that is representative of the built environment in early 20th century Louisville; and

WHEREAS, the HPC finds that these and other characteristics specific to the Leslie House have social and architectural significance as described in Section 15.36.050.A of the Louisville Municipal Code; and

NOW, THEREFORE, BE IT RESOLVED BY THE HISTORIC PRESERVATION COMMISSION OF THE CITY OF LOUISVILLE, COLORADO:

1. The application to landmark 501 Jefferson Avenue be approved for the following reasons:
    a. Architectural integrity of the vernacular Craftsman-style structure has been largely maintained over time.
    b. Association with Louisville's heritage.
2. The Historic Preservation Commission recommends the City Council approve the landmark incentive grant in the amount of $5,000.
3. With the amendment that the structure be named the Leslie House.

PASSED AND ADOPTED this _____ day of _____, 2021.

_____
Lynda Haley, Chairperson

RESOLUTION NO. 8
SERIES 2021

A RESOLUTION MAKING FINDINGS AND RECOMMENDATIONS REGARDING A PRESERVATION AND RESTORATION GRANT FOR THE LESLIE HOUSE LOCATED AT 501 JEFFERSON AVENUE

WHEREAS, there has been submitted to the Louisville Historic Preservation Commission (HPC) an application requesting a preservation and restoration grant for the Leslie House, a historic residential structure located at 501 Jefferson Avenue, on property legally described as Lots 15-17, Block 3, Acme Place, Town of Louisville, City of Louisville, State of Colorado; and

WHEREAS, the City Staff and the HPC have reviewed the application and found it to be in compliance with Section 3.20.605.D and Section 15.36.120 of the Louisville Municipal Code; and

WHEREAS, the HPC has held a properly noticed public hearing on the preservation and restoration grant; and

WHEREAS, the preservation and restoration work being requested for the Leslie House includes making repairs to the existing structure; and

WHEREAS, the Historic Preservation Commission finds these proposed improvements will assist in the preservation of the Leslie House, which is to be landmarked by the City;

NOW, THEREFORE, BE IT RESOLVED BY THE HISTORIC PRESERVATION COMMISSION OF THE CITY OF LOUISVILLE, COLORADO:

1. The Historic Preservation Commission recommends the City Council approve the proposed Preservation and Restoration Grant application for the Leslie House, in the amount of **$7,436**.

PASSED AND ADOPTED this _____ day of _____, 2021.

_____
Lynda Haley, Chairperson

City of Louisville
COLORADO • SINCE 1882

Historic Preservation Commission

Meeting Minutes
September 20th, 2021
Virtual Meeting
6:30 PM

Chair Haley **called the meeting to order** at 6:30 pm.

Roll Call was taken and the following members were present:

Commission Members Present:	Chair Lynda Haley Christine Burg Andrea Klemme Gary Dunlap
Commission Members Absent:	Keith Keller
Staff Members Present:	Lisa Ritchie, Interim Planning Director Kim Bauer, Preservation Planner Amelia Brackett Hogstad, Planning Clerk

APPROVAL OF AGENDA

Klemme made a motion to approve the September 20, 2021 agenda. Seconded by Burg. The agenda was approved unanimously by voice vote.

APPROVAL OF MEETING MINUTES

Klemme made a motion to approve the August 16, 2021 minutes. Seconded by Burg. The minutes were approved unanimously as written by voice vote.

PUBLIC COMMENTS ON ITEMS NOT ON AGENDA

None.

PUBLIC HEARING

501 Jefferson Avenue: A request to Landmark 501 Jefferson Avenue and a request for an Alteration Certificate and Preservation and Restoration Grant.

Bauer presented the criteria for landmarking, stating that the structure was old enough and met the criteria for architectural and social significance. She also presented the alteration and grant requests, which covered window rehabilitation work.

Haley asked how the Commission would know if there were any larger projects pending without an assessment.

Bauer replied that there was an assessment for this property and it included other deficiencies on the site.

Caroline Ford and Christopher Beam, applicants, thanked the Commission and staff, and stated that they had a couple of other pressing projects coming up, including fixing the structure of the roof. Ms. Ford asked if putting a snow fence to deal with snow from their solar panels would affect the historic elements of the site.

Haley stated that they would have to formally review it to know for sure but in general if an element could be removed it could be okay with the historic preservation process.

Dunlap commented that there had been national conversations about solar panels on historic structures and the general thought was that the environmental considerations should take precedence.

Seeing no public comment, Chair Haley opened commissioner discussion.

Discussion on the location of the solar panels, in which it was stated that the solar panels were not visible in the staff packet images and did not seem to affect the architectural view of the building.

Klemme stated that the structure met the criteria for landmarking and the dormer on the side did not affect the ability to landmark.

Burg noted that moving houses was not uncommon historically and stated that the architecture was representative of place and style around Louisville.

Klemme moved to approve Resolution 6, Series 2021, and Dunlap seconded. Motion approved unanimously by roll call vote.

Klemme stated that since 1948 no one had expanded or changed the windows, which was great, and the proposed change was a swap to have windows that would be better for energy bills but would not affect historic preservation.

Dunlap asked if there was a guide for historic styles that would help the Commission assess the language about windows maintaining a similar style or if the Commission was meant to use their subjective judgement on that language.

Bauer replied there was Preservation Brief 9 from the National Park Service about windows and there were books like Virginia McCalister's guide to architectural styles.

Dunlap stated that the re-visitation of the Old Town Overlay was addressing materials through resident surveys and that might be a good place for notes on styles.

Bauer replied that she would make a note of Commissioner Dunlap's idea and shared that staff also assessed style when reviewing these proposals.

Klemme moved to approve Resolution 7, Series 2021 and Burg seconded. Motion approved unanimously by roll call vote.

Bauer noted that all the replacement windows would be 3 over 1 in this proposal.

General agreement that this proposal was the point of the matching grant and the amount seemed reasonable.

Klemme moved to approve Resolution 8, Series 2021, and Commissioners Burg and Dunlap seconded. Motion approved unanimously by roll call vote.

ITEMS FROM STAFF

Bauer shared subcommittee deliberations for 801 Main Street and details about the upcoming plaque ceremony. She noted that there would be a joint session at the October 18th meeting to update the commission on the updates to the Old Town Overlay.

Dunlap asked if 809 Main had been forward to the full commission and Planner Bauer replied that it had not as of yet.

Bauer presented two historic structure assessments, the first for 724-728 Main Street. She described the changes to the structure over time and the scope of work for structural elements that would need to be addressed to preserve the building, including reviewing the foundation support systems and the floor framing. The second structure was 928 LaFarge and Planner Bauer presented changes over time and the scope of work for structural work, including removing the vinyl siding and reviewing the crawlspace walls.

Haley asked if the assessments had included structural engineers.

Josh Johnston, with DAJ Design at 922A Main Street, stated that they had a structural professional visit the house and make the recommendations regarding structural work. He noted that they couldn't go in and specify each item with a house of this size but they could observe that the soil had been compromised, giving them an idea of what to look for without getting too specific. The engineers for assessments were not hired to say here's what needs to be done on a specific level, more to look at what needs to be addressed and reviewed.

Klemme appreciated Planner Bauer's presentation and staff packet and Chair Haley agreed and added that it was helpful to see these projects again.

Dunlap asked whether the Assessment should include the structural engineering element, as per the Commission's previous conversations. He noted that this was a little vague even though structural engineers were involved in both projects.

Klemme replied that the assessments had made note of the issues but that it wouldn't be until the applicant wanted grant money that the Commission would need more specifics about who the applicant had talked to.

Bauer noted that some assessments did include written narratives from the structural engineer in addition to the structural engineering comment within the assessment. Structural engineers would go further into detail for project applications rather than at this stage.

Dunlap stated that one of the hopes they had was to accept or reject grant proposals that requested rehabilitation work and asked if that too much to expect from an assessment.

Bauer replied that they were following the questions asked in the assessment and that's where the engineers' answers came from. They could ask other questions if the Commission wanted. She added that there were grants from the state that existed for this kind of work.

Haley asked if Dunlap wanted cost estimates or more detail.

Dunlap replied that estimates would be ideal but might not be possible. On the other hand, he stated that maybe they were a little vague on what they were expecting from the engineers and maybe that's why the engineers' answers were vague.

Haley summarized that Planner Bauer gave a synopsis of the report but the assessment that had been submitted was more detailed and she stated that that might be helpful to see the assessment itself. Other commissioners noted this was in the packet.

Klemme stated she felt good about the level of information and asked Planner Bauer for more detail in the next meeting's presentation.

Haley noted that the staff packet showed all that information and added that any amounts in assessments would not reflect constant changes in pricing. She added that there was also a lot of work that had to go into figuring out the crawlspace issues, for example, and the assessors would not mess with that if they didn't end up doing anything.

Dunlap stated that he was talking about the fact that both assessment said that they needed more structural work. He agreed with Chair Haley that it was about making sure they were getting their money's worth on the assessments to better understand the extent of comments stating that further assessment was required.

UPDATES FROM COMMISSION MEMBERS

Dunlap asked about having an ongoing table of projects to be available to the public. He gave the example of the status of different landmarking efforts.

Discussion ensued on how to keep updated on ongoing projects.

Klemme stated that staff updates on ongoing projects could be helpful in the agenda and Chair Haley suggested a single document that had that information.

ADJOURN

Burg motioned to adjourn and Klemme seconded. Motion passed unanimously by voice vote. Meeting adjourned at 7:44 PM.

Andrea Klemme, Vice Chair

Lynda Haley, Chair

City Council

501 Jefferson Avenue

A request to landmark 501 Jefferson Avenue and approve a Historic Preservation Fund Grant

Resolution 71 (Landmark)
Resolution 72 (Historic Preservation Fund Grant)

501 Jefferson Avenue: Location

501 Jefferson Avenue, Boulder County Assessor's Card, 1948

501 Jefferson Avenue: Historic and Current Conditions

Criteria for Landmarking:

- *At least 50 years old*
- *Architectural, social or geographic/environ. significance*
- *Physical integrity*

- Age: The principal structure at 501 Jefferson Avenue was constructed at an unknown date and relocated to Louisville in 1948. It has been located at its current site for 72 years.
- Architectural Significance: By its size, shape, and style – Craftsman-type Bungalow – it was likely built c. 1905-1930, when that style was at its height of popularity. . Character defining features of the Craftsman are present throughout.
- Cultural Significance: William "Bill" Leslie was born in Louisville in 1897. Bill worked at the Matchless Mine and retired from mining in 1941. Following that, he worked as a marshal/patrolman from 1947-1964 and monitored Louisville for "speeders, drunk driving cases, traffic accidents, illegal gambling, teenager pranks, and unruly conduct at the town's taverns."
- Physical Integrity: The house at 501 Jefferson Avenue is found in the same location it was moved to in 1948.

501 Jefferson Avenue: Landmarking

Grants:
Under Resolution No. 17, Series 2019, approved work must fall under the following categories to qualify for grant funds:

Preservation
- Front Door
- Chimney
- Siding Repair

Rehabilitation
- Foundation/crawlspace
- Floor Structure
- Roof Structure
- Front Porch
- Site Grading

Restoration
- Window Replacement

501 Jefferson Avenue: Grant

Windows	$14,872	*Remove replacement windows and reinstall windows that are sensitive to the original windows.*

Total: $14,872
Grant Request: $7,436

501 Jefferson Avenue: Grant

Staff Recommendations

- Approval of Resolution 71, Series 2021, approving the local landmark designation request
- Approval of Resolution 72, Series 2021, approving a Historic Preservation Fund Grant request of $7,436

501 Jefferson Avenue: Staff Recommendations

City of Louisville
COLORADO • SINCE 1878

CITY COUNCIL COMMUNICATION
AGENDA ITEM 7B

SUBJECT: **ORDINANCE NO. 1816, SERIES 2021 – AN ORDINANCE ADOPTING BY REFERENCE THE 2021 INTERNATIONAL ENERGY CONSERVATION CODE, WITH AMENDMENTS, REPEALING CHAPTER 15.60 OF THE LOUISVILLE MUNICIPAL CODE CONCERNING THE PRESCRIPTIVE ENERGY CODE AND DESIGN CRITERIA, AND AMENDING TITLE 17 OF THE LOUISVILLE MUNICIPAL CODE CONCERNING ELECTRIC VEHICLE CHARGING INFRASTRUCTURE – 2nd READING, PUBLIC HEARING (advertised *Daily Camera* 9/26/21)**

DATE: **OCTOBER 19, 2021**

PRESENTED BY: **ROB ZUCARRO, INTERIM DEPUTY CITY MANAGER**
LISA RITCHIE, INTERIM DIRECTOR OF PLANNING AND BUILDING SAFETY
CHAD ROOT, CHIEF BUILDING OFFICAL
KATIE BAUM, SUSTAINABILITY COORDINATOR

SUMMARY:
Ordinance 1816, Series 2021 amends Municipal Code Title 15, Building and Construction, for the purpose of adopting the 2021 International Energy Conservation Code (IECC) with amendments, and amends Municipal Code Chapter 17.20, Off-street Parking and Loading to add electric vehicle charging requirements. The proposed amendments to the 2021 IECC include prescriptive energy code standards, solar readiness standards, electric vehicle (EV) charging standards, and mixed fuel (building electrification infrastructure) standards for residential and commercial construction.

AMENDMENTS AND ADDITIONAL INFORMATION FOLLOWING 1ST READING:
Amendments to Ordinance Since 1st Reading:
Several changes were made to Ordinance No. 1816, Series 2021 following 1st reading to add clarification to certain provisions, to strengthen requirements for certain high efficiency gas appliances, and address applicability of the EV charging requirements. The changes are shown as **bold underline** and ~~**bold strikethrough**~~ in Attachment No. 1 and summarized below:

- Construction documentation requirements were updated to require fuel source and location of pathways between solar ready zones and electric service panels (Updates to Sections C103.2 and R103.2). Clear identification on the construction documents will allow for easier code compliance review and inspections.
- Requirements were added for all residential and commercial new construction to be all-electric or built to a higher efficiency standard for certain gas-powered appliances. Providing the all-electric alternative addresses a federal preemption that does not allow local jurisdictions to adopt HVAC efficiency standards above a certain level without an alternative compliance path. As with the first reading,

the ordinance continues to require electric-ready infrastructure for all combustion equipment, which requires buildings to be designed and constructed to support the easy transition to electric systems at any time during the life of the building. Exceptions are provided for industrial and commercial processing (noted as factory, laboratory and high hazard occupancies) and for commercial kitchens. The Building Official may also make exceptions for commercial development if an applicant demonstrates compliance is not feasible and they are using the most efficient appliance available (Updates to Sections C202, C401.2.1, C404.3.2, R202, R401.2, and R403.7).

- Provision added to prohibit gas-fired lighting appliances (Added amendments to Sections C405.4.3 and R404.1.1).
- An exception to allow doors with fenestrations that exceed the maximum allowed fenestration requirement. This provide flexibility for tenant finishes that may want to utilize glass doors or windows in doors (Amendment to Section C505.1). The Building Code Board of Appeals recommends this amendment.
- Require roof snow loads to be maintained at 30 pounds per square foot rather than allow reductions in roof snow loads for other structural enhancements (Amendment to Sec. 15.18.040). The Building Code Board of Appeals recommends this amendment.
- EV charging requirements were updated so that the provisions are enforced at the time of building permit. This clarifies that projects with Planned Unit Developments (PUDs) approved prior to the enactment of the ordinance would also need to comply if they have not obtained a building permit prior to the effective date of the ordinance (Updates to Sec. 17.20.170).

Additional Information Requested at 1st Reading:

Council requested the following additional information at first reading:

- Council requested copies of the IECC Zero Energy Residential and Commercial Appendices (Attachments Nos. 2 and 3). The appendices provide a code option that requires buildings to be constructed to meet an “Energy Rating Index” compliance path for higher efficiency construction and on-site or off-site power generation with the intent that new buildings have zero net energy consumption needs over a year.
- Council requested additional information on policies for Building Electrification. Building electrification addresses the transition away from onsite fossil fuel combustion in buildings, as the electricity grid (including renewable energy sources) move towards 100 percent carbon-free. Xcel Energy currently has a goal of producing 100% carbon-free electricity by 2050. At this time, Xcel Energy is on target to achieve 60% carbon-free electricity by 2030. Staff has provided the following documents (Attachment Nos. 4-10) and a subsequent summary of State and local policies for transitioning to all electric building construction.
    - Colorado House Bill 19-1261
    - Colorado Greenhouse Gas Pollution Reduction Roadmap
    - Beneficial Electrification in Colorado, Market Potential 2021-2030

- Beneficial Electrification in Colorado, Market Barriers and Policy Recommendations
- Colorado Senate Bill 21-246
- Denver's Net Zero Energy (NZE) New Buildings and Homes Implementation Plan
- Cupertino, CA All-Electric Building Code

In May, 2019 Governor Polis signed into law House Bill 19-1261, The Climate Action Plan to Reduce Pollution (Attachment 7). In January, 2021 the Governor released the Colorado Greenhouse Gas Pollution Reduction Roadmap, which lays out a plan for implementation of House Bill 19-1261 (Attachment 8). Building Electrification is discussed on pp. 74-76 of the Roadmap. This Roadmap references studies made by the Colorado Energy Office on beneficial electrification. Both the Beneficial Electrification in Colorado, Market Potential 2021-2030 final report, and Beneficial Electrification in Colorado, Market Barriers and Policy Recommendations final report are attached for reference (Attachments 9 and 10).

In June, 2021 Governor Polis signed into law Senate Bill 21-246, The Healthy and Efficient Homes and Building Act (Attachment 11). The bill directs electric utility companies to create and implement plans to incentivize installation of high efficiency electric heat pump appliances, such as electric heat pump water heaters and furnaces. The plans must also include education and training, programs to target low-income households, and setting of targets for electrification programs. Public electric utilities must file plans with the Public Utilities Commission that include 10-year targets by April 1, 2024.

Denver has a local initiative to consider adoption of net zero building codes that would require all-electric residential construction in 2024 and require all-electric construction for most commercial buildings in 2027. These are steps towards an intended 2030 performance based net zero building code. Attached for reference is Denver's Net Zero Energy (NZE) New Buildings and Homes Implementation Plan that sets the code adoption goals and analyzes policy issues such as cost, market feasibility and technology considerations (Attachment 12). The Denver plan targets transition of new hotel, office, retail, and warehouse development to be all electric by 2027. However, the plan notes that "manufacturing and industrial natural gas loads are a separate issue that are not addressed in the NZE Plan" due to challenges with some industrial processing technologies.

Staff is not aware of any locally adopted building electrification requirements in Colorado. However, several California communities have adopted versions of building electrification requirements. Attached for reference is the Cupertino, California ordinance (Attachment 13). The Cupertino code requires all new construction to be fully electric with some exceptions. The exceptions include

factory, high hazard, research laboratory occupancy types, essential facilities (public safety facilities), non-residential kitchens, and accessory dwelling units. Any development that qualifies for an exception must be built electric-ready, meaning it has the necessary wiring and electrical capacity to support converting from natural gas to electric appliances/equipment in the future.

- Council requested the EV charging appendices to the 2021 IECC. While there was an EV charging appendix under consideration for adoption with the 2021 IECC, this appendix was ultimately not adopted. As previously noted, staff has provided changes to the ordinance to require all new construction to comply with the proposed EV charging standards at the time of building permit regardless of PUD status.

Work Plan Phasing:

The City Council 2021 Work Plan includes two phases for considering updates to the City's building codes related to sustainability (Figure 1 below). We are currently in Phase 1. The purpose of having a two-phased approach is to address the adoption of the 2021 IECC and EV charging requirements as early as possible considering that these initiatives are considered more common and standardized codes and would not require the same level of analysis and public engagement as the Phase 2 work.

If Council desires to pursue Phase 2 provisions, such as adoption of the Zero Energy appendices or mandatory all-building electrification, staff recommends adoption of the current ordinance as drafted and to have a separate process for the Phase 2 work. This allows for the Phase 2 items to have more public and stakeholder involvement and the benefit of City board and commission review and recommendation prior to Council consideration. Alternatively, if Council desires to adopt all provisions in a single ordinance, staff recommends continuing this hearing to allow for more public and stakeholder involvement and City board and commission review and recommendation on the additional scope.

Figure 1: City Council 2021 Work Plan Code Adoption Phasing

15	Quality Programs and Amenities	Community Design	* Sustainability/EE Additions to Building code – Consider building code changes that promote or require higher levels of energy efficiency and carbon reduction than current building code. • Phase 1: Consideration of adoption of the 2021 IECC standard, a portion of the standards, or similar standards to improve energy efficiency and carbon reduction. (To replace or supplement our current code of 2018 IECC.) ○ Consideration of EV charging station readiness in all new development/major redevelopment.	1 Study Session, 2 City Council meetings	Q2 – Q3
16	Quality Programs and Amenities	Community Design	Sustainability/EE Additions to Building code – • Phase 2: Consideration of additional measures such as all-building electrification, LEED-type development rating system,	2 City Council meetings	Q3 – Q4

BACKGROUND:
Currently, the City of Louisville enforces the 2018 International Energy Conservation Code (IECC), a Prescriptive Energy and Design Criteria, and solar ready requirements for both residential and commercial development. The City Council's 2021 Work Plan includes consideration of adopting the 2021 International Energy Conservation Code and electric vehicle charging requirements for new construction and major redevelopment. Staff has also included the proposals to continue implementing solar ready construction requirements and mixed fuel standards to support building electrification. The proposed energy efficiency and sustainability additions to the building code also supports the Louisville Sustainability Action Plan (October 2020) and the adopted community-wide climate action goals (August 2019).

2021 INTERNATIONAL ENERGY CONSERVATION CODE
The IECC is part of the International Building Code series that sets out minimum efficiency standards for residential and commercial new construction for a structure's walls, floors, ceilings, lighting, windows, doors, duct leakage and air leakage. The IECC also includes appendices covering solar readiness and net zero pathways. The IECC is updated every three years, often with increasing efficiency between code updates. Due to the nature of code development, the 2015 and 2018 IECC codes are only slightly more efficient than the 2012 IECC. The 2021 IECC is the first edition with significant efficiency gains since 2012. The Department of Energy's recent analysis of the residential side of the 2021 IECC code indicates that residential buildings meeting the 2021 IECC results in a nearly 9% energy savings and 8.66% energy cost savings over the 2018 IECC. Commercial buildings are not as uniform and more difficult to quantify savings, however the DOE estimates a 4% energy savings.

Energy Impact Assistance Grant Funding Opportunity
In early 2021, a group of Front Range communities supported by Lotus Engineering and Sustainability and Southwest Energy Efficiency Project (SWEEP) applied for an Energy/Mineral Impact Assistance Fund grant through the state's Department of Local Affairs (DOLA). The intent of the grant application was to support the adoption of the 2021 IECC across Boulder County and other local communities and create a strategic plan for renewables planning and additional net zero code strategies. Ultimately the grant funding was not awarded at that time, however, staff continued to move forward with drafting an ordinance for the adoption of the 2021 IECC standard. Other communities that may be pursuing similar code updates include: City of Lafayette, Town of Superior, Town of Erie, and Boulder County.

The cohort, with the City of Louisville recognized as an observing participant due to our adoption timeline, reapplied for the EIAF grant, which was awarded in October 2021. Staff will continue to work with the cohort with the opportunity to fully participate during the net zero strategic planning, which is anticipated to begin in February 2022.

ORDINANCE 1816, SERIES 2021:

IECC Amendments and Prescriptive Standards

The adoption of the 2021 IECC is by reference and includes several amended sections of the code to create a "prescriptive" path for compliance with the standards. The 2021 IECC can be viewed at the following link: https://codes.iccsafe.org/content/IECC2021P1.

The "prescriptive" standards included within the adoption language are in lieu of what was previously a separate section of the building code (Chapter 15.60) that would be repealed with this Ordinance. The "prescriptive" standards provide the development community with a clear path for compliance and is easier to administer for designers and building staff.

Solar Readiness:

The 2021 IECC provides two appendices, one for residential and one for commercial, that are intended to encourage the installation of renewable energy systems by preparing buildings for the future installation of solar energy equipment, piping, and wiring by establishing rooftop solar-ready zones. The proposed ordinance includes the adoption of both appendices to support future homeowners and tenants in the installation of rooftop solar without prohibitive retrofit costs.

Electric Vehicle Readiness:

The Ordinance requires parking in new buildings to include minimum numbers of electric vehicle (EV) charging stations and the electrical equipment necessary to enable the easy and low-cost installation of additional EV charging stations in the future. This would provide more people the option to drive an EV by increasing the number of charging stations and by bringing down charger installation costs by 75% or more compared to installing EV chargers during a building retrofit (SWEEP).

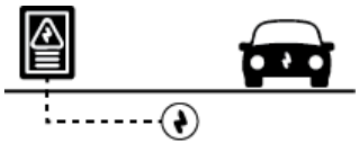
One of Governor Polis' first executive orders, Executive Order B 2019 002 Supporting a Transition to Zero Emission Vehicles, supports the acceleration of widespread electrification of cars, buses and trucks and adopting the 2018 EV Plan goal of 940,000 light-duty EVs in Colorado by 2030. Local governments across Colorado and the Front Range have adopted EV infrastructure and readiness building codes to support this transition and ensure the built environment can appropriately accommodate transportation electrification.

Figure 2: EV Charging Basic Definitions

Basic definitions:

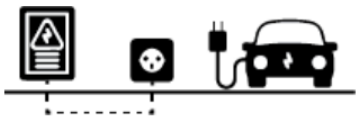
EV-Capable Parking Space: Electrical Panel Capacity & Conduit

- Install panel capacity and conduit (raceway) to accommodate the future build-out of EV charging with 208/240 V, 40-amp circuits.
- Rationale: Provide hard-to-retrofit elements during new construction while minimizing up-front cost.



EV-Ready Parking Space: Install full circuit

- Full circuit installations include 208/240V, 40-amp panel capacity, raceway, wiring, receptacle, and overprotection devices similar to a dryer circuit.
- Rationale: Full circuits are plug-and-play ready and minimize total costs and additional barriers to installing Electric Vehicle Supply Equipment (EVSE).



EV-Installed: Install EV Charging Station (also known as Electric Vehicle Supply Equipment or EVSE).

- Install charging stations during new construction.
- Rationale: Provide a visible signal that building supports EV charging and reduce future EV charger installation costs to zero.

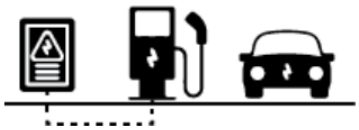


Table 1: Peer Community EV Infrastructure Building Code

Municipality	Year	Single-Family	Multi-Family	Commercial
City of Boulder	2020	1 EV-Ready Space per dwelling Unit	5% EV-Installed, 15% EV-Ready, 40% EV-Capable (25+ spaces)	5% EV-Installed, 10% EV-Ready, 10% EV-Capable
City and County of Denver		1 EV-Ready Space per dwelling Unit	5% EV-Installed, 15% EV-Ready, 80% EV-Capable	5% EV-Installed, 10% EV-Ready, 10% EV-Capable
Summit County	2020	1 EV-Ready Space per dwelling Unit	5% EV-Installed, 10% EV-Ready, 40% EV-Capable (10+ spaces)	5% EV-Installed, 10% EV-Ready, 40% EV-Capable (25+ spaces)
City of Lakewood	2019	1 EV-Capable Space per dwelling unit	2% EV-Installed, 18% EV-Capable (10+ spaces) Different by use	2% EV-Installed, 13% - 18% EV-Capable (10+ spaces) Different by use
City of Fort Collins	2019	1 EV-Capable Space per dwelling Unit	10% EV-Capable	
City of Golden	2019		1 EV-Installed Space per 15 parking space, 15% EV-Capable	1 EV-Installed Space per 15 parking space, 15% EV-Capable
Boulder County	2015	1 EV-Ready Space per dwelling Unit	2% EV-Ready (for new construction and 50% or 5,000 SF additions)	2% EV-Ready (for new construction and 50% or 5,000 SF additions)

Table 2: Proposed City of Louisville EV Infrastructure Requirements

	EVSE Installed	EV Ready	EV Capable
Residential Uses			
Single-Family unit		1 space	1 space
Multi-Family unit, with dedicated parking spaces or garages		1 space	1 space
Tier 1			
Multi-Family, without dedicated parking spaces or garages	10% of spaces	10% of spaces	50% of spaces
Hotel, Motel, Extended Stay Lodging Facility			
Tier 2 – Employment oriented uses	7% of spaces	10% of spaces	15% of spaces
Business and Professional Offices			
General research facilities, light industrial facilities including manufacturing, assembly, warehouse and fabrication			
Hospital			
Tier 3 – Service and Sales oriented uses	5% of spaces	10% of spaces	10% of spaces
Private and public recreational and social facilities, membership clubs, lodges, and fraternal organizations			
Religious institution			
Commercial amusement, indoor and outdoor			
Schools, including public, private, vocational or business			
Restaurant			
Retail			
Personal service			
Medical and dental clinics			

Mixed Fuel (Building Electrification Infrastructure):

The proposed ordinance requires all residential or commercial new construction to be all-electric or be built with high efficiency gas appliances and with electric-ready infrastructure, supporting the easy transition over to electric systems at any time during the life of the building. This includes requiring electrical service to be sized for full electrification and pre-wiring for future replacement of any gas appliances that may be installed. This approach provides flexibility for new construction, removes barriers for buildings to go all-electric in the future if not already built to that standard, and provides a workaround to the federal preemption which does not allow municipalities to require beyond the federal HVAC efficiency requirements unless presented as a secondary option. If not presented as an option to the all-electric, the City would lose significant efficiency to gas HVAC equipment. Industrial and manufacturing uses are exempt from these requirements.

At this time, no other community in Colorado has adopted all-electric building code ordinances. As previously discussed, the City and County of Denver is currently weighing this option and has adopted the goal of all new buildings achieving net zero energy by 2030. Their milestones to reach this goal are:

- Net zero energy, all-electric new homes in the 2024 Building Code
- Net zero energy, all-electric new buildings in the 2027 Building Code
- New buildings perform as designed with performance verification in the 2030 Building Code

BUILDING CODE BOARD OF APPEALS ACTION:
The Building Code Board of Appeals (BCBOA) reviewed the proposed building code and zoning update on August 26th, in a special meeting on September 8th, and again on September 16th. The BCBOA provided recommendations on insulation and fenestration requirements as reflected in the proposed ordinance. Additionally, BCBOA recommended the removal of EV Ready spaces with the corresponding spaces being moved into EV Capable requirements across the use table. The BCBOA recommendations on the IECC provisions were incorporated into the final draft, but the electric vehicle charging recommendations were not (see Attachment 11 for minutes).

PLANNING COMMISSION ACTION:
The Planning Commission reviewed the Electric Vehicle Charging Infrastructure Code Amendment in Title 17 on September 9th, 2021. The Planning Commission recommended approval of the draft ordinance with an increase in EV Capable parking spaces for multi-family properties as reflected in the proposed ordinance (see Attachment 12 for minutes).

SUSTAINABILITY ADVISORY BOARD ACTION:
The Sustainability Advisory Board reviewed the proposed building code and zoning update with staff presentation on August 18th. The Sustainability Advisory Board recommends the adoption of the 2021 IECC and requested additional amendments be considered. Specifically, the Board recommends the adoption of the Zero Energy residential and commercial appendices, requiring all electric residential construction, requiring commercial solar installation, and considerations for additional sustainability-related building code updates (see Attachment 13 for minutes and Attachment 14 for letter of support).

RECOMMENDATION:
Staff recommends adoption of Ordinance 1816, Series 2021.

FISCAL IMPACT:
There is no anticipated fiscal impact to the City for the adoption of the 2021 IECC and EV infrastructure standards. These provisions would be implemented as part of zoning and building permit reviews and is not anticipated to create a significant increase in administrative costs.

PUBLIC COMMENTS:
Public comments received by staff are included as Attachment No. 15.

PROGRAM/SUB-PROGRAM IMPACT:
The adoption of the 2021 IECC and reach amendments supports the Sustainability Sub-Program with the objective of using environmental, economic, and human resources to meet present and future needs without compromising the ecosystems on which we depend.

ATTACHMENT(S):
1. Ordinance No. 1816, Series 2021 (Amended from 1st Reading)
2. Appendix CC Zero Energy Commercial Building Provisions
3. Appendix RC Zero Energy Residential Building Provisions
4. Colorado House Bill 19-1261
5. Colorado Greenhouse Gas Pollution Reduction Roadmap
6. Beneficial Electrification in Colorado, Market Potential 2021-2030
7. Beneficial Electrification in Colorado, Market Barriers and Policy Recommendations
8. Colorado Senate Bill 21-246
9. Denver's Net Zero Energy (NZE) New Buildings and Homes Implementation Plan
10. Cupertino, CA All-Electric Building Code
11. Building Code Board of Appeals Meeting Minutes
12. Planning Commission Meeting Minutes
13. Louisville Sustainability Advisory Board Minutes
14. Louisville Sustainability Advisory Board Letter of Support
15. Public Comments
16. Presentation

STRATEGIC PLAN IMPACT:

☐	**Financial Stewardship & Asset Management**	☒	**Reliable Core Services**
☒	**Vibrant Economic Climate**	☐	**Quality Programs & Amenities**
☐	**Engaged Community**	☐	**Healthy Workforce**
☐	**Supportive Technology**	☒	**Collaborative Regional Partner**

Second Reading Amendments

Ordinance No. 1816, Series 2021 is revised to read as follows (amendments are shown in **bold underline** and ~~**bold strikeout**~~):

ORDINANCE NO. 1816

AN ORDINANCE ADOPTING BY REFERENCE THE 2021 INTERNATIONAL ENERGY CONSERVATION CODE, WITH AMENDMENTS, REPEALING CHAPTER 15.60 OF THE LOUISVILLE MUNICIPAL CODE CONCERNING THE PRESCRIPTIVE ENERGY CODE AND DESIGN CRITERIA, AND AMENDING TITLE 17 OF THE LOUISVILLE MUNICIPAL CODE CONCERNING ELECTRIC VEHICLE CHARGING INFRASTRUCTURE

WHEREAS, the City Council has adopted from time to time certain building and construction standards; and

WHEREAS, it is deemed to be in the interest of the public health, safety and general welfare to adopt by reference thereto the 2021 edition of the International Energy Conservation Code; and

WHEREAS, the City of Louisville remains committed to its adopted goals to reduce energy consumption, increase clean energy sources, and support the transition to a low-carbon community as outlined in the Sustainability Action Plan and Resolution 25, Series 2019, "A Resolution Setting Clean Energy and Carbon Reduction Goals"; and

WHEREAS, reducing building energy consumption is an effective strategy to reduce community-wide energy consumption and increase long-term cost savings for residents and businesses; and

WHEREAS, the City Council desires to add requirements for solar readiness, electric vehicle charging infrastructure, and building electrification to build a more resilient building stock and support future building and transportation electrification efforts pursued by residents and businesses; and

WHEREAS, the City Council, after proper notice as required by law, has held a public hearing on this ordinance providing for the adoption of said codes; and

WHEREAS, the 2021 edition of the International Energy Conservation Code has been submitted to the City Council in writing and the City Council has determined that such codes should be adopted as herein set forth.

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF LOUISVILLE, COLORADO:

Section 1. Chapter 15.18 of the Louisville Municipal Code is hereby repealed and reenacted to read as follows:

INTERNATIONAL ENERGY CONSERVATION CODE

Sec. 15.18.010. Adoption.
Sec. 15.18.020. Appendices adopted.
Sec. 15.18.030. Amendments and Deletions to the 2021 International Energy Conservation Code.
Sec. 15.18.040. Design criteria.
Sec. 15.18.050. Applicability.
Sec. 15.18.060. Copies available.
Sec. 15.18.070. Violations and penalties.

Sec. 15.18.010. - Adoption.

The International Energy Conservation Code, 2021 Edition, published by the International Code Council, 4051 West Flossmoor Road, Country Club Hills, Illinois, 60478-5795, is hereby adopted by reference thereto and incorporated into and made a part of the Louisville Municipal Code. The subject matter of the International Energy Conservation Code is to regulate and govern energy efficient building envelopes and the installation of energy efficient mechanical, lighting and power systems in the City of Louisville, and to provide for the issuance of permits and collection of fees therefor. The International Energy Conservation Code, 2021 Edition, is adopted as amended by the City, including the outline table of contents and index, for the minimum requirements for minimum energy efficiency.

Sec. 15.18.20. Appendices adopted.

The following appendices of the 2021 International Energy Conservation Code are hereby specifically adopted; any appendices not listed are not adopted: Appendix CB, Solar Ready Zone – Commercial and Appendix RB, Solar Ready Provisions – Detached One and Two-Family Dwellings and Townhouses. Group R2, R3, and R4, three stories or less shall comply with Appendix RB.

Sec. 15.18.030. - Amendments and Deletions to the 2021 International Energy Conservation Code

The 2021 International Energy Conservation Code adopted in Section 15.18.010 is hereby amended in the following respects. An ellipsis (…) indicates when the remainder of a section of the 2021 International Energy Conservation Code is to remain unchanged and in full force and effect.

1. ***Section C101.1 Title***, is amended to insert "the City of Louisville" so the section will read:

C101.1 Title. These regulations shall be known as the Energy Conservation Code of the City of Louisville, and shall be cited as such. It is referred to herein as "this code."

2. *Section C103.2 Information on construction documents*, is hereby amended to read as follows:

C103.2 Information on construction documents. Construction documents shall be drawn to scale upon suitable material. Electronic media documented are permitted to be submitted when *approved* by the *code official*. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment herein governed. Details shall include the following as applicable:

1. **Energy compliance path.**
2. **Insulation materials and their *R*-values**
3. **Fenestration *U*-factor and solar heat gain coefficients (SHGCs).**
4. **Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.**
5. **Mechanical system design criteria.**
6. **Mechanical and service water heating systems and equipment types, sizes, fuel source and efficiencies.**
7. **Economizer description.**
8. **Equipment and system controls.**
9. **Fan motor horsepower (hp) and controls.**
10. **Duct sealing, duct and pipe insulation and location.**
11. **Lighting fixture schedule with wattage and control narrative.**
12. **Location and *daylight* zones on floor plans.**
13. **Air barrier and air sealing details, including the location of the air barrier.**
14. **Location of pathways for routing of raceways or cable from the solar ready zone to the electrical service panel.**

~~2.~~ **3.** ***Section C202 General Definitions***, is hereby amended by adding, in alphabetical order, the following definitions:

All-Electric Building: **A building that contains no combustion equipment, or plumbing for combustion equipment, installed within the building or building site.**

Combustion Equipment: Any equipment or appliance used for space heating, service water heating, cooking, clothes drying and/or lighting that uses fuel gas or fuel oil.

Electric Vehicle (EV): A vehicle registered for on-road use, primarily powered by an electric motor that draws current from a rechargeable storage source that is charged by being plugged into an electrical current source.

Electric Vehicle Supply Equipment (EVSE): The electrical conductors and associated equipment external to the electric vehicle that provide a connection between the premises wiring and the electric vehicle to provide electric vehicle charging.

Electric Vehicle Capable Space: A designated parking space that is provided with conduit sized and rated for a minimum 40-amp, 208/240-Volt dedicated branch circuit and shall be no less than 1" in size. Conduit must be continuous from the future or existing electrical panelboard or switchboard location(s) and end at a junction box or receptacle located within close proximity of the parking space. The electrical panel serving the parking space shall have sufficient capacity and physical space for a dual-pole, 40-amp breaker. The conduit shall be sealed at the junction or outlet box that is capped off, with the conduit sealed and the cap labeled as "For future electric vehicle charging".

Electric Vehicle Ready Space: A designated parking space that is provided with a dedicated branch circuit with wiring capable of supporting a minimum 40-ampere, 208/240- Volt circuit that terminates at a receptacle, plug, junction box, or an installed electric vehicle supply equipment within close proximity of the parking space. There shall be adequate reserved space in an electrical panelboard or switchboard to meet the electric vehicle requirements.

Electric Vehicle Supply Equipment (EVSE) Installed Space: A designated parking space with dedicated electric vehicle supply equipment capable of supplying a minimum 40-amp, dedicated circuit rated at 208/240 Volt from a building electrical panelboard.

~~3.~~ **4.** ***Section C401.2 Application,*** is hereby amended to read as follows:

C401.2 Application
Commercial buildings shall comply with Section C401.2.1

~~4.~~ **5.** ***Section C401.2.1 International Energy Conservation Code,*** is hereby deleted and replaced to read as follows:

C401.2.1 International Energy Conservation Code

Commercial buildings shall **be built all-electric unless the fuel gas options of C403.3.2 and the additional electric infrastructure requirements of C405.14 are met. All buildings must comply** with the following:

City of Louisville's Prescriptive Compliance. The Prescriptive Compliance option requires compliance with Sections C401.3, C401.4, C402 through C406, and Section C408.

Core and shell buildings shall be required to comply with the provisions of Section C402.1.3 through C402.5 of the 2021 International Energy Conservation Code.

~~5.~~ **6.** ***Section C401.2.2 ASHRAE 90.1***, is hereby deleted in its entirety.

~~6.~~ **7.** A new ***Section C401.4 Mandatory Requirements for Commercial Buildings***, is hereby added to read as follows:

C401.4 Mandatory Requirements for Commercial Buildings. Commercial buildings must comply with Table C401.4.

Table C401.4 (Mandatory)
Requirements for Commercial Buildings

Title	IECC Section
Air leakage	C402.5
Calculation of heating and cooling loads	C403.1.1
Data centers	C403.1.2
System Design	C403.2
Heating and cooling equipment efficiency	C403.3
Heating and cooling system controls	C403.4, except C403.4.3, C403.4.4, C403.4.5
Economizer fault detection and diagnostics	C403.5.5
Ventilation and exhaust systems	C403.7, except C403.7.4.1
Fan and fan controls	C403.8, except C403.8.6
Large diameter ceiling fans	C403.9
Refrigeration equipment performance	C403.11, except C403.11.3
Construction of HVAC system elements	C403.12
Mechanical systems located outside of the building thermal envelope	C403.13
Service water heating	C404
Electrical power and lighting systems	C405, except C405.3

Maintenance information and system commissioning	C408

~~7.~~ **8.** ***Table C402.1.3 Opaque Thermal Envelope Insulation Component Minimum Requirements, R-Value Method,*** is hereby deleted and replaced with the following:

Table C402.1.3 (Mandatory)
Opaque Thermal Envelope Insulation Component of an Average Minimum Requirements, *R*-Value Method in following locations:

Roof C402.2.1	
Insulation entirely above roof deck	R-49
Metal buildings[a]	R-21 + R-11 LS
Attic and other	R-49
Walls. Above grade C402.2.2	
Mass[d]	R-21
Metal buildings	R-21
Metal framed	R-21
Wood framed and other	R-21
Walls, Below grade C402.2.5	
Below-grade wall[b]	R-10
Floors C402.2.3	
Mass[c]	R-21
Joist/framing	R-38
Slab-on-grade floors C402.2.4	
Unheated	R-20 for 24" below
Heated[e]	R-15 for 36" below + R-5 full slab

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.
NR = No Requirement, LS = Liner System.

a.Where using *R*-value compliance method, a thermal spacer block shall be provided,
b.Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
c."Mass floors" shall be in accordance with Section C402.2.3.
d."Mass walls" shall be in accordance with Section C402.2.2.
e. The first value is for perimeter insulation and the second value is for full, under-slab insulation.

~~8.~~ **9.** ***Section C402.1.4 Assembly U-factor, C-factor or F-factor-based method***, is hereby deleted in its entirety.

~~9.~~ **10.** ***Section C402.1.5 Component performance alternative***, is hereby deleted in its entirety.

~~10.~~ **11.** ***Table C402.4 Building Envelope Fenestration Maximum U-Factor and SHGC Requirements***, is hereby deleted and replaced with the following:

Table C402.4
Building Envelope Fenestration

Vertical Fenestration	
Maximum U-Factor	0.30
Maximum SHGC	0.33
Maximum Air leakage rate for all fenestration except curtain walls and storefront glazing	.20 cfm/ft2
Maximum air leakage rate for curtain walls and storefront glazing	.06 cfm/ft
Skylights	
Maximum U-Factor	0.50
Maximum SHGC	0.40
Maximum Air leakage rate	.20 cfm/ft2

~~11.~~ **12.** ***Section C402.4.1 Maximum area***, is hereby deleted and replaced with the following:

> **C402.4.1 Minimum area of natural lighting.** Not less than eight percent of the floor area shall be glazed.

~~12.~~ **13.** ***Section C402.4.2 Minimum skylight fenestration area***, is hereby deleted and replaced with the following:

> **C402.4.2 Minimum area of natural lighting.** A minimum skylight area of three percent of the roof area shall be provided for all roofs.
>
> **Exception:** Roof areas designated for solar ready zones shall not be included in roof area calculation.

~~13.~~ **14.** ***Section C403.3.2 HVAC equipment performance requirements*****, is hereby deleted in its entirety and replaced to read as follows:**

~~**A. The first paragraph is hereby deleted in its entirety and replaced to read as follows:**~~

> **C403.3.2 HVAC/fuel fired equipment performance requirements. Unless built all-electric, all new combustion equipment shall comply with the more efficient HVAC equipment performance of Sections C406.2, C406.2.3, and C406.2.4 and the additional electric infrastructure requirements in Section C405.14. A mechanical compliance certificate demonstrating compliance with section C406.2.3 and/or C406.2.4 shall be required for all HVAC, fuel fired and Service Water Heating equipment.**

The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrates that the combined efficiency of the specified components meets the requirements herein. (Tables C403.2.(1) through (16) are expressly retained and remain applicable to HVAC equipment performance.)

Exceptions:

1. Factory, laboratory, and high hazard occupancy combustion equipment, except for HVAC and domestic water heating.

2. Commercial Kitchens.

3. Other combustion equipment approved by the Building Official based on demonstration by the applicant that compliance with this section is not feasible and the equipment proposed is the most efficient appliance reasonably available.

~~13~~. **15.** ***Section C403.4.1 Thermostatic controls***, is hereby deleted and replaced with the following:

C403.4.1 Thermostatic controls. The supply of heating and cooling energy to each *zone* shall be controlled by individual thermostatic controls capable of responding to temperature within the *zone*. Where humidification or dehumidification or both is provided, no fewer than one humidity control device shall be provided for each humidity control system. Occupancy sensors shall be provided on the thermostat to setback in accordance with C403.4.2.1

Exception: Independent perimeter systems that are designed to offset only building envelope heat losses, gains or both serving one or more perimeter *zones* also served by an interior system provided that both of the following conditions are met:

1. The perimeter system includes not fewer than one thermostatic control *zone* for each building exposure having exterior walls facing only one orientation (within ±45 degrees) (0.8 rad) for more than 50 contiguous feet (15 240 mm).
2. The perimeter system heating and cooling supply is controlled by thermostats located within the *zones* served by the system.

~~14.~~ **16.** ***Section C403.12.1 Duct and plenum insulation and sealing***, is hereby deleted and replaced with the following:

C403.12.1 Duct and plenum insulation and sealing. All supply and return air ducts and plenums shall be insulated with not less than R-12. Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with Section 603.9 of the International Mechanical Code.

~~15.~~ **17.** ***Section C403.12.3 Piping insulation***, is hereby amended to read as follows:

C403.12.3 Piping insulation. Piping serving as part of a heating or cooling system shall be thermally insulated to R-5.

~~16.~~ **18.** ***Section C404.4 Insulation of piping***, is hereby amended to read as follows:

C404.4 Insulation of piping. Piping from a water heater to the termination of the heated water fixture supply pipe shall be insulated to R-3. On both the inlet and outlet piping of a storage water heater or heated water storage tank, the piping to a heat trap or the first 8 feet (2438 mm) of piping, whichever is less, shall be insulated. Piping that is heat traced shall be insulated to R-3 or the heat trace manufacturer's instructions.

~~17.~~ **19.** ***Section C405.2.1 Occupant sensor controls***, is hereby amended to read as follows:

C405.2.1 Occupant sensor controls. Occupant *sensor controls* shall be installed to control lighting.

~~18.~~ **20.** ***Section C405.2.2 Time-switch controls***, is hereby deleted in its entirety.

~~19.~~ **21.** ***Section C405.2.2.1 Time-switch control function***, is hereby deleted in its entirety.

~~20.~~ **22.** ***Section C405.2.3 Light-reduction controls***, is renumbered to C405.2.2.

~~21.~~ **23.** ***Section C405.2.3.1 Light-reduction function***, is renumbered to C405.2.2.1.

~~22.~~ **24.** ***Section C405.2.4 Daylight-responsive controls***, is renumbered to C405.2.3.

~~23.~~ **25.** ***Section C405.2.4.1 Daylight-responsive control function***, is renumbered to C405.2.3.1.

~~24.~~ **26.** ***Section C405.2.4.2 Sidelit daylight zone***, is renumbered to C405.2.3.2.

~~25.~~ **27.** ***Section C405.2.4.3 Toplit daylight zone,*** is renumbered to C405.2.3.3.

~~26.~~ **28.** ***Section C405.2.4.4 Atriums,*** is renumbered to C405.2.3.4.

~~27.~~ **29.** ***Section C405.2.5 Specific application controls,*** is renumbered to C405.2.4.

~~28.~~ **30.** ***Section C405.2.6 Manual controls,*** is renumbered to C405.2.5.

~~29.~~ **31.** ***Section C405.2.7 Exterior lighting controls,*** is renumber to C405.2.6.

~~30.~~ **32.** ***Section C405.2.7.1 Daylight shut off,*** is renumbered to C405.2.6.1.

~~31.~~ **33.** ***Section C405.2.7.2 Building façade and landscape lighting,*** is renumbered to C405.2.6.2.

~~32.~~ **34.** ***Section C405.2.7.3 Lighting setback,*** is renumbered to C405.2.6.3.

~~33.~~ **35.** ***Section C405.2.7.4 Exterior time-switch control function,*** is renumbered to C405.2.6.4.

~~34.~~ **36.** ***Section C405.2.8 Parking garage lighting control***, is renumbered to C405.2.7.

37. ***Section C405.4.3 Gas lighting, is hereby amended to read as follows:***

> **C405.4.3 Gas lighting. Gas-fired lighting appliances shall not be permitted.**

~~35.~~ **38.** A new ***Section C405.13 Electric vehicle charging infrastructure for new construction and building addition of 25% or more of original square footage***, is hereby added to read as follows:

> **Section C405.13.1 Electric vehicle charging infrastructure for new construction and building addition of 25% or more of original square footage.** Electric vehicle charging shall be provided and installed in accordance with this section, National Electrical Code (NFPA 70), and Section 17.20.170 of the Louisville Municipal Code. When parking spaces are added or modified without an increase in building floor area, only the new parking spaces are subject to this requirement. All *EVSE Installed*, *EV Ready* and *EV Capable* spaces are to be included in the calculation for the number of minimum vehicle spaces required, as provided by the applicable article of the Louisville Zoning Code.
>
> **Section C405.13.2 Identification.** The circuit breakers or circuit breaker spaces reserved for the *EVSE Installed*, *EV Ready*, and *EV Capable* spaces shall be clearly identified in the panelboard directory. The conduit for electric vehicle capable spaces shall be clearly identified at both the panelboard and the termination point at the parking space.

~~36.~~ **39.** A new ***Section C405.14 Additional electric infrastructure***, is hereby added to read as follows:

Section C405.14 Additional electric infrastructure. All *combustion equipment* and end-uses shall be installed in accordance with this section.

C405.14.1 Electric infrastructure for dwelling and sleeping units. *Combustion equipment* and end-uses serving individual dwelling units or sleeping units shall comply with Section R404.5.

C405.14.2 Combustion equipment. *Combustion equipment* shall be provided with conduit that is continuous between a junction box located within 3 feet (914 mm) of the appliance or equipment and an electrical panel. The junction box, conduit and bus bar in the electrical panel shall be rated and sized to accommodate a branch circuit with sufficient capacity for an equivalent electric appliance, equipment or end use with an equivalent equipment capacity. The electrical junction box and electrical panel shall have labels stating, "For Future Electric Equipment".

Exception: Industrial and manufacturing uses are exempt from Section C405.14.

~~37.~~ **40.** ***Section C505.1 General***, is hereby amended to read as follows:

C505.1 General. Where the use in a space changes from one use in Table C405.3.2(1) or C405.3.2(2) to another use in Table C405.3.2(1) or C405.3.2(2), the installed lighting wattage shall comply with Section C405.3. Where the space undergoing a change in occupancy or use is in a building with a fenestration area that exceeds the limitations of Section C402.4.1, the space is exempt from Section C402.4.1 provided that there is not an increase in fenestration area.

Exception: Egress doors with fenestration are allowed to bring total fenestration percentages over the allowed maximum amount of vertical fenestration.

~~38.~~ **41.** ***Section R101.1 Title,*** is amended to insert "the City of Louisville" so the section will read:

R101.1 Title. These regulations shall be known as the Energy Conservation Code of the City of Louisville and shall be cited as such. It is referred to herein as "this code."

42. *Section R103.2 Information on construction documents*, is amended to read as follows:

R103.2 Information on construction documents. Construction documents shall be drawn to scale upon suitable material. Electronic

media documented are permitted to be submitted when *approved* by the *code official*. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment herein governed. Details shall include the following as applicable:

1. **Energy compliance path.**
2. **Insulation materials and their *R*-values**
3. **Fenestration *U*-factor and solar heat gain coefficients (SHGCs).**
4. **Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.**
5. **Mechanical system design criteria.**
6. **Mechanical and service water heating systems and equipment types, sizes, fuel source and efficiencies.**
7. **Equipment and system controls.**
8. **Duct sealing, duct and pipe insulation and location.**
9. **Air sealing detail.**
10. **Location of pathways for routing of raceways or cable from the solar ready zone to the electrical service panel.**

~~39.~~ **43.** ***Section R202 General Definitions***, is hereby amended by adding, in alphabetical order, the following definitions:

All-Electric Building: **A building that contains no combustion equipment, or plumbing for combustion equipment, installed within the building or building site.**

Combustion Equipment: Any equipment or appliance used for space heating, service water heating, cooking, clothes drying and/or lighting that uses fuel gas or fuel oil.

Electric Vehicle (EV): A vehicle registered for on-road use, primarily powered by an electric motor that draws current from a rechargeable storage source that is charged by being plugged into an electrical current source.

Electric Vehicle Supply Equipment (EVSE): The electrical conductors and associated equipment external to the electric vehicle that provide a connection between the premises wiring and the electric vehicle to provide electric vehicle charging.

Electric Vehicle Capable Space: A designated parking space that is provided with conduit sized and rated for a minimum 40-amp, 208/240-Volt dedicated branch circuit and shall be no less than 1" in size. Conduit must be continuous from the future or existing electrical panel board or switchboard

location(s) and end at a junction box or receptacle located within close proximity of the parking space. The electrical panel serving the parking space shall have sufficient capacity and physical space for a dual-pole, 40-amp breaker. The conduit shall be sealed at the junction or outlet box that is capped off, with the conduit sealed and the cap labeled as "For future electric vehicle charging".

Electric Vehicle Ready Space: A designated parking space that is provided with a dedicated branch circuit with wiring capable of supporting a minimum 40-ampere, 208/240- Volt circuit that terminates at a receptacle, plug, junction box, or an installed electric vehicle supply equipment within close proximity of the parking space. There shall be adequate reserved space in an electrical panel board or switchboard to meet the electric vehicle requirements.

~~40.~~ **44.** ***Section R401.2 Application,*** is hereby deleted and replaced with the following:

> **R401.2 Application.** Residential buildings shall be **built ~~100%~~** all-electric unless **the** fuel gas **options of R403.7 and additional electric infrastructure requirements of R404.5** are met. **~~and all~~ All** residential buildings shall comply with the R401.2.1 City of Louisville's Prescriptive Compliance or R406 Energy Rating Index with a maximum rating index of 50 before the installation of solar panels.
>
> **Exception:** Additions, alterations, repairs and changes of occupancy to existing buildings complying with Chapter 5.

~~41.~~ **45.** ***Section R401.2.1 Prescriptive Compliance Option,*** is hereby deleted and replaced with the following:

> **R401.2.1 City of Louisville's Prescriptive Compliance.** The City of Louisville's Prescriptive compliance requires compliance with Sections R401 through R404.

~~42.~~ **46.** ***Section R401.2.2 Total Building Performance Option***, is hereby deleted in its entirety.

~~43.~~ **47.** ***Section R401.2.4 Tropical Climate Region***, is hereby deleted in its entirety.

~~44.~~ **48.** ***Section R401.2.5 Additional Energy Efficiency***, is hereby amended to read as follows:

> **Section R401.2.5 Additional Energy Efficiency.** Building shall comply with one of the additional efficiency options and shall be installed in according to Section R408.2.

~~45.~~ **49.** A new ***Section R401.4 Mandatory requirements for residential buildings***, is hereby added to read as follows:

R401.3 Mandatory requirements for residential buildings. Residential building must comply with the following sections from the 2021 International Energy Conservation Code.

Table R401.3
Mandatory requirements for residential buildings

Title	**IECC Section**
Vapor retarder	R402.1.1
Eave baffle	R402.2.3
Access hatches and doors	R402.2.4.1
Crawl space wall insulation	R402.4.1.2
Maximum fenestration U-factor and SHGC	R402.5
Mechanical Controls	R403.1
Ducts	R403.3 except R403.3.2, R403.3.3, and R403.6
Mechanical system piping insulation	R403.4
Heated water circulation and temperature maintenance systems	R403.5.1
Drain Water heat recovery units	R403.5.3
Mechanical ventilation	R403.6 including E403.6.1
Equipment sizing and efficiency rating	R403.7
Systems serving multiple dwelling units	R403.8
Snow melt and ice systems	R403.9
Energy consumption of pools and spas	R403.10
Portable spas	R403.11
Residential pools and permanent residential spas	R403.12
Lighting equipment	R404.1
Interior lighting controls	R404.2

~~46.~~ **50.** ***Section R402.1 General***, is hereby amended to read as follows:

R402.1 General. The building thermal envelope shall comply with the requirements of Section R402.1.1 and R402.1.2.

~~47.~~ **51.** ***Section R402.1.2 Insulation and fenestration***, is hereby deleted and replaced with the following***:***

R402.1.2 Insulation and fenestration. Assemblies shall have R-value of insulation materials equal to or greater than that specified in Table R402.1.2 unless an alternative path is specified while using HERS energy rating index of 50.

Table R402.1.2
Average Insulation and Fenestration Requirements by Component

Roof	R-60
Above grade walls	R-21
Below grade walls	R-21
Floors	R-38
Non heated slab on grade	R-10 for 4ft
Heated slab on grade	R-15 for 4 ft + R-5 under full slab
Fenestration U-Factor	.30
Fenestration SHGC	.33
Skylight U-Factor	.50
Skylight SHGC	.40

~~48.~~ **52.** ***Section R402.1.5 Total UA alternative***, is hereby deleted in its entirety.

~~49.~~ **53.** ***Section R402.3.3 Glazed fenestration exemption***, is hereby amended to read as follows:

> **R402.3.3 Glazed fenestration exemption**. Not greater than 15 square feet (1.4 m^2) of glazed fenestration per dwelling unit shall be exempt from the U-factor and SHGC requirements in Section R402.1.2.

~~50.~~ **54.** ***Section R402.4.1.2 Testing***, is hereby deleted and replaced to read as follows:

> **Section R402.4.1.2 Testing.** All new buildings or dwelling units that are heated or cooled, and additions over 500 square feet shall be tested for air leakage.

~~51.~~ **55.** ***Section R402.5 Maximum fenestration U-factor and SHGC***, is hereby deleted and replaced with the following***:***

> **Section R402.5 Maximum fenestration U-factor and SHGC.** The maximum U-factor and solar heat gain coefficient (SHGC) for fenestration shall not be required in storm shelters complying with ICC 500.

~~52.~~ **56.** ***Section R403.3.1 Ducts located outside conditioned space,*** is hereby deleted and replaced with the following*:*

R403.3.1 ***Ducts located outside conditioned space*****.** All supply and return ducts shall be insulated to a minimum R-8 if located outside a conditioned space.

~~53.~~ **57.** ***Section R403.5.2 Hot water pipe insulation,*** is hereby deleted and replaced with the following*:*

R403.5.2 Hot water pipe insulation. All service hot water piping shall be insulated to a minimum R-5.

~~54.~~ **58.** ***Section R403.6.1 Heat and recovery ventilation,*** is hereby deleted and replaced in its entirety and the following is hereby added in lieu thereof*:*

R403.5.2 Heat and recovery ventilation. All new buildings and additions over 500 square feet shall be provided with a heat recovery or energy recovery ventilation system. The system shall be balanced with a minimum sensible heat recovery efficiency of 65 percent at 32°F (0°C) at a flow greater than or equal to the design airflow.

~~55.~~ **59.** ***Section R403.7 Equipment sizing and efficiency rating,*** is hereby deleted and replaced with the following*:*

R403.7 Equipment sizing and efficiency rating. All new buildings and additions greater than 500 square feet with heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies. In addition to complying with Sec. R404.6 Additional Electric Infrastructure, new and replacement **electrical** heating and cooling equipment shall have an efficiency rating equal to or greater than the minimum required by federal law for the geographic location where the equipment is installed. **New gas heating equipment shall comply with the following efficiencies:**

1. **Gas furnaces shall have a minimum of 96% efficiency.**
2. **Gas boilers shall have a minimum of 90% AFUE.**
3. **On demand water heaters shall have a greater than .92 uniform energy factor.**

Exception: Solid fuel stoves/gas fireplaces, outdoor fire pits, gas stoves and ovens.

60. ***Section R404.1.1 Fuel gas lighting equipment, is hereby amended to read as follows:***

R404.1.1 Fuel gas lighting equipment. Fuel gas lighting systems shall not be installed.

~~56.~~ **61.** A new ***Section R404.4 Electric vehicle charging infrastructure for new construction and building addition of 50% or more of original square footage,*** is hereby added to read as follows:

Section R404.4 Electric vehicle charging infrastructure for new construction and building addition of 50% or more of original square footage. Electric infrastructure for the current and future charging of *electric vehicles* shall be installed in accordance with this section per Section 17.20.170 of the Louisville Municipal Code. *EV ready spaces and EV capable spaces* are permitted to be counted toward meeting minimum parking requirements.

R404.4.1 One- and two- family dwellings and townhouses. One- and two-family dwellings and townhouses with a dedicated attached or detached garage or on-site parking spaces shall be provided with electric vehicle charging in accordance with Section 17.20.170 of the Louisville Municipal Code.

R404.4.1.1 Minimum EV Ready infrastructure. Minimum EV Ready Space infrastructure shall require the following:

1. Installation of conductors:
    a. Conductors shall be installed of sufficient size to accommodate a minimum 240VAC 40Amp branch circuit to each parking space where required.
    b. Conductors shall terminate in either a receptacle, plug, junction or outlet box, or an *EVSE* installed in the parking space.
2. The electrical panel directory shall designate the branch circuit as "EV Ready" and the junction box or receptacle shall be labelled "EV Ready."

R404.4.1.2 Construction documents. Construction documents shall graphically indicate and label all EV ready spaces and associated termination locations. For all Townhouses and one- and two-family dwellings with an electrical utility service 200 Amps or greater, a panelboard schedule shall be provided indicating the EV Ready circuit breaker space(s) and the circuit designation(s).

R404.4.2 Group R occupancies. Group-R occupancies (R-2, R-3, and R-4 buildings three stories and less) with three or more dwelling units and/or sleeping units shall be provided with electric vehicle

charging in accordance with Section 17.20.170 of the Louisville Municipal Code.

Electric vehicle charging shall be provided and installed in accordance with this section and the National Electrical Code (NFPA 70). When parking spaces are added or modified without an increase in building floor area, only the new parking spaces are subject to this requirement.

~~57.~~ **62.** A new ***Section R404.5 Additional electric infrastructure,*** is hereby added to read as follows:

R404.5 Additional electric infrastructure. *Combustion equipment* shall be installed in accordance with this section.

R404.5.1 Combustion equipment and end-uses. *Combustion equipment* shall be provided with a dedicated, appropriately phased circuit that shall have a minimum amperage requirement for a comparable electric appliance, equipment or end use, an electrical receptacle or junction box that is connected to the electric panel, and conductors of adequate capacity within 6 feet (1829 mm) of the appliance or equipment.

Each such circuit shall be accessible with no obstructions. A reserved circuit breaker space shall be installed in the electrical panel adjacent to the circuit breaker for the branch circuit and labeled for each circuit. Both ends of the unused conductor or conduit shall be labeled "For Future Electric Equipment" and be electrically isolated.

~~58.~~ **63.** ***Section R405 Total building performance,*** is deleted in its entirety.

~~59.~~ **64.** ***Section R406.3 Building thermal envelope,*** is hereby deleted and replaced with the following*:*

R406.3 Building thermal envelope. Building and portions thereof shall comply with Table R406.3.

Table R406.3
Average of the Insulation and Fenestration Requirements by Component

Roof	R-60
Above grade walls	R-21
Below grade walls	R-21
Floors	R-38
Non heated slab on grade	R-10 for 4ft

Heated slab on grade	R-15 for 4 ft + R-5 under full slab
Fenestration U-Factor	.30
Fenestration SHGC	.33
Skylight U-Factor	.50
Skylight SHGC	.40

~~60.~~ **65.** ***Section R406.3.1 On-site renewables are not included,*** is deleted in its entirety.

~~61.~~ **66.** ***Section R406.3.2 On-site renewables are included,*** is deleted in its entirety.

~~62.~~ **67.** ***Section R406.3.2 Tropical Climate Region Compliance Path,*** is deleted in its entirety.

~~63.~~ **68.** ***Section R505.1 General,*** is hereby amended to remove the exception.

~~64.~~ **69.** ***Section R505.1.1 Unconditioned space,*** is hereby deleted and replaced with the following:

> **R505.1.1** Unconditioned space. Any unconditioned or low-energy space that is altered to become a conditioned space shall comply with Section R503.

Sec.15.18.040. – Design criteria.

All new heated commercial and residential heated structures shall meet the following design criteria:

1. **Non-reducible ~~Snow~~ roof snow load**: 30 pounds per square foot.

2. Wind speed:

   a. 145 miles per hour three second gust ASCE-7-10;

   b. ASTM D3161 test with Class F Application.

3. Wind exposure: "C", unless in the opinion of the Chief Building Official greater restrictions are needed to protect public safety.

4. Seismic zone: B.

5. Frost line depth: 36 inches below finished grade.

6. Weathering: Severe – Climate Zone 5B.

7. Termite: Slight.

8. Decay: Slight.

9. Winter design temperature: one degree.

10. Anticipated snow: six inches.

11. Ice and water shield: required on all shingled roofs – eaves only. Shields must extend from the lowest edges to a point at least 24 inches inside the exterior wall line of the building.

12. Drip edge: required on both eaves and rakes of roof.

13. Air freezing index: less than 1000.

14. Mean annual temperature: 47 degrees.

15. Elevation: 5,337 feet above sea level.

16. Sump pumps:

a. Cannot drain into sanitary or storm sewer;

b. Must daylight into lawn away from foundation;

c. Perimeter foundation systems must day light or drain into sump pit and then sump pump, and sump pump must drain into lawn.

17. Drainage from house: slope at least six inches in the first ten feet.

18. Retaining walls:

a. Less than 48 inches from the bottom of the footing to the top of the retaining wall with no surcharge: no permit required.

b. More than 48 inches from bottom of footing to top of retaining wall, or any wall with surcharge: requires stamped engineering plans.

19. Backflow preventer: required on all residential irrigation systems (see cross connection control regulations).

20. Hot water heaters:

a. Expansion tanks required for all hot water heaters;

b. Drain pan required if placed on wood floor.

Sec.15.18.050. - Applicability.

Notwithstanding anything in the International Energy Conservation Code to the contrary, a developer/owner of a residential or commercial building may elect an inspection in accordance with the policies and procedures of the International Energy Conservation Code, as amended herein.

Sec. 15.18.060. - Copies available.
At least one copy of the International Energy Conservation Code, 2021 Edition, as amended herein, certified to be true and accurate, shall be available for public inspection at the office of the Building Safety Division, during business hours. The city clerk shall at all times maintain a reasonable supply of copies of the code available for purchase by the public at a moderate price. Electronic copies are available, without amendment, at https://codes.iccsafe.org/public/collections/I-Codes.

Sec. 15.18.070. - Violations and penalties.
It shall be unlawful for any person, firm, or corporation to erect, construct, enlarge, alter, repair, move, improve, remove, convert or demolish, equip, use, occupy or maintain any building or structure or cause or permit the work to be done, in violation of the provisions of this chapter or the terms of the code or standards adopted and incorporated in this chapter. Any person convicted of a violation of any provision of this chapter or of the provisions of the code or standards adopted and incorporated in this chapter shall be subject to the penalty provided in section 1.28.010.

Section 2. Chapter 15.60 of the Louisville Municipal Code is hereby repealed.

Section 3. Title 17 the Louisville Municipal Code is hereby amended by the addition of a new Section 17.20.170 to read as follows:

Sec. 17.20.170. – Electric vehicle charging infrastructure. ~~Vehicle Charging Infrastructure.~~

A. Purpose and Intent. The purpose and intent of this section is to facilitate and encourage the use of electric vehicles, to expedite the establishment of convenient and cost-effective electric vehicle infrastructure, and establish the minimum requirements for such infrastructure to serve both short and long-term parking needs.

B. Definitions. The following definitions shall apply to this Section:

Electric vehicle charging stations (EVCS) means a public or private parking space that is served by battery charging station equipment that has as its primary purpose the transfer of electric energy (by conductive or inductive means) to a battery or other energy storage device in an electric vehicle.

Electric vehicle charging station – private restricted use means an electric vehicle charging station that is:

1. Privately owned and restricted access (e.g., single-family dwelling unit, executive parking, designated employee parking, assigned parking at multi-family residential building); or

2. Publicly owned and restricted (e.g., fleet parking with no access to the general public).

Electric vehicle charging station – public use means an electric vehicle charging station that is:

1. Publicly owned and publicly available (e.g., Park-n-ride, public library parking lot, Recreation and Senior Center lot, etc); or

2. Privately owned and available to visitors of the use (e.g., shopping center, hotel, office, etc.)

Electric vehicle parking space means any marked parking space that identifies the use to be exclusively for the parking of an electric vehicle.

C. Number of required electric vehicle charging stations. The following table sets forth the number of required charging stations for all new development or redevelopments as required in Chapter 15.18 of the Louisville Municipal Code. This list is not intended to be exhaustive of each use category, however is intended to establish general categories of use tiers. The Director of Planning and Building Safety shall determine the appropriate tier if the use is not identified in the table below.

1. Requirements will be rounded up to the nearest whole number.

2. Minimum electrical and hardware requirements for EVSE Installed, EV Ready, and EV Capable are set forth in Chapter 15.18 of the Louisville Municipal Code.

	EV Installed	EV- Ready	EV Capable
Residential Uses			
Single-Family unit		1 space	1 space

Multi-Family unit, with dedicated parking spaces or garages		1 space	1 space
Tier 1			
Multi-Family, without dedicated parking spaces or garages	10% of spaces	10% of spaces	50% of spaces
Hotel, Motel, Extended Stay Lodging Facility			
Tier 2 – Employment oriented uses	7% of spaces	10% of spaces	15% of spaces
Business and Professional Offices			
General research facilities, light industrial facilities including manufacturing, assembly, warehouse and fabrication			
Hospital			
Tier 3 – Service and Sales oriented uses	5% of spaces	10% of spaces	10% of spaces
Private and public recreational and social facilities, membership clubs, lodges, and fraternal organizations			
Religious institution			
Commercial amusement, indoor and outdoor			
Schools, including public, private, vocational or business			
Restaurant			
Retail			
Personal service			
Medical and dental clinics			

D. Permitted locations.

1. EVCS are permitted in every zoning district when accessory to a principal permitted use. Such stations located a single-family and designated multi-family units shall be private restricted use only.

2. If the primary use of the parcel is the retail electric charging of vehicles, then the use shall be considered an automotive fueling station for zoning purposes. Installation shall be located in zone districts which permit this use.

E. General requirements.

1. Accessible spaces. A charging station will be considered accessible if it is located adjacent to, and can serve, an accessible parking space as

defined and required by the ADA. It is not necessary to designate the EVSE exclusively for the use of vehicles parked in the accessible space.

2. EVCS – public use shall be subject to the following requirements.

a. The EVCSs shall be located in a manner that will be easily seen by the public for informational and security purposes.

b. The EVCSs shall be located in desirable and convenient parking locations will serve as an incentive for the use of electric vehicles.

c. The EVCSs must be operational during the normal business hours of the use(s) that it serves.

d. The EVSE shall be maintained in all respects, including the functioning of equipment. A phone number or other contact information shall be provided on the equipment for reporting problems with the equipment or access to it.

e. The property owner may collect a service fee for the use of EVSE.

F. The requirements of this section shall be shall be implemented through the building permit process and shall apply to:

1. All new construction, expansion or modification projects for which a building permit has not been issued as of _____, 2021; and

2. All planned unit developments for which a building permit has not been issued as of _____, 2021, irrespective of whether such planned unit development was approved or approved and recorded prior to such date, unless a waiver was expressly granted through the planned unit development review process set forth in Chapter 17.28.

Section 4. If any article, section, paragraph, sentence, clause, or phrase of this ordinance is held to be unconstitutional or invalid for any reason, such decision shall not affect the validity or constitutionality of the remaining portions of this ordinance. The City Council hereby declares that it would have passed this ordinance and each part or parts hereof irrespective of the fact that any one part or parts be declared unconstitutional or invalid.

Section 5. The repeal or modification of any provision of any prior ordinance by this ordinance shall not release, extinguish, alter, modify, or change in whole or in part any penalty, forfeiture or liability, either civil or criminal, which shall have been incurred under such provision, and each provision shall be treated and held as still remaining in force for the purpose of sustaining

any judgment, decree, or order which can or may be rendered, entered, or made in such actions, suits, proceedings, or prosecutions.

Section 6. All other ordinances or portions thereof inconsistent or conflicting with this ordinance or any portion hereof are hereby repealed to the extent of such inconsistency or conflict.

INTRODUCED, READ, PASSED ON FIRST READING, AND ORDERED PUBLISHED this _____ day of _____, 2021.

_____
Ashley Stolzmann, Mayor

ATTEST:

_____
Meredyth Muth, City Clerk

APPROVED AS TO FORM:

_____
Kelly PC, City Attorney

PASSED AND ADOPTED ON SECOND AND FINAL READING, this _____ day of _____, 2021.

_____
Ashley Stolzmann, Mayor

ATTEST:

_____
Meredyth Muth, City Clerk

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APPENDIX CC

ZERO ENERGY COMMERCIAL BUILDING PROVISIONS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

User note:

About this chapter: *Appendix CC provides a model for applying new renewable energy generation when new buildings add electric load to the grid. This renewable energy will avoid the additional emissions that would otherwise occur from conventional power generation.*

SECTION CC101
GENERAL

CC101.1 Purpose. The purpose of this appendix is to supplement the *International Energy Conservation Code* and require renewable energy systems of adequate capacity to achieve net zero carbon.

CC101.2 Scope. This appendix applies to new buildings that are addressed by the *International Energy Conservation Code*.

Exceptions:

1. Detached one- and two-family dwellings and townhouses as well as Group R-2 buildings three stories or less in height above grade plane, manufactured homes (mobile dwellings), and manufactured houses (modular dwellings).
2. Buildings that use neither electricity nor fossil fuel.

SECTION CC102
DEFINITIONS

CC102.1 Definitions. The definitions contained in this section supplement or modify the definitions in the *International Energy Conservation Code*.

ADJUSTED OFF-SITE RENEWABLE ENERGY. The amount of energy production from off-site renewable energy systems that may be used to offset building energy.

BUILDING ENERGY. All energy consumed at the *building site* as measured at the site boundary. Contributions from on-site or off-site renewable energy systems shall not be considered when determining the building energy.

ENERGY UTILIZATION INTENSITY (EUI). The site energy for either the baseline building or the proposed building divided by the gross *conditioned floor area* plus any semiheated floor area of the building. For the baseline building, the EUI can be divided between regulated energy use and unregulated energy use.

OFF-SITE RENEWABLE ENERGY SYSTEM. Renewable energy system not located on the building project.

ON-SITE RENEWABLE ENERGY SYSTEM. Renewable energy systems on the building project.

RENEWABLE ENERGY SYSTEM. Photovoltaic, solar thermal, geothermal energy and wind systems used to generate energy.

SEMIHEATED SPACE. An enclosed space within a building that is heated by a heating system whose output capacity is greater than or equal to 3.4 Btu/h × ft^2 of floor area but is not a conditioned space.

ZERO ENERGY PERFORMANCE INDEX (ZEPI PB/EE). The ratio of the proposed building EUI without renewables to the baseline building EUI, expressed as a percentage.

SECTION CC103
MINIMUM RENEWABLE ENERGY

CC103.1 Renewable energy. On-site renewable energy systems shall be installed, or off-site renewable energy shall be procured to offset the building energy as calculated in Equation CC-1.

$$RE_{onsite} + RE_{offsite} \geq E_{building} \qquad \textbf{(Equation CC-1)}$$

where:

RE_{onsite} = Annual site energy production from on-site renewable energy systems (see Section CC103.2).

$RE_{offsite}$ = Adjusted annual site energy production from off-site renewable energy systems that may be credited against building energy use (see Section CC103.3).

$E_{building}$ = Building energy use without consideration of renewable energy systems.

When Section C401.2.1(1) is used for compliance with the *International Energy Conservation Code*, building energy shall be determined by multiplying the gross *conditioned floor area* plus the gross semiheated floor area of the proposed building by an EUI selected from Table CC103.1. Use a weighted average for mixed-use buildings.

When Section C401.2.1, Item 2 or Section C401.2.2 is used for compliance with the *International Energy Conservation Code*, building energy shall be determined from energy simulations.

CC103.2 Calculation of on-site renewable energy. The annual energy production from on-site renewable energy

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TABLE CC103.1
ENERGY UTILIZATION INTENSITY FOR BUILDING TYPES AND CLIMATES (kBtu/ft² – yr)

BUILDING AREA TYPE	CLIMATE ZONE																
	0A/1A	0B/1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
	kBtu/ft² – yr																
Healthcare/hospital (I-2)	119	120	119	113	116	109	106	116	109	106	118	110	105	126	116	131	142
Hotel/motel (R-1)	73	76	73	68	70	67	65	69	66	65	71	68	65	77	72	81	89
Multiple-family (R-2)	43	45	41	41	43	42	36	45	43	41	47	46	41	53	48	53	59
Office (B)	31	32	30	29	29	28	25	28	27	25	29	28	25	33	30	32	36
Restaurant (A-2)	389	426	411	408	444	420	395	483	437	457	531	484	484	589	538	644	750
Retail (M)	46	50	45	46	44	44	37	48	44	44	52	50	46	60	52	64	77
School (E)	42	46	42	40	40	39	36	39	40	40	39	43	37	44	40	45	54
Warehouse (S)	9	12	9	11	12	11	10	17	13	14	23	17	15	32	23	32	32
All others	55	58	54	53	53	51	48	54	52	51	57	54	50	63	57	65	73

systems shall be determined using the PVWatts software or other software approved by the code official.

CC103.3 Off-site renewable energy. Off-site energy shall comply with Sections CC103.3.1 and CC103.3.2.

CC103.3.1 Qualifying off-site procurement methods. The following are considered qualifying off-site renewable energy procurement methods:

1. Community renewables: an off-site renewable energy system for which the owner has purchased or leased renewable energy capacity along with other subscribers.
2. Renewable energy investment fund: an entity that installs renewable energy capacity on behalf of the owner.
3. Virtual power purchase agreement: a power purchase agreement for off-site renewable energy where the owner agrees to purchase renewable energy output at a fixed price schedule.
4. Direct ownership: an off-site renewable energy system owned by the building project owner.
5. Direct access to wholesale market: an agreement between the owner and a renewable energy developer to purchase renewable energy.
6. Green retail tariffs: a program by the retail electricity provider to provide 100-percent renewable energy to the owner.
7. Unbundled Renewable Energy Certificates (RECs): certificates purchased by the owner representing the environmental benefits of renewable energy generation that are sold separately from the electric power.

CC103.3.2 Requirements for all procurement methods. The following requirements shall apply to all *off-site renewable* energy procurement methods:

1. The building owner shall sign a legally binding contract to procure qualifying off-site renewable energy.
2. The procurement contract shall have duration of not less than 15 years and shall be structured to survive a partial or full transfer of ownership of the property.
3. RECs and other environmental attributes associated with the procured *off-site renewable energy* shall be assigned to the building project for the duration of the contract.
4. The renewable energy generating source shall include one or more of the following: photovoltaic systems, solar thermal power plants, geothermal power plants and wind turbines.
5. The generation source shall be located where the energy can be delivered to the building site by the same utility or distribution entity, the same independent system operator (ISO) or regional transmission organization (RTO), or within integrated ISOs (electric coordination council).
6. The *off-site renewable energy* producer shall maintain transparent accounting that clearly assigns production to the building. Records on power sent to or purchased by the building shall be retained by the building owner and made available for inspection by the code official upon request.

CC103.3.3 Adjusted off-site renewable energy. The process for calculating the adjusted *off-site renewable energy* is shown in Equation CC-2.

$$RE_{offsite} = \sum_{i=1}^{n} PF_i \times RE_i = PF_1 \times RE_1 + PF_2 \times RE_2 + \ldots + PF_n \times RE_n$$

(Equation CC-2)

where:

$RE_{offsite}$ = Adjusted off-site renewable energy.

PF_i = Procurement factor for the i^{th} renewable energy procurement method or class taken from Table CC103.3.3.

RE_i = Annual energy production for the i^{th} renewable energy procurement method or class.

n = The number of renewable energy procurement options or classes considered.

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TABLE CC103.3.3
DEFAULT OFF-SITE RENEWABLE ENERGY PROCUREMENT METHODS, CLASSES AND COEFFICIENTS

CLASS	PROCUREMENT FACTOR (PF)	PROCUREMENT OPTIONS	ADDITIONAL REQUIREMENTS (see also Section CC103.3.2)
1	0.75	Community solar	—
		REIFs	Entity must be managed to prevent fraud or misuse of funds.
		Virtual PPA	—
		Self-owned off-site	Provisions shall prevent the generation from being sold separately from the building.
2	0.55	Green retail tariffs	The offering shall not include the purchase of unbundled RECs.
		Direct access	The offering shall not include the purchase of unbundled RECs.
3	0.20	Unbundled RECs	The vintage of the RECs shall align with building energy use.

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APPENDIX RC
ZERO ENERGY RESIDENTIAL BUILDING PROVISIONS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

User Note:

About this appendix: *This appendix provides requirements for residential buildings intended to result in net zero energy consumption over the course of a year. Where adopted by ordinance as a requirement, Section RC101 language is intended to replace Section R401.2.*

SECTION RC101
COMPLIANCE

RC101.1 Compliance. Existing residential buildings shall comply with Chapter 5. New residential buildings shall comply with Section RC102.

SECTION RC102
ZERO ENERGY RESIDENTIAL BUILDINGS

RC102.1 General. New *residential buildings* shall comply with Section RC102.2.

RC102.2 Energy Rating Index zero energy score. Compliance with this section requires that the rated design be shown to have a score less than or equal to the values in Table RC102.2 when compared to the Energy Rating Index (ERI) reference design determined in accordance with RESNET/ICC 301 for both of the following:

1. ERI value not including on-site power production (OPP) calculated in accordance with RESNET/ICC 301.
2. ERI value including on-site power production calculated in accordance with RESNET/ICC 301 with the OPP in Equation 4.1.2 of RESNET/ICC 301 adjusted in accordance with Equation RC-1.

Adjusted OPP = OPP + CREF + REPC **(Equation RC-1)**

where:

CREF = Community Renewable Energy Facility power production—the yearly energy, in kilowatt hour equivalent (kWheq), contracted from a community renewable energy facility that is qualified under applicable state and local utility statutes and rules, and that allocates bill credits to the rated home.

REPC = Renewable Energy Purchase Contract power production—the yearly energy, in kilowatt hour equivalent (kWheq), contracted from an energy facility that generates energy with photovoltaic, solar thermal, geothermal energy or wind systems, and that is demonstrated by an energy purchase contract or lease with a duration of not less than 15 years.

TABLE RC102.2
MAXIMUM ENERGY RATING INDEX[a]

CLIMATE ZONE	ENERGY RATING INDEX NOT INCLUDING OPP	ENERGY RATING INDEX INCLUDING ADJUSTED OPP (as proposed)
1	43	0
2	45	0
3	47	0
4	47	0
5	47	0
6	46	0
7	46	0
8	46	0

a. The building shall meet the requirements of Table R406.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table R402.1.2 or R402.1.3.

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NOTE: This bill has been prepared for the signatures of the appropriate legislative officers and the Governor. To determine whether the Governor has signed the bill or taken other action on it, please consult the legislative status sheet, the legislative history, or the Session Laws.

An Act

HOUSE BILL 19-1261

BY REPRESENTATIVE(S) Becker and Jackson, Jaquez Lewis, Bird, Cutter, Duran, Froelich, Galindo, Hooton, Kennedy, Kipp, Melton, Roberts, Singer, Sirota, Snyder, Sullivan, Tipper, Titone, Valdez A., Weissman, Arndt, Benavidez, Buckner, Buentello, Caraveo, Exum, Gonzales-Gutierrez, Gray, Hansen, Lontine, McCluskie, Michaelson Jenet, Mullica, Esgar, Herod, McLachlan;
also SENATOR(S) Winter and Williams A., Moreno, Bridges, Court, Danielson, Donovan, Fenberg, Fields, Foote, Ginal, Gonzales, Lee, Pettersen, Story, Todd, Zenzinger.

CONCERNING THE REDUCTION OF GREENHOUSE GAS POLLUTION, AND, IN CONNECTION THEREWITH, ESTABLISHING STATEWIDE GREENHOUSE GAS POLLUTION REDUCTION GOALS AND MAKING AN APPROPRIATION.

Be it enacted by the General Assembly of the State of Colorado:

SECTION 1. In Colorado Revised Statutes, **amend** 25-7-102 as follows:

25-7-102. Legislative declaration. (1) In order to foster the health, welfare, convenience, and comfort of the inhabitants of the state of Colorado and to facilitate the enjoyment and use of the scenic and natural

Capital letters or bold & italic numbers indicate new material added to existing law; dashes through words or numbers indicate deletions from existing law and such material is not part of the act.

resources of the state, it is declared to be the policy of this state to achieve the maximum practical degree of air purity in every portion of the state, to attain and maintain the national ambient air quality standards, and to prevent the significant deterioration of air quality in those portions of the state where the air quality is better than the national ambient air quality standards. To that end, it is the purpose of this ~~article~~ ARTICLE 7 to require the use of all available practical methods which are technologically feasible and economically reasonable so as to reduce, prevent, and control air pollution throughout the state of Colorado; to require the development of an air quality control program in which the benefits of the air pollution control measures utilized bear a reasonable relationship to the economic, environmental, and energy impacts and other costs of such measures; and to maintain a cooperative program between the state and local units of government. It is further declared that the prevention, abatement, and control of air pollution in each portion of the state are matters of statewide concern and are affected with a public interest and that the provisions of this ~~article~~ ARTICLE 7 are enacted in the exercise of the police powers of this state for the purpose of protecting the health, peace, safety, and general welfare of the people of this state. The general assembly further recognizes that a current and accurate inventory of actual emissions of air pollutants from all sources is essential for the proper identification and designation of attainment and nonattainment areas, the determination of the most cost-effective regulatory strategy to reduce pollution, the targeting of regulatory efforts to achieve the greatest health and environmental benefits, and the achievement of a federally approved clean air program. In order to achieve the most accurate inventory of air pollution sources possible, this ~~article~~ ARTICLE 7 specifically provides incentives to achieve the most accurate and complete inventory possible and to provide for the most accurate enforcement program achievable based upon that inventory.

(2) IT IS FURTHER DECLARED THAT:

(a) CLIMATE CHANGE ADVERSELY AFFECTS COLORADO'S ECONOMY, AIR QUALITY AND PUBLIC HEALTH, ECOSYSTEMS, NATURAL RESOURCES, AND QUALITY OF LIFE;

(b) COLORADO IS ALREADY EXPERIENCING HARMFUL CLIMATE IMPACTS, INCLUDING DECLINING SNOWPACK, PROLONGED DROUGHT, MORE EXTREME HEAT, ELEVATED WILDFIRE RISK AND RISK TO FIRST RESPONDERS, WIDESPREAD BEETLE INFESTATION DECIMATING FORESTS, INCREASED RISK

OF VECTOR-BORNE DISEASES, MORE FREQUENT AND SEVERE FLOODING, MORE SEVERE GROUND-LEVEL OZONE POLLUTION CAUSING RESPIRATORY DAMAGE AND LOSS OF LIFE, DECREASED ECONOMIC ACTIVITY FROM OUTDOOR RECREATION AND AGRICULTURE, AND DIMINISHED QUALITY OF LIFE. MANY OF THESE IMPACTS DISPROPORTIONATELY AFFECT RURAL COMMUNITIES, COMMUNITIES OF COLOR, YOUTH AND THE ELDERLY, AND WORKING FAMILIES. REDUCING STATEWIDE GREENHOUSE GAS POLLUTION AS OUTLINED IN THIS SUBSECTION (2) WILL PROTECT THESE FRONTLINE COMMUNITIES, FIRST RESPONDERS, AND ALL COLORADO RESIDENTS FROM THESE AND OTHER CLIMATE IMPACTS.

(c) WE MUST WORK TOGETHER TO REDUCE STATEWIDE GREENHOUSE GAS POLLUTION IN ORDER TO LIMIT THE INCREASE IN THE GLOBAL AVERAGE TEMPERATURE TO ONE AND ONE-HALF DEGREES CELSIUS, WHICH SCIENTISTS AGREE WOULD PROVIDE A MORE STABLE AND HOSPITABLE CLIMATE FOR CURRENT AND FUTURE GENERATIONS AND MITIGATE THE RISK OF CATASTROPHIC CLIMATE IMPACTS IN COLORADO;

(d) BY REDUCING GREENHOUSE GAS POLLUTION, COLORADO WILL ALSO REDUCE OTHER HARMFUL AIR POLLUTANTS WHICH WILL, IN TURN, IMPROVE PUBLIC HEALTH, REDUCE HEALTH CARE COSTS, IMPROVE AIR QUALITY, AND HELP SUSTAIN THE ENVIRONMENT;

(e) REDUCING GREENHOUSE GAS POLLUTION WILL CREATE NEW MARKETS, SPUR INNOVATION, DRIVE INVESTMENTS IN LOW-CARBON TECHNOLOGIES, AND PUT COLORADO SQUARELY ON THE PATH TO A MODERN, RESILIENT, ONE-HUNDRED-PERCENT CLEAN ECONOMY. DELAY IN PURSUING AND SECURING GREENHOUSE GAS REDUCTIONS AS OUTLINED IN THIS SUBSECTION (2) WILL PREVENT COLORADO COMMUNITIES FROM CAPTURING THE BENEFITS OF THESE NEW JOBS AND MARKETS, IN ADDITION TO EXACERBATING THE CLIMATE IMPACTS THAT HARM COLORADANS. THE CLEAN ENERGY ECONOMY IS ALREADY BRINGING TENS OF THOUSANDS OF JOBS AND BILLIONS OF DOLLARS IN DIRECT INVESTMENT TO COUNTIES ACROSS THE STATE, BENEFITTING WORKERS, FAMILIES, AND COMMUNITIES. COLORADO CAN CONTINUE TO FACILITATE SUCH A TRANSITION TO A CLEAN ENERGY ECONOMY. FOOD AND FIBER PRODUCTION HAS MADE SIGNIFICANT ACHIEVEMENTS IN AREAS OF PRODUCTIVITY AND SUSTAINABILITY. MODERN TECHNOLOGY IN THIS SECTOR CONTRIBUTES TO REDUCTIONS IN GREENHOUSE GAS EMISSIONS BY SEQUESTERING CARBON IN THE SOIL AND ENHANCING SUSTAINABILITY THROUGH TECHNOLOGIES THAT REDUCE METHANE

EMISSIONS AND PRODUCE RENEWABLE ENERGY. CONTINUING TO ENCOURAGE THESE TYPES OF ACHIEVEMENTS IS BENEFICIAL.

(f) BY EXERCISING A LEADERSHIP ROLE, COLORADO WILL ALSO POSITION ITS ECONOMY, TECHNOLOGY CENTERS, FINANCIAL INSTITUTIONS, AND BUSINESSES TO BENEFIT FROM NATIONAL AND INTERNATIONAL EFFORTS TO REDUCE GREENHOUSE GASES;

(g) ACCORDINGLY, COLORADO SHALL STRIVE TO INCREASE RENEWABLE ENERGY GENERATION AND ELIMINATE STATEWIDE GREENHOUSE GAS POLLUTION BY THE MIDDLE OF THE TWENTY-FIRST CENTURY AND HAVE GOALS OF ACHIEVING, AT A MINIMUM, A TWENTY-SIX-PERCENT REDUCTION IN STATEWIDE GREENHOUSE GAS POLLUTION BY 2025, A FIFTY-PERCENT REDUCTION IN STATEWIDE GREENHOUSE GAS POLLUTION BY 2030, AND A NINETY-PERCENT REDUCTION IN STATEWIDE GREENHOUSE GAS POLLUTION BY 2050. THE REDUCTIONS IDENTIFIED IN THIS SUBSECTION (2)(g) ARE MEASURED RELATIVE TO 2005 STATEWIDE GREENHOUSE GAS POLLUTION LEVELS.

SECTION 2. In Colorado Revised Statutes, 25-7-103, **amend** the introductory portion; and **add** (22.5) as follows:

25-7-103. Definitions. As used in this ~~article~~ ARTICLE 7, unless the context otherwise requires:

(22.5) "STATEWIDE GREENHOUSE GAS POLLUTION" MEANS THE TOTAL NET STATEWIDE ANTHROPOGENIC EMISSIONS OF CARBON DIOXIDE, METHANE, NITROUS OXIDE, HYDROFLUOROCARBONS, PERFLUOROCARBONS, NITROGEN TRIFLUORIDE, AND SULFUR HEXAFLUORIDE, EXPRESSED AS CARBON DIOXIDE EQUIVALENT CALCULATED USING A METHODOLOGY AND DATA ON RADIATIVE FORCING AND ATMOSPHERIC PERSISTENCE DEEMED APPROPRIATE BY THE COMMISSION.

SECTION 3. In Colorado Revised Statutes, 25-7-105, **amend** (1) introductory portion; and **add** (1)(e) as follows:

25-7-105. Duties of commission - rules - legislative declaration - definitions. (1) Except as provided in sections 25-7-130 and 25-7-131, the commission shall promulgate such rules and regulations as are consistent with the legislative declaration set forth in section 25-7-102 and

necessary for the proper implementation and administration of this ~~article~~ ARTICLE 7, including, but not limited to:

(e) (I) STATEWIDE GREENHOUSE GAS POLLUTION ABATEMENT.

(II) CONSISTENT WITH SECTION 25-7-102 (2)(g), THE COMMISSION SHALL TIMELY PROMULGATE IMPLEMENTING RULES AND REGULATIONS. THE IMPLEMENTING RULES MAY TAKE INTO ACCOUNT OTHER RELEVANT LAWS AND RULES, AS WELL AS VOLUNTARY ACTIONS TAKEN BY LOCAL COMMUNITIES AND THE PRIVATE SECTOR, TO ENHANCE EFFICIENCY AND COST-EFFECTIVENESS, AND SHALL BE REVISED AS NECESSARY OVER TIME TO ENSURE TIMELY PROGRESS TOWARD THE 2025, 2030, AND 2050 GOALS. THE IMPLEMENTING RULES SHALL PROVIDE FOR ONGOING TRACKING OF EMISSION SOURCES THAT ADVERSELY AFFECT DISPROPORTIONATELY IMPACTED COMMUNITIES AND ARE SUBJECT TO RULES IMPLEMENTED PURSUANT TO THIS SUBSECTION (1)(e) AND MUST INCLUDE STRATEGIES DESIGNED TO ACHIEVE REDUCTIONS IN HARMFUL AIR POLLUTION AFFECTING THOSE COMMUNITIES.

(III) THE COMMISSION WILL IDENTIFY DISPROPORTIONATELY IMPACTED COMMUNITIES. IN IDENTIFYING THESE COMMUNITIES, THE COMMISSION WILL CONSIDER: MINORITY, LOW-INCOME, TRIBAL, OR INDIGENOUS POPULATIONS IN THE STATE THAT POTENTIALLY EXPERIENCE DISPROPORTIONATE ENVIRONMENTAL HARMS AND RISKS. THIS DISPROPORTIONALITY CAN BE A RESULT OF INCREASED VULNERABILITY TO ENVIRONMENTAL DEGRADATION, LACK OF OPPORTUNITY FOR PUBLIC PARTICIPATION, OR OTHER FACTORS. INCREASED VULNERABILITY MAY BE ATTRIBUTABLE TO AN ACCUMULATION OF NEGATIVE OR LACK OF POSITIVE ENVIRONMENTAL, HEALTH, ECONOMIC, OR SOCIAL CONDITIONS WITHIN THESE POPULATIONS. "DISPROPORTIONATELY IMPACTED COMMUNITIES" DESCRIBES SITUATIONS WHERE MULTIPLE FACTORS, INCLUDING BOTH ENVIRONMENTAL AND SOCIO-ECONOMIC STRESSORS, MAY ACT CUMULATIVELY TO AFFECT HEALTH AND THE ENVIRONMENT AND CONTRIBUTE TO PERSISTENT ENVIRONMENTAL HEALTH DISPARITIES.

(IV) THE DIVISION, AT THE DIRECTION OF THE COMMISSION, SHALL SOLICIT INPUT FROM OTHER STATE AGENCIES, STAKEHOLDERS, AND THE PUBLIC ON THE ADVANTAGES OF DIFFERENT STATEWIDE GREENHOUSE GAS POLLUTION MITIGATION MEASURES, SPECIFICALLY SOLICITING INPUT FROM THOSE MOST IMPACTED BY CLIMATE CHANGE, INCLUDING DISPROPORTIONATELY IMPACTED COMMUNITIES; LARGE EMISSION SOURCES;

WORKERS IN RELEVANT INDUSTRIES, INCLUDING ADVANCED ENERGY AND FUEL DELIVERY; AND COMMUNITIES THAT ARE CURRENTLY ECONOMICALLY DEPENDENT ON INDUSTRIES WITH HIGH LEVELS OF GREENHOUSE GAS EMISSIONS.

(V) THE IMPLEMENTING RULES AND POLICIES MAY INCLUDE, IN ADDITION TO RENEWABLE ENERGY DEVELOPMENT STRATEGIES, REGULATORY STRATEGIES THAT HAVE BEEN DEPLOYED BY ANOTHER JURISDICTION TO REDUCE MULTI-SECTOR GREENHOUSE GAS EMISSIONS, THAT FACILITATE ADOPTION OF TECHNOLOGIES THAT HAVE VERY LOW OR ZERO EMISSIONS, AND THAT ENHANCE COST-EFFECTIVENESS, COMPLIANCE FLEXIBILITY, AND TRANSPARENCY AROUND COMPLIANCE COSTS, AMONG OTHER REGULATORY STRATEGIES. THE COMMISSION MAY COORDINATE WITH OTHER JURISDICTIONS IN SECURING EMISSION REDUCTIONS, INCLUDING IN SATISFYING FUTURE FEDERAL REGULATIONS. THE COMMISSION MAY ACCOUNT FOR REDUCTIONS IN NET GREENHOUSE GAS EMISSIONS THAT OCCUR UNDER COORDINATED JURISDICTIONS' PROGRAMS IF THE COMMISSION FINDS THAT THE IMPLEMENTING REGULATIONS OF EACH COORDINATED JURISDICTION ARE OF SUFFICIENT RIGOR TO ENSURE THE INTEGRITY OF THE REDUCTIONS IN GREENHOUSE GAS EMISSIONS TO THE ATMOSPHERE AND MAY ACCOUNT FOR CARBON DIOXIDE THAT ELECTRICITY CONSUMPTION IN THIS STATE CAUSES TO BE EMITTED ELSEWHERE.

(VI) IN CARRYING OUT ITS RESPONSIBILITIES UNDER THIS SUBSECTION (1)(e), THE COMMISSION SHALL CONSIDER: THE BENEFITS OF COMPLIANCE, INCLUDING HEALTH, ENVIRONMENTAL, AND AIR QUALITY; THE COSTS OF COMPLIANCE; ECONOMIC AND JOB IMPACTS AND OPPORTUNITIES; THE TIME NECESSARY FOR COMPLIANCE; THE RELATIVE CONTRIBUTION OF EACH SOURCE OR SOURCE CATEGORY TO STATEWIDE GREENHOUSE GAS POLLUTION BASED ON CURRENT DATA UPDATED AT REASONABLE INTERVALS AS DETERMINED BY THE COMMISSION; HARMONIZING EMISSION REPORTING REQUIREMENTS WITH EXISTING FEDERAL REQUIREMENTS, WHERE THE COMMISSION DEEMS APPROPRIATE; THE IMPORTANCE OF STRIVING TO EQUITABLY DISTRIBUTE THE BENEFITS OF COMPLIANCE, OPPORTUNITIES TO INCENTIVIZE RENEWABLE ENERGY RESOURCES AND POLLUTION ABATEMENT OPPORTUNITIES IN DISPROPORTIONATELY IMPACTED COMMUNITIES, OPPORTUNITIES TO ENCOURAGE CLEAN ENERGY IN TRANSITIONING COMMUNITIES; ISSUES RELATED TO THE BENEFICIAL USE OF ELECTRICITY TO REDUCE GREENHOUSE GAS EMISSIONS; WHETHER PROGRAM DESIGN COULD ENHANCE THE RELIABILITY OF ELECTRIC SERVICE; THE POTENTIAL TO

ENHANCE THE RESILIENCE OF COLORADO'S COMMUNITIES AND NATURAL RESOURCES TO CLIMATE IMPACTS; AND WHETHER GREATER OR MORE COST-EFFECTIVE EMISSION REDUCTIONS ARE AVAILABLE THROUGH PROGRAM DESIGN.

(VII) NOTWITHSTANDING SECTION 24-1-136 (11)(a)(I), THE DIVISION, AT THE DIRECTION OF THE COMMISSION, SHALL REPORT TO THE GENERAL ASSEMBLY EVERY ODD-NUMBERED YEAR AFTER THE EFFECTIVE DATE OF THIS SUBSECTION (1)(e) REGARDING: PROGRESS TOWARD THE GOALS SET FORTH IN SECTION 25-7-102 (2)(g); ANY NEWLY AVAILABLE, FINAL COST-BENEFIT OR REGULATORY ANALYSIS, DEVELOPED UNDER SECTION 24-4-103 (2.5) OR (4.5), FOR RULES ADOPTED TO ATTAIN THE GOALS; AND ANY RECOMMENDATIONS ON FUTURE LEGISLATIVE ACTION TO ADDRESS CLIMATE CHANGE, SUCH AS IMPLEMENTATION OF CLIMATE ADAPTATION POLICIES OR ACCELERATING DEPLOYMENT OF CLEANER TECHNOLOGIES.

(VIII) (A) IN CARRYING OUT ITS RESPONSIBILITIES UNDER THIS SUBSECTION (1)(e), THE COMMISSION SHALL CONSULT WITH THE PUBLIC UTILITIES COMMISSION, INCLUDING ON ISSUES OF COST OF ELECTRICITY, RELIABILITY OF ELECTRIC SERVICE, TECHNOLOGY DEVELOPMENTS IN ELECTRICITY PRODUCTION, AND BENEFICIAL ELECTRIFICATION, AND KEEP A RECORD OF ITS CONSULTATION.

(B) THE GENERAL ASSEMBLY HEREBY FINDS, DETERMINES, AND DECLARES THAT IT IS BENEFICIAL TO ENCOURAGE THE DEVELOPMENT OF CLEAN ENERGY PLANS THAT WILL REQUIRE GREENHOUSE GAS EMISSIONS CAUSED BY COLORADO RETAIL ELECTRICITY SALES TO DECREASE EIGHTY PERCENT BY 2030 RELATIVE TO 2005 LEVELS TO PROVIDE FOR THE COST-EFFECTIVE AND PROACTIVE DEPLOYMENT OF CLEAN ENERGY RESOURCES.

(C) IN DESIGNING, IMPLEMENTING, AND ENFORCING PROGRAMS AND REQUIREMENTS UNDER THIS SUBSECTION (1)(e), THE COMMISSION AND THE DIVISION SHALL TAKE INTO CONSIDERATION ANY CLEAN ENERGY PLAN AT THE PUBLIC UTILITIES COMMISSION THAT, AS FILED, WILL ACHIEVE AT LEAST AN EIGHTY-PERCENT REDUCTION IN GREENHOUSE GAS EMISSIONS CAUSED BY THE UTILITY'S COLORADO RETAIL ELECTRICITY SALES BY 2030 RELATIVE TO 2005 LEVELS, AS VERIFIED BY THE DIVISION. WHEN INCLUDING PUBLIC UTILITIES IN ITS PROGRAMS OR REQUIREMENTS UNDER THIS SUBSECTION

(1)(e), THE COMMISSION SHALL NOT MANDATE THAT A PUBLIC UTILITY REDUCE GREENHOUSE GAS EMISSIONS CAUSED BY THE UTILITY'S COLORADO RETAIL ELECTRICITY SALES BY 2030 MORE THAN IS REQUIRED UNDER SUCH AN APPROVED CLEAN ENERGY PLAN OR IMPOSE ANY DIRECT, NONADMINISTRATIVE COST ON THE PUBLIC UTILITY DIRECTLY ASSOCIATED WITH QUANTITIES OF GREENHOUSE GAS EMISSIONS CAUSED BY THE UTILITY'S COLORADO RETAIL ELECTRICITY SALES THAT REMAIN AFTER THE REDUCTIONS REQUIRED BY SUCH A CLEAN ENERGY PLAN THROUGH 2030 IF THOSE REDUCTIONS ARE ACHIEVED AND THE DIVISION HAS VERIFIED THAT THE APPROVED CLEAN ENERGY PLAN WILL ACHIEVE AT LEAST A SEVENTY-FIVE-PERCENT REDUCTION IN GREENHOUSE GAS EMISSIONS CAUSED BY THE UTILITY'S COLORADO RETAIL ELECTRICITY SALES BY 2030 RELATIVE TO 2005 LEVELS.

(D) IMPLEMENTING RULES DEVELOPED BY THE COMMISSION MUST NOT INCLUDE ANY REQUIREMENTS DICTATING THE MIX OF ELECTRIC GENERATING RESOURCES THAT ANY PUBLIC UTILITY SHALL USE TO MEET APPLICABLE POLLUTION LIMITS.

(E) IMPLEMENTING RULES DEVELOPED BY THE COMMISSION MUST CONSIDER ISSUES RELATING TO JOINT OWNERSHIP OF ELECTRIC GENERATING RESOURCES AS BETWEEN MULTIPLE PARTIES AND THE EXTENT TO WHICH THE PUBLIC UTILITY IS RELYING ON POWER PURCHASED FROM THIRD PARTIES IN MEETING ITS OBLIGATIONS UNDER SUCH A CLEAN ENERGY PLAN.

(F) A CLEAN ENERGY PLAN VOLUNTARILY FILED BY A COOPERATIVE ELECTRIC ASSOCIATION THAT HAS VOTED TO EXEMPT ITSELF FROM REGULATION BY THE PUBLIC UTILITIES COMMISSION PURSUANT TO ARTICLE 9.5 OF TITLE 40 OR BY A MUNICIPAL UTILITY SHALL BE DEEMED APPROVED BY THE PUBLIC UTILITIES COMMISSION AS FILED IF: THE DIVISION, IN CONSULTATION WITH THE PUBLIC UTILITIES COMMISSION, PUBLICLY VERIFIES THAT THE PLAN DEMONSTRATES THAT, BY 2030, THE COOPERATIVE ELECTRIC ASSOCIATION OR MUNICIPAL UTILITY WILL ACHIEVE AT LEAST AN EIGHTY PERCENT REDUCTION IN GREENHOUSE GAS EMISSIONS CAUSED BY THE ENTITY'S COLORADO RETAIL ELECTRICITY SALES RELATIVE TO 2005 LEVELS; AND THE CLEAN ENERGY PLAN HAS PREVIOUSLY BEEN APPROVED BY A VOTE OF THE ENTITY'S GOVERNING BODY. VOLUNTARY SUBMISSION OF A CLEAN ENERGY PLAN BY A COOPERATIVE ELECTRIC ASSOCIATION OR MUNICIPAL UTILITY DOES NOT ALTER THE ENTITY'S REGULATORY STATUS WITH RESPECT TO THE PUBLIC UTILITIES COMMISSION, INCLUDING UNDER ARTICLE 9.5 OF

TITLE 40.

(IX) (A) IN ADDRESSING GREENHOUSE GAS EMISSIONS FROM AN ENERGY-INTENSIVE, TRADE-EXPOSED MANUFACTURING SOURCE, THE COMMISSION SHALL REQUIRE THE SOURCE TO EXECUTE AN ENERGY AND EMISSION CONTROL AUDIT, ACCORDING TO CRITERIA ESTABLISHED BY THE COMMISSION, OF THE SOURCE'S OPERATIONS EVERY FIVE YEARS THROUGH AT LEAST 2035. A QUALIFIED THIRD PARTY, AS DETERMINED BY THE COMMISSION, SHALL CONDUCT THE AUDIT AND SUBMIT THE RESULTS TO THE COMMISSION. IF THE COMMISSION DETERMINES THAT THE SOURCE CURRENTLY EMPLOYS BEST AVAILABLE EMISSION CONTROL TECHNOLOGIES FOR GREENHOUSE GAS EMISSIONS AND BEST AVAILABLE ENERGY EFFICIENCY PRACTICES, THE COMMISSION SHALL NOT IMPOSE A DIRECT NONADMINISTRATIVE COST ON THE SOURCE DIRECTLY ASSOCIATED WITH AT LEAST NINETY-FIVE PERCENT OF THE SOURCE'S GREENHOUSE GAS EMISSIONS ATTRIBUTABLE TO MANUFACTURING A GOOD IN THIS STATE FOR A PERIOD OF FIVE YEARS, IF THE SOURCE'S EMISSIONS ARE NOT GREATER THAN THE EMISSIONS ASSOCIATED WITH USE OF THE BEST AVAILABLE EMISSION CONTROL TECHNOLOGIES AS DETERMINED BY THE COMMISSION. THE COMMISSION SHALL CONSIDER HOW PROGRAM DESIGN AS RELEVANT TO THOSE SOURCES CAN FURTHER MITIGATE THE COST OF REDUCING EMISSIONS FOR SUCH MANUFACTURERS WHILE PROVIDING AN INCENTIVE TO IMPROVE EFFICIENCY AND REDUCE EMISSIONS. SPECIFICALLY, THE COMMISSION SHALL DESIGN THE PROGRAM AS RELEVANT TO THOSE SOURCES SUCH THAT AS THE SOURCES ARE SUBJECT TO EMISSION REDUCTION REQUIREMENTS, THOSE SOURCES WILL HAVE, UNDER THE PROGRAM, A PATHWAY TO OBTAIN EQUIVALENT LOWER-COST EMISSION REDUCTIONS AT OTHER REGULATED SOURCES TO SATISFY THEIR COMPLIANCE OBLIGATIONS.

(B) AS USED IN THIS SUBSECTION (1)(e)(IX), "ENERGY-INTENSIVE, TRADE-EXPOSED MANUFACTURING SOURCE" MEANS AN ENTITY THAT PRINCIPALLY MANUFACTURES IRON, STEEL, ALUMINUM, PULP, PAPER, OR CEMENT AND THAT IS ENGAGED IN THE MANUFACTURE OF GOODS THROUGH ONE OR MORE EMISSIONS-INTENSIVE, TRADE-EXPOSED PROCESSES, AS DETERMINED BY THE COMMISSION.

(X) NOTHING IN THIS SUBSECTION (1)(e) DIMINISHES THE EXISTING AUTHORITY OF THE COMMISSION OR THE DIVISION. NOTHING IN THIS SUBSECTION (1)(e) ALTERS THE REGULATORY EXEMPTIONS PROVIDED IN SECTION 25-7-109 (8)(a). NOTHING AUTHORIZED IN THIS SUBSECTION (1)(e),

INCLUDING THE ASSIGNMENT OF EMISSION REDUCTION OBLIGATIONS OR EMISSION AUTHORIZATIONS AND EXCLUDING PROGRAM DEVELOPMENT AND ADMINISTRATIVE COSTS, IMPLICATES STATE FISCAL YEAR SPENDING AS DEFINED IN SECTION 24-77-102. NOTHING IN THIS SUBSECTION (1)(e) ALTERS ANY REQUIREMENT TO PREPARE A COST-BENEFIT ANALYSIS UNDER SECTION 24-4-103 (2.5) OR ANY REQUIREMENT TO ISSUE A REGULATORY ANALYSIS UNDER SECTION 24-4-103 (4.5). NOTHING IN THIS SUBSECTION (1)(e) DIMINISHES THE AUTHORITY OF THE PUBLIC UTILITIES COMMISSION UNDER THE PUBLIC UTILITIES LAW, INCLUDING SECTIONS 40-3-101 AND 40-3-102.

(XI) AS USED IN THIS SUBSECTION (1)(e):

(A) "COST-EFFECTIVE" OR "COST-EFFECTIVENESS" MEANS THE COST PER UNIT OF REDUCED EMISSIONS OF GREENHOUSE GASES EXPRESSED AS CARBON DIOXIDE EQUIVALENT.

(B) "GREENHOUSE GAS" INCLUDES CARBON DIOXIDE, METHANE, NITROUS OXIDE, HYDROFLUOROCARBONS, PERFLUOROCARBONS, NITROGEN TRIFLUORIDE, AND SULFUR HEXAFLUORIDE, EXPRESSED AS CARBON DIOXIDE EQUIVALENT.

(C) "RETAIL ELECTRICITY SALES" MEANS ELECTRIC ENERGY SOLD TO RETAIL END-USE ELECTRIC CONSUMERS.

SECTION 4. Appropriation. (1) For the 2019-20 state fiscal year, $281,588 is appropriated to the department of public health and environment. This appropriation is from the general fund. To implement this act, the department may use this appropriation as follows:

(a) $188,321 for use by the air pollution control division for program costs, which amount is based on an assumption that the division will require an additional 2.0 FTE; and

(b) $93,267 for the purchase of legal services.

(2) For the 2019-20 state fiscal year, $93,267 is appropriated to the department of law. This appropriation is from reappropriated funds received from the department of public health and environment under subsection (1)(b) of this section and is based on an assumption that the department of law will require an additional 0.5 FTE. To implement this act, the

department of law may use this appropriation to provide legal services for the department of public health and environment.

SECTION 5. Safety clause. The general assembly hereby finds, determines, and declares that this act is necessary for the immediate preservation of the public peace, health, and safety.

KC Becker SPEAKER OF THE HOUSE OF REPRESENTATIVES	Leroy M. Garcia PRESIDENT OF THE SENATE
Marilyn Eddins CHIEF CLERK OF THE HOUSE OF REPRESENTATIVES	Cindi L. Markwell SECRETARY OF THE SENATE

APPROVED_____
(Date and Time)

_____
Jared S. Polis
GOVERNOR OF THE STATE OF COLORADO

Colorado Greenhouse Gas Pollution Reduction Roadmap

January 14, 2021

GOVERNOR JARED POLIS

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FREQUENTLY USED ABBREVIATIONS AND ACRONYMS

ACRE3	Advancing Colorado's Renewable Energy and Energy Efficiency Program
ACRO	Agricultural Climate Resilience Office of the Colorado Department of Agriculture
AgEE	Agricultural Energy Efficiency program of the Colorado Energy Office
APCD	Air Pollution Control Division of the Colorado Department of Public Health and Environment
AQCC	Air Quality Control Commission
BE	Beneficial Electrification
CCEF	Colorado Clean Energy Fund
CCHS	Colorado Collaborative for Healthy Soils
CCUS	Carbon Capture, Use and Sequestration
CDA	Colorado Department of Agriculture
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CEO	Colorado Energy Office
CEP	Clean Energy Plan
CH4	Methane
CFS	Clean Fuel Standard
CO2	Carbon Dioxide
$CO2_e$	Carbon Dioxide Equivalent

COGCC	Colorado Oil and Gas Conservation Commission
CRO	Colorado Resiliency Office
CSG	Community Solar Garden
CCUS	Carbon Capture Utilization and Storage
DER	Distributed Energy Resource
DNR	Colorado Department of Natural Resources
E3	Energy + Environmental Economics Consulting Firm
EERS	Energy Efficiency Resource Standard
EPA	Environmental Protection Agency
ERP	Electric Resource Plan
EV	Electric Vehicle
HB 19-1261	Colorado House Bill 1261 (2019), the Climate Action Plan
HDV	Heavy Duty Vehicle
IECC	International Energy Conservation Code
IPCC	The United Nations Intergovernmental Panel on Climate Change
JTAC	Just Transition Advisory Committee
LDAR	Leak Detection and Repair
LDV	Light Duty Vehicle
MDV	Medium Duty Vehicle
NOAA	National Oceanic and Atmospheric Administration
NWL	Natural and Working Lands

OJT	Colorado Office of Just Transition
PRPA	Platte River Power Authority
PUC	Public Utilities Commission
RPS	Renewable Portfolio Standard
SB19-077	Colorado Senate Bill 077 (2019)
SB19-181	Colorado Senate Bill 181 (2019)
SIP	State Implementation Plan
SLB	State Land Board
STIP	Statewide Transportation Improvement Program
TAG	Technical Advisory Group
TDM	Transportation Demand Management
VMT	Vehicle Miles Traveled
WAP	Weatherization Assistance Program
ZEV	Zero Emission Vehicle

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RECOGNITION

The State of Colorado thanks the many Coloradans who provided input on the Roadmap throughout its development. A special thanks to the Technical Advisory Group— Dr. Morgan Bazilian, Jill Cooper, Dr. Bryan Hannegan, Jeff Lyng, Dr. Keith Paustian, Dr. Gabriella Petron, and Lee White— for their generous support throughout the development process, including discussions about modeling approaches and reviews of draft reports. The state would also like to recognize the work of state climatologist Russ Schumacher, who reviewed the comment draft and provided feedback on the impacts of climate change in Colorado. Finally, Colorado would like to recognize the support of Dr. Martin Keller for his role as observer to the process.

ADDITIONAL MATERIALS

Several additional materials related to the Roadmap have not been included with the published version of the report but are available from the Roadmap website. These additional online materials include the following documents and technical appendices:

E3 Technical Appendix

The state hired Energy + Environmental Economics (E3) to model potential pathways, or scenarios, that would make progress toward meeting emissions reduction targets. E3 used its PATHWAYS model, which is built using bottom-up data for all emissions produced and energy consumed in Colorado, to model GHG emissions from all sectors of the economy and its RESOLVE model to develop least-cost electricity generation portfolios. The technical appendix provides greater detail about the modeling and the inputs used to build these modeled scenarios.

State of Colorado Technical Appendix

During the course of the development of the Roadmap, the Air Quality Control Commission and other stakeholders requested details on policies and near term actions the state might take to meet the GHG reduction goals. The state's Technical Appendix outlines how state staff aligned the sector emissions projections produced by E3 with the emissions reductions from near term strategies that Colorado expects to pursue.

Roadmap Outreach Plan and Feedback

This document includes the Stakeholder Outreach Plan, a description of the Technical Advisory Group, and the results of outreach activities.

Question and Answers on the Roadmap

This Q&A summary provides responses to the more frequently asked questions about the Roadmap.

GOVERNOR'S INTRODUCTORY LETTER

When we began developing the Colorado Greenhouse Gas Pollution Reduction Roadmap more than a year ago, the world looked very different. Over the past 12 months, the global COVID-19 pandemic has changed nearly every aspect of our lives, challenged our public health system, and strained our economy. Coloradans have faced devastating consequences, from losing a job to losing a loved one, and everything in between. We have seen firsthand the impacts of a changing climate in our own backyard as we experienced the worst wildfire season in Colorado's history. Extreme, statewide drought laid the foundation for these fires, and has made conditions even more challenging for farmers, ranchers, our outdoor recreation industry, and many other sectors of our economy.

But despite everything we've faced this year, our commitment to climate action and clean air has not wavered. In fact, there is an even greater sense of urgency. Looking forward, we know that clean energy will be critical to helping us build a more sustainable and just economy as we begin to recover from this pandemic. It's not just about improving quality of life today, but protecting the Colorado we know and love for generations to come.

Thanks to Colorado's history of leadership on clean energy, including what we've accomplished together over the last two years, we are already on a path to achieving half of the emissions reductions needed to meet our 2025 and 2030 targets. And to build on that momentum, this Roadmap identifies a comprehensive set of actionable strategies that will help propel us toward our goals. These near-term actions keep environmental justice and equity considerations at the center, while reducing local air pollution, generating economic growth, and creating high quality jobs.

One of my primary goals when announcing my candidacy for Governor included a swift transition to 100% renewable energy by 2040, and since taking office we have supported an unprecedented growth of renewables. By working collaboratively with electric utilities that operate over 99% of the fossil-based generation of emissions in Colorado, those utilities have committed to reducing greenhouse gas pollution at least 80% by 2030, while maintaining reliability and saving customers money. And we are building on this expansion with a host of new policies, standards, investments, innovations and partnerships across the economy.

Finally, I want to acknowledge the countless public stakeholders, including members of our Technical Advisory Group, who provided invaluable expertise and insight over the past 12 months, as well as the dozens of employees who closely collaborated across state government and worked tirelessly to finalize the Roadmap. To be successful we are going to need the continued engagement and perspective from diverse stakeholders across the state. We look forward to the critical work that lies ahead.

Jared Polis
Governor
State of Colorado

EXECUTIVE SUMMARY

To address climate change, the Polis Administration has prioritized action on a just and equitable transition to renewable energy and pollution reduction that diversifies and strengthens our economy, creates good-paying, local jobs, and improves the health and well-being of our communities. **This work is motivated by an imperative to protect the health and safety of all Coloradans, as well as the unprecedented opportunity to drive innovation and ensure prosperity for future generations.**

In the 2019 legislative session Colorado passed House Bill 19-1261, the *Climate Action Plan to Reduce Pollution* ("Climate Action Plan"),[i] which includes science-based targets of reducing statewide greenhouse gas pollution 26% by 2025, 50% by 2030, and 90% by 2050 from 2005 levels. To ensure that

Colorado continues to make progress toward these targets, Governor Polis directed state agencies to develop this comprehensive *Greenhouse Gas Pollution Reduction Roadmap* ("Roadmap").

As a result of prior policies, economic shifts, and legislative, regulatory, and other actions taken by this administration, Colorado is already on a pathway to achieving half of the emissions reductions needed to meet the 2025 and 2030 targets. The Roadmap delivers a list of near term actions the state will pursue over the next one to two years to make significant progress toward the 2025 and 2030 Climate Action Plan goals. The Roadmap also analyzes further actions that can help put the state on a solid path to meeting the 2050 goal.

Reducing greenhouse gas pollution across our economy to meet the state's science-based goals will be no small task. While we have taken a number of historic steps, we have much work to do to protect the Colorado way of life for generations to come. This work will continue to be multi-faceted and will require the ongoing expertise and engagement of all Coloradans.

The Roadmap represents the work of many state agencies including the Colorado Energy Office and the Departments of Agriculture, Natural Resources, Public Health and Environment, and Transportation. Additional support was provided by the Department of Local Affairs, the Colorado Resiliency Office and the Office of Just Transition. Colorado hired Energy + Environmental Economics ("E3"), a leading national consulting firm with expertise in GHG modeling, to develop a model of the state's economy-wide emissions by sector. Technical staff from the Climate Change Unit at the Colorado Department of Public Health and Environment provided additional analysis of projected emissions reductions from near term policy recommendations.

The development of the Roadmap started in late 2019 with a review of Colorado's 2015 Greenhouse Gas Inventory, which was updated in 2019, and an evaluation of the data used to project future GHG emissions for Colorado in the Environmental Protection Agency's State Inventory Tool. The state agencies, in consultation with E3 and other outside experts from a Technical Advisory Group, began gathering updated state-level data and refining modeling methods to establish a more accurate accounting of greenhouse gas emissions in Colorado in 2005. Among other changes to prior analyses, the state agencies revised estimates of 2005 emissions from oil and gas operations upwards from EPA stock assumptions to reflect more recent scientific information about methane emissions.

Using this updated data and E3's modeling tools, the Roadmap team constructed a **Reference Case**, which represents a projection of the state's GHG emissions based on policies that were in place prior to 2019. The Reference case assumes no new policies or actions to reduce emissions. That assessment found that the four largest emitting sectors were the same in 2020 as 2005. As shown below in Figure 1, in 2020 transportation displaced electricity generation as the largest source of pollution. Electricity generation, oil and gas production, and fossil methane use in the residential, commercial and industrial sectors remain the other three largest emitters. In the transportation sector, passenger vehicles are the largest contributor to emissions in the state. Electricity generation emissions largely come from coal-fired power plants with a small portion from fossil methane gas-fired

Roadmap Modeling Cases

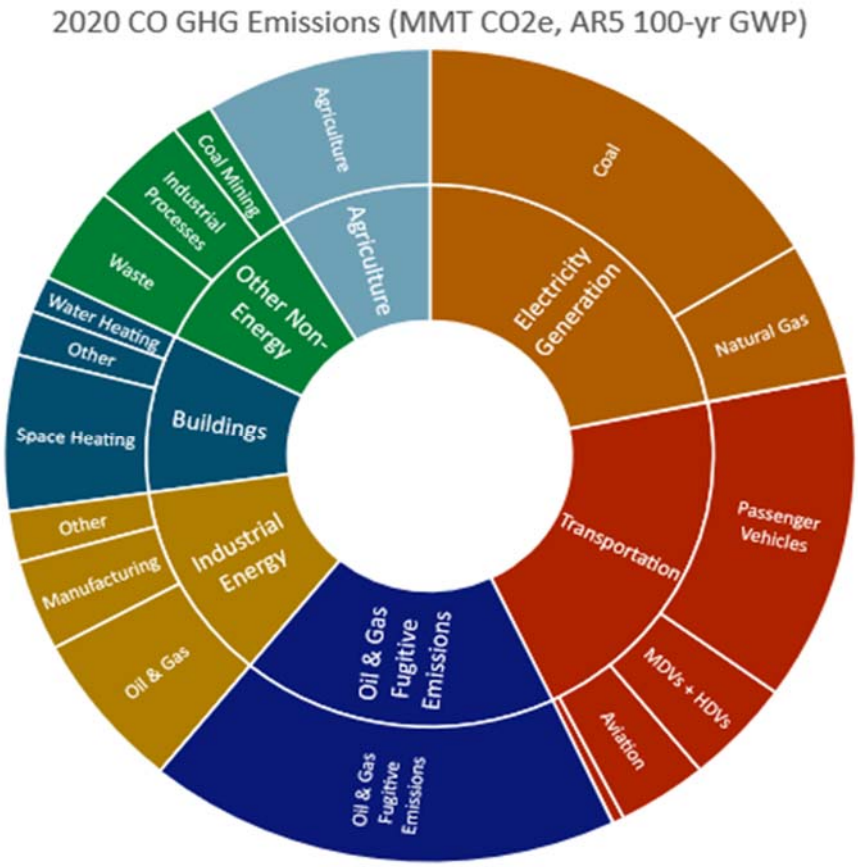
Reference Case
Modeled emissions reductions based on all existing state policy prior to 2019

2019 Action Scenario
Modeled emissions reductions based on prior state policy and legislative, administrative, and voluntary actions adopted in 2019

1261 Targets Scenario
Modeled an illustrative path Colorado could take to meet the GHG reduction targets in HB 19-1261,

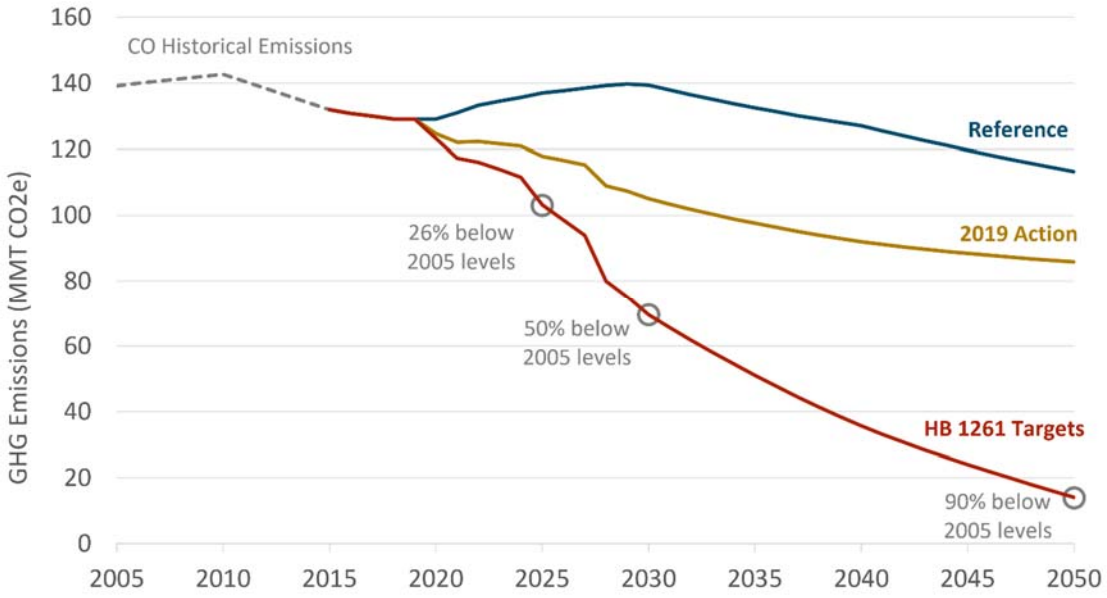
power plants. Emissions from the oil and gas sector include fugitive methane emissions from upstream and downstream operations in Colorado as well as on-site combustion of fossil fuels in industrial operations.

Figure 1: 2020 CO GHG Emissions (MMT CO2e, AR5 100-yr GWP)



To better understand the impacts of recent policy changes, E3 evaluated projected pollution reductions resulting from legislation passed in 2019 and 2020 and from administrative actions to date by the Polis Administration— *The 2019 Action Scenario. This evaluation showed that the state's actions in the last two years to address climate change, when added to prior actions, put Colorado on trajectory to achieve approximately half of the emissions reduction needed to meet the 2025 and 2030 goals.*

Figure 2: Scenario Projections of Colorado's Potential GHG Emissions



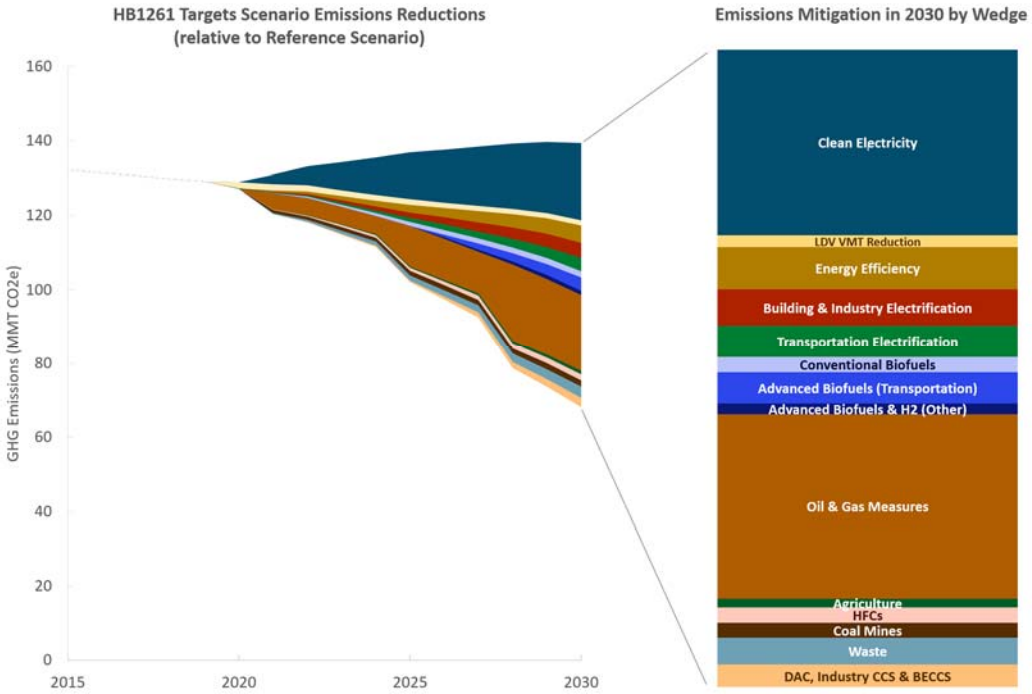
While the state has made significant progress toward meeting the 2025 and 2030 goals, the analysis showed that additional actions are needed to reach the targets. E3 modeled an illustrative scenario, the **HB 1261 Targets Scenario,** to represent one approach Colorado could take to meet the Climate Action Plan targets through 2050. Based on these analyses, the Roadmap proposes administrative, regulatory, legislative, procurement, incentive-based, and other measures to reduce emissions in different sectors of the state's economy to achieve GHG pollution reductions in a cost-effective and equitable way. **Modeled Emissions Trajectories.**

That path to reaching the state's emissions goals builds on the significant transition that is already underway toward clean, low-cost renewable energy and will accelerate as we implement policies to shift the way we move people and goods, and light and heat our homes and businesses from fossil fuels to clean energy. A key to making equitable progress toward our goals is to promote investments needed to modernize our economy more

quickly in disproportionately and historically impacted communities. Transitioning toward a resilient, low carbon economy will require investments, regulations, and other measures by the state as well as federal and local governments. The transition also will require business investment and leadership and the engagement of the nearly six million Coloradans who own more than five million vehicles and almost 2.5 million housing units. The Climate Action Plan provides the Air Quality Control Commission with authority to consider progress made through all of these means as it considers the need to develop regulations:

"The implementing rules may take into account other relevant laws and rules, as well as voluntary actions taken by local communities and the private sector, to enhance efficiency and cost-effectiveness, and shall be revised as necessary over time to ensure timely progress toward the 2025, 2030, and 2050 goals."

Figure 3: Representative Pollution Reductions in 1261 Target Scenario to Meet 2030 Climate Goals



The Roadmap describes actions Colorado has taken to address climate change, analyzes the current trajectory for GHG emissions, and presents a suite of actions the state can pursue in the near term to make progress toward the Climate Action Plan goals.

KEY FINDINGS

- The largest sources of GHG pollution in Colorado are transportation, electricity generation, oil and gas production, and fuel use in residential, commercial and industrial spaces.
- Achieving Colorado's 2025 and 2030 GHG emissions targets is feasible with existing technologies but will require actions, laws, and policies beyond those Colorado has taken already.
- Achieving the 2030 goals will rely on deep reductions in pollution from electricity generation by continuing the transition to renewable energy, as well as deep reductions in methane pollution from the oil and gas industry, which makes up the largest source of non-combustion emissions in the state.
- Making changes to transportation planning and infrastructure to reduce growth in driving is an important tool.
- Electrification of end uses in buildings and transportation will play an important role in achieving these targets, with action needed in the near term to accelerate the transition.
- By 2050, very high levels of electrification of vehicles will be needed, with nearly 100% of all cars on the road being electric and a 100% market share for zero emissions trucks among new sales.
- Reducing methane emissions from landfills, sewage plants and other sources, and enhancing waste reduction, recycling and diversion efforts, is necessary, especially to reach emissions targets after 2030.
- Protecting, restoring, and enhancing the resilience of Colorado's natural and working lands is critical for sequestering carbon.
- Policy transitions to reduce GHG pollution will reduce air quality burdens that disproportionately impact lower income communities and communities of color.
- Policies will need to be designed carefully to ensure that benefits are distributed equitably.

Air Quality Control Commission Greenhouse Gas Subcommittee

E3 provided a projection of Colorado's GHG emissions and modeled scenarios for how the state could reduce emissions in different sectors of the economy, but was not tasked with developing detailed policy proposals. During the development of the Roadmap, the Air Quality Control Commission convened a GHG subcommittee to investigate near term strategies Colorado could adopt to reduce GHG pollution in different sectors. This level of more detailed policy development was originally intended to occur after the GHG Roadmap was completed, but the state agencies agreed with AQCC and other stakeholders that the presentation of more detailed near term action plans will accelerate the transition and better enable Colorado to make progress toward its goals. Those actions are now included in this Roadmap.

To support the AQCC subcommittee, the Air Pollution Control Division ("APCD") staff evaluated potential GHG reductions resulting from near term AQCC rulemakings, PUC proceedings, legislative actions, and other approaches. This spreadsheet-based analysis provides an assessment of emissions reduction based on how the state is likely to implement policies and adds to the level of analysis E3 provided in its scenario modeling. The APCD's analysis grouped emissions into three broad categories: Energy Production (Electricity and Oil and Gas); Energy Consumption (Transportation and Residential, Commercial, and Industrial fuel use); and Non-Energy (Agriculture, Coal Mine Methane, Waste, HFCs) to evaluate emissions reductions by policy approach in a sector. Energy production and consumption encompass the largest emitting sectors and cover greater than 80% of Colorado GHG emissions.[ii]

The APCD staff developed a spreadsheet tool that builds emissions reductions from particular policies and actions based in sectors based on where the greatest short-term emissions reductions were possible. The APCD

approach reflects a more granular approach to developing individual legislation, regulatory policy, and other approaches than E3 used in developing its HB 1261 Targets Scenario.

As a result of the differences in approach, the APCD analysis presents lower potential near term emissions reductions in certain sectors than E3 modeled in the HB 1261 Targets Scenario, but shows greater potential reductions in others. In the residential, commercial, and industrial fuel use sector APCD showed lower potential reductions based on assumptions about the length of the transition for home and business owners to adopt heat pumps and other lower emitting technologies. The difference in achievable potential in transportation emissions is based on APCD using a more conservative assumption about the number of electric vehicles that Colorado consumers will buy under existing policies. APCD also assumed lower reductions from coal mine methane than assumed in the HB 1261 Targets Scenario. However, based on changes in the oil and gas industry and the requirements of Senate Bill 19-181, the APCD tool shows deeper reductions in the oil and gas sector for 2025 than E3 modeled in its scenarios.

The AQCC adopted a resolution establishing a process for review and publication of metrics critical to tracking progress toward the statewide goals established in HB19-1261.[iii] The resolution also adopted provisional sector specific targets for 2025 and 2030 that are based on APCD's work. The AQCC is expected to finalize the resolution after the release of the Roadmap. The table below shows the AQCC's provisional targets, which are informed by the near term actions identified in the Roadmap.

NEAR TERM ACTIONS TO REDUCE POLLUTION

Sector	Revised 2005 Baseline (MMT CO2e)	2025 Target (MMT CO2e)	2030 Target (MMT CO2e)
Electricity	40.28	21	8
Oil and Gas	20.17	13	8
Transportation	30.71	23	18
Residential, Commercial, Industrial Energy Use	24.65	26	20
Other	23.42	19.9	15.6
Total	139.22	102.9	69.6
Percent Reduction	--	26%	50%

The E3 scenario analysis and APCD spreadsheet tool show that reductions across multiple sectors of the economy provide pathways to making progress towards the 2025 and 2030 targets. Based on E3's HB 1261 Targets Scenario, this comprehensive approach also helps lay a strong foundation for reaching the deeper reductions needed between 2030 and 2050. There is no single "silver bullet" solution; the modeling shows that a "silver buckshot" approach of reductions across all the major sectors is needed.

The analysis in the Roadmap finds that Colorado can meet its science-based GHG pollution reduction targets with existing technologies. Decarbonizing the leading sources of pollution will require investments and innovation as well as a broad suite of new policies, standards, and partnerships.

Even as the state works toward an 80% pollution reduction in electricity generation by 2030 through utility actions and enforceable electric resource plans, Clean Energy Plans, and Regional Haze rules, there is a need

to create incentives and pathways to spur further investment in pollution reductions beyond 80%. During the rapid transition to clean, renewable energy for the production of electricity, it is important to promote further investment and innovation in the electrification of new sectors, such as transportation and buildings. These efforts, along with increased energy efficiency, will expand the impact of clean electricity across the economy.

With the transportation sector now being the leading source of GHG emissions and a significant contributor to local air pollution that disproportionately impacts lower-income communities and communities of color, a key priority is to increase the number of electric vehicles, including trucks and buses, on Colorado roads. Establishing new standards that stimulate investment and remove barriers to EV ownership will make it easier and more affordable to drive an EV. Additionally, changing the way we make development decisions, including for land use, housing, and infrastructure, can enhance accessibility, cut pollution, and reduce the need to drive. To ensure that this transition is equitable and broad-based, the state needs to develop policies and programs that will benefit communities that have been most heavily impacted by the pollution from transportation infrastructure, including highways and refineries.

Progressing towards the state's GHG goals requires deep methane emissions reduction from the oil and gas industry, landfills, sewage treatment plants, coal mines, and other sources. Methane is a potent contributor to climate change, with each ton creating 28 times more warming than a ton of CO2 over 100 years (and even higher in the short term). Given the importance

of achieving reductions of this potent greenhouse gas, the APCD staff anticipate proposing regulations to the AQCC in 2021 that will achieve over a 30% reduction across the oil and gas sector by 2025 and over 50% (12 million CO2e tons) by 2030. If adopted, these regulations will result in oil and gas sector emissions of roughly 8 million tons in 2030, down from 20 million tons in 2005.

Additionally, regulatory measures, such as those finalized in the Colorado Oil and Gas Conservation Commission Mission Change rulemaking, that eliminate routine flaring, require equity-focused siting analysis, minimize emissions, and prioritize vulnerable populations and disproportionately impacted communities, are designed to make important progress in GHG reductions and equity benefits.

The majority of Colorado homes and businesses use fossil methane gas to heat water and indoor air. Fossil methane use is also a key source of pollution from the industrial sector. To advance near term GHG goals, Colorado needs to reduce fuel use in buildings and industrial processes through increasing energy efficiency, transitioning water and home heating and industrial operations to electricity where it is cost-effective, and reducing the GHG intensity of the gas that serves these uses. In the residential sector, this shift will provide additional co-benefits that include more comfortable homes and better indoor air quality. Requiring utilities to transition to lower emissions gas will create an incentive for investments in the development of biogas from sources such as agricultural operations and sewage treatment plants as well as spur investment in green hydrogen production.

The state will also need to implement its actions to reduce HFCs (refrigerants and aerosols), and advance climate-smart strategies on natural and working lands. Colorado's natural and working lands include our forests, grasslands, agricultural croplands and rangelands, wetlands, riparian areas,

and urban greenspaces. Natural and working lands are both sources of GHG pollution, including emissions from wildfires, agricultural equipment and fertilizer use, and serve as carbon sinks by holding or sequestering carbon in plants and soils. Colorado must work to increase access to energy efficiency and renewable energy on farms and ranches by increasing utilization of the Agricultural Energy Efficiency program and expanding the Advancing Colorado's Renewable Energy and Energy Efficiency program. This program is designed to achieve a number of goals, including supporting voluntary participation in such efforts as Field to Market, Soil Health Partnership, and Precision Agriculture programs, and protecting, restoring, and enhancing carbon sequestration on farms, ranches, and other natural and working lands.

Colorado also needs to continue efforts to better manage waste streams through diversion, composting, and other initiatives, especially for organic wastes that can form methane in landfills. In 2019, recycling and composting in Colorado reduced greenhouse gas emissions by 1.92 million metric tons of CO2e, which is the one-year equivalent of either removing 407,000 cars from the road, or removing 148,000 homes from the grid, or conserving 2.34 million barrels of oil or 113 million gallons of gasoline. Because Colorado's recycling and waste diversion rates have been below the average of other states, recycling and waste diversion provide critical opportunities to reduce emissions.

In coordination with the E3 modeling showing potential pathways to achieve emission reduction targets, APCD and AQCC have engaged in a more granular, bottom up process of evaluating the emissions reductions associated with potential near term strategies and policy actions. The state has used this analysis to develop a set of recommended regulatory, legislative and programmatic strategies for enactment in 2021 and 2022.

Near Term Actions by Sector

The table below summarizes near term actions that the administration will pursue to achieve sector specific GHG emissions reductions that help Colorado make progress toward meeting the state's climate goals.[iv] The section on near term actions, starting at page 33 in the report, describes these strategies in greater detail and explains why these strategies were selected. As we pursue these steps, we will continue our commitment to climate equity and environmental just through enhancing engagement with stakeholders in disproportionately impacted communities; building on partnerships with Sovereign Tribal nations through consultation and enhanced engagement; and, reducing barriers to public participation in AQCC rulemaking process. We will also build evaluation of potential equity impacts into rulemaking processes and invest more resources in climate equity and environmental justice.

Table 1: Near Term Actions to Reduce GHG Pollution

Sector	Near Term Actions	Targeted 2030 Emissions Reductions From 2005 baseline Million Metric Tons
Electricity	• **Adopt Clean Energy Plans and Electric Resource Plans, including evaluating plans using the full social cost of carbon emissions.** • **Incorporate coal plant retirements from utility commitments and adopted utility plans into AQCC Regional Haze rulemakings.** • **Evaluate mechanisms such as performance based regulation and**	**32.3 mmt**

	other tools to create incentives for deeper emissions reductions and serving beneficial electrification loads with zero carbon generation.	
Transportation	• State GHG pollution standards for transportation plans. • Trip reduction/Transportation Demand Management (TDM) requirements and encouraging telecommuting for large employers. • Clean trucking strategy with multiple components including infrastructure investments, incentives for fleet turnover, and evaluation of regulatory options. More details are on page 57 of the report. • Secure new revenue to fund infrastructure and incentives to transition to electric cars, trucks, and buses. • Offer incentives for land use decisions by local governments that reduce vehicles miles traveled, reduce GHG and other pollutants, and support greater access to housing near jobs. • Indirect source standards for some types of new development. • Expand public transit, including front range rail and RTD completing the statutorily required Fastracks system that	12.7 mmt

	voters passed in 2004 including Northwest Rail (2025 Ridership: 8,600-10,100)..[v] • Develop an EV Equity study to ensure access to EV's for all Coloradans. • Provide input into development of new clean car standards by both the federal government and for state-based standards.	
Residential, Commercial, and Industrial Fuel Use (Gas utilities)[vi]	• Expand energy efficiency investments from gas utilities to support building shell improvements. • Set carbon reduction targets and biogas requirements for gas utilities. • Require large commercial buildings to track energy use and make progress toward energy and pollution performance standards. • Support adoption of advanced building codes. • Require regulated electric utilities to create programs that support customer adoption of electric	4.7 mmt

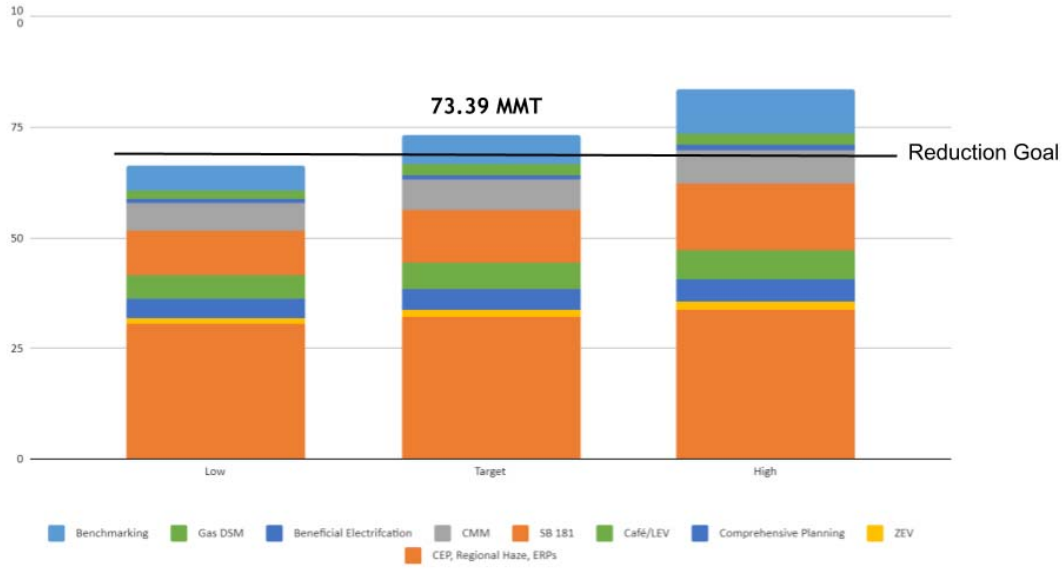
	heat pumps and other forms of beneficial electrification. • Expand access to financing programs for building retrofits by capitalizing a green bank, expanding existing programs and advocating for utility on-bill finance programs. • AQCC action on industrial energy and emission audits requirements and Best Available Control Technology requirements, setting the stage for future performance requirements.	
Oil and Gas	• AQCC rulemaking to achieve methane pollution reductions from the oil and gas industry - at least 33% reduction in total emissions by 2025 and over 50% by 2030. • COGCC implementation of new rules that eliminate routine flaring, require minimizing emissions, and track pre-production and production air emissions.	12.2 mmt
Natural and Working Lands	• Develop a comprehensive emissions inventory. • Develop a Natural and Working Lands Strategic Plan. • Increase producer utilization of Agricultural Energy Efficiency (AgEE) program.	1.0 mmt[vii]

	• Expand Advancing Colorado's Renewable Energy and Energy Efficiency (ACRE3) program. • Improve soil function and carbon sequestration through regenerative farming practices. • Support voluntary participation in such efforts as Field to Market, Soil Health Partnership and Precision Agriculture programs.	
Waste	• Reduce methane emissions from coal mines, landfills, sewage treatment plants, and agriculture through continued reductions in coal extraction, utility biogas incentives[viii], potential AQCC rulemaking and grants for waste reduction and diversion through the Front Range Waste Diversion Enterprise and CDPHE. • Improve recycling end markets and recycling and reuse.	7.5 mmt
Industrial Process Emissions[ix]	• Federal HFC reduction provisions adding to AQCC rules (refrigerants, aerosols, etc.)	0.3 mmt

Other Actions	• **Advance the Governor's FY 2021-22 budget, which includes a number of innovative funding proposals that will help protect Coloradans from the existential threat of climate change, improve air quality, and position Colorado to seize the economic benefits of a renewable energy economy. More detail on the budget is included on page 92.** • **Convene a task force on Carbon Capture, Utilization and Storage (CCUS) starting in mid-2021, which will report to the Governor within a year on recommended framework, including policies and actions steps for advancing CCUS in Colorado.** • **Support local government and private sector climate action efforts.**	**0.3 tons**

The table above shows potential emissions reductions from the APCD's analysis by sector of the economy. In addition to creating a Target case for emissions reduction achievable from the near term actions, the APCD staff developed a Low and High case based on different assumptions about policy implementation. The chart below shows that in 2030 the Target case results in a 53% reduction compared to a goal of a 50% reduction (represented by the solid black line). Even the Low case achieves a roughly 66 MMT reduction, leaving a small emissions gap of less than 3% from the goal.

Figure 4: Comparison of State Pollution Reduction Cases



Near Term Action by Venue and Timeline

The chart below provides a list of near term actions over the next two years arranged by venue (e.g., regulatory agency or legislature) and by year the state anticipates the action being initiated (unless noted otherwise).

Table 2: Near Term Actions to Reduce GHG Pollution by Venue and Timeline

	Fall / Winter 2020	Spring 2021	Summer 2021	Fall 2021	Winter 2021	2022
Public Utilities Commission (PUC)[x]	Tri-State Electric Resource Plan Xcel Transportation Electrification Plan	Xcel Clean Energy Plan Black Hills Transportation Electrification Plan	Xcel Renewable Energy Plan Black Hills Energy Efficiency Plan Black Hills Renewable Energy Plan			Black Hills Clean Energy Plan
Air Quality Control Commission (AQCC)	Regional Haze Rules Ozone Plan Oil and Gas Well Monitoring Rules Outreach on 2021 Oil and Gas Rules	Regional Haze Rules Phase 2 Stakeholder Processes for Transportation, Industrial, Oil and Gas Rules	Transportation Emission Rules (GHG standards for Transportation Plans and Trip Reduction Plans) Industrial Energy and Emissions Audits Rules	Greenhouse Gas emission reduction progress evaluation	Oil and Gas Emission Reduction Rules Structures/ Building Emission Reduction Rules	Transportation Emission Reduction Rules

Colorado Oil and Gas Conservation Commission (COGCC)	**Mission Change Rulemaking: 200 Series - general and record keeping; 300 Series - permitting process; 400 Series - operational practices; 500 Series - hearing process; 600 Series - safety (and residential setbacks); 800 Series - underground injection control wells; 900 Series - environmental and Exploration & Production waste management; and 1200 Series - wildlife (and riparian setback).**	**Rulemaking: 700 Series - financial assurance (bonding); Imposing permit fee; and requiring worker certification (These three topics complete mandatory SB 19-181 rulemakings.)**		**Greenhouse Gas emission reduction progress evaluation, in coordination with CDPHE**		
Other State Agency Actions	**Clean Trucking Strategy Initiated Just Transition Plan Completed**	**Convene taskforce on Carbon Capture, Utilization and Storage Study on how to incentivize progress on land use decisions Climate Equity Framework Completed**	**Clean Trucking Technical Analysis Completed**	**Natural and Working Lands Task Force Pathways Analysis Completed Electric Vehicle Equity Plan Completed**	**Draft Natural and Working Lands Strategic Plan Completed**	

Legislation		**Transportation** • New revenue to fund infrastructure and incentives to transition to low and zero emissions cars, trucks and buses. **Buildings and Gas Utilities** • Set carbon reduction targets for gas utilities. • Set biogas requirements for gas utilities. • Require existing large commercial buildings to track energy use and make progress toward energy and pollution performance standards. • Require regulated electric utilities to create programs that support beneficial electrification. • Expand energy efficiency investments from gas utilities. **Governor's Proposed FY 21-22 Budget Proposal** • Clean Energy Finance ($40 M) • Wildfire relief, mitigation and prevention ($78 M) • Supporting local government investment in renewables and efficiency ($5 M) • Climate Resilience Office at the CO Department of Agriculture • Building the capacity of Colorado's Office of Just Transition			

Leadership and Innovation Required to Meet 2050 GHG Goal

The Roadmap not only models pathways to 2025 and 2030 GHG pollution reductions but examines how Colorado can make progress toward the longer term goal of meeting a 90% GHG pollution reduction by 2050. It is important to recognize that the modeling gets more uncertain over this longer time horizon and that the 1261 Targets Scenario for 2050 is best viewed as an illustrative scenario showing one reasonable pathway toward the state's 2050 emission goals. This is particularly true given the uncertainties in how technologies such as long duration energy storage, green

hydrogen production, carbon capture utilization and storage, and advanced biofuels will develop over the coming decades.

KEY FINDINGS FOR 2050 GOALS

- All sectors have an important role to play in emissions reductions if the state is to reach 90% reductions by 2050. Every sector that is a significant energy producer or consumer— including electricity generation, oil and gas production, transportation, buildings and industry— would need to achieve reductions of 90% to 100%.
- In the illustrative scenario, our two largest utilities, Xcel Energy and Tri-State, meet energy needs with zero-carbon electricity by 2050 while smaller utilities reduce emissions 80% compared to 2005 levels. This is a conservative assumption.
- In transportation, we will need to transition to close to 100% electric cars on the road by 2050 and 100% market share for new vehicle sales of zero emissions trucks and buses by 2050. Achieving this will require close to 100% of new car sales to be electric by 2040. In addition, we need to continue pursuing strategies that reduce vehicle miles traveled.
- Unlike the 2030 goal, achieving the 2050 goal likely will require further technical innovation and economies of scale to bring costs down and allow deployment at scale in a number of sectors. Important technologies may include green hydrogen, long duration energy storage, carbon capture and storage, advanced biofuels, and synthetic fuels based on air capture of carbon.
- In the buildings sector, the 1261 Targets Scenario for full decarbonization by 2050 is based on a large-scale shift to the use of electric heat pumps, powered by zero carbon electricity, for space and water heating. There may be other pathways, depending on technological developments, which is why the near term actions support a wide variety of strategies for the buildings sector.
- Land conservation, restoration, and climate-adaptive ecosystem management will be critical for maintaining and enhancing resilient carbon sequestration on natural and working lands. Achieving these activities at sufficient pace and scale will require significantly scaled up technical assistance, research, and financial incentives.
- In agriculture, all sectors of the industry can adopt GHG reduction strategies in addition to sequestration targets. The development of markets that pay producers for ecosystem services may be an increasingly important tool to help producers remain viable while helping to reach our shared climate goals.

This Roadmap has been developed to meet the requirements of Colorado Revised Statute § 24-20-111, which calls for development of a state climate plan setting forth a strategy to address climate change and reduce greenhouse gas emissions, while taking into account previous state actions and efforts as well as voluntary actions taken by the private sector and local governments.

The GHG Roadmap represents a significant step forward for climate action and pollution reduction planning at the state level and advances Colorado's policy and programmatic vision for pursuing timely, enduring, and equitable strategies. Progressing toward our goals will continue to be iterative and multi-faceted. We look forward to continuing engagement from a diverse set of stakeholders from across the state.

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COLORADO'S ROADMAP TO GREENHOUSE GAS POLLUTION REDUCTION

Introduction

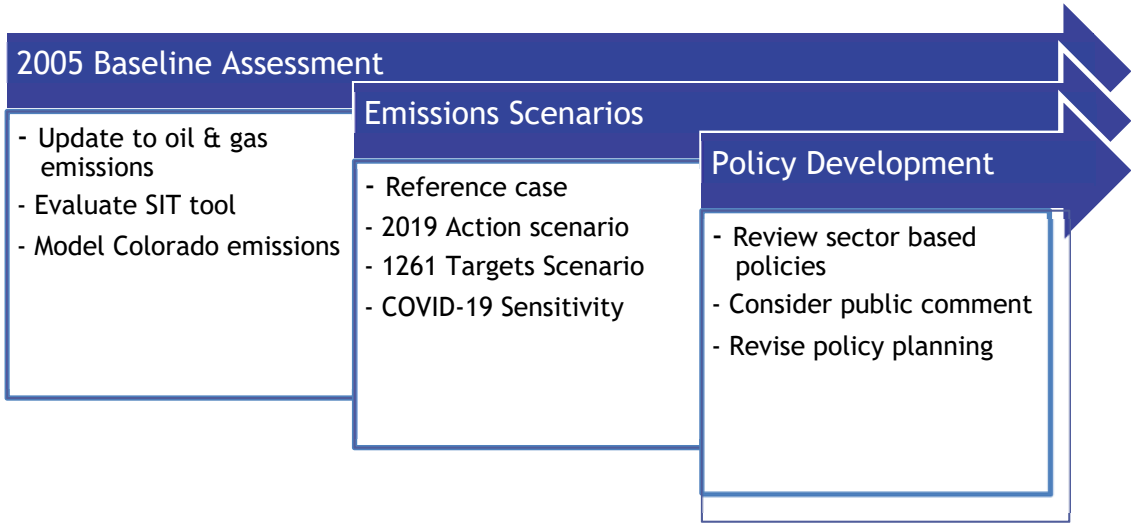
Vision

Since 2004, when Colorado became the first state to adopt a voter-approved renewable energy standard, the state has been at the forefront of the renewable energy transition. Governor Polis ran on a platform of achieving 100% renewable energy by 2040, reducing pollution and ensuring that Colorado does its part to confront the climate crisis. Fighting climate change and reducing harmful air pollution protects the health, safety, and welfare of all Coloradans today and for generations to come. The transition to a cleaner and more just economy provides an unprecedented opportunity to drive innovation and harness consumer and economic benefits.

Over the past year, Colorado and the nation have grappled with a number of profound challenges: the COVID-19 pandemic and ensuing economic impacts, heightened attention to systemic injustices against Black, Indigenous, and people of color, and historic fires driven by drought and heat that have worsened from a warming climate. Despite these challenges, Colorado's commitment to renewable energy, climate action, and clean air has not wavered. The investment it will take to build the clean, renewable energy Colorado needs, to shift to cleaner trucks, buses and cars, and to

reduce energy use in homes and businesses is critical to building a more just and equitable economy and society, protecting the health and safety of all communities across the state, and safeguarding the Colorado way of life.

Figure 5: Roadmap Development Process



To better plan for and mobilize what Colorado can do to meet these goals, the governor directed state agencies to work together to produce a Roadmap to reduce greenhouse gas pollution. As shown in Figure 5, the Roadmap process started with modeling and analysis. It then identified policy actions and other steps the state can prioritize to meet GHG pollution reduction and air quality goals. Those policy proposals were refined in response to stakeholder feedback and are aligned with the equity framework in this document.

We know that Coloradans are already experiencing negative impacts from climate change and we know that Black and Latino Coloradans, Indigenous people, lower-income residents, and those living near multiple sources of pollution experience disproportionate impacts from pollution linked with climate change. To promote equity and justice, the state must work with impacted communities to intentionally and strategically design and implement programs and policies that reduce GHG and invest in impacted communities.

The state's partnerships with the sovereign Nations of the Southern Ute Indian Tribe and Ute Mountain Ute Tribe are an important component of implementing the strategies found in this Roadmap. Strengthening government-to-government relationships through formal consultation, staff peer-to-peer information exchange, and enhanced stakeholder outreach and engagement with members of the Tribes will support successful climate action for all involved. Thoughtful consultation on sector-specific initiatives, such as oil and gas regulation, electric vehicle charging infrastructure investments, and renewable energy project development, will help ensure that potential impacts of state GHG reduction policies and programs are carefully considered.

In order to be meaningful partners in the vital work to improve equity in the United States, we need to first acknowledge that, as state government, we represent an institution that has a history of being a part of the problem when it comes to inequalities in communities. From the beginning of our country, government at the local, state, and national levels have played a role in creating and maintaining racial inequity, including everything from determining who is a citizen, who can vote, who can own property, who is property, and where one can live, just to name a few. Governmental laws, policies, and practices continue to create a racial and human hierarchy and determine, based on race, economic class, access to power, and other characteristics, who benefits and who is burdened. But even with this painful past, Colorado and other communities around the country are working to try to undo harmful policies and practices. It is our sincere goal to work together to build equity and justice principles into systems and processes addressing climate change in Colorado.

We understand that the State of Colorado is on indigenous lands and recognize the 48 contemporary Tribes with homelands in Colorado.
As part of our work to build equity and justice into Colorado's climate change initiatives, it is essential that we acknowledge the Tribal Nations that are Colorado's first inhabitants and first stewards of these lands. As we work to ensure wellbeing and resilience of the places we live, work, and play, it is important that we partner with Tribes and do so in a manner that honors their status as sovereign nations and upholds Colorado's, State-Tribal government-to-government relationships.

State government cannot do this work alone. It is going to take the commitment, expertise, and engagement of Coloradans from diverse perspectives and from across the state to further refine, mobilize, and implement actions identified in this Roadmap. This work involves transforming our collective approach to powering, moving, heating and lighting in our state. Achieving these goals will require action not only from state government, but investments and actions from individuals, businesses, and local governments.

GHG Pollution, Air Quality, and Climate Justice

Reducing GHG emissions will improve Colorado's air quality because many sources of climate pollution are also responsible for local and regional air pollution that damages public health. Targeting reduction to communities historically most impacted will further equity goals.

Transportation is not only the top source of GHG pollution but is also a leading source of nitrogen oxides, one of the precursors to ground level ozone, and particulate matter, a damaging pollutant and contributor to ozone. These pollutants are concentrated in places like North Denver and Commerce City. Equitable investing in EVs and EV infrastructure can address this.

Oil and gas production is the leading source of volatile organic compounds (another ozone precursor) and a top source of methane, a potent greenhouse gas. Reducing pollution from production in Denver-Julesburg basin will reduce ozone across the Front Range and lessen related health impacts.

Hotter days, a direct result of climate change, worsen the formation of ground level ozone. Addressing climate change and working to mitigate temperature increases can help address these problems.

Background on Climate Science

Climate change results from certain gases, including carbon dioxide and methane, absorbing energy from the infrared radiation emitted by the Earth and trapping heat. This heat trapping effect, the "greenhouse effect," causes atmospheric warming resulting in changes to the climate, including more frequent and intense extreme weather events.[xi]

Current measurements show atmospheric CO_2 at 415 parts per million. The National Aeronautics and Space Administration ("NASA"), concludes that CO2 concentrations have increased 47% from pre-industrial levels.[xii] The scientific consensus concludes that human caused emissions of greenhouse gases, primarily from the burning of fossil fuels, is causing atmospheric warming.

Figure 6: CO_2 in the atmosphere and annual emissions (1750-2019). Source: NASA.

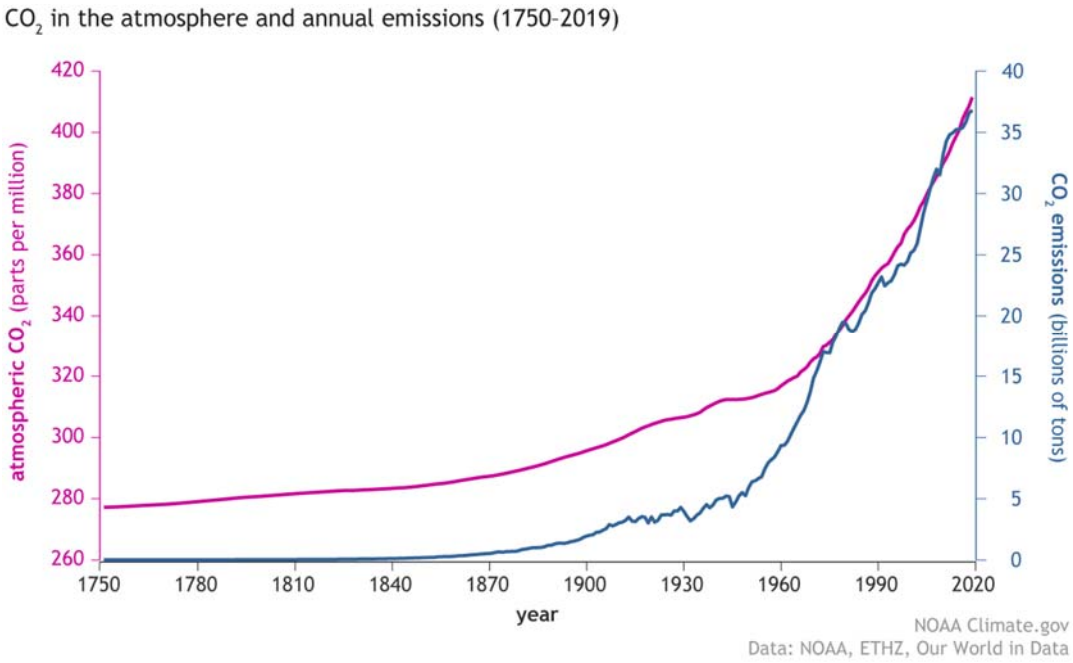
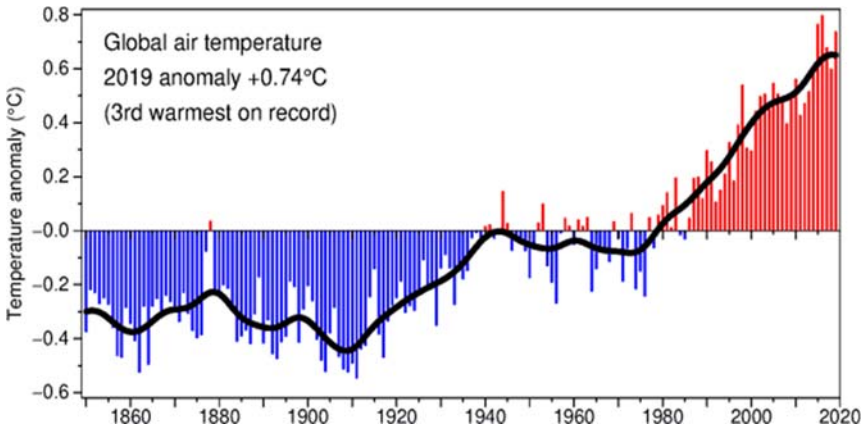


Figure 7 shows the change in average global air temperature (the thick black line), which has increased since the 19th Century. The steepest increases have come over the last half-century. The chart also shows that

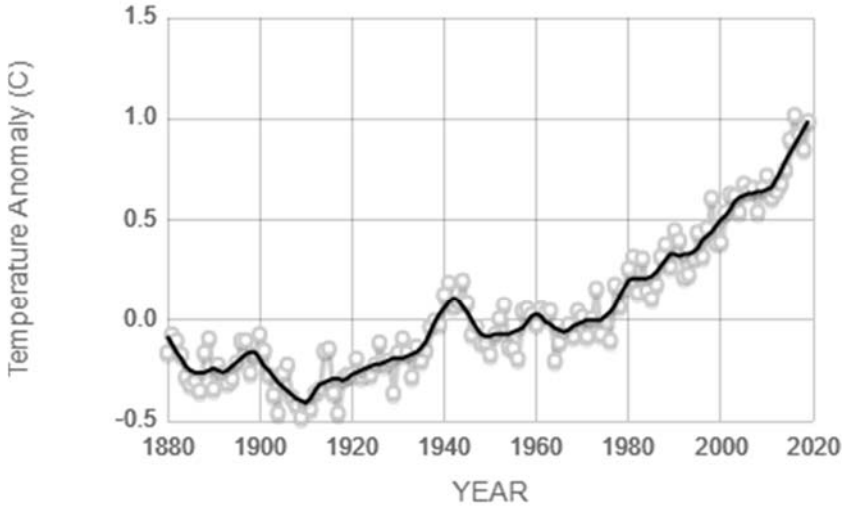
average temperatures are warmer (in red) and warmer by increasing amounts over that same period.

Figure 7: Global Air Temperature. Source: University of East Anglia.



Similar results of warming are shown in Figure 8 (below), which represents the changes in global surface temperature compared to the average temperatures from 1951-1980.

Figure 8: Change in Global Surface Temperature. Source: NASA.



Source: climate.nasa.gov

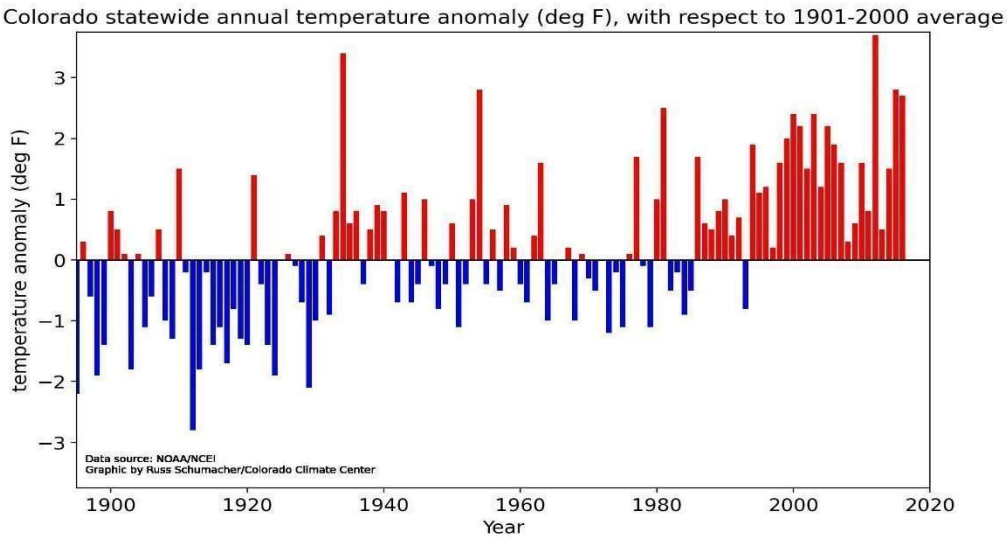
The United Nations Intergovernmental Panel on Climate Change ("IPCC") *Special Report on the Impact of Global Warming of 1.5°C* concludes that human activity is estimated to have caused a 1.0°C global temperature increase by above pre-industrial levels. The IPCC report notes that climate-related risks to health, livelihoods, food security, water supply, and economic growth are projected to increase with global warming of 1.5°C and increase further with warming to 2°C.

According to the IPCC report, disadvantaged and vulnerable populations, indigenous peoples, and communities that are dependent on agriculture are at a disproportionately higher risk of adverse consequences from warming. The IPCC report explains that lowering the levels of carbon-dioxide and other greenhouse gases starting immediately improves the chance that global warming can be limited to 1.5°C and thus avert worsening impacts. The report finds that delaying actions to reduce greenhouse gas pollution increases the challenge and cost of meeting the goal of keeping temperature increases to below 1.5°C. Further, not investing in lower-emitting technologies risks locking in a greenhouse gas-emitting infrastructure.

Climate Change in Colorado

Colorado's climate is changing. The state has warmed 2°F since the beginning of the 20th century.[11] Colorado Climate Center analysis of National Oceanic and Atmospheric Administration ("NOAA") data (Figure 9) shows that over the last 30 years Colorado has experienced an increasing frequency of hotter than average days as represented by the red bars on the graph. NOAA states that,

Figure 9: Colorado Statewide Temperature Anomalies. Source: Colorado Climate Center.

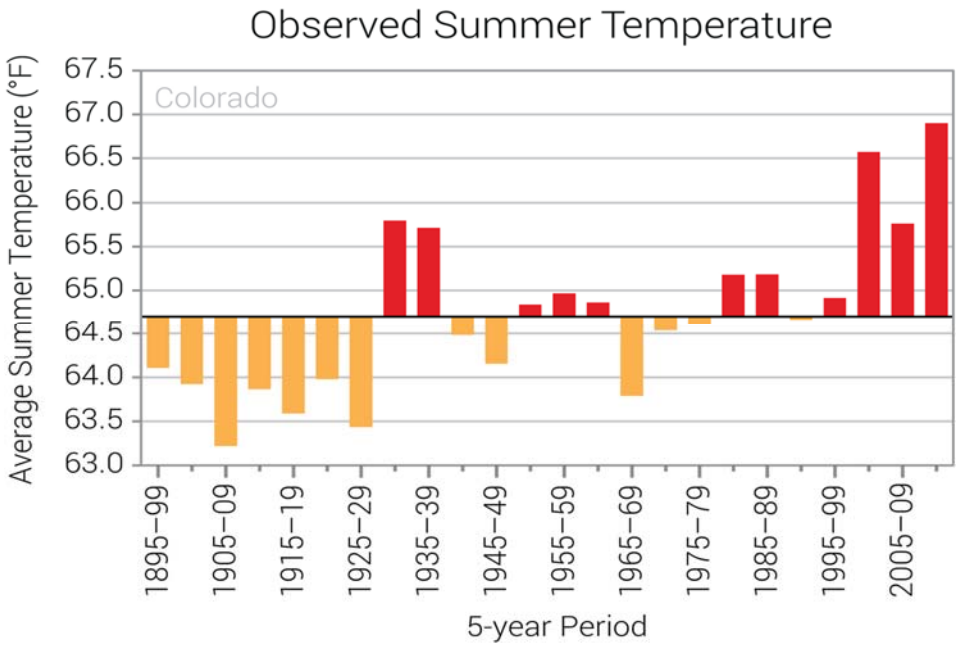


"Average annual temperatures for Colorado have remained consistently higher than the long-term average (1895–2015) over the past two decades."[xiii]

In Colorado, nine of the twelve warmest years on record have occurred since 2000. In addition, recent data from NOAA's Center for Environmental Information shows that Colorado's summer temperatures over the last three decades are the highest on record (Figure 9). The data also shows that Colorado's recent average summer temperatures are even higher than the extreme heat of the 1930s Dust Bowl era.[xiv] In western Colorado, the combination of heat and a lack of precipitation in the most recent three

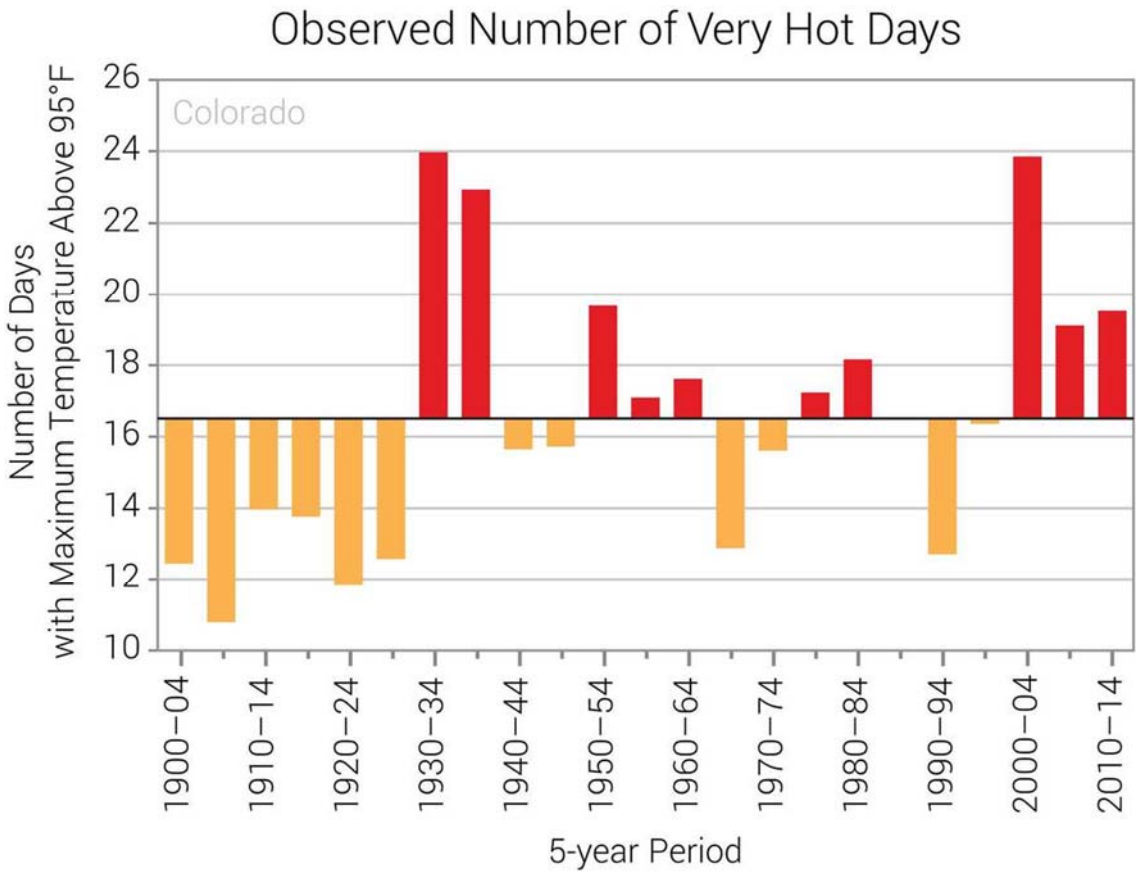
monsoon seasons (July-August of 2018, 2019, and 2020) have been the worst on record.

Figure 10: Summer Temperatures in Colorado. Source: CICS-NC and NOAA NCEI.



Data shows that not only are average days getting hotter, but that Colorado is experiencing an increasing number of extreme heat days. NOAA defines "very hot days" as having a temperature above 95°F. While NOAA notes that temperatures vary across the state, it concludes that, "The number of very hot days has been above average since 2000"[xv] as reflected in Figure 11.

Figure 11: Observed Very Hot Days in Colorado. Source: Source: CICS-NC and NOAA NCEI.



Changes to Colorado's climate from warming is causing an increasing trend of heat waves, droughts, wildfires, and more frequent and severe floods. In addition, the warming, along with other factors, has led to peak runoff from snowmelt coming one to four weeks earlier. Earlier runoff is increasing ecosystem stress through reduced stream flows, high evapotranspiration rates, drier soils, and increasing disease prevalence. Warming temperatures and drier soils also increase the likelihood of large wildfires. The 20 largest wildfires in recorded history in Colorado have all occurred since 2000, with the three largest burning in 2020. The record for the largest amount of acreage burned— over 650,000 acres, was set in 2020.

Future estimates project that temperatures could rise an additional 2.5 to 5°F by 2050.[xvi] As a result of continued warming, Colorado is projected

to become more arid, increasing the severity of droughts and wildfires. However, projections also indicate an increase in extreme precipitation events because of increases in the atmospheric water vapor (due to rising sea surface temperatures), which could result in more frequent and intense flooding in the state.[xvii]

Rising temperatures and a changing climate will impact key natural resources and environments in the state and industries that depend on them such as farming, ranching and outdoor recreation.

Agriculture is a key driver of Colorado's economy. According to a 2020 study, agriculture in Colorado is a nearly $47 billion industry that employs 195,000 people.[xviii] With more than 38,000 farms operating on more than 32 million acres of private land and 20 million acres of leased federal and state land, the success of the state's farms and ranches is tied to the health of Colorado's climate and land.[xix] As Colorado's climate changes, Colorado's farmers and ranchers face increasing challenges. Earlier spring snowmelt is decreasing instream flows in many basins and warmer and drier summers means that even less water is available in the later part of the season. Hotter days and warmer nights are increasing soil dryness, which will become worse with time. Together, the changes that result from a warmer, dryer climate in Colorado could reduce crop yields, force ranchers to reduce herd size, and increase incidences of invasive weeds and pests. In addition, these impacts will result in more and larger wildfires— in 2020 alone the state saw the three largest wildfires in its history. The 2015 *Colorado Climate Plan* concluded "the Colorado of the future is unlikely to look like that of the past."[xx]

The state's mountains and rivers are not only a symbol of Colorado, but the ski resorts, parks, and gold-medal fishing waters are a leading source of tourism, jobs, and revenue for the state. According to a 2018 report from Colorado Parks and Wildlife,[xxi] outdoor recreation resulted in $62.5 billion in spending and contributed $35 billion to the state's Gross Domestic Product.

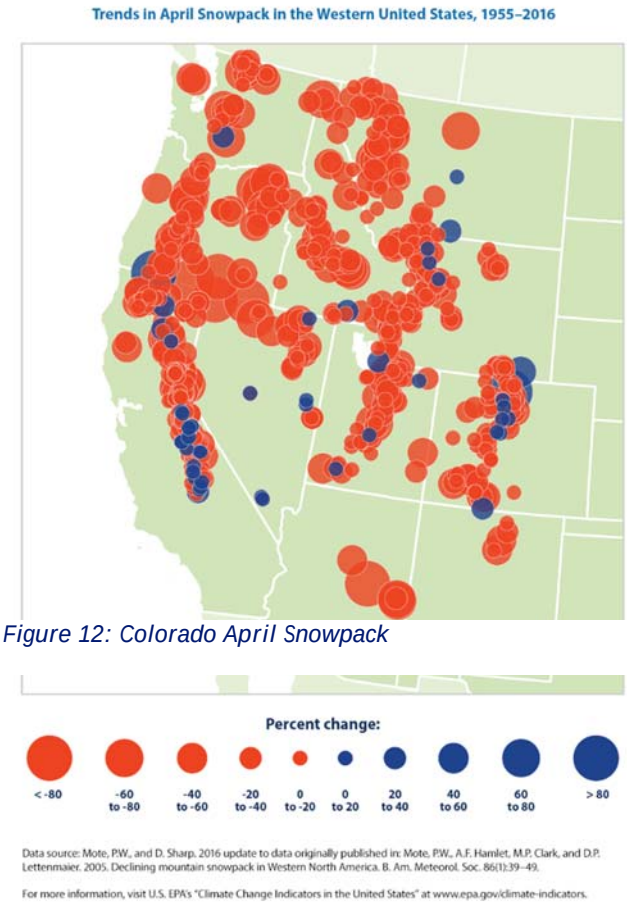


Figure 12: Colorado April Snowpack

The more than 500,000 jobs in outdoor recreation represent 18.7% of the state's employment. But Colorado's skiing is vulnerable to decreased snowpack and early melt, reducing the number of skiable days. Figure 12 shows that in many parts of Colorado's mountains, spring snowpack is declining, which may result in fewer ski days and fewer mountain visits. In addition, lower instream flow can increase water temperatures impacting signature fish species and impacting gold-medal fishing areas. In short, Colorado's outdoor recreation industries are vulnerable to the warming temperatures resulting from the changing climate.

Table 3 summarizes key changes to Colorado's natural resources from climate change and some of the impacts that those changes will have.

Table 3: Impacts of Climate Change in Colorado

Water	• Decreased snowpack and earlier runoff • Less water availability • Lower water quality • Risks of increased flooding
Soil	• Increased drought and drier soil • Decrease crop yields • Smaller herd size
Forest Health and Wildfires	• Increased insect, disease, and drought impacts on trees & crops • Increased risk of wildfires • Increased area burned
Public Health	• Summer heat-related health risks • Health impacts from higher ozone levels due to hot summer days • Increased risk of asthma and other respiratory diseases • Increased risk of vector-borne diseases
Wildlife	• Heat, drought, and reduced snowpack impact wildlife populations • Increases in invasive species

Disproportionate Impacts and Climate Equity in Colorado

House Bill 19-1261, Colorado's Climate Action Plan, directs the AQCC to identify communities disproportionately impacted by climate change to ensure that the actions the state takes to reduce emissions include strategies to reduce harmful air pollution affecting those communities. In identifying these communities, the AQCC is directed to consider communities of color, low-income residents, and tribal or indigenous populations. The statute also identifies that disproportionate impacts may result from increased vulnerability to environmental degradation, lack of opportunity for public participation, or other factors. The AQCC is required to prioritize and direct the benefits of regulatory compliance, including economic, health, environmental, and resiliency benefits, to disproportionately impacted communities. Furthermore, the statute requires the state to solicit stakeholder input on advantages of different regulatory measures, specifically soliciting input from disproportionately impacted communities, and requires the state to evaluate any impacts of potential rules on those communities.

As Colorado designs policies to meet its GHG targets, the state must recognize that the effects of air pollution and climate change on human health, safety, and economic prosperity do not affect all people equally. People of color, the sovereign Tribes in Colorado, lower-income individuals, historically underrepresented groups, and those experiencing multiple

environmental burdens and social factors, such as systemic racism, are often most severely impacted.

Studies show that lower-income individuals and people of color experience increased health impacts and premature death due to exposure to particulate matter in the air.[xxii] Individuals and families who may already be dealing with chronic health conditions, inadequate healthcare or insurance, or a lack of access to trustworthy information may be more vulnerable to impacts from air pollution and climate change.[xxiii] Communities that face impacts from pollution often face multiple impacts and a greater frequency of more intense exposure to pollution— often including the confluence of industrial facilities, highways, and other sources of air pollution— and a correlation to higher frequency of upper respiratory health problems and other dangerous health impacts. These communities frequently face additional factors that compound the negative impacts of pollution like homes with poor ventilation and, in the current environment, factors that increase the risks associated with COVID-19, such as more crowded living conditions, doing essential work, or working in occupation that cannot be done remotely. Especially in communities with inadequate or poorly maintained infrastructure, with less access to air conditioning, and with greater reliance on public transportation for mobility, high levels of particulate pollution, very hot days, and natural disasters can be dangerous, or even deadly.

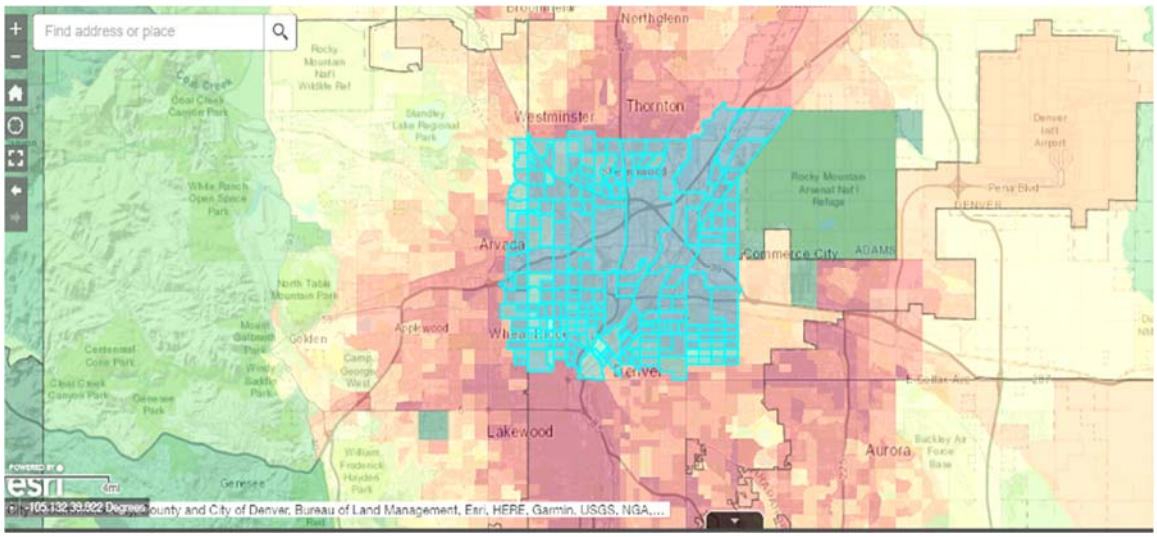
Greenhouse gas reduction policies and programs must be developed with direct input and consideration from disproportionately impacted communities, along with significant analysis to improve understanding of how those policies will impact those communities. Climate action and air quality improvement strategies that are informed by community concerns and priorities, and that are designed creatively to promote equity and enhance quality of life will encourage buy-in and result in lasting change.

CDPHE is using data mapping to identify impacted communities by showing the geographic distribution of specific demographic data, cumulative environmental burdens, and certain health conditions across the state. In the map below, areas in darker red have higher impacts, often resulting from experiencing a multiple of these factors. The data viewer will be a tool to help the state prioritize community engagement efforts and be a lens through which state agencies and stakeholders can consider potential impacts of policy and regulatory decisions.

Colorado's Climate Equity Framework

To ensure that climate policies and programs effectively promote racial equity and economic justice, they must be designed intentionally and strategically and with input from impacted communities.

The **Climate Equity Framework** is a guidance document that helps identify disproportionately impacted communities across Colorado, based on statutory guidelines from HB 19-1261. The



Area in darker red have higher health and impacts.

Framework details best practices for effective outreach and engagement. It also identifies ways to improve access to participation in rulemaking processes, such as providing meetings and materials in common spoken languages such as Spanish, providing evening meetings, and making the public comment process as simple and convenient as possible. The framework also provides a set of questions to be asked before rule concepts and language are developed and during rulemaking proceedings to make sure equity considerations are meaningfully demonstrated in the outcomes. CDPHE will use the equity framework to guide processes at the AQCC and other commissions. The Colorado Oil and Gas Conservation Commission also adopted regulations in November 2020 to incorporate environmental justice into its permitting decisions. These measures are one part of the state's commitment to creating a foundation for equitable climate action.

Key equity principles shaping Colorado's climate response:

Principle 1: Equitable Representation - The GHG policy process should make it possible for any interested person to easily participate. Policies that impact communities should be shaped by community input.

Principle 2: Prioritizing Benefits - For GHG reduction strategies with the potential to provide direct benefits to individuals or communities, disproportionately impacted communities should be prioritized.

Principle 3: Economic Impacts - GHG reduction strategies should reduce costs, including currently externalized costs, and increase economic benefits, especially for disproportionately impacted communities wherever possible.

Principle 4: Health Impacts - GHG reduction strategies should minimize negative health impacts and improve health for disproportionately impacted communities.

Principle 5: Access to Solutions - GHG reduction strategies should ensure that clean technologies are made available to everyone who wants them, in ways that make sense for them.

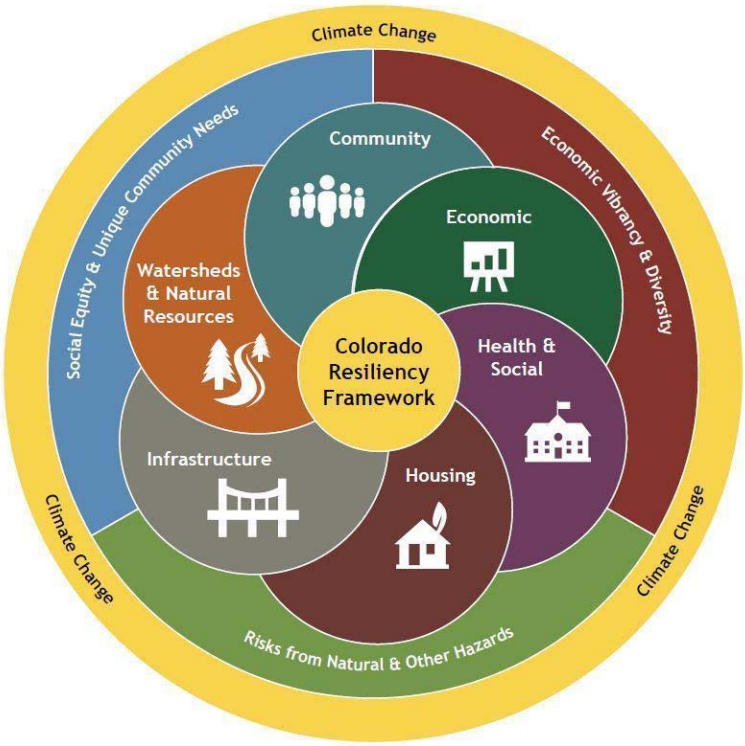
Principle 6: Building Resilience - GHG reduction strategies should improve resilience and quality of life for disproportionately impacted communities.

Resilience Planning in Colorado

Climate change poses one of the biggest threats to Colorado's resiliency to future shock events and long-term stressors. With prolonged and more intense drought, more frequent and larger wildfires, and more frequent and intense flooding, climate change will continue to disrupt every part of our communities if left unaddressed.

Colorado continues to plan for how to address these and other climate-related threats. As a central part of this work, the Colorado Resiliency Office updated the Colorado Resiliency Framework ("Framework") in 2020.

Figure 13: Colorado's Resilience Framework



With the release of the Framework in 2015, Colorado led the nation as the first state to develop and implement a framework for holistically addressing risks and vulnerabilities to acute shock events (like a wildfire or

pandemic) and long-term stressors (like climate change, housing affordability or aging infrastructure), particularly those related to natural hazards including wildfire, drought, and flooding.

With the five-year update in 2020, the Framework includes priority strategies that address the impacts of Climate Change in three major areas of focus: Risks from Natural & Other Hazards, Social Equity & Unique Community Needs, and Economic Vibrancy & Diversity. The Framework contains an inner circle of six overlapping resiliency sectors to be considered holistically in developing resiliency solutions. As a result, the Framework's priority areas of focus are defined as having Climate & Natural Hazard Resiliency, Building & Infrastructure Sustainability, Agriculture & Food Security, Housing Attainability, a Future-Ready Economy & Workforce, and Community Capacity. These strategies will enable state departments and partners to:

- Identify and mitigate risk to Colorado communities
- Enhance resiliency planning and capacity in Colorado communities through equitable engagement and regional collaboration
- Develop, align, and streamline policies to empower resiliency
- Create a culture of inclusivity that fosters resiliency, equity, and holistic solutions, and an inherent sense of responsibility to one's community
- Ingrain equity and resiliency into investments in Colorado

The Roadmap: Purpose and Process

In the 2019 session, the Colorado General Assembly passed 14 pieces of legislation aimed at advancing clean energy and reducing the state's greenhouse pollution. House Bill 19-1261 the *Climate Action Plan to Reduce Pollution*,[xxiv] concluded:

> **Colorado is already experiencing harmful climate impacts, including declining snowpack, prolonged drought, more extreme heat, elevated wildfire risk and risk to first responders, widespread beetle infestation decimating forests, increased risk of vector-borne disease, more frequent and severe flooding, more severe ground-level ozone pollution causing respiratory damage and loss of life, decreased economic activity from outdoor recreation and agriculture, and diminished quality of life. Many of these impacts disproportionately affect rural communities, communities of color, youth and older adults and working families. Reducing statewide greenhouse gas pollution as outlined in this subsection (2) will protect these frontline communities, first responders, and all Colorado residents from these and other climate impacts.**

To reduce the potential that the state will see more severe impacts from climate change, Colorado's *Climate Action Plan* sets science-based targets for GHG pollution reductions of 26% by 2025, 50% by 2030, and 90% by 2050 from a 2005 baseline, and delegates authority to the Air Quality Control Commission to enact rules to make progress towards these goals. The statute also directs the AQCC to include strategies designed to reduce harmful air pollution affecting disproportionately impacted communities.

A key to equitable progress toward these goals is to promote the investment needed to modernize the economy more quickly in disproportionately and historically impacted communities. Transitioning towards a resilient, low carbon economy requires investments, regulations, and other measures by the state as well as federal and local governments. It will also require business investment and leadership and the engagement of the nearly six million Coloradans with more than five million vehicles and almost 2.5 million housing units.

HB 19-1261 provides that the Air Quality Control Commission can consider progress made through all of these means in developing regulations: "The implementing rules may take into account other relevant laws and rules, as well as voluntary actions taken by local communities and the private sector, to enhance efficiency and cost-effectiveness, and shall be revised as necessary over time to ensure timely progress toward the 2025, 2030, and 2050 goals."

2019 Colorado Legislative Action Addressing Climate Change

Climate Policy

Senate Bill 19-096: Collect Long-term Climate Change Data
Requires the AQCC to collect and report on GHG pollution, forecast future emissions, and adopt a state-wide GHG reporting rule by June 1, 2020 and to begin proposing rules to address emissions by July 1, 2020.

House Bill 19-1261: Climate Action Plan to Reduce Pollution
Establishes GHG pollution reduction goals of 26% by 2025, 50% by 2030 and 50% and 2050 from 2005 level. The bill allows the AQCC to consider other actions, including other statutes, administrative or regulatory policies, local plans and rules, and voluntary efforts as it promulgates rules to reduce pollution and ensure an equitable distribution of benefits.

Energy Efficiency

House Bill 19-1231: New Appliance and Water Efficiency Standards
Updates and adopts energy efficiency and water efficiency standards for certain appliances and plumbing fixtures.

House Bill 19-1260: Building Energy Code
Requires cities or counties to adopt one of the 3 most recent energy conservation codes when they update building codes.

Electric Vehicles

Senate Bill 19-077: PUC Electric Vehicle Infrastructure Programs
Starting in 2020, requires regulated electric utilities to file a plan every three years to invest in electric vehicle infrastructure and to support customers' investments in electric vehicles.

Senate Bill 19-239: Address Impacts of Transportation Changes
Required CDOT to convene and consult with a stakeholder group to examine impacts of new transportation technologies and business models, identify means of addressing impacts, and report findings and make recommendations to the general assembly (completed in 2019).

House Bill 19-1159: Modification to EV Tax Credits
Extends the tax credits for purchase of an EV or hydrogen fuel cell vehicle through 2025.

House Bill 19-1198: EV Grant Fund
Allows CEO to provide grants for and to offset operating costs for charging stations.

Modernizing Utilities and Oil and Gas Development

Senate Bill 19-181: Protect Public Welfare Oil and Gas Operations
Changes authority over surface impacts of oil and gas development and directs adoption of rules to minimize air pollution from oil and gas operation and strengthen protections for health, safety and the environment.

Senate Bill 19-236: Public Utilities Commission (PUC)
Directs the PUC to use a social cost of carbon in utility resource planning, to investigate utility rates, utility regulatory models, and the impacts of joining an organized electricity market. Requires the PUC to promulgate rules addressing utility resource and distribution system planning. Requires utilities to submit a workforce transition plan when proposing retirement of a coal-fired power plant. Requires Xcel Energy to file a plan to reduce carbon emissions by at least 80% by 2030 and permits other utilities to file plans to meet that target.

House Bill 19-1003: Community Solar Gardens Modernization Act
Increases the size of an individual community solar garden (CSG) to 5 megawatts and removes certain location restrictions.

House Bill 19-1272: Housing Authority and New Energy Improvements
Clarifies that housing authorities may use the Colorado Commercial Property Assessed Clean Energy(C-PACE) program to finance energy improvements.

House Bill 19-1314: Just Transition from Coal-Based Energy Economy
Creates the Just Transition Office, provides support to coal workers, provides grants for communities impacted by the coal transition, and requires electric utilities that propose to retire a coal-fired power plant to file a workforce transition plan with the Just Transition Office.

Legislation enacted in 2019 also directs the AQCC to conduct enhanced and more frequent collection of greenhouse gas pollution data from sectors across the state's economy and to report that data to the public. The data reporting is to include historic emissions and an improved forecast of future emissions. The ongoing tracking and reporting of emissions, including projections of potential future emissions, will help ensure that Colorado remains on track toward meeting its goals.

After the passage of this legislation, Governor Polis directed state agencies to work together to develop a Roadmap for pollution reduction to inform how Colorado can make progress toward the emission targets in the *Climate Action Plan*. To achieve this goal, the Roadmap assesses the various sources of the state's greenhouse gas pollution and identifies policy actions and other strategies Colorado can prioritize to reduce greenhouse gas emissions while also reducing other air pollutants, cultivating a strong economy, and addressing inequities in economic and health outcomes.

State agencies, including the Colorado Energy Office and the Departments of Public Health and Environment, Agriculture, Natural Resources, and Transportation, with additional support from other agencies, worked together to develop the Roadmap. In addition, Colorado hired Energy + Environmental Economics, a leading national consulting firm, to provide greenhouse gas modeling used in the Roadmap.

The development of the Roadmap included (i) an assessment of the 2005 baseline, (ii) the modeling of different emissions scenarios, and (iii) the development of policies Colorado can implement with a focus on early action to address the 2025 and 2030 GHG reduction goals.

The Roadmap evaluation finds that as a result of prior policies as well as legislative, regulatory and other actions taken during the last two years, Colorado is on a path to a greenhouse gas reduction of 13% in 2025 and 26% in 2030. The evaluation shows that additional actions are needed and the

Roadmap identifies administrative, regulatory, legislative, investment, procurement, incentive-based, and other measures to progress towards the 2025 and 2030 GHG reduction goals in an equitable and cost-effective way.

Phase I - Developing the 2005 Baseline

The *Climate Action Plan* sets targets for GHG pollution reductions measured from a 2005 baseline. The 2019 *Colorado Greenhouse Gas Inventory Update Including Projections to 2020 & 2030*, which reassessed the state's 2005 emissions, identified that, "There is still considerable uncertainty in much of the activity data, the emission factors, and many calculation methods" of the approach used in the modeling for that report.[xxv] To resolve those issues and harmonize E3's modeling with the state inventory, the development of the Roadmap began in December 2019 when state agencies and E3 began gathering data and reassessing the 2005 baseline greenhouse gas emissions inventory for Colorado. In addition, the agencies and E3 worked with a Technical Advisory Group of Colorado-based experts (see sidebar) to evaluate the design of the Roadmap analysis, including model inputs and assumptions. The state also met with other stakeholders conducting emissions modeling exercises to understand the similarities and differences in their respective efforts. As part of this process, the Roadmap team adjusted baseline inventories of oil and gas methane emissions upwards to better reflect current scientific understanding of emissions.

Technical Advisor Group

Early in the process, the State sought input and feedback from a Technical Advisory Group:

Dr. Morgan D. Bazilian - Director, Payne Institute, Colorado School of Mines

Jill Cooper - Senior Principal, Geosyntech

Dr. Bryan Hannegan - President and CEO, Holy Cross Energy

Jeffrey Lyng - Director of Energy and Environmental Policy, Xcel Energy

Dr. Keith Paustian - Distinguished Professor Department of Soil and Crop Sciences, Colorado State University

Dr. Gabrielle Petron - Research Scientist NOAA ESRL Global Monitoring Division

Tracy Winfree - Senior Program Manager CDR

Lee White - Managing Director Stifel Public Finance

Additional documentation about the Roadmap process and technical appendices are available from the Roadmap webpage.

Phase II - Building the Baseline and Early Policy Development

In early 2020, E3 began modeling the trajectory of Colorado's greenhouse gas pollution under a **Reference Case Scenario**. This reference case models an emissions trajectory based on policies and actions taken prior to 2019.

E3 also modeled a **2019 Action Scenario** to show the GHG emissions reductions from utility commitments, legislation, and administrative actions taken since January 2019. This evaluation, initially done prior to the COVID-19 pandemic, shows that Colorado is on course to achieve a 13% reduction in GHG pollution by 2025 and nearly halfway to the 2030 target of a 50% reduction from 2005 levels. Because the 2019 Action Scenario showed that Colorado needs to take additional actions to meet its goals, the state directed E3 to model an illustrative target scenario that shows one possible set of investments and transitions across the economy that meets the targets established in the *Climate Action Plan* (**1261 Targets Scenario**).

Table 4: Key Assumptions in the Reference and 2019 Action Scenarios

Sector	Measure	Reference Scenario	2019 Action Scenario
Buildings and Industry	Energy Efficiency	Utility efficiency programs; appliance standards	2019 New Appliance Standards (HB 1231)
Transportation	CAFE Standards	Extended through 2026	
	Zero Emission Vehicles (ZEVs)	Economic adoption (EIA), 9% sales by 2030	Navigant modeled scenario, 42% sales by 2030
Electricity Generation	Coal Retirements	Planned retirements (pre-2019 announcements)	Recent announcements (Craig 2 and 3)
	Distributed Solar	Projected trends in rooftop solar adoption	
	Carbon Targets	N/A	80% GHG Reductions by 2030, Tri-State and Xcel targets by 2050, SB 236
Oil & Gas	Control regulations	Post 2018 regulation impacts not currently modeled	
Waste and Refrigerants	Total Emissions	Grow with population, no measures	
Agriculture and Coal Mine Methane	Total Emissions	Remain constant, no measures	

Throughout the winter of 2019 and spring of 2020, the Roadmap team continued meeting with members of the Technical Advisory Group to discuss the on-going modeling efforts. In February, the state agencies also provided the first of a series of regular updates on the status of the Roadmap to the AQCC. These updates included a discussion of any revisions to methodological assumptions, key findings, and potential policies the state might evaluate for early action. AQCC provided time for public comment on the Roadmap at each monthly meeting where the Roadmap team provided an update. In

addition to extensive written comments the AQCC also heard 23 public comments in February, 66 comments in April, and 47 comments in October regarding the draft Roadmap.

During this phase, the Roadmap project team began holding meetings with different groups. Over the course of the development of the project more than 60 meetings were held with groups representing local governments, the Southern Ute Indian Tribal leadership and environmental program staff, the Ute Mountain Ute Tribal environmental program staff, the business community, environmental advocacy organizations, the outdoor recreation industry, utilities, the oil and gas industry, mining, farmers and ranchers, and organizations representing disproportionately impacted communities.

Feedback from these meetings led to several changes in the report. First, as the COVID-19 pandemic began to take hold, the Roadmap team heard from many groups that the modeling needed to reassess certain assumptions in light of changes to oil and gas development, driving habits, and the state's economy from COVID-19. The Roadmap includes this sensitivity analysis, which is designed to show a reasonable potential of the impacts of the COVID-19 pandemic on the state's overall GHG emission trajectory. Also in response to feedback, the Roadmap team conducted further review of the baseline emissions from oil and gas development, ultimately revising the numbers to align with best current information and practices.

The team also received feedback that the Roadmap should include a more targeted assessment of pollution reduction from any specific policies that the state is considering for early action to demonstrate that those policies will ensure progress toward the 2025 and 2030 goals. That analysis is now included in this report and referred to throughout as the state modeling or Colorado modeling.[xxvi]

Phase III - Refinement of Policy Alternatives

During the course of summer 2020, E3 and state agency staff began the third phase of the project, modeling emissions reductions across sectors of Colorado's economy that would enable the state to make progress toward meeting the *Climate Action Plan* goals. The state team also began to evaluate potential additional administrative, regulatory, legislative, procurement, incentive-based, and other measures to advance toward the 2025, 2030, and 2050 GHG reduction goals in an equitable and cost-effective way.

Through the summer months the state staff continued providing updates to an AQCC subcommittee and meeting with stakeholder groups. State agencies held a virtual, online public listening session in August 2020. More than 300 Coloradans joined the two-hour event, which was hosted in Spanish and English. The state held a second listening session in October, which over 200 people attended. Over the course of the Roadmap development process, CEO received roughly 370 public comments through the Roadmap webpage.

Throughout the process, the Roadmap has been developed to help inform policy making and to ensure progress toward meeting the emissions targets in the Colorado Climate Action Plan. Making progress toward these emission targets will be a total state effort involving agencies and departments across state government. It will also be iterative and multi-faceted in nature and require a broad portfolio of investments, incentives, and regulatory and legislative strategies. Because the state government cannot do it alone, it is the intention to partner with a diverse array of local governments and public and private partners.

The GHG Roadmap represents a significant step forward for climate action and pollution reduction planning at the state level, advancing Colorado's policy and programmatic vision for pursuing timely, enduring and equitable strategies. Progressing toward these goals will continue to be

iterative and multi-faceted, as continued engagement is encouraged from a diverse set of stakeholders from across the state.

Community Engagement Highlights

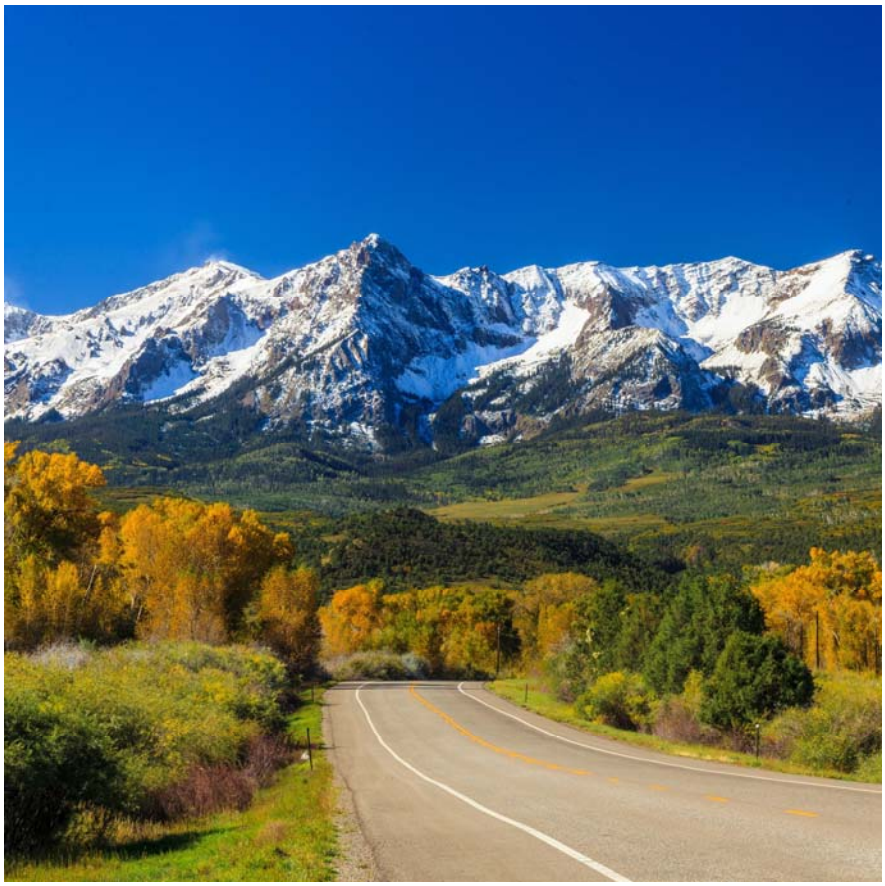
~600 community members participated in feedback sessions

+2,200 emails received

+50 small group meetings held

Key findings

- The largest sources of GHG pollution in Colorado are transportation, electricity generation, oil and gas production, and fuels use in the residential, commercial and industrial space.
- Achieving Colorado's 2025 and 2030 GHG emissions targets is feasible with existing technologies, but would require actions, laws, and policies beyond those Colorado has taken already.
- Achieving the 2030 goals would rely on deep reductions in pollution from electricity generation by continuing the transition to renewable energy, as well as deep reductions in methane pollution from the oil and gas industry, which makes up the largest source of non-combustion emissions in the state.
- Making changes to transportation planning and infrastructure to reduce growth in driving is an important tool in reducing emissions.
- Electrification of end uses in buildings and transportation will play an important role in achieving these targets, with action needed in the near term to accelerate the transition.
- By 2050, very high levels of electrification of vehicles will be needed, with nearly 100% of all cars on the road being electric and a 100% market share for zero emissions trucks among new sales.
- Reducing methane emissions from landfills, sewage plants and other sources, and enhancing waste reduction, recycling and diversion efforts, is also necessary, especially to reach emissions targets after 2030.
- Protecting, restoring and enhancing the resilience of Colorado's natural and working lands is critical for sequestering carbon.
- These transitions will reduce air quality burdens that impact lower income communities and communities of color disproportionately.
- In each of the sectors, policy will need to be carefully designed to ensure that benefits are distributed equitably.



The policies in this Roadmap build on earlier commitments Colorado made to address the climate crisis, including leading the transition to renewable energy, adopting aggressive goals for clean and electric vehicles, and passing legislation to clean up or retire coal-fired power plants. This work would not have been possible without a strong partnership among the General Assembly, public interest groups, private sector leaders, local governments, and the public. The findings in this Roadmap are supported by the analysis conducted by E3 and the additional work done by the state Air Pollution Control Division.

NEAR TERM ACTIONS TO REDUCE POLLUTION

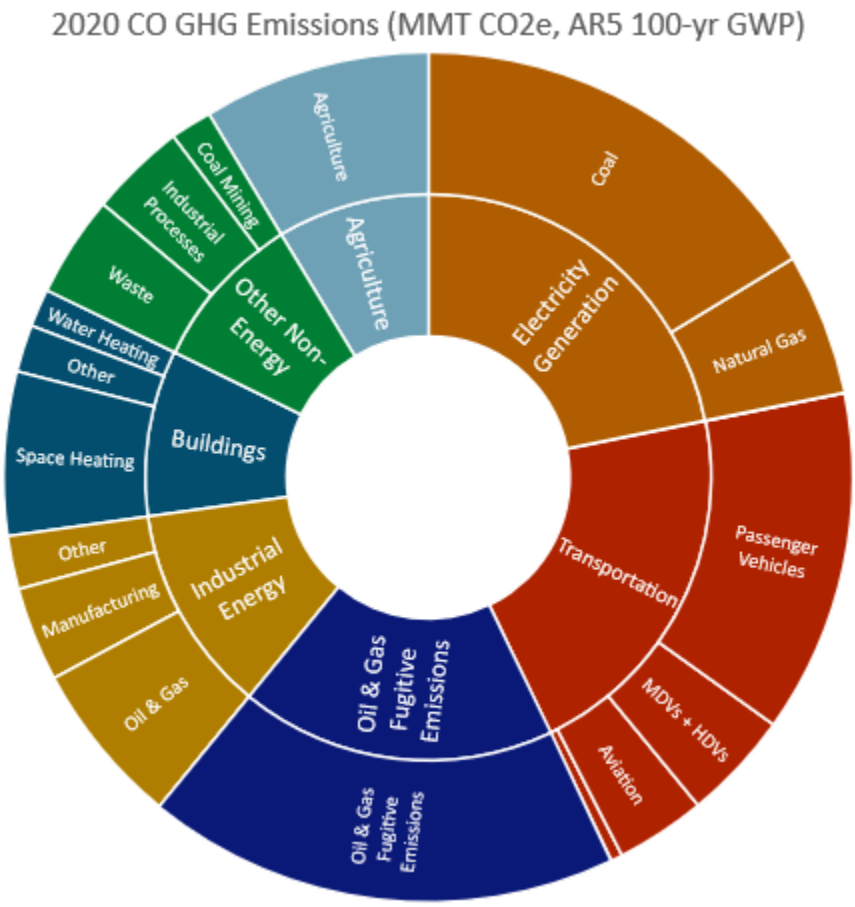
The Roadmap incorporates and builds on the existing legislation and policy framework. The Roadmap assesses the sources of the state's greenhouse gas pollution and identifies a series of policy actions the state can take to reduce GHG pollution. The report focuses primarily on near term action, meaning action that may be implemented over the next one to two years to make progress toward Colorado's 2025 and 2030 GHG targets. The Roadmap also considers a range of other actions that help ensure that Colorado is on a pathway to meet its 2050 target of a 90% reduction in GHG pollution from its 2005 level.

The plan presented here was developed with the help of ten months of conversations with disproportionately impacted communities, community leaders, Colorado's farmers and ranchers, the Southern Ute Indian Tribe, the Ute Mountain Ute Tribe, faith groups, business leaders, environmental organizations, industries affected by the transition, and other Coloradans. State agencies received feedback on a wide array of topics, including recommendations on how to model GHG pollution and what policies should be considered to reduce those emissions.

Making progress towards Colorado's 2025 and 2030 GHG pollution reduction goals is feasible but will require continuing the transition to renewable electricity generation to achieve an 80% reduction below 2005 levels by 2030, reducing methane emissions from the oil and gas sector more than 50% by 2030, increasing investments in energy efficiency and expanding electrification of buildings and industry. Reducing pollution from transportation requires a transition to electric vehicles and reductions in VMT, but by the end of the decade will also require expanding the use of clean fuels such as biogas. The state will also need to seek reductions in non-

combustion GHGs, through leak reduction from fossil gas utilities and oil and gas development, waste diversion to minimize organics in landfills, and through capture of biogas from sources like landfills, wastewater treatment plants, and farms. Significant reductions in methane emissions from the oil and gas industry may also be necessary. The following diagram shows the major sources of GHG pollution in Colorado.

Figure 14: 2020 CO GHG Emissions (MMT CO2e, AR5 100-yr GWP)

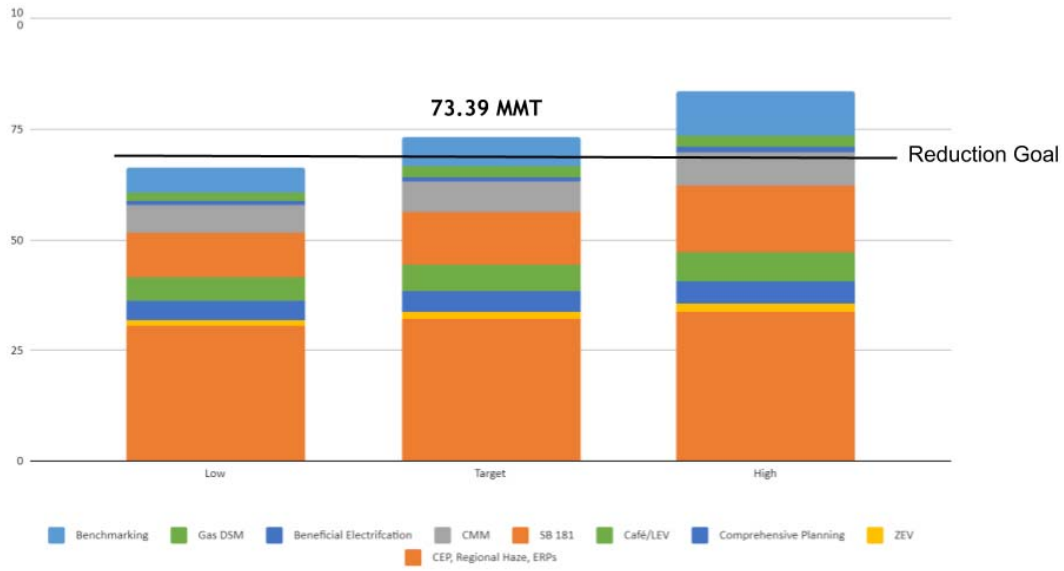


Summary of Near Term Action Plan

Colorado's largest four sources of GHG pollution are transportation, electricity generation, oil and gas, and fuel use in buildings and industry.

As shown in figure 15 (below), two sectors— electricity generation and oil and gas— account for approximately two thirds of the total 2030 reductions needed to reach the state climate goals.

Figure 15: Comparison of State Pollution Reduction cases



Colorado projects a 32 million ton reduction in emissions from electricity and a 12 million ton reduction in emissions from the oil and gas industry under the near term action plan. These sectors play such a large role in the near term reductions for several reasons. First, each is a large source of current emissions. Second, reductions can be achieved at a reasonable cost with existing technology. Third, in each of these sectors the majority of the emissions come from a small number of emitting sources. This can be contrasted with the transitions that are necessary to achieve savings in the

built environment and transportations sectors, which will come through the actions of millions of Coloradoans making individual decisions and investments.

For electricity, the dramatic decline in the cost of wind, solar, and battery storage has made deep emissions reductions possible, often at a cost savings. The costs of new utility scale wind and solar, with some associated battery storage, are lower than the cost of operating existing coal generation. This shift is allowing utilities to retire coal generation and replace it with wind, solar and storage, using existing natural gas generation (or in some cases small additions of gas combustion turbines) as backup to the renewables. There is high confidence that the state's utilities can achieve the target of at least an 80% reduction by 2030 without significant rate increases to their customers. The six utilities that operate more than 99 percent of the state's fossil-fired generation, Xcel Energy, Tri-State Generation and Transmission, Colorado Springs Utilities, Platte River Power Authority, Black Hills Energy, and Holy Cross Energy, have already committed to resource plans that meet or exceed an 80% GHG reduction by 2030.

The state is not proposing to require reductions greater than 80% by 2030 across the board, although it is hopeful that the 80% reductions might be reached earlier or exceeded by 2030. Despite the low costs of renewables, getting all the way to 100% carbon free generation across the entire state will require some combination of technological development and price declines for long duration storage and firm zero carbon generation as well as broader access to regional markets for electricity and greater integration of flexible demand into the grid. Despite these challenges, some utilities have committed to deeper, cost effective reductions by 2030. Platte River Power Authority has adopted a plan for 90% reductions and Holy Cross Energy has committed to 100% carbon free power by 2030. State agencies will engage in the PUC process to consider Xcel Energy and Tri-State's electric resource and

clean energy plans to help ensure the maximum level of cost effective emissions reductions.

The oil and gas production, processing, and transmission sector has many opportunities to reduce methane emissions at relatively low cost. The E3 analysis found a cost of only $4/ton CO2e. Many leading oil and gas producers have made environmental, social, and governance commitments that include reducing methane emissions to 0.2% of production volume by 2025. Major advances have been made towards the ability to do continuous emissions monitoring. Based on the commitments made and technologies available, setting a regulatory requirement for a greater than 50% emissions reduction by 2030 is feasible. This will result in a roughly 12 million ton reduction by 2030. A CDPHE-led stakeholder process will allow a full exploration of how best to structure this requirement, leading to an AQCC rulemaking in late 2021.

The other two largest sources of emissions (transportation and fuel use in buildings and industry) are very different in character from electricity and oil and gas. The reductions in transportation are comparable in magnitude to those from oil and gas, approximately 12 million tons CO2e by 2030, but about half of this is from the gradual turnover of older to new cars and trucks that meet existing federal and state vehicle emissions standards. The future actions in the near term action plan will lead to approximately 6 million tons of additional reductions by 2030. The reductions from fuel use in buildings and industry will be about 4.7 million tons by 2030.

Reducing emissions from vehicles and fuel use in buildings and industry will require changes to transportation planning and land use decisions made not only by the state but by numerous local governments. The transition will also require millions of individuals and businesses to make decisions about how they travel, the vehicles they use, and about energy use in their homes and businesses. These are not sectors that can be addressed through

overarching rules or emissions caps. While there is a role for regulation in areas such as vehicle standards, requirements for gas and electric utilities to support end use energy efficiency and electrification and make use of biogas, industrial energy and emission audit requirements, and building codes and performance standards, many of the necessary changes will require incentives to encourage action, public investment, outreach and education and industry leadership through efforts such as national-scale electric vehicle production. These sectors also have a relatively long stock turnover time, with cars lasting 15 years or longer, trucks often being used for decades, and the time between major upgrades of buildings often being in the decades. Because of this, it is important to begin action now. Even though the emissions reductions from these near term actions will be relatively modest in the near term, they will grow to become very significant in the period after 2030.

The near term action recommendations also target reductions in methane emissions from waste through expanded waste diversion, recycling, and incentives and regulations targeting capturing and using waste methane. Emissions reductions from capturing and using methane are shown in the buildings and industrial fuel use category, since they will primarily displace fossil methane use in these sectors. The large reduction in emissions in the waste category (7 million tons) comes mostly from reductions in coal mine methane. This is because active mines emit far more than inactive mines, so as demand for coal drops and mines close, methane emissions drop significantly. The state agencies also received substantial feedback from a variety of stakeholders that the Roadmap should more actively address carbon capture utilization and sequestration (CCUS). The state is planning to create a task force to examine issues related to the potential development of CCUS in Colorado.

We also know that natural and working lands have an important role to play but are not yet able to quantify the impact of policies in this area. We

are pursuing a portfolio of measures to enhance our understanding and begin action in these areas.

Finally, in every one of these areas it is important to address how they can be implemented in an equitable manner. This needs to be addressed in each policy, but also in a holistic way, and the state intends to pursue strategies designed to enhance the opportunities for key stakeholders from disproportionately impacted communities to provide input and help design these policies.

We also note that many stakeholders have pointed out that while there is a high level analysis of the marginal costs of emissions abatement, the Roadmap does not provide a detailed cost benefit analysis for each regulatory proposal. This is true, but inevitable for such a broad analysis. As each proposal is brought to the appropriate regulatory body, the policy will be subject to the full review process required for adoption including costs and benefits. For example, under state law, rules brought to the AQCC will require rigorous regulatory and economic impact analysis, and participating parties may request full cost benefit analysis as part of the process.

Table 5 presents a summary of the near term actions by sector that the administration will pursue (this table also appeared in the Executive Summary). These actions are discussed in more detail in this section following the table.

Table 5: Near Term Actions to Reduce GHG Pollution

Sector	Near Term Actions	Targeted 2030 Emissions Reductions From 2005 baseline Million Metric Tons
Electricity	• **Adopt Clean Energy Plans and Electric Resource Plans, including evaluating plans using the full social cost of carbon emissions.** • **Incorporate coal plant retirements from utility commitments and adopted utility plans into AQCC Regional Haze rulemakings.** • **Evaluate mechanisms such as performance based regulation and other tools to create incentives for deeper emissions reductions and serving beneficial electrification loads with zero carbon generation.**	**32.3 mmt**
Transportation	• **State GHG pollution standards for transportation plans.** • **Trip reduction/Transportation Demand Management (TDM) requirements and encouraging telecommuting for large employers.** • **Clean trucking strategy with multiple components including infrastructure investments, incentives for fleet turnover, and evaluation of regulatory options. More details are on page 57 of the report.**	**12.7 mmt**

	• **Secure new revenue to fund infrastructure and incentives to transition to electric cars, trucks, and buses.** • **Offer incentives for land use decisions by local governments that reduce vehicles miles traveled, reduce GHG and other pollutants, and support greater access to housing near jobs.** • **Indirect source standards for some types of new development.** • **Expand public transit, including front range rail and RTD completing the statutorily required Fastracks system that voters passed in 2004 including NW rail (2025 Ridership:8,600-10,100).**[xxvii] • **Develop an EV Equity study to ensure access to EV's for all Coloradans.** • **Provide input into development of new clean car standards by both the federal government and for state-based standards.**	

Residential, Commercial, and Industrial Fuel Use (Gas utilities)[xxviii]	• **Expand energy efficiency investments from gas utilities to support building shell improvements.** • **Set carbon reduction targets and biogas requirements for gas utilities.** • **Require large commercial buildings to track energy use and make progress toward energy and pollution performance standards.** • **Support adoption of advanced building codes.** • **Require regulated electric utilities to create programs that support customer adoption of electric heat pumps and other forms of beneficial electrification.** • **Expand access to financing programs for building retrofits by capitalizing a green bank, expanding existing programs and advocating for utility on-bill finance programs.** • **AQCC action on industrial energy and emission audits requirements and Best Available Control Technology requirements, setting the stage for future performance requirements.**	**4.7 mmt**

Oil and Gas	• **AQCC rulemaking to achieve methane pollution reductions from the oil and gas industry - at least 33% reduction in total emissions by 2025 and over 50% by 2030.** • **COGCC implementation of new rules that eliminate routine flaring, require minimizing emissions, and track pre-production and production air emissions.**	**12.2 mmt**
Natural and Working Lands	• **Develop a comprehensive emissions inventory.** • **Develop a Natural and Working Lands Strategic Plan.** • **Increase producer utilization of Agricultural Energy Efficiency (AgEE) program.** • **Expand Advancing Colorado's Renewable Energy and Energy Efficiency (ACRE3) program.** • **Improve soil function and carbon sequestration through regenerative farming practices.** • **Support voluntary participation in such efforts as Field to Market, Soil Health Partnership and Precision Agriculture programs.**	**1.0 mmt**[xxix]
Waste	• **Reduce methane emissions from coal mines, landfills, sewage treatment plants, and agriculture through continued reductions in coal extraction, utility biogas incentives**[xxx]**, potential AQCC**	**7.5 mmt**

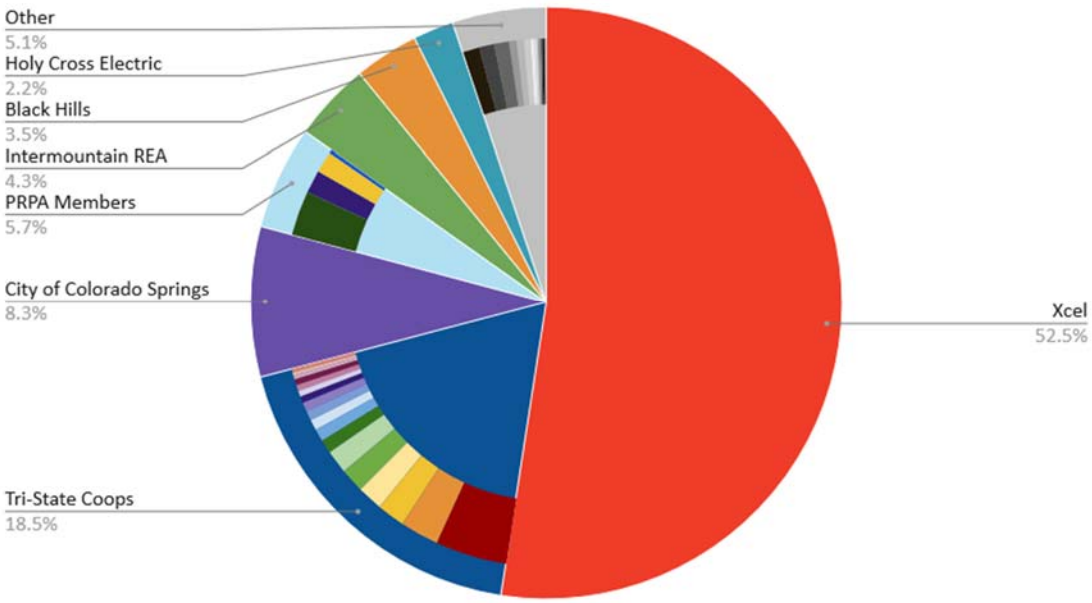
	rulemaking and grants for waste reduction and diversion through the Front Range Waste Diversion Enterprise and CDPHE. • Improve recycling end markets and recycling and reuse.	
Industrial Process Emissions[xxxi]	• Federal HFC reduction provisions adding to AQCC rules (refrigerants, aerosols, etc.)	**0.3 mmt**
Other Actions	• Advance the Governor's FY 2021-22 budget, which includes a number of innovative funding proposals that will help protect Coloradans from the existential threat of climate change, improve air quality, and position Colorado to seize the economic benefits of a renewable energy economy. More detail on the budget is included on page 92. • Convene a task force on Carbon Capture, Utilization and Storage (CCUS) starting in mid-2021, which will report to the Governor within a year on recommended framework, including policies and actions steps for advancing CCUS in Colorado. • Support local government and private sector climate action efforts.	**0.3 tons**

Electric Utility Sector

Colorado's utility sector is composed of 54 electric utilities and 12 gas utilities that provide the electricity and fossil methane that heat our homes and businesses and power the state's economy. As shown in the previous table of near term actions, the largest single opportunity for near term reductions is in the electricity sector, where the Roadmap is targeting an 80% reduction, or 32 million tons, below 2005 emissions levels by 2030. Utilities representing more than 99% of the state fossil generation have already committed to resource plans that meet or exceed an 80% GHG pollution reduction by 2030.

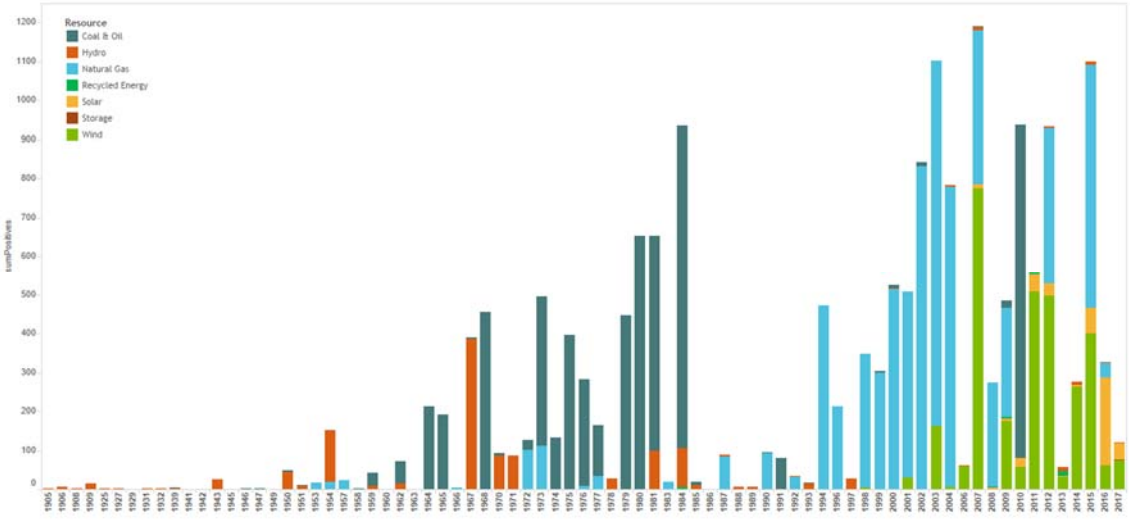
Xcel Energy is the state's largest electric and gas utility. As shown in Figure 16, Xcel accounts for roughly 52% of the state's electricity sales. Colorado Springs utility and Platte River Power Authority ("PRPA") are the second and third largest retail utilities in the state with a combined sales share of roughly 14%. Tri-State Generation and Transmission provides electricity to other utilities across Colorado and three other states.

Figure 16: Percent of Total Electric Sales in Colorado by Utility (2018 MWh)



As shown in the figure below, Colorado has historically depended on coal-fired power plants to provide electricity. Starting in the 1990s, the state saw more investment in gas-fired generation. Then, in 2004, with the passage of a renewable portfolio standard, Colorado began to see increasing investment in wind and solar. As investments in wind and solar grew nationally and prices declined, the state saw additional growth in renewable resources. Colorado is positioned to further this transition by accelerating the retirement of fossil-fired generation, reducing GHG emissions, and meeting renewable generation goals.

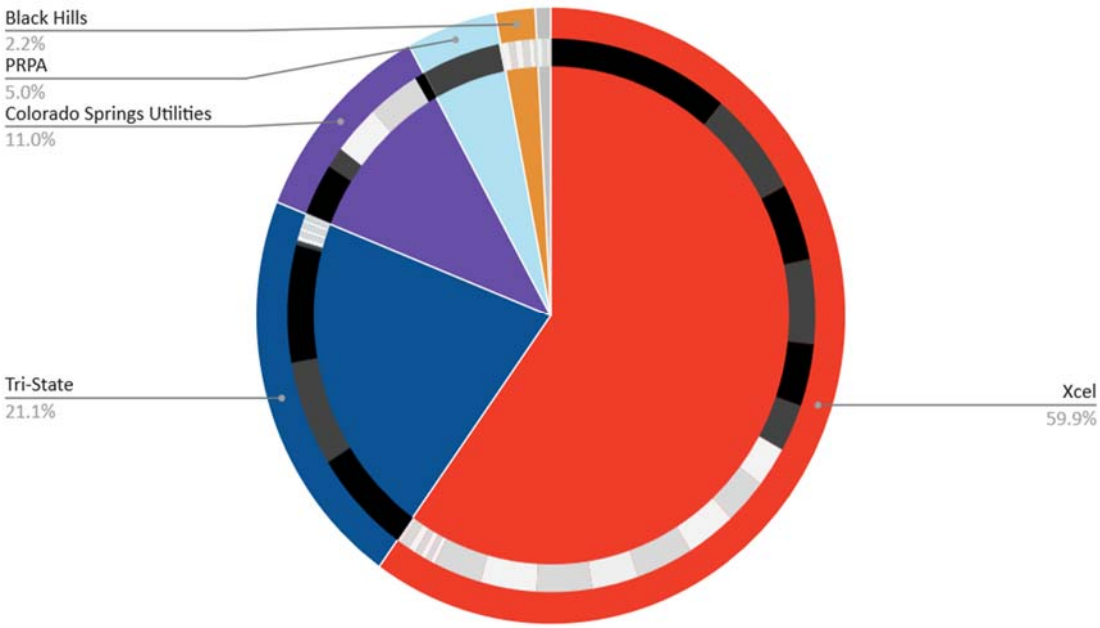
Figure 17: Colorado Electric Generator Capacity by Type and Year Installed



Source: EIA Electric Monthly Current

Based on a recent analysis by the Colorado Energy Office, roughly 99% of the fossil-fired generation in the state is operated by only five utilities: Xcel Energy, Tri-State, Colorado Springs, PRPA, and Black Hills.

Figure 18: Percent of Fossil Fuel Generation in Colorado by Plant Operator (2019, MWh)



Clean Energy Plans and Voluntary Fossil-Plant Retirements

The current legal and regulatory framework in Colorado creates a pathway for the state's electric utilities to reach an 80% reduction in carbon emissions from 2005 levels by 2030. Legislation passed in 2019 requires Colorado's largest investor owned utility, Xcel Energy, to file a Clean Energy Plan with the Public Utilities Commission. The PUC ordered Xcel Energy to file its plan no later than March 31, 2021. By law, a Clean Energy Plan must demonstrate an 80% reduction in CO_2 emissions associated with the utility's Colorado sales in 2030, as measured from a 2005 baseline. Because a CEP is part of the utility's resource planning, the Clean Energy Plan will include power plant retirements and additions through 2030. The PUC can also consider whether it is economically beneficial to retire fossil-fired power plants earlier than scheduled retirement dates. Because of legislative changes in 2019, the retirements and additions will be evaluated, in part, using a social cost of carbon, which quantifies the impacts of GHG pollution and will therefore make it more expensive for a utility to use fossil fuel fired

power plants. Legislative changes in 2019 also authorized Xcel Energy to utilize a loan refinancing mechanism known as securitization, that could create savings for the benefit of ratepayers, communities, and workers directly impacted by the early retirement of fossil-fired power plants.

Colorado's second largest utility, Tri-State Generation & Transmission, submitted a resource plan to the PUC in December 2020 that targets an 80% reduction in emissions from the generation that serves load in Colorado. In the evaluation by the PUC of Tri-State's resource plan, the full social cost of carbon is required to be taken into account.

The combination of a 2030 GHG pollution reduction target and the potential for any utility to file a Clean Energy Plan provides an important framework to implement enforceable emissions reductions. Under the Clean Energy Plan statute, other utilities are permitted to file with the PUC Clean Energy Plans (CEPs) that meet the minimum target of reducing GHG emissions 80% by 2030. A utility with an approved CEP that demonstrates that they will achieve these reductions is given a "safe harbor" from further regulation of GHG emissions through 2030. The administration has worked with utilities to adopt plans that achieve at least an 80% emissions reduction. Platte River Power Authority has adopted a resource plan that will achieve a 90% emissions reduction by 2030 and Colorado Springs Utilities has adopted a resource plan that will achieve an 80% reduction. Holy Cross Energy has committed to 100% carbon free power by 2030. In January of 2021 Black Hills announced its intent to file a clean energy plan that will achieve an 80% pollution reduction by 2030. The administration continues to work with these utilities to file these plans as CEPs, making these voluntary commitments

Major Colorado utilities with commitments to meet clean energy goals of an 80% GHG emissions reduction by 2030:

Black Hills Electric

Colorado Springs Utilities

Platte River Power Authority

Tri-State G&T

Xcel Energy

enforceable to achieve deep pollution reductions and a quick transition to renewables.

Through the mandatory and voluntary filing of CEPs, a clear and complete picture of the ongoing transition of the Colorado electric utility sector will be publicly available and tracked to ensure the electricity sector achieves emissions reductions consistent with the modeling performed for this report. For those utilities not filing CEPs, the APCD will monitor ongoing reduction efforts to evaluate the need and benefits of pursuing any AQCC regulatory action needed to meet the state's goals. The APCD will include its evaluation of utility reduction efforts as part of the tracking included with the GHG Dashboard.

There may be opportunities to create additional regulatory mechanisms that can provide incentives for utilities to make even deeper GHG emissions reductions. For investor owned utilities, performance based regulation may be one option. Traditional utility regulation creates an incentive for a utility to make large capital investments such as building new power plants. Under a performance based regulatory framework, a utility earns based on achieving specific outcomes determined by state regulators. Such outcomes can include cost performance, meeting state pollution reduction or environmental goals, just transition outcomes, and environmental justice goals. Because performance based regulation is outcome driven, it may better enable the creation of financial mechanisms that can drive utilities to seek deeper GHG pollution reductions or incentivize the use of zero carbon resources to serve new electrification loads. There may also be other mechanisms that could be explored to incentivize deeper reductions, including from utilities whose rates are not regulated by the PUC.

The implementation of CEPs and the movement away from coal-powered electricity in the state also has significant benefits for human health. Reducing the co-pollutants from coal combustion, including

particulate matter (PM10 and PM2.5), Sulphur dioxide (SO2), ozone-generating oxides of nitrogen (NOx), and volatile organic compounds (VOCs), will improve health conditions such as asthma, chronic obstructive pulmonary disease, and other respiratory and cardiovascular diseases. These conditions are aggravated by exposure to the co-pollutants of coal combustion and are experienced more frequently by communities of color and low-income Coloradans.

Regional Haze Rule

Several of the announced early retirement dates for coal-fired electric generating units in Colorado will become codified through inclusion in Colorado's Regional Haze State Implementation Plan ("SIP"), providing legal certainty that these retirements will take place. The federal Regional Haze rules call for state and federal agencies to work together to improve visibility in 156 national parks and wilderness areas across the United States. In Colorado, there are 12 "Class I" areas that fall under the Regional Haze rule. EPA approved Colorado's first 10-Year Regional Haze SIP in 2012. Colorado's next Regional Haze SIP is due to EPA in July 2021. The AQCC has completed rulemaking that includes closure dates for 11 sources, mostly electric generating units at power plants around the state and a coal mine on the western slope. The intent is not to supplant the resource planning function of the utility governing boards and the PUC, but rather to take the coal plant retirement dates that have been established through these processes and incorporate them into the regional haze plan, making them enforceable. The projected emission reductions from these closures are up to 35,773 tons per year for visibility impairing pollutants (NOx, SO2, and PM). While the SIP is focused on these pollutants, it will have the co-benefit of locking in the associated GHG pollution reductions.

The table below (Table 6) projects an annual CO2e reduction of 21.7 million metric tons per year from coal plant retirements included in the Regional Haze rulemaking. The state bases these calculations on the

facilities' most recent representative three years (2016-2018) of operation. The retirements included in the Regional Haze SIP are not inclusive of all changes in the electric sector. The type and quantity of replacement resources and transmission improvements will likely be determined through each utility's resource planning process. We note that this does not yet include either the recent announcement from Xcel Energy that it plans to retire Hayden Unit 1 in 2028 and Hayden Unit 2 in 2027 or any additional or accelerated retirements that Xcel Energy may propose or that the PUC may require as part of Xcel Energy's March 2021 Clean Energy Plan. These changes likely would be included in the second phase of the Regional Haze rule at the AQCC.

Table 6: CO2e Reductions from Regional Haze Generating Unit Retirements

Facility/Unit	CO2e Reduction (metric tons)	Closure Date	Utility
Drake Unit 5	4,275	1/1/2017	Colorado Springs
Valmont	601,866	9/1/2017	Xcel Energy
Nucla	175,343	9/1/2019	Tri- State
Drake Unit 6	446,247	12/31/2022	Colorado Springs
Drake Unit 7	755,376	12/31/2022	Colorado Springs
Comanche Unit 1	2,090,251	12/31/2022	Xcel Energy
Comanche Unit 2	2,287,504	12/31/2025	Xcel Energy
Craig Unit 2	2,821,418	9/30/2028	PacifiCorp, Platte River Power Authority, Salt River Project, Tri-State Generation and Transmission Association, and Xcel Energy
Cherokee Boiler 4	1,427,354	12/31/2028	Xcel Energy
Rawhide Unit 1	1,963,468	12/31/2029	Platte River Power
Nixon Unit 1	1,242,179	12/31/2029	Colorado Springs
Craig Unit 3	2,445,888	12/31/2029	Tri-State
TOTAL	20,364,765	Metric tons	

Transportation Sector

The state is targeting a 12.1 million ton reduction from transportation by 2030. E3 projects that approximately half of this, 6 million tons, is the result of prior vehicle emissions policies which are resulting in older vehicles being replaced by cars and trucks built that meet current fuel economy and emissions standards. Despite the rise in population and vehicle miles traveled, the vehicle improvements required under these policies are resulting in modest reductions in GHG emissions. The state projects that the other 6 million tons will come from additional actions, including public investment, incentives, changes to transportation planning designed to reduce the growth of vehicle miles traveled, regulatory requirements, and increased adoption of zero emissions cars, trucks and buses.

Zero Emission Vehicles

The transportation sector is the single largest source of GHG pollution both nationwide and in Colorado. Nearly 60% of these emissions come from light-duty vehicles— the majority of cars and trucks that Coloradans drive every day. Pursuing the near-complete electrification of these vehicles by 2050, with an interim target of nearly 1 million light-duty EVs in service by 2030, will significantly reduce the state's overall GHG emissions while reducing harmful pollutants, saving consumers money, and producing complementary benefits to the state's rapidly decarbonizing electrical grid.

In April of 2020, the state released an updated Electric Vehicle Plan that establishes goals for zero emission vehicle adoption statewide, including having at least 940,000 EVs on the road by 2030 (including at least 1,000 transit vehicles), reaching near full electrification of the light-duty fleet by

2050, and reaching 100% zero emissions from new medium- and heavy duty fleets by 2050.

Because light duty vehicles tend to remain on the road for ten years or more, the plan identifies a number of strategies designed to increase consumer awareness, ensure equity in access to EVs, and continue the build out of the charging and fueling infrastructure needed to support widespread EV adoption. Achieving near full electrification by 2050 will require that EVs make up a high share of new vehicle sales in prior decades. To enable consumers to more confidently shift to EVs, potential regulatory action along with a number of complementary state actions will be essential, including ensuring consumer incentives to bring down the initial purchase price of vehicles, building out a statewide network of charging stations to ensure that EV drivers are able to easily access charging when needed, and accelerating the turnover of fleet vehicles, including in government fleets, to more rapidly get the oldest and most polluting vehicles off Colorado roads. Together, these actions will be critical to meeting the emissions reductions in the transportation sector.

It is critical that the transition to EVs provide benefits to low and moderate income Coloradans as well as rural and disproportionately impacted communities. While some benefits are universal— all of us benefit from lower levels of GHG pollution— other benefits, such as reduced fueling and maintenance costs and better vehicle performance are specific to those driving EVs. Lower levels of local air pollution and vehicle noise are specific to geographical areas with greater levels of EV adoption.

In 2021, the Colorado Energy Office will be conducting a stakeholder process leading to a study on EV Equity that will baseline, define, and map frontline communities that are or may be disproportionately affected by transportation pollution or experience barriers preventing their ability to equitably access electric transportation or the benefits of transportation

electrification. The report will assess barriers to EV adoption and will examine strategies to remove those barriers. Transportation air pollution, including MDV and HDV emission impacts, will be evaluated and summarized via mapping. Criteria to evaluate and prioritize potential programming, with stakeholder engagement, will be developed.

With this context in mind, the following set of strategies will be pursued in the transportation sector to achieve the GHG emissions reductions necessary to make progress toward the 2025 and 2030 targets.

- Post-2025 Clean Car Standards: In November 2018, the AQCC adopted Regulation 20 on Low Emission Vehicle ("LEV") standards for new light and medium duty vehicles sold in Colorado beginning in model year 2022. With that action, Colorado joined twelve other states and the District of Columbia in adopting California's vehicle standards under Section 177 of the Federal Clean Air Act. Currently, regulations requiring improvements in vehicle efficiency or Zero Emission Vehicle adoption beyond 2025 are not in place at either the federal level or in California. It is likely that both the federal government and California will soon pursue post-2025 standards. Colorado could adopt any future California standards as a means to reach deeper emissions reductions after 2025. The state can participate in the development of California and federal standards. Because adoption of policy in Colorado is contingent on California or the federal government adopting new standards that do not exist yet, it is likely a few years out before Colorado could consider updating its regulations. For those reasons, post-2025 vehicle standards are not included in the summary chart. However, the state will actively engage in rulemaking proceedings to help shape federal or state-based standards in the near term and will then make a decision on whether the new federal standards meet Colorado's needs or whether the state should initiate a rulemaking at the AQCC to adopt the state-based standards. The state's active

engagement in shaping future standards is included in the summary of near term action.

- EV Incentives for Consumers, including Low-Income Consumers: Current EV tax credits in Colorado are only available for the purchase or lease of new vehicles. Many consumers, particularly those in lower-income communities, are not able to use these incentives. Further, individuals and households must have the ability to carry these costs until they can be credited on the following year's taxes. Establishing new incentives that cut across electrification of multiple modes will help spread the benefits of transportation electrification more equitably to all Coloradans. Enabling incentives to be applied at the point of sale or lease will also ensure that these incentives can meaningfully reduce costs for Coloradans. One example of this approach comes from a recent PUC proceeding in which the Colorado Energy Office proposed that Xcel Energy, the state's largest utility, offer to its customers a rebate on new or used vehicles that would apply through the dealer at the time of purchase or lease. The proposal includes a recommendation to earmark a percentage of available rebate funds for used vehicles and for income-qualified households and would provide a larger rebate for income-qualified customers. The PUC approved a roughly $110 million TEP, which included $5 million in vehicle rebates for lower-income customers.

- Electric Bikes and Micromobility: The Colorado Energy Office is currently developing a pilot electric micromobility project to provide electric bikes and scooters to lower-income essential workers who have been negatively impacted by COVID-19-related public transit disruptions. This pilot project could result in subsequent scaling of this model potentially through legislation.

- EV Charging Infrastructure Incentives: Colorado has supported the build-out of publicly-accessible EV charging infrastructure at workplaces, public buildings, and along major travel corridors for years through the Charge Ahead Colorado and Alt Fuels Colorado programs and must continue to do so as the adoption of EVs grows statewide. Particular emphasis must be placed on filling gaps on the state highway network to allow for longer-distance travel and addressing the greater charging requirements needs of medium and heavy duty vehicles. In addition, installing chargers at multi-family housing will remove a significant barrier to EV access and allow renters and some lower-income individuals to more easily transition to EVs. Increasing the number of public DC fast-charging stations will provide those without access to home charging the ability to purchase an EV.

- Local Government EV Planning: While state regulatory and policy efforts to plan for and deploy zero emission vehicles and infrastructure are vital, local action by counties and municipalities is also needed. Some Colorado communities have taken the lead in developing vehicle electrification plans and investing in implementing those plans. However, many local governments lack the roadmap needed to begin making progress. State agencies can help local governments in taking this critical first step by providing grants, tools, and technical assistance for transportation electrification planning.

- Public Investment in Clean Vehicles and Infrastructure: Significant public investment will be needed to support electrification of medium and heavy duty vehicles. These include investment in infrastructure as well as vehicle purchase incentives. In addition, investment will be needed to both accelerate light duty vehicle electrification and to

make it equitable, through mechanisms that could allow lower-income Coloradans with old and inefficient cars and small businesses with older trucks to upgrade to electric vehicles or other zero emission vehicles. The level of funding that will be required to achieve the transition to high levels of zero emissions vehicles is unlikely to be available through the state general fund, and instead would need bondable and sustained long term revenue mechanisms that could be considered either as a standalone clean transportation measure or as part of a broader transportation funding package.

Clean Trucking Strategy and Fleet Rules

In July 2020, Colorado joined a multistate memorandum of understanding on zero emissions trucks. The Department of Transportation, along with CDPHE and CEO, announced plans to develop an all-of-the-above strategy to reduce pollution from medium and heavy duty transportation. With transportation now the largest source of air pollution in Colorado— and with our economy increasingly reliant on freight, as exemplified during the COVID-19 crisis— it is critical that we develop a thoughtful and balanced approach that provides a pathway for emissions reductions from medium and heavy duty vehicles. The draft strategy includes a suite of ideas that will be evaluated comprehensively, including through stakeholder input and in-depth technical evaluation, to determine the most impactful and reasonable actions. Possible actions include:

- Getting older vehicles off the road, especially replacing them with electric vehicles
- Providing incentives for cleaner trucks
- Planning for the fueling needs of zero emission trucks
- Building partnerships with fleets for short- and long-term planning
- Training people to maintain and repair new transport technologies
- Leading by example and working with other states to explore possibilities together
- Considering potential regulatory strategies such as fleet rules or the Advanced Clean Truck rule

As motor carriers have noted, decades-old diesel trucks, manufactured prior to the enactment of more recent federal emissions standards for medium and heavy duty trucks, play an outsized role in current fleet emissions of particulates and nitrogen oxides. The federal government strengthened vehicle standards beginning with Model Year 2014, and a second, stronger set of federal standards was scheduled to take effect in Model Years 2018 or 2021, depending on the class of vehicles. **Accelerating opportunities for fleet turnover within the conventional truck fleet, including diesel emissions reduction strategies, and continuing to pursue a variety of strategies to ensure that the diesel fleet is as clean as possible, should be an important component of a clean truck strategy.** Colorado is exploring a number of opportunities to design and support a public-private partnership program that focuses on displacing high emitting diesel trucks with cleaner models, especially emissions free. This should be structured to increasingly reward models that meet the most rigorous emissions standards, with the major focus on advancing zero emissions vehicle adoption.

As zero emission vehicle truck technologies, including electrification and hydrogen fuel cells proliferate, their success will depend on a robust network of charging and fueling infrastructure. Developing infrastructure to support zero emission vehicles in medium and heavy duty fleets is critical to

their success and the state is working with utilities and other industry partners to identify a strategy for supporting this sector with charging and fueling infrastructure.

Infrastructure improvements include incorporating clean technologies into key freight corridors and highway projects and developing a strategy for medium/heavy duty ZEV fueling infrastructure along these critical routes. These strategies include features such as runaway truck ramps and signage to designate steep grades and other safety concerns, and it should also incorporate improvements that facilitate cleaner trucking— be it fueling infrastructure or elements that can help reduce pollution along those corridors, including a careful look at the siting for charging and hydrogen fueling infrastructure, working with impacted communities, utilities, and industry partners. Considering that many of Colorado's freight corridors and industrial centers are located in close proximity to lower-income and disproportionately impacted communities such as Commerce City and North Denver, careful attention must also be paid to ensuring that these communities are early beneficiaries of cleaner and quieter medium and heavy duty electric vehicles.

State agencies are exploring opportunities for cleaner fleets by engaging with major fleet owners to discuss how best to support large scale transition to ZEV fleets, including identifying what vehicle classes work best for early adoption and what complementary policies can support fleet transition. The state is also working with shippers and carriers to explore acquisition of refrigerated trailers with electric standby units as well as having the necessary charging system to support those units at distribution or receiving sites. While major fleet operators control the purchase decisions for a large portion of the medium and heavy duty vehicles in operation in Colorado, the trucking industry is dominated by very small companies, 91.3% of which operate six or fewer trucks.[xxxii] These small companies often purchase used vehicles and the state will need to closely consider their needs

when designing purchase incentives to ensure that small fleets can also benefit from the efficiency and lower maintenance costs of electric vehicles.

Reducing emissions from last mile freight delivery and pickup will be an important part of meeting transportation emissions reduction targets. Both locally and on the internet, home and business deliveries have increased substantially, a trend that has only increased since the coronavirus pandemic, and downtown business areas have been particularly affected. As we seek to reduce emissions in our downtowns, diminish congestion and make these areas more multimodal and pedestrian-friendly, it is important to work with logistics companies and businesses on a series of strategies to achieve those objectives. These include the greater adoption of cleaner and zero emission vehicles, use of routing optimization software, providing advanced parking solutions for deliveries, establishing freight consolidation centers, encouraging off-peak deliveries, and creating strategies to reduce dwell time and idling. As in other elements of the Clean Trucking strategy, particular emphasis should be taken to ensure that disproportionately impacted neighborhoods surrounding freight hubs are prioritized for early adoption of EVs and charging infrastructure.

As manufacturers introduce new ZEV technologies into the medium and heavy duty market, we must explore all options to ensure that Colorado truck consumers have access to innovations that are being made available elsewhere in the country. Thus, as other states explore Advanced Clean Truck regulations, **Colorado is beginning an analysis of its own to evaluate the benefits and any drawbacks of joining the program, as well as potential regulatory flexibilities that may be allowable under the Clean Air Act should Colorado pursue rulemaking**.

CDOT, in collaboration with CDPHE and CEO, will engage in stakeholder discussions and have contracted with M.J. Bradley & Associates, a leading national consulting firm, to do a technical and economic analysis of the

potential for ZEV adoption in Colorado. The M.J. Bradley study, in conjunction with stakeholder input, will be used to inform a decision on what regulatory proposals will be submitted to the AQCC. The study should be completed in summer of 2021, with regulatory consideration at the AQCC in 2022. Any formal rulemaking proposal could include potential fleet rules requiring fleets above certain size thresholds to transition to ZEVs. In addition, Indirect Source rules, as described later in this section, could support ZEV adoption as a mechanism for mitigating emissions associated with some types of development.

Moving toward ZEV vehicles will require investments on the part of truck dealers, private repair shops, and fleets with their own on-site maintenance. These groups will need to retrofit or upgrade their facilities to perform maintenance on newer vehicle technologies and train mechanics and other personnel to service them. The state must begin working with and assisting truck dealerships and private maintenance shops in supporting workforce development that will be necessary for successful ZEV implementation. This could be part of a larger workforce development effort targeted at increasing the number of mechanics and technicians and supporting curriculum development at our vocation and technical schools. It is critical that the state work with these different maintenance operations on how we can better support the movement toward more ZEV trucks.

In addition to ZEV efforts, there are a number of existing strategies to improve the fuel economy of traditional diesel trucks that will also improve the efficiency and range of electric vehicles. The state can encourage private fleets to become involved in the SmartWay Transport Partnership, a collaborative program among logistics companies and the EPA. The program helps companies to adopt and implement technologies and strategies that will reduce emissions and improve fuel efficiency, including methods like aerodynamic packages and low rolling resistance tires.

The state is committed to "walking the talk" and will take a leading role toward reducing emissions from medium and heavy duty trucks, both in its own fleet and with those private fleets with which it conducts business through green procurement practices. The state is already working to turn over its light duty fleet to ZEVs and more efficient fleet vehicles—including reducing the footprint of vehicles, where possible, to categories that are available in more efficient models. As more ZEV and hybrid options become available in the medium and heavy duty market, state procurement targets should look to these vehicle classes as well. Further, the state will explore whether there are options to improve air quality performance on its projects during construction.

VMT Reduction Strategies

In addition to transitioning the fleet toward zero emissions vehicles, reducing the growth in vehicle miles traveled is a critical element of reducing pollution from the transportation sector. For 2030, the HB 1261 Targets Scenario models a 10% VMT reduction below the levels in the Reference Scenario. Land use decisions and providing more options to travelers is important to reducing the emissions impacts of driving. This includes both increasing access to clean transit vehicles but also providing more choices to manage demand, and associated pollution, on the roadways over time. Notably, VMT during the "Stay at Home" period of the COVID-19 pandemic was significantly lower compared to pre-COVID-19 levels. It is notable that VMT reductions hovered close to 10% during the summer of 2020 and were maintained for an additional period of months even though there was an uptick in economic activity during that time period. The state has embedded this 10% reduction in its projections based on the assumption that shifts in behavior over a meaningful period of time may make this reduced level of VMT sustainable, especially when coupled with supportive policies to help manage driving demand such as affordable housing close to job locations and ensuring that Colorado's economy remains in the top tier of the nation. This will likely require a suite of policy solutions, such as:

- Transportation Demand Management (TDM): Utilizing incentives, marketing, and other tools to encourage non-Single Occupancy Vehicle travel, is a core strategy in reducing VMT. Traditionally, this has meant working with employers to provide transit passes, encourage carpooling, and making multimodal options more appealing. In light of COVID-19, a specialized focus on making teleworking more permanent will be essential in promoting a longer-term shift toward alternatives to driving. This must be a concerted effort to support and encourage employees, employers, and local communities in reshaping the work commute. One strategy is trip reduction planning for large employers, which would ensure that employers over an employee size threshold develop TDM programs for their employees. The state intends to submit this proposal to the AQCC in 2021 for consideration in the transportation GHG rulemaking. TDM requirements can save companies money, save employees time, and are likely necessary to help achieve tight 70 and 75 ppb standards for ground level ozone. If the Denver/North Front Range Nonattainment Area is re-designated as Severe for ozone, TDM requirements will likely be required under the federal Clean Air Act.

- Land use planning and land use incentives: VMT is driven in part by the land use planning decisions made at local and regional levels. Designing and building communities that allow for and encourage the use of biking, walking, transit, and other low-carbon modes of transportation will decrease emissions. Local governments often make decisions that have the effect of separating housing at long distances from employment, as well as often placing major trip destinations,

such as grocery stores, schools, colleges and hospitals, far away from where people live, often far from public transit access, and often using exclusionary zoning to limit the ability to increase housing supply within communities. In many cases, limited state transportation funds are then used to try to address the high levels of traffic that come from these land use decisions. These land use patterns negatively impact the state budget and often lead to racial and social inequities as lower-income workers are forced into very long commutes, and worsen GHG and other air pollution. State agencies must work with local governments and metropolitan planning organizations to develop strategies to promote more sustainable land use planning. As part of this effort, the state will explore options for how best to incentivize smart land use decisions. It should also be noted that land use planning strategies can have a beneficial multiplier effect on other transportation policies. For example, pairing land use planning policies or incentives with vehicle electrification will result in higher GHG reductions than doing either policy in isolation. It is important to recognize the challenges in addressing this issue, particularly given the long history of local control of land use decisions in Colorado. State agencies will lead a study and stakeholder engagement process in 2021 that can develop detailed proposals for agency action and potential legislation in 2022.

- Integrate State GHG Pollution Standards and Analysis in Regional, and Statewide Plans: The transportation planning process in Colorado does not fully account for the impacts of GHG emissions when identifying and selecting projects for funding and construction. The Statewide Transportation Plan, Regional Transportation Plans, and Statewide Transportation Improvement Program are key documents that establish funding priorities for future years and decades, but do not meaningfully factor estimated increases or decreases in GHG emissions

into cost-benefit analyses of specific projects or entire funding programs. Establishing GHG budgets for projects, programs, and future plans and requiring the inclusion of the social cost of carbon in benefit-cost analyses will more accurately reflect the trade-offs between projects and allow for planners, decision-makers, and the public to evaluate them accordingly. For regional and state plans, a possible model is the existing air quality conformity process, in which CDOT would work with the AQCC to establish emissions budgets, as is done today for ozone and other criteria pollutants. The state can also more fully incorporate GHG emissions in project level environmental review. The specifics of such policies must be developed through close collaboration between CDPHE, CDOT and major metropolitan planning areas— especially those that are currently situated in nonattainment areas, which is where policies should be most focused, in order to maximize the co-benefits of reduced ozone pollution. This will be submitted to the AQCC for consideration in a summer 2021 transportation GHG rulemaking. Note that while this is listed under VMT reduction strategies, it will also support planning decisions and mitigation activities that support ZEV adoption.

- Enhanced multimodal options: Increased transit and active transportation options are critical to reducing VMT. This could include more investment in physical infrastructure such as mobility hubs or light or commuter rail (e.g., the proposed Front Range Passenger Rail project along I-25). It could also include more regular and reliable service along existing routes, such as more frequent and expansive bus rapid transit along congested corridors. Increased investment in transit and multimodal infrastructure can yield the behavior change required to get people out of their cars, as evidenced in Seattle, where a large ballot measure to fund light rail, enhanced bus services, and congestion mitigation, all contributed to a drop in VMT.[xxxiii] This will

require incorporating such elements into future transportation funding packages, and prioritizing multimodal options in programming existing revenue streams. For example, the Governor's FY 2021-22 budget request includes $70M for CDOTs Safer Main Streets and Revitalizing Main Streets programs which provides communities with funds for projects that encourage safe, multimodal and active transportation options for Colorado's downtowns and rural main streets.

Indirect Source Rulemaking

Indirect sources are recognized by the federal Clean Air Act as emissions sources that generate or attract motor vehicle activity, such as shopping malls, developments, office buildings, warehouses, or industrial sites. In California, regulation has been used to mitigate the impacts of these sources' vehicular activity on air quality more directly than motor vehicle emissions standards. This can be done through the NEPA process for some federally-funded or approved projects. For all or some categories of projects, indirect source rules could supplement local land use authority to ensure the impacts from large attractors of mobile sources are evaluated and mitigated. Implementation of this type of regulation could help encourage more sustainable, multimodal and transit-oriented development, and could generate mitigation measures that support electrification. In developing proposed standards, state agencies will work with disproportionately impacted communities to prioritize emissions reductions that will have direct public health benefits to these communities in addition to reducing GHG pollution. The intent is to develop a proposal for submission to the AQCC for consideration in a 2022 transportation rulemaking.

Clean Fuels Standard

A Clean Fuel Standard ("CFS") is designed to decrease the carbon intensity of the state's transportation fuels and provide an increasing range of low-carbon and renewable fuel alternatives. A CFS functions by establishing carbon intensity ratings for different fuel types based on their lifecycle

emissions impact and then establishing carbon intensity benchmarks that increase in stringency over time. Fuels that are below the carbon intensity benchmark generate credits while those above the benchmark generate deficits, and thereby a market is created that encourages greater investment in low carbon fuels and discourages continued production and use of high-carbon alternatives. A CFS could serve as a mechanism for continued progress toward reducing the emissions generated by the transportation system. The CEO conducted a feasibility study in 2020 that examined a range of clean fuel standard scenarios that would achieve reductions in carbon intensity of 10%, 15%, and 20% over 10 years.[xxxiv] While the study concluded that a CFS is feasible, a number of questions remain unanswered, including potential double counting between emissions reductions from other light and heavy duty electrification efforts and from a CFS. A more significant issue is that the modeling indicated that, at least for the first decade, the bulk of emissions reductions would come through replacement of gasoline and diesel fuel with conventional biofuels. The state has not had a comprehensive analysis or public process examining the tradeoffs involved with large scale use of conventional biofuels, so it is premature to move forward with a CFS. In addition, the compliance cost for a CFS would likely be passed along to consumers of high carbon fuels such as gasoline and diesel, potentially making the policy regressive for consumers who are unable to purchase lower emitting vehicles. It may be more appropriate in the near term to look at revenue mechanisms that directly support adoption of zero emissions vehicles. Thus, we are not recommending that a CFS be part of the near term action agenda for the state but instead should be further evaluated.

The state did receive substantial comment from many segments of the biofuels industry on this topic, as well as from companies involved in carbon capture and sequestration, urging the state to consider adopting a clean fuels standard. The state also received comments from stakeholders concerned about the indirect land use impacts of biofuels production. We are not

recommending that a CFS be part of the near term action agenda for the state but instead that it should be evaluated further, with full discussion of the appropriate role for biofuels and how CFS program design would best support the state's policy objectives.

Aviation

While not as large a contributor to greenhouse gases as surface transportation, aviation will become increasingly important between now and 2050. Emissions from the sector are estimated at 4 million tons in 2015 and 5 million tons annually from 2020 to 2030. Emissions from aviation are more difficult to manage due to extensive federal control of the sector and expectations for long-term growth in demand. Industry, technology and supply chain changes will be important for long-term sustainability of aviation greenhouse gas emissions.

Fortunately, airlines are committing to investments and approaches to reduce long-term emissions from aviation. For example, United Airlines, which has a large hub in Denver, pledged in December 2020 to reduce its net greenhouse gas (GHG) emissions by 100% by 2050. In 2018, United became the first U.S. airline to commit to reducing its GHG emissions by 50% by 2050. United recently committed to a multimillion-dollar investment in atmospheric carbon capture technology known as direct air capture, and is continuing to invest in the development and use of sustainable aviation fuel (SAF), with 80 percent lower lifecycle emissions. Other airlines are expected to undertake similar commitments and make changes to reduce emissions over time, and we expect additional international efforts to reduce aviation emissions.

Technology will also play a critical role. In addition to approaches like direct air capture and biofuels like SAF, manufacturers, researchers and airlines are exploring use of electricity and hydrogen in some aviation contexts to reduce emissions. Ground operations can also be electrified.

Residential, Commercial and Industrial Fuel Use

The Roadmap analysis shows that the use of fossil methane in buildings and industry is one of the four major sources of GHG pollution in Colorado. Emissions from burning of fossil methane for space heating, water heating, and cooking not only contribute to GHG pollution but worsen indoor air quality.

Meeting the state's GHG targets will require reducing pollution from buildings and industry. The state's Near Term Action Plan includes new requirements for gas utilities to reduce carbon emissions. To ensure that utilities are making progress toward these goals, the Roadmap calls for increasing utility investments in energy efficiency, the use of lower carbon fuels such as biogas or hydrogen, benchmarking energy use and setting energy and emissions performance standards for large commercial buildings, requiring investor owned electric utilities to develop beneficial electrification programs to support customer adoption of technologies like electric heat pumps, transitioning certain appliances from fossil methane to electricity, moving to advanced building codes, enhancing financing opportunities for customers who want to invest in lower-carbon technologies, and requiring industrial and energy emissions audits and use of best available control technologies by industrial operations.

Colorado's Gas Utilities

The 1261 Targets Scenario for 2030 includes emissions reductions of 37% below 2005 levels from fossil methane end uses (exclusive of electricity generation). However, Colorado does not have requirements for the state's gas distribution utilities to reduce GHG pollution. In the development of the near term actions, the state agency team concluded that a 20% reduction from 2005 levels (4.75 million tons from residential, commercial and industrial fuel use) was achievable by 2030.

The Public Utilities Commission has taken an important step in looking at the role of gas utilities in meeting the state GHG goals. In fall 2020, the PUC opened a proceeding to investigate whether changes in fossil methane utilities could help meet the state's GHG pollution reduction goals and the impacts that those changes might have on utilities and their customers.[xxxv] At the time this report was published, the investigation was still on-going. However, PUC commissioners have stated that they intend to investigate steps the PUC can take now to reduce pollution from gas utilities while long-term regulatory changes are being implemented, including gathering information about:

- Historic gas utility customer GHG emissions and associated system and upstream emissions
- Expectations for reduction of GHG emissions from the retail fossil methane sector or customers
- Options to decarbonize retail fossil methane utilities and the costs and benefits of those actions
- Impacts on customers who participate in income-qualified programs
- Potential for electrification of current fossil methane loads

In addition to the planning actions taken at the PUC, we are recommending legislation in 2021 to set statutory goals for the reduction of emissions by gas distribution utilities. The emissions reduction trajectory will be more gradual than in the electric sector, in part because there are fewer lower-cost technologies available and because many of the actions needed require action by utility customers, not just the utility company. Legislation could allow a utility flexibility in the measures used to achieve the emissions reduction goals and could include direction to the PUC to consider both the emissions reduction achieved and the cost of the plan. By setting a technology neutral emissions standard, the legislation would enable utilities to cost effectively achieve needed emissions reductions through a number of strategies, including, providing incentives for building energy efficiency

improvements; lowering the carbon intensity of gas that is used through some combination of use of biogas and hydrogen produced from renewable resources rather than fossil methane; the electrification of some end uses in buildings and industrial processes; increasing usage of electric and induction stoves; and reducing methane leaks from utility gas distribution systems.

Biogas Portfolio Standard and Leak Standards for Gas Utilities

As the state considers options for reducing the carbon intensity of fossil methane delivered to Colorado homes and businesses, it may look at a program that would require certain gas utilities to meet a GHG intensity standard across their portfolio. As part of a program like this, biogas and hydrogen from renewable energy resources could be used to replace a portion of the fossil methane currently sold to residential, commercial, or industrial customers. Biogas refers to methane that is captured from sources such as sewage treatment plants, landfills and dairy farms and otherwise is emitted directly into the atmosphere. Biogas could also be used to generate electric power or in the transportation sector to reduce emissions there.

In addition to requiring the use of lower-carbon fuels, the state could also set enhanced leak detection and repair requirements that apply to the gas distribution system. This could be structured as a standalone requirement for utilities without GHG targets or could be one measure that gas utilities could take as part of a suite of measures to achieve GHG reduction targets in a gas clean energy plan. It will be important to have a process at the PUC to evaluate costs for this transition and the impacts on customers, especially lower-income customers. One important note is that the potential supply of biogas from waste is relatively constrained, probably topping out at 5-10% of current gas use in the state, based on the 2019 renewable natural gas study conducted for the Colorado Energy Office.[xxxvi] However, because much of this is currently emitted directly to the atmosphere, and since the global warming potential of methane is so high compared to carbon dioxide, if biogas use by

utilities stimulates a market that captures this methane, the reduction in emissions could be quite high.

Modernizing Gas Energy Efficiency Programs

Colorado adopted its initial gas demand-side management program in 2007. Under those programs, the state's regulated gas utilities are required to provide rebates and incentives to customers that help those customers purchase more efficient appliances that reduce gas use and save money. While recent statutory changes extended those programs, the investment and savings have been very modest compared to the level of efficiency improvements that are achieved by leading utility programs. Modernizing the state's statutory requirements for gas efficiency programs will create one pathway to reducing emissions from the gas utilities. Modernizing gas efficiency could include requiring the PUC to set savings-based targets to achieve all cost effective and achievable energy savings, incorporating the social cost of greenhouse gas emissions in cost benefit analysis (as is done for electric sector DSM), and better aligning gas DSM with the state's goal of improving building shells and increasing electrification in buildings.

In order to ensure that these strategies promote equity and avoid potential unintended consequences, programs need to prioritize accessibility to efficiency improvements and electrification for lower-income households and provide special consideration and compliance flexibility for affordable housing. Efforts should be made to create education and outreach initiatives that provide clear and credible information to people about the benefits of energy efficiency and of transitioning to electric appliances. It is also important to ensure that utility investments help to develop workforce skills and provide good jobs. To achieve these goals, legislative action should ensure appropriate apprenticeship opportunities and labor standards for large projects included in utility funded programs.

Commercial Building Benchmarking and Performance Standards

While state and local governments and utilities are seeking to decarbonize their building stock, it is challenging to set energy or emissions reduction targets without an understanding of how buildings are performing currently.

The Colorado Energy Office is in the process of launching a commercial building benchmarking program. The program, when fully developed, will enable building owners to report energy use data to a statewide database. The program will work to modernize utility data protocols to improve customer access to building level energy data. Making whole building energy use data more transparent will help identify cost-effective opportunities for energy efficiency and beneficial electrification upgrades. After establishing baselines for buildings, the program will require less efficient buildings to make improvements that will reduce energy consumption, save money for owners, and lower GHG emissions. Once the program requirements are in place, fee for service or fines for non-compliance could fund this program and provide additional dollars for education and technical assistance to further building decarbonization work.

The Colorado Housing and Finance Authority ("CHFA") will require affordable housing projects that receive tax credits to annually assess and report their building energy performance using the free ENERGY STAR Portfolio Manager tool. Benchmarking building energy use will help CHFA and other partners understand energy savings and costs in publicly-funded affordable housing, leading to better design of energy efficiency standards and incentives.

Building Electrification Requirements for Utilities

A Colorado Energy Office study of beneficial electrification potential estimated the technical, economic, and achievable potentials for beneficial electrification in buildings in Colorado over the next ten years. As shown below, the report concluded that electrification in Colorado provides

substantial opportunities to reduce GHG emissions in the built environment. The research identified key technologies and sectors that can benefit from this transition. The report found a high potential adoption of residential space and water heating, concluding that with the right policy support nearly 200,000 homes could have electric heat pumps by 2030. The report also found that switching from propane to electrified end-uses is cost effective currently and recommended the state consider prioritizing efforts that can help transition customers from propane to electrification.

Figure 19: GHG Reduction Potential from CEO's Electrification Report

TABLE 1-2 CO2E REDUCTION POTENTIAL UNDER BENEFICIAL ELECTRIFICATION SCENARIOS

Potential Scenario	2030 Cumulative CO2e Reduction (short tons)
Technical Potential	31,147,459
Economic Potential	20,797,877
High Electrification	3,499,843
Moderate Electrification	2,085,315

The report analyzed market barriers that will impede electrification efforts and provides policy and program recommendations to accelerate the adoption of BE technologies noting that the BE market in Colorado is nascent—the next five years will be a critical market preparation period to develop policies, programs, outreach, awareness, contractor training and the supply chain to drive higher adoption rates over the long-term.

Consistent with the administration's efforts to build a Colorado for all, growth in BE adoption must occur equitably and include Colorado's most vulnerable residents. Successful BE adoption must address current barriers and ensure that affordable technologies are available and financially accessible to all customers and that vulnerable customers do not shoulder a disproportionate share of the cost for this transition.

Based on the analysis in the Roadmap, the state is advancing policies that will cultivate market transformation including adoption of a requirement for investor-owned utilities to file plans to support beneficial building electrification by providing rebates and incentives for customers to switch to electric heat-pump water heaters and heat-pump space heating. As with Senate Bill 19-077 and the resulting consideration of transportation electrification plans at the PUC, it will be important to require that utility beneficial electrification plans have a particular focus on enabling electrification by lower-income customers and in disproportionately impacted communities. The state is also intending to pursue expansion of finance programs that support building improvements, including electrification. Currently, the RENU loan program supports the installation of eligible heat pump technology in the residential sector and the Colorado C-PACE program recently enacted a program change to further accommodate the deployment of BE technologies in the commercial sector. The state will also look for opportunities to expand beneficial electrification for lower-income residents through the Weatherization Assistance Program. It is also important to ensure that utility investments help to develop workforce skills and provide good jobs. In order to achieve this, legislative action should ensure appropriate apprenticeship opportunities and labor standards for large projects included in utility funded programs.

Advanced Building Codes

Strong building energy codes require new construction or major renovation projects to improve energy performance and lower emissions. But building energy codes do more than reduce energy use in buildings, they ensure the safety, health, durability, sustainability, and affordability of buildings. The state, through the work of the Colorado Energy Office, is committed to continuing to support building energy code training and technical assistance to enable local governments to more easily adopt current and advanced building energy codes on a regular cycle, and to get them on a path to zero energy or zero carbon standards. CEO engages with stakeholders

and jurisdictions through the Colorado Energy Code Compliance Collaborative and other networks to ensure that local governments have the latest information they need to make informed building code decisions through training, resources, and technical assistance. The state may explore regulatory or legislative avenues to strengthen building codes statewide and make the built environment more resilient to the effects of climate change.

Financing

Achieving Colorado's GHG pollution reduction goals will require innovative financing mechanisms and products to help deliver the capital needed to transform the built environment. As noted earlier in the report, the state has deployed several programs including Energy Performance Contracting, C-PACE, and RENU, which have realized significant results to date and demonstrate how public-private partnerships can be used to leverage public money to generate considerable private sector capital investment. The state also worked with the U.S. Department of Energy and the Coalition for Green Capital to create the Colorado Clean Energy Fund, intended as a green bank for the state that could fund clean energy and energy efficiency investments. There is tremendous opportunity to continue to scale these programs to ensure that residential, commercial, and public sectors have access to low-cost financing for clean energy projects. The state supports developing and expanding other innovative financing models including utility on-bill financing or on-bill repayment options to reduce a barrier to upgrading inefficient buildings, reach new markets, and ensure equitable and universal access to clean energy technologies. These low-risk models have the potential to increase adoption of energy efficient appliances, beneficial electrification technologies such as heat pumps, heat pump water heaters and induction cooktops, as well as on-site renewable energy systems or EV chargers for all sectors, but especially for income-qualified households.

One particular near term opportunity is to expand RENU and C-PACE, and to capitalize the CCEF. As outlined in further detail below, Governor Polis has requested $40 million in supplemental stimulus funding in FY 2020-21 for clean energy finance as part of his budget request to the legislature.

Industrial Energy and Emissions Audit Requirements

As part of addressing GHG pollution from Colorado's energy-intensive trade exposed industries, HB 19-1261 directs the AQCC to require such industries to undertake energy and emissions audits. These audit requirements may also be extended to other industrial sectors as a mechanism to assess potential for GHG reduction strategies. APCD is beginning a stakeholder process in late fall 2020 to develop the requirements for conducting and reporting these audits. It is expected that the energy and emissions audit program will be part of a broader GHG rulemaking package scheduled on the AQCC long-term calendar for Summer 2021. It is anticipated, as called for in HB 19-1261, that sources undertaking energy and emission audits will be required to implement best available control technologies and efficiency practices to reduce GHG emissions or achieve comparable reductions through other measures. The audits will also give state agencies a greater understanding of the potential for emissions reductions in diverse industrial operations and may be used to inform future programs or rulemakings.

Oil and Gas

Implementation of SB 19-181 & Minimizing Sector Emissions

AQCC rulemakings to implement SB 19-181 have already commenced and will be an iterative process over the next few years. The AQCC completed a rulemaking that included combustion emissions from stationary engines used in this sector, mandatory monitoring for new wells, pre-production emissions controls and other measures in September 2020. Additional rulemakings are included in the AQCC long term planning calendar for 2021 and 2022 and are expected to focus on reducing methane pollution throughout the sector.

To achieve the state's 2025 and 2030 emissions goals, methane emissions from the oil and gas sector as a whole will need to be reduced by at least 33% by 2025 and over 50% by 2030. The state is targeting 12 million tons of emission reductions from the oil and gas sector by 2030, compared to the 2005 baseline. This level of emissions reductions is deeper than modeled in the HB 1261 Targets Scenario. The decision to pursue deeper reductions in the oil and gas sector reflects the fact that low cost technological solutions are available to get these reductions and that getting deeper reductions from oil and gas will reduce the need to seek reductions from other sectors that may be harder to decarbonize. The specific requirements of the rule are expected to be informed through a stakeholder process, including a review of technological and operational changes that can be implemented to reduce methane releases. The APCD initiated the stakeholder process for this rule on November 5, 2020, and the AQCC long-term calendar plans a hearing in the fourth quarter of 2021.

Reducing the release of methane also reduces the VOCs and other emissions that are co-pollutants with the methane gas stream being controlled. These reductions will further the state's progress in attaining ozone standards and minimizing emissions of the co-pollutants which disproportionately impact the health of Colorado communities.

In addition to the ongoing activities to implement the SB 19-181 requirements, SB 20-204 allocated additional funding to the APCD and created a new Air Quality Enterprise for Colorado. The additional resources allocated to APCD are expected to be applied toward the increased need for permitting, inspection, and enforcement activities associated with the high number of oil and gas facilities operating under permit requirements that are classified as serious nonattainment for ozone. For the first time, the Air Quality Enterprise creates a mechanism for planning and funding collaborative research through educational institutions with public and private sector involvement. Some of this research is expected to focus on

gaining a better understanding and reconciling the differences between top-down monitoring and bottom-up inventory methodologies for the oil and gas sector. Understanding these measurement dynamics is critical to ensuring that the projected emissions reductions are realized through the implementation of the SB 19-181 requirements.

COGCC Flaring Restrictions and Comprehensive Planning

On November 23, 2020, the COGCC completed a series of comprehensive rule changes to implement the updated priorities of the COGCC under SB 19-181. This rulemaking included revisions to regulations to strengthen flaring restrictions, comprehensive planning, reducing emissions, and other increased protections for public health and environment. The rulemaking also requires evaluating and addressing the cumulative impacts of oil and gas development, and includes specific cumulative impact regulatory requirements directed at reducing air emissions. In addition, the COGCC rules:

- Prohibit routine flaring of natural gas from pre-production and operations at oil and gas sites. There is a limited one-year exception for existing facilities to come into compliance. By itself, this measure is expected to improve local air quality and reduce significant CO2e emissions by 2025.
- Require all new oil and gas development plans to provide detailed information regarding greenhouse gas emissions associated with proposed oil and gas development as well as cumulative impact plans detailing how these emissions will be avoided and minimized. The COGCC will be responsible for determining if permit applications avoid and minimize impacts to public health and the environment.
- Create extensive public comment and consultation provisions to consider the effects of proposed oil and gas development.

- Require ongoing consideration of the cumulative effects of greenhouse gas emissions through an annual report that includes an assessment of whether actual emissions reductions are on track with the trajectory identified in this Roadmap for achieving statewide reduction targets, the identification of technologies to achieve further emissions reductions, and recommendations of additional steps that may be needed to improve the implementation of regulatory requirements.

Natural and Working Lands Greenhouse Gas Inventory

A comprehensive natural and working lands emissions inventory is essential for monitoring and verifying changes in GHG pollution and carbon sequestration from land-based activities and is a critical priority for the Natural and Working Lands Task Force over the next one to three years. While Colorado's existing GHG inventory includes metrics such as emissions from agricultural fertilizer applications, methane associated with livestock production, forest carbon, and certain emissions from wildfires, it is not comprehensive. For example, it does not fully quantify the effects of land use conversion on the total carbon balance of Colorado's natural and working lands. Accounting for the impact of land use change, including when natural and working lands are developed, will allow the state to track and measure the critical roles land conservation, agricultural stewardship, and ecosystem restoration play in reducing GHG pollution. This will also help support policies and programs to improve land use planning. An agricultural GHG inventory will also measure voluntary reductions in emissions from implementation of CDA's Soil Health Program and Farm Bill conservation practices through the Natural Resources Conservation Service ("NRCS").

In addition, the state must determine whether the federal forest carbon flux estimates used in Colorado's GHG inventory accurately estimate Colorado's forest carbon flux given the large wildfires Colorado has experienced since 2000. In 2020, Colorado experienced the three largest

wildfires ever recorded. Research indicates that forests may not naturally reestablish post-fire in some areas as quickly as they have in the past, meaning that without reforestation, wildfires may not be carbon neutral within the 21st century. Colorado should establish a baseline estimate for GHG emissions associated with natural fire regimes prior to 20th century fire suppression to compare with recent wildfire emissions. The state also does not have an accurate estimate of the amount of forest carbon sequestered in sustainable wood products each year (e.g., in construction materials). The state aims to resolve some of these questions by working with the research community. In spite of these research needs, Colorado is moving forward with no-regrets strategies to mitigate climate change through improved conservation, restoration, and management of our natural and working lands.

Natural and Working Lands Strategic Plan

The NWL Task Force, in partnership with The Nature Conservancy, is currently conducting a technical analysis funded by the U.S. Climate Alliance to quantify the potential of Colorado's natural and working lands (forests, rangelands, grasslands, croplands, riparian areas and wetlands, and urban landscapes) to contribute to the state's ambitious greenhouse gas reduction goals by 2050. This effort will result in a *Natural and Working Lands Strategic Plan* in 2021 that will identify priority pathways for carbon-smart land management, set quantifiable emissions and sequestration goals for this sector, and inform strategic NWL research, program, and policy development. The NWL Strategic Plan will also evaluate ways to align state grant programs to promote natural climate solutions and will support and leverage other state and local planning processes, including, but not limited to the Colorado Water Plan,[xxxvii] Colorado Resiliency Framework,[xxxviii] State Wildlife Action Plan,[xxxix] Drought Mitigation Plan,[xl] Forest Action Plan,[xli] and sustainable land-use planning efforts led by the Department of Transportation.

While this technical work is underway, state agencies are implementing carbon-smart policies and programs. The Colorado State Forest

Service, in partnership with the U.S. Forest Service, Natural Resources Conservation Service, and other federal, state and local partners, carry out forest restoration work that reduces the risk of high-severity wildfire and improves forest health. While reducing woody fuels through thinning and prescribed fire may initially reduce the carbon stored in Colorado's forests, these treatments can increase the resilience of forests to wildfires, insects, and disease, thereby ensuring forest carbon stocks are more stable over time. Dozens of existing forest collaboratives, as well as the new Rocky Mountain Restoration Initiative and state-level Shared Stewardship initiative, are working to increase the pace and scale of this work. These partnerships are also seeking solutions to expand Colorado's limited forestry workforce and markets for woody biomass utilization, which pose one of the biggest barriers to cost-effective forest management in Colorado.

Colorado Parks and Wildlife, the Colorado State Forest Service, the State Land Board and other agencies, conserve several million acres of natural lands in Colorado that are important carbon sinks. These conservation efforts include the acquisition of Fisher's Peak in 2020, Colorado's second largest state park. As these efforts continue, state staff are exploring a variety of opportunities and policy actions to further support this work.

Soil Health Program

Starting in 2020, the Colorado Department of Agriculture has been participating in a soil health initiative in coordination with individual stakeholders, the Colorado Collaborative for Healthy Soils, the U.S. Department of Agriculture's Natural Resources Conservation Service, conservation districts, the Colorado Department of Natural Resources, and the Natural and Working Lands Task Force. The goal of this initiative, which is voluntary and incentive-based, is to provide technical assistance and grants to producers to implement soil health practices that benefit the environment and the state's climate goals while supporting the financial stability of Colorado's farmers and ranchers. This effort aligns with a growing number of

public and private efforts throughout the United States and other parts of the world to mitigate climate change through the voluntary implementation of improved agricultural stewardship practices that simultaneously help mitigate risk and expand revenue opportunities for producers.

Through increased access to private market opportunities that support producers who wish to transition to practices that regenerate the soil and help meet climate goals, Colorado agricultural producers will be able to take advantage of national programs such as Field to Market, Soil Health Partnership, and the Ecosystem Services Market Consortium in a way that works for their business. CDA is aligning these tools through traditional pathways, such as conservation districts, and new routes, such as improved market incentives. In addition, CDA's soil health initiative is building toward the development of an inventory framework to aggregate and measure climate mitigation activities within the agricultural sector.

In 2021, CDA will launch a new Soil Health Program built from its current Soil Health Initiative to support and encourage farmers and ranchers to adopt voluntary practices that sequester carbon, reduce GHG emissions, increase drought resilience, conserve energy resources, and promote sustainable agriculture in Colorado. While many farmers and ranchers have been practicing various soil conservation practices over the last 20 years, creating a Soil Health Program will provide research, technical assistance, and incentives to support producers looking to map and quantify biological benefits for agricultural operations transitioning from conventional tillage programs to more biologically beneficial methods. Encouraging and potentially creating incentives for voluntary participation in these practices will enhance resilience to extreme weather and natural catastrophes, such as drought, flood and wildfire events. The program may also create a pathway for Colorado farmers and ranchers to participate in emerging environmental services and carbon markets.

Agricultural Climate Resilience Office

CDA is pursuing creation of an Agricultural Climate Resilience Office that would expand and advance CDA's capacity to provide direct support and resources to producers, conservation districts, and other agricultural entities to reduce GHG emissions, enhance carbon sequestration and cycling, and engage in emerging marketplaces that support producers' bottom lines while incentivizing regenerative or climate-friendly practices. ACRO will be located within the Conservation Services Division to administer programs that help absorb risk by providing technical and grant support for Colorado agriculture facing significant climate-related threats, and by creating the administrative framework to help address and measure the agricultural greenhouse gas reduction targets in the Colorado Greenhouse Gas Pollution Reduction Roadmap through voluntary, farmer and rancher led stewardship practices.

As CDA advances its work on climate change from the agricultural perspective a number of administrative barriers have been identified that limit its ability to continue existing programs, to implement new programs, and to administer programs effectively. The ACRE3 Program and Soil Health Initiative operate under authority from two separate boards housed within two separate divisions at CDA. ACRO would align those programs under one umbrella while allowing the department to develop and deploy more resources that support Colorado agriculture in advancing climate solutions.

Natural/Working Lands Strategies in Rural/Urban Communities

The economic strength of many rural communities depends on natural and working lands, whether through agricultural production, outdoor recreation and tourism, or other natural resource industries. These communities are particularly vulnerable to increasing climate-related natural hazards, such as drought, pests, floods, wildfires, storms and tornadoes. Natural climate solutions present a critical opportunity for equitable climate change adaptation and mitigation in Colorado. Industries that are dependent on healthy natural and working lands are vital to providing jobs and sustaining

local businesses, as well as funding infrastructure and services like schools, government programs, and hospitals.

Farm workers and equipment operators play essential roles in farm, ranch, and forestry operations and require adequate housing, access to healthcare and other services, and safe and healthy working conditions. In many instances, workers, such as migrant laborers, may not be eligible for Medicaid, and social isolation can increase mental health challenges across all rural economic levels. In rural areas, people of color, lower-income residents, and linguistically isolated individuals are often the hardest hit when climate change-related natural hazards occur. These individuals may experience direct financial losses and have fewer financial resources and social connections for them to adequately prepare for and recover from natural disasters.

Considering equity in natural and working lands policy is also important in urban areas. Long-term disinvestment in urban canopy cover in lower-income communities and communities of color contributes to disparities in urban heat impacts. Insufficient access to greenspace further amplifies inequalities in mental and physical health. Therefore, in addition to helping to address climate change, expanding urban canopy cover and greenspace has multiple social co-benefits, particularly when paired with affordable housing, energy, and transportation policies. Prioritizing land for urban agriculture programs can also address disparities in education and food security.

Natural climate solutions must be informed by principles of environmental justice, as well as enhanced outreach and engagement with these important stakeholder groups. The state can enhance equity considerations in natural climate solutions through various strategies, including modifying grant making requirements for rural communities and those with fewer economic resources, providing targeted technical support, developing resources to communicate with linguistically-diverse audiences,

and consulting with and learning from impacted groups. This work will be developed and strengthened as state agencies continue to build an equity, diversity, and inclusion framework into programs and services.

ACRE3

Going forward, the Advancing Colorado's Renewable Energy and Energy Efficiency Program has identified three strategic priorities: (i) agricultural energy efficiency and photovoltaics, which focuses on reducing energy costs in energy-intensive operations, such as dairies, pumped irrigation, and greenhouses; (ii) agricultural hydropower, which focuses on energy-recovery hydropower and water resources conservation in irrigated fields and irrigation canals and ditches; and (iii) renewable thermal technologies, which focuses on solar water heating, solar space heating, and ground-source heat pumps in agricultural applications. The ACRE3 program is evaluating criteria for agrivoltaic projects as an emerging fourth priority.

Other Sectors

Coal Mine Methane Regulations

Coal mine emissions in Colorado are already declining significantly with the transition away from coal-fired electricity generation, as demonstrated in the 2019 Colorado GHG Inventory. The overall trend of declining emissions is expected to continue as additional mines reduce production or close between 2020 and 2030. The analysis underpinning the state strategy for achieving the 2030 economy wide targets includes an expected reduction of 7 million tons CO2e in annual emissions from coal mines due to mine closures by 2030. Monitoring of production levels and the number of active mines in operation will be performed as part of the tracking of critical metrics that are reported

annually to the AQCC and will be used in emissions projections for future GHG inventory reports. Should these metrics indicate significant increases in production or if new mines are opened, permit requirements may be implemented or regulations addressing methane venting may be proposed for future consideration at the AQCC. CDPHE and the Department of Natural Resources will also work with land managers and other parties to explore opportunities for using or flaring emissions from abandoned mines.

Methane from Landfills and Wastewater & Waste Diversion

In recent years, a number of new legislative efforts have provided an influx of additional funds and resources towards improving Colorado's waste diversion rate. In 2019, the legislature created the Front Range Waste Diversion Enterprise Fund that will spur economic development and advance the state's circular economy efforts with the goal of increasing the Front Range waste diversion rate to 51% by 2036. The Enterprise Fund is financed by an increase in user fees at Front Range landfills. Collection of these fees began in January 2020 and will increase by 50 cents per ton per year for four years, then annually by inflation, ultimately providing an estimated $15 million per year for waste diversion projects. The program announced the first set of nine grant awards in November 2020 that will divert an additional 18,000 tons of waste from landfills.

CDPHE and CDA are collaborating on a 2021-22 fiscal year study and plan to manage agricultural organic waste and promote compost use. The study will conduct a gap analysis of the state’s current capacity to manage organic waste, identify and prioritize key locations within the state that need additional processing infrastructure, and examine a cost-benefit analysis and net GHG implications of both infrastructure expansion and increased compost use including agricultural healthy soil initiatives.

Waste management currently makes up a small but growing fraction of Colorado’s GHG inventory. Colorado will continue accelerating waste diversion efforts through funding under the Front Range Waste Diversion

Enterprise, Recycling Resources Economic Opportunity Program and other recycling end use market development. Based on the statutory goal for the Front Range Waste Diversion Enterprise of a 51% diversion rate by 2035, the state is aiming for 32% and 39% rates by 2025 and 2030, respectively. The state will continue to look for other opportunities to accelerate diversion rates, especially for organic materials that can form methane.

Methane capture from landfills and wastewater treatment facilities offers an opportunity to slow and ultimately reverse the emissions growth in this sector. Capital investments and new infrastructure are required to capture methane from these sources and these investments would benefit from legislative action on a biogas standard to create a market for the captured methane. In addition, future regulations may be considered for adoption by the AQCC to address methane emissions from these sources. A biogas standard will also spur investment in methane capture from agricultural operations unlikely to be addressed by regulations, such as dairy farms. As noted above, the emissions reductions associated with these policies are shown in the residential, commercial and industrial fuel use category, to avoid double counting.

HFC Regulation

In May 2020, Colorado became the first state to adopt the Climate Alliance States' Model Framework for the phasing out of hydrofluorocarbons. The Model Framework, adopted by AQCC as part of Air Regulation Number 22, establishes phase out dates for the use of these potent greenhouse gases in foams, aerosols, air conditioning, and refrigeration. The phase out of HFCs in these products in Colorado is projected to reduce cumulative GHG pollution by 6.34 MMT CO2e by 2030. Additional measures to reduce HFC emissions are also being explored at the state and federal level. Potential measures include bolstering maintenance and repair requirements for products in service that use HFCs, such as air conditioners, and expanding the scope of the phase out to additional end uses.

Carbon Capture, Use and Sequestration

The state received comment from multiple stakeholders that the draft Roadmap did not sufficiently address the potential for carbon capture utilization and storage to play a role in reducing GHG emissions in the next decade and did not speak to any actions the state would take to enable or support CCUS. We agree with this critique given the need for rapid reductions in net emissions, the fact that there is serious consideration by the private sector of carbon capture at some Colorado facilities, such as the Holcim/LaFarge cement plant in Florence, and the existence of significant federal incentives in the form of the 45(Q) tax credits. A further example is United Airlines' December 2020 commitment to completely eliminate greenhouse gas emissions through strategies such as direct air capture and sequestration of carbon dioxide.

At the same time, because this is not an area where the state government has existing experience or expertise, many questions remain unanswered: How can the state encourage carbon capture and sequestration while also advancing reductions in localized air pollution? How should the state treat carbon capture that is used for enhanced oil recovery as compared to long term sequestration without enhanced oil recovery? Are there existing state regulations or permitting processes that need to be modified to enable CCUS? Should the state seek primacy over the EPA for permitting CCUS operations? Are there requirements or incentives that should be enacted for CCUS? Are there opportunities to provide jobs and economic development in areas that are impacted by the move away from fossil fuels? How can policies be designed to ensure benefits to diverse and disproportionately impacted communities?

In order to address these questions and develop an action plan, the state will convene a task force on CCUS starting in mid-2021, which will report back to the Governor within a year with a recommended framework,

including policies and actions steps for pursuing CCUS that are aligned with Colorado's emissions reduction targets.

Governor's FY 2021-22 Budget

The Governor's FY 2021-22 Budget advances a number of innovative funding proposals that will help protect Coloradans from the existential threat of climate change, improve air quality, and position Colorado to seize on the economic benefits of a renewable energy economy. Although forecasted revenues have improved, the economic forecast continues to project an operating deficit. That is why this budget proposes stimulus and strategic investments to help Colorado climb out faster and better. These proposals include:

- $78M for wildfire relief, mitigation and prevention in light of the extraordinarily destructive recent wildfire season, driven by a changing climate and declining forest health.
- $40M for clean energy finance programs in FY 2020-21 to ensure that we build our economy back better and position Colorado to seize on the economic benefits of the clean energy economy.
    - Funding will be distributed among multiple existing programs supported by the Colorado Energy Office, including the Colorado Clean Energy Fund, the Colorado New Energy Improvement District, CEO's RENU loan program, and the Charge Ahead Colorado program. The funding to these private-public partnership programs will deploy limited state dollars to leverage greater private capital for investments in clean energy retrofits and construction.
- $5M in FY 2020-21 to further supplement the DOLA Renewable and Clean Energy Challenge that supports local government investment in renewable energy, energy efficiency, and energy conservation.
    - Investment will provide grants to local governments for a variety of renewable and clean energy projects. Examples of projects in the pipeline include micro-hydro systems, energy performance contracting with solar photovoltaic components, community solar gardens, charging stations for electric vehicles, and solar/EV bus charging canopies with microgrid potential.
- The creation of an innovative new Agricultural Climate Resilience Office at the Department of Agriculture.

    - The new office will provide technical support for Colorado agricultural producers facing significant climate-related threats, set up an inventory framework, and create the administrative framework to help address agricultural GHG reduction and carbon sequestration targets.
- $0.3M to build the capacity of Colorado's Office of Just Transition to ensure a just and equitable transition from a coal based economy.

- $70M in additional funding for CDOT's Safer Main Streets and Revitalizing Main Streets programs to be distributed directly to local communities through grants. These programs directly help communities reimagine public spaces in dramatic fashion, implementing necessary COVID-19 mitigations, increasing multimodal transportation access, and making it safer and easier for pedestrians and cyclists to navigate Colorado main streets— actions that reduce VMT.

The Governor's FY 2021-22 Budget protects funding for high priority programs and services, including:

- the Air Pollution Control Division ($28.9M) at CDPHE
    - provides air monitoring, researches pollution, and permits and inspects air pollutant emitters.
- the Public Utilities Commission ($16.8M) at DORA
    - regulates utilities and facilities so that the people of Colorado receive safe, reliable and reasonably priced services consistent with the economic, environmental and social values of our state.
- the Oil & Gas Conservation Commission ($20.2M) at DNR
    - regulates the development of Colorado's oil and gas natural resources in a manner consistent with the protection of public health, safety, the environment, and wildlife.
- Program Administration ($6.3M) at the Colorado Energy Office
    - supports the Executive Director's Office, the CEO Policy Team, a portion of the Transportation & Fuels Technology Team, and a portion of the Building Innovation & Energy Finance Team.

<u>Resource and Funding Considerations</u>

Even beyond this upcoming year's budget, additional funding, staff, and resources will be necessary to develop rules, administer programs, and make the investments needed to transform Colorado's economy. House Bill 19-1261 provided $188,588 per year for 2 full-time equivalent positions at the

Air Pollution Control Division to develop and implement climate programs. Senate Bill 19-096 provided $265,589 annually for 3.1 full time equivalent positions to administer greenhouse gas inventories and other efforts under that bill. Over the coming decades, the funding and staffing needed to develop the rules, programs, incentives and other tools to transform Colorado's economy will be considered as part of the annual budget process.

For high level illustrative context, the table below compares the resources available to the Division to California's Air Resources Board program for climate regulations, as well as funding believed necessary for economy wide cap-and-trade programs for legislation in Washington and Oregon. This comparison focuses on staffing and administrative capacity and does not include the substantially larger amounts that will likely be needed for incentives, infrastructure investment, and other tools to achieve necessary progress to implement change. While these comparisons are not indicative of specific resource needs for Colorado, the table illustrates funding and resource capacity in other states leading on climate action.

	California Air Resources Board Climate Program	Washington Proposed Bill SB 5981	Oregon Proposed Bill SB 1530B	Colorado Air Pollution Control Division
Annual Budget[xlii]	**$148M**	**$8.5M**	**$9.9M**	**$454,177**
Staff	**211.4**[xliii]	**38**	**26.5**	**5.1**

NOTE: The CARB spending is only for certain administrative expenses and does not include incentives and other program costs which range to billions of dollars.

Under Colorado's constitution and laws, the General Assembly must approve any departmental or agency spending, as well as provide new fee authority. The voters must approve any new or increased taxes. The state is working to maximize the use of existing funds and evaluate additional, targeted resource needs and revenue sources moving forward to fully implement the Roadmap as part of the annual budget process.

Carbon Pricing Mechanisms

The Roadmap focuses on a sector based approach to meeting the state's GHG pollution reduction goals with an emphasis on near term actions that can help the state make progress toward the 2025 and 2030 goals and ensure that the state remains on a path toward meeting the 2050 goals. These sector based policies, based on standards and investment, are the fastest pathways towards near and mid-term emissions reductions. As part of the Roadmap process, the state has begun to evaluate the merits of shifting tax burdens from income to GHG pollution. However, the work to develop the sophisticated tax and economic modeling that would be necessary to further explore this policy approach is outside the scope of this Roadmap. It would require further evaluation for such an approach to be considered in the future.

While the state received feedback about consideration of an economy-wide or individual sector cap and trade programs, the Roadmap is not recommending pursuing an economy-wide cap. Colorado is taking an approach that draws upon strong collaboration between the public and private sectors— as opposed to focusing on a singular state rule that would be costly to administer, does not guarantee the critical emissions reductions needed, and risks shifting even more pollution to lower-wealth communities and communities of color that are already bearing the brunt of poor environmental quality. As outlined throughout the Roadmap, we have identified a variety of opportunities to achieve near term, lasting emissions reductions through a number of sector based policies spanning standards, investment, innovation, and partnerships with key industries, local governments, and other diverse stakeholders. It should be noted that in the two sectors that are best suited to emissions regulation— electricity generation and oil and gas development— the state's policies will achieve sector wide emissions reductions of 80% and over 50%, respectively, with a high degree of enforceability.

Reporting, Tracking and Management of Progress Adaptation

Consistent with the resolution passed by the AQCC in October 2020, the Air Pollution Control Division of the Department of Public Health and Environment will report annually to the AQCC on current and projected GHG inventories, will provide a complete assessment every two years, and will provide assessments of the most dynamic sectors (e.g., oil and gas, transportation, etc.) and areas of major change every other year. The reports will compare current and projected emissions against subsector targets from the Roadmap and identify proposed measures to return to a trajectory to meet House Bill 19-1261 targets, if necessary. As part of its reporting, APCD will also develop a dashboard of vital metrics that can be tracked monthly or quarterly, such as oil and gas production, rig counts, VMT, and gas deliveries. The intent is to allow regular periodic evaluation of whether the state is making progress toward the targets set by HB 19-1261.

In an October Resolution, the AQCC provisionally adopted the following sectoral targets to guide rulemakings. The AQCC intends to revisit these targets and amend the Resolution as necessary following publication of the final Roadmap.

Table 7: Emissions Reductions by Sector

Sector	Revised 2005 Baseline (MMT CO2e)	2025 Target (MMT CO2e)	2030 Target (MMT CO2e)
Electricity	40.28	21	8
Oil and Gas	20.17	13	8
Transportation	30.71	23	18
Residential, Commercial, Industrial Energy Use	24.65	26	20
Other	23.42	19.9	15.6
Total	139.22	102.9	69.6
Percent Reduction	--	26%	50%

In the October Resolution the AQCC also resolved to hold a public meeting each September, starting in 2022, to assess whether the state is on track to meet these targets. If not, the AQCC will take actions required to get back on track to meet the emissions targets.

E3 SCENARIO ANALYSIS

Identifying pathways to make progress toward Colorado's GHG pollution reduction goals requires a comprehensive analysis of potential GHG reduction measures across all sectors of the state's economy. The state hired Energy + Environmental Economics to conduct this evaluation of the emission trajectory of the state and to model emissions reductions from policies and actions taken since 2019. E3 also modeled potential emissions reductions from additional measures Colorado could adopt to meet the pollution reduction targets in the *Colorado Climate Action Plan*. This analysis provides an initial foundation for Colorado to assess various decarbonization options, identify areas for additional analysis, and consider concrete next steps in making progress towards its 2025, 2030 and 2050 targets.

Colorado's Emissions

E3 benchmarked its analysis to Colorado's emission in 2015, the last year that the state released a comprehensive GHG inventory. Colorado's GHG emissions in 2015 were dominated by electricity generation, transportation, and the oil and gas sector. Electricity generation emissions are predominantly attributed to coal combustion with a lesser portion from fossil methane generators. Emissions from the oil and gas sector include fugitive methane emissions from upstream and downstream operations in Colorado as well as on-site combustion of fossil fuels in industrial operations. Passenger vehicles are the largest contributor to transportation emissions in the state, followed by large trucks and air travel. Remaining direct emissions come from manufacturing and other industries, building energy use (especially space

heating and water heating), agriculture, waste, refrigerants, and coal mining.[xliv]

Figure 20: 2020 CO GHG Emissions (MMT CO2e, AR5 100-yr GWP)

Model Framework

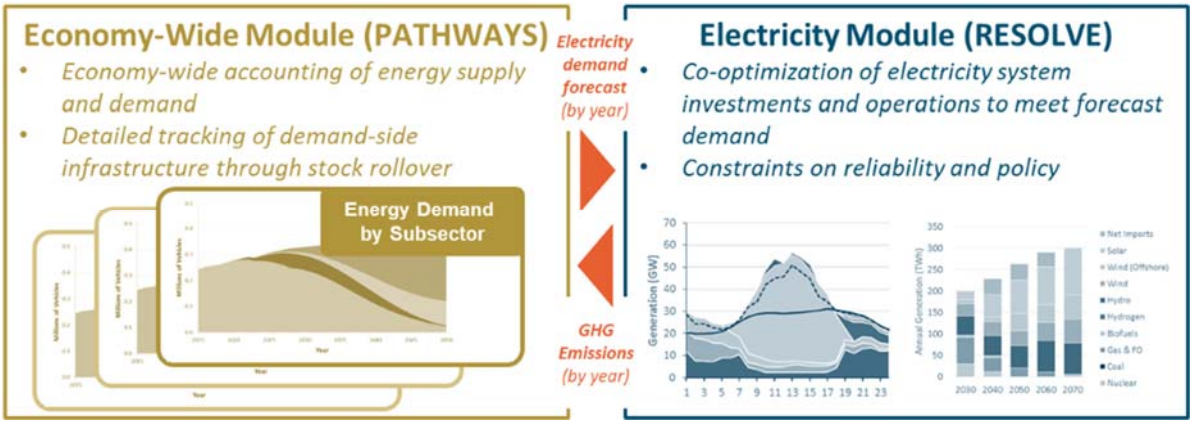
This analysis uses E3's PATHWAYS model to create distinct scenarios of future energy demand and GHG pollution in Colorado. The model is built using a "bottom-up" accounting of all energy-consuming devices and their pollution for key sectors of the economy along with a more general accounting of all energy demand and pollution for sectors where device-level data are not readily available. Scenarios are designed to test "what if" questions and to provide a comparison of emissions reductions under a range of mitigation measures.

PATHWAYS also captures interactions between demand and supply-side variables (e.g., electrification of space heating leads to a reduction in fossil methane demand and its related emissions, while causing an increase in electricity demand and any related emissions), with constraints and assumptions informed by existing analyses of resource availability, technology performance, and cost.

For key sectors like buildings and transportation, PATHWAYS uses a bottom-up stock rollover approach primarily based on data from the federal Energy Information Administration's National Energy Modeling System that is validated through benchmarking to historical "top-down" energy consumption data for Colorado. For certain sectors like industry or off-road transportation where equipment stock data are not readily available, we benchmark directly to historical energy consumption data. Non-combustion emissions from sources like agricultural methane, industrial processes, and oil and gas extraction are benchmarked to a combination of federal and state data sources.

The E3 modeling approach also incorporates a detailed representation of the electric sector using E3's RESOLVE model. RESOLVE is used to develop least-cost electricity generation portfolios that achieve Colorado's policy goals, including an 80% by 2030 emissions reduction, while maintaining reliability. Finally, we calculate potential bioenergy supply from a variety of feedstocks as well as emissions reduction potential for a variety of negative emissions technologies, including CCUS for industrial process emissions and the direct air capture of CO2. Figure 20 illustrates the relationship between the different modules of the analysis.

Figure 21: E3 Modeling Framework



More detail on modeling approach and assumptions is available in a technical appendix that is available on the Roadmap website.

SCOPE OF GREENHOUSE GAS INVENTORY

UNDER HB 19-1261, COLORADO IS RESPONSIBLE FOR ADDRESSING AND REDUCING "STATEWIDE GREENHOUSE GAS POLLUTION." STATEWIDE GREENHOUSE GAS POLLUTION INVENTORIED IN THIS ROADMAP AND IN AIR POLLUTION CONTROL DIVISION ANALYSIS INCLUDES POINTS OF EMISSIONS WITHIN THE STATE OF COLORADO, SUCH AS VEHICLE TAILPIPES, FUGITIVE EMISSIONS FROM OIL AND GAS, OR SMOKESTACKS FROM INDUSTRY AND POWER PLANTS. THIS IS CONSISTENT WITH INVENTORY ACCOUNTING FOR OTHER STATE AND NATIONAL GREENHOUSE GAS INVENTORY AND REDUCTION PROGRAMS, INCLUDING THE PARIS ACCORDS, AND AVOIDS DOUBLE COUNTING PROBLEMS BETWEEN JURISDICTIONS.

THIS MEANS THAT SOME EMISSIONS THAT ARE RELATED TO COLORADO, BUT THAT DO NOT OCCUR IN THE STATE, ARE NOT INCLUDED IN THE INVENTORIES FOR COMPLIANCE WITH HB 19-1261. FOR EXAMPLE, EMISSIONS FROM OTHER STATES OR COUNTRIES TO PRODUCE GOODS AND PRODUCTS CONSUMED IN COLORADO (E.G., CARS FROM MICHIGAN, FOOD FROM THE MIDWEST, ELECTRICITY GENERATED IN WYOMING, OR APPLIANCES MADE IN ASIA) ARE NOT INCLUDED. SIMILARLY, EMISSIONS OUTSIDE OF THE STATE FROM COLORADO-PRODUCED FOSSIL FUELS (COAL, OIL AND GAS) ARE NOT INCLUDED.

HOWEVER, LIFE-CYCLE EMISSIONS ARE IMPORTANT AND USEFUL FOR MANY POLICY DISCUSSIONS. UNDER SB 19-096, SB 19-236, AND HB 19-1261, CDPHE AND PUC CONSIDER THE TOTAL EMISSIONS ASSOCIATED WITH ELECTRICITY CONSUMED IN COLORADO, AND CLEAN ENERGY PLANS ARE TIED TO 80 PERCENT REDUCTIONS IN EMISSIONS ASSOCIATED WITH ELECTRICITY CONSUMED IN COLORADO, EVEN IF SOME OF THE GENERATION TAKES PLACE OUT OF STATE. SIMILARLY, UNDERSTANDING THE EMISSIONS ASSOCIATED WITH BURNING OIL AND GAS THAT IS PRODUCED IN COLORADO CAN BE USEFUL FOR UNDERSTANDING THE TOTAL IMPACTS OF FUEL PRODUCTION IN COLORADO. THESE ARE ESTIMATED IN APPENDIX TK. UNDERSTANDING NET GLOBAL EMISSIONS FROM FOSSIL FUELS CONSUMED IN OTHER STATES IS COMPLICATED, BECAUSE CONSUMERS MIGHT SUBSTITUTE FUELS PRODUCED IN TEXAS OR NORTH DAKOTA FROM FUELS PRODUCED IN COLORADO. IN ADDITION, LIFECYCLE EMISSIONS CAN BE VERY HELPFUL FOR WASTE REDUCTION AND DIVERSION POLICY DEVELOPMENT, EVEN IF NOT ALL EMISSIONS "CREDIT" OCCURS IN THE STATE.

HOW ARE METHANE AND OTHER GHGS COMPARED TO CARBON DIOXIDE?

THE ROADMAP INVENTORIES USE 100-YEAR GREENHOUSE GAS GLOBAL WARMING POTENTIAL VALUES TO TRANSLATE METHANE AND OTHER GASES TO CO_2E, BASED ON THE MOST RECENT IPCC AR5 METHODOLOGY. FOR EXAMPLE, ONE TON OF METHANE IS EQUIVALENT TO 28 TONS OF CO_2 OR ONE TON OF NITROUS OXIDE IS EQUIVALENT TO 265 TONS OF CO_2.

BECAUSE DIFFERENT GASES WILL PERSIST IN THE ATMOSPHERE FOR DIFFERENT PERIODS (E.G., SHORTER FOR METHANE AND LONGER FOR CO_2), USING DIFFERENT TIME PERIODS CAN RESULT IN DIFFERENT GLOBAL WARMING POTENTIALS. FOR EXAMPLE, BECAUSE IT IS VERY POTENT ON A SHORTER-TIME FRAME, THE GLOBAL WARMING POTENTIAL FOR 20 YEARS FOR ONE TON OF METHANE IS 84 [TK CHECK] TONS OF CARBON DIOXIDE. LIKE OTHER STATE AND NATIONAL INVENTORIES, COLORADO IS USING 100-YEAR GLOBAL WARMING POTENTIAL VALUES TO CAPTURE THE LONG-TERM RISKS OF CLIMATE POLLUTANTS AND ENSURE THAT EARLY INVESTMENTS ARE MADE IN CO_2 EMISSIONS REDUCTIONS. HOWEVER, PROPOSED EARLY REDUCTIONS IN METHANE AND HYDROFLUOROCARBONS WILL CREATE EVEN GREATER SHORT-TERM (20 YEAR) BENEFITS.

Scenario Development

For this analysis, E3 developed three distinct scenarios: a Reference Scenario that reflects a "business-as-usual" projection of energy consumption and emissions under policies adopted prior to 2019, a 2019 Action Scenario that includes the impacts of both legislative and regulatory policies and measures adopted in 2019, and a HB-1261 Targets Scenario that is designed to meet the state's goals in 2025, 2030, and 2050.

- **Reference Scenario:** Includes existing sector-specific policies adopted before the 2019 legislative session, including the Renewable Portfolio Standard (RPS) for electricity and federal CAFE standards for passenger vehicles.
- **2019 Action Scenario:** Includes the impact of key policies adopted during 2019, such as electric sector GHG emissions targets (HB19-1261), the incorporation of the social cost of carbon in electric sector planning, (SB19-236), increased efficiency standards for certain appliances (HB10-1231), and the creation of a Zero Emission Vehicle (ZEV) program (EO B 2019 002). Since a number of the pieces of legislation passed in 2019 require regulatory implementation, this scenario includes what we believe are reasonable assumptions about implementation.
- **HB-1261 Targets Scenario:** Includes one illustrative scenario of sectoral changes and the impacts of additional measures needed to reach the 2025 target of reducing greenhouse gas emissions by 26%, reducing 2030 by 50%, and 2050 emissions by 90% from 2005 levels.

Table 8: Key Strategies by Sector in E3 Scenarios

Strategy	Reference	2019 Action	HB19-1261 Targets
Clean Electricity	Existing RPS, announced coal retirements	80% reduction in pollution from Colorado generation by 2030, 95% by 2050 Includes Xcel & Tri-State commitments and HB 1261	Same as 2019 Action
Building Efficiency	**Utility efficiency programs, existing appliance standards**	**Appliance efficiency standards covered under HB 1231**	**Appliance efficiency standards for all end-uses, efficient building shell requirements**
Building Electrification	None	Same as Reference	High electrification for all end-uses
Transportation Efficiency	CAFE Standards	Same as Reference	CAFE Standards, LDV VMT reductions
Transportation Electrification	EIA AEO 2019 Reference Forecast	ZEV Standard for LDV, state EV Plan target of 940,000 EVs by 2030	Aggressive ZEV sales for all vehicle types
Low-Carbon Fuels	Existing ethanol and biodiesel blends	Same as Reference	Advanced biofuels and hydrogen production
Oil & Gas	Projected oil and gas production	2019 Updates to AQCC Reg. 7	SB19-181, significant reductions in methane emissions
Agriculture	ACRE3	Same as Reference	Soil Health Program

Sensitivity Analysis for Impacts of COVID-19 on the Economy

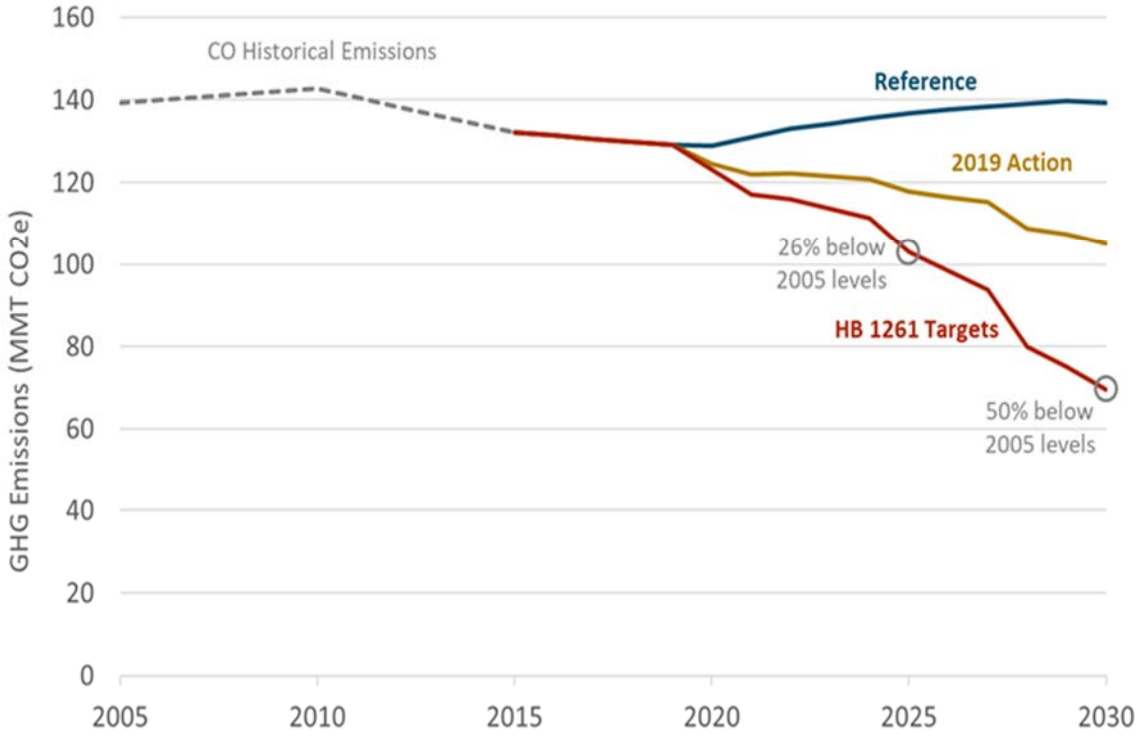
The three core scenarios (Reference, 2019 Action, HB-1261 Targets) modeled in this study are based on pre-COVID-19 conditions and do not take into account impacts from the recent COVID-19 pandemic. To reflect some of the potential impacts from COVID-19, E3 ran sensitivities on the 2019 Action and HB-1261 Target that included:

- A lower population and household growth rate from 2020 through 2025 to reflect lower migration to Colorado.
- A reduction in vehicle miles traveled (VMT) in 2020 consistent with what has been observed through the first half of this year. Annual VMT slowly increases back to pre-COVID-19 levels by 2027.
- Flat oil and gas production levels from 2020 through 2030, in comparison to the production increase seen over the same period in the three core scenarios.

Scenario Results for 2025 and 2030

E3's analysis finds that achieving Colorado's 2025 and 2030 GHG emissions targets is feasible with existing technologies. However, as shown in Figure 21 below, **this will require additional measures and policies beyond those that are included in the 2019 Action Scenario**. The changes needed to achieve the 2030 goals rely primarily on existing mature technologies. Achieving the 2050 goals likely requires innovation to drive costs down and enable large scale deployment of technologies that are less mature. More information on the key transformations needed by 2050 is available later in the report.

Figure 22: E3 GHG Emissions Projections by Scenario Through 2030

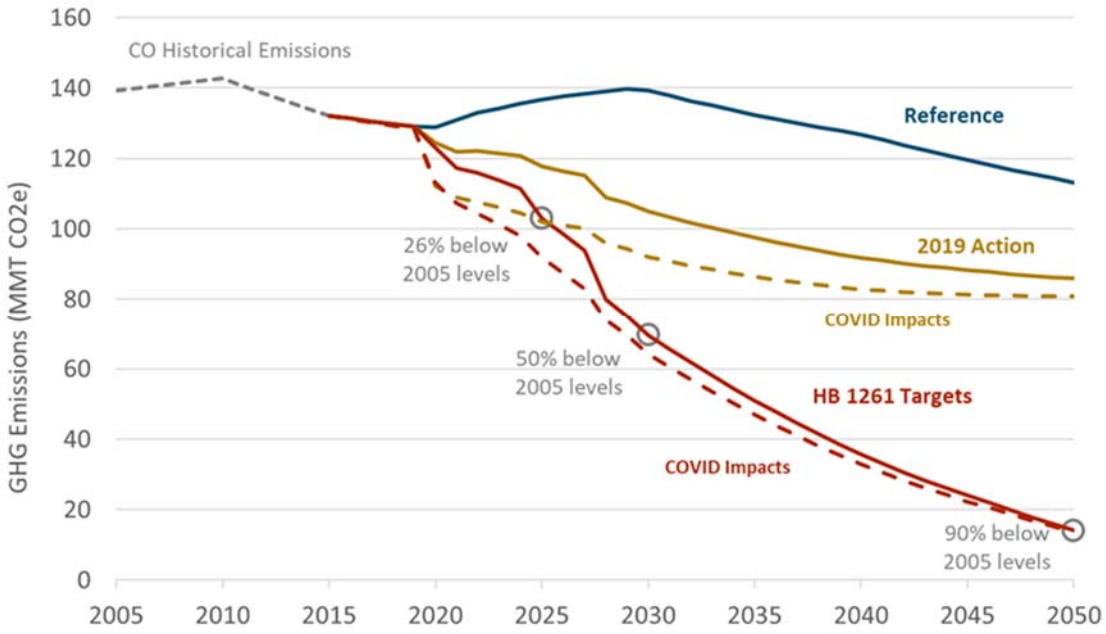


Making progress towards the 2025 and 2030 goals primarily will rely on continuing the transition to renewable electricity generation, reducing methane emissions from oil and gas development and operations, accelerating the transition to electric cars, trucks and buses, making changes to transportation planning and infrastructure to reduce the growth in driving, accelerating improvements to building efficiency and electrification of buildings, reducing methane emissions from landfills, sewage plants and agriculture, and investing in natural and working lands and the people who steward them to help mitigate the impacts of climate change and build greater resilience.

Impacts of COVID-19 on pollution may be large in the near term, but long term effects are unknown. The modeled COVID-19 sensitivities show significantly lower emissions in 2025, although this difference is modeled conservatively as smaller by 2030 and essentially gone by 2050. The emissions

impact of lower population growth, reduced VMT, and flat oil and gas production is larger in the 2019 Action scenario because of the higher rates of building and vehicle electrification and lower oil and gas methane leak rate in the HB-1261 Targets Scenario. It is uncertain what long-standing effects will be felt after 2030 with respect to how Coloradans live, work, and travel, but these sensitivities indicate that the impacts in 2025 and 2030 may be substantial. And while the state is not relying on COVID-19 sensitivity assumptions for purposes of achieving emission reduction targets, it will continue to evaluate how they impact actual emissions trajectories over time and update relevant modeling accordingly.

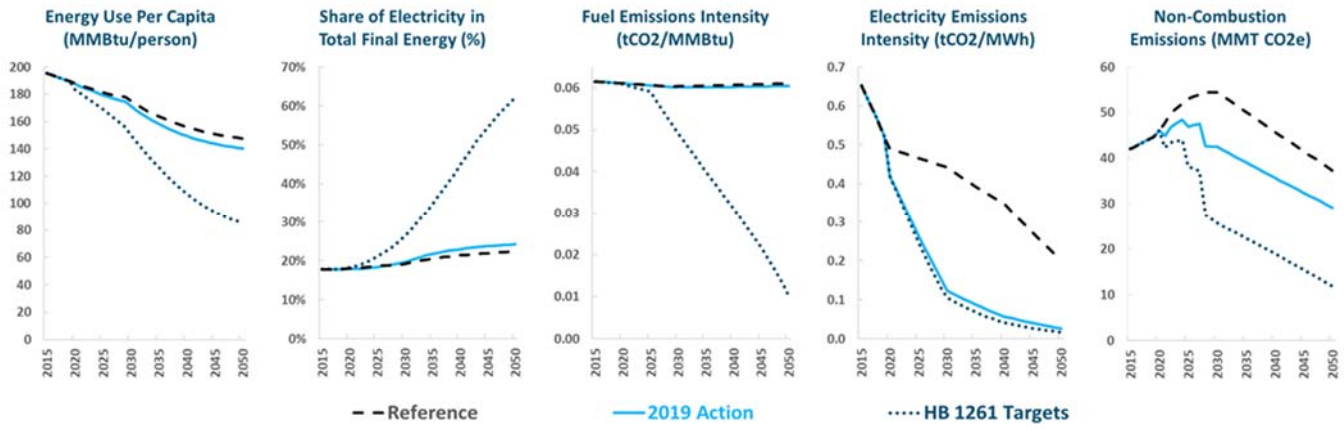
Figure 23: E3 GHG Emission Projections by Scenario Through 2050



Any deep decarbonization pathway to 2030 and 2050 will require a transformation in energy infrastructure and consumption patterns. **The deep decarbonization transition in Colorado will be supported by five pillars: energy efficiency, electrification, low-carbon fuels, decarbonizing electricity supply, and reducing non-combustion emissions.** The scale of

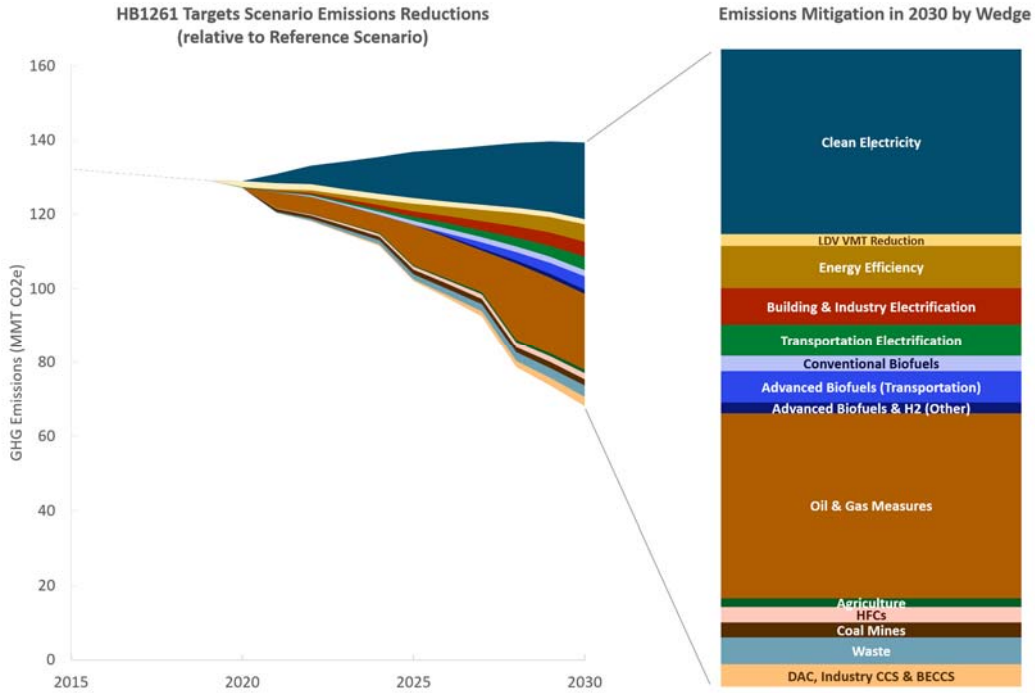
transformational change needed in each of these categories for the 2050 targets is illustrated in the figure below.

Figure 24: Five Pillars of Decarbonization in Colorado by Scenario



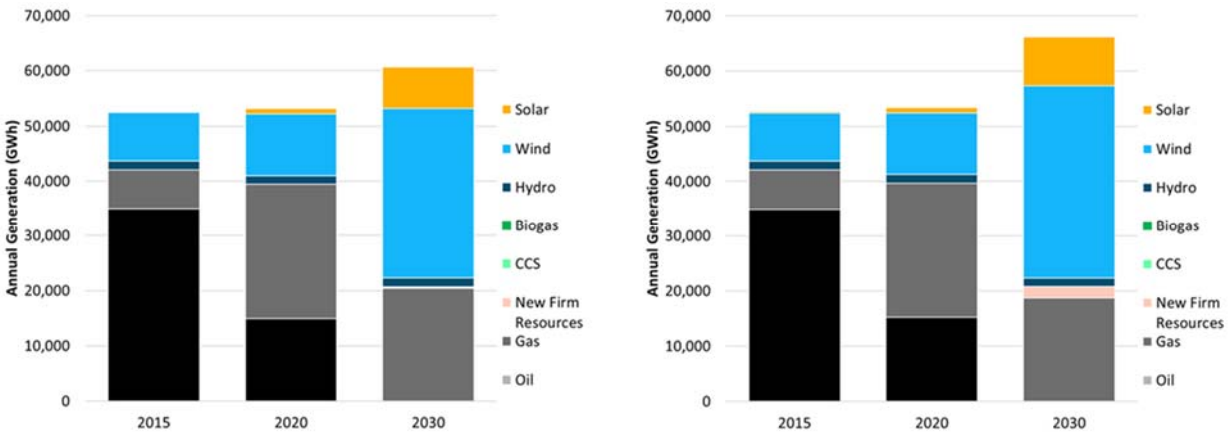
To meet 2025 and 2030 targets, emissions reductions are needed across many sectors. Figure 25 below shows the breakdown of emissions reduction by distinct sets of measures or "wedges" in 2030. The largest near term gains can be made in electricity generation and oil and gas, but early effort is also needed in buildings, transportation, industry, refrigerants, waste reduction, and reducing methane emissions from landfills, sewage treatment plants, and agricultural operations, waste, and coal mine methane.

Figure 25: Emissions Reduction by Measure in 2030



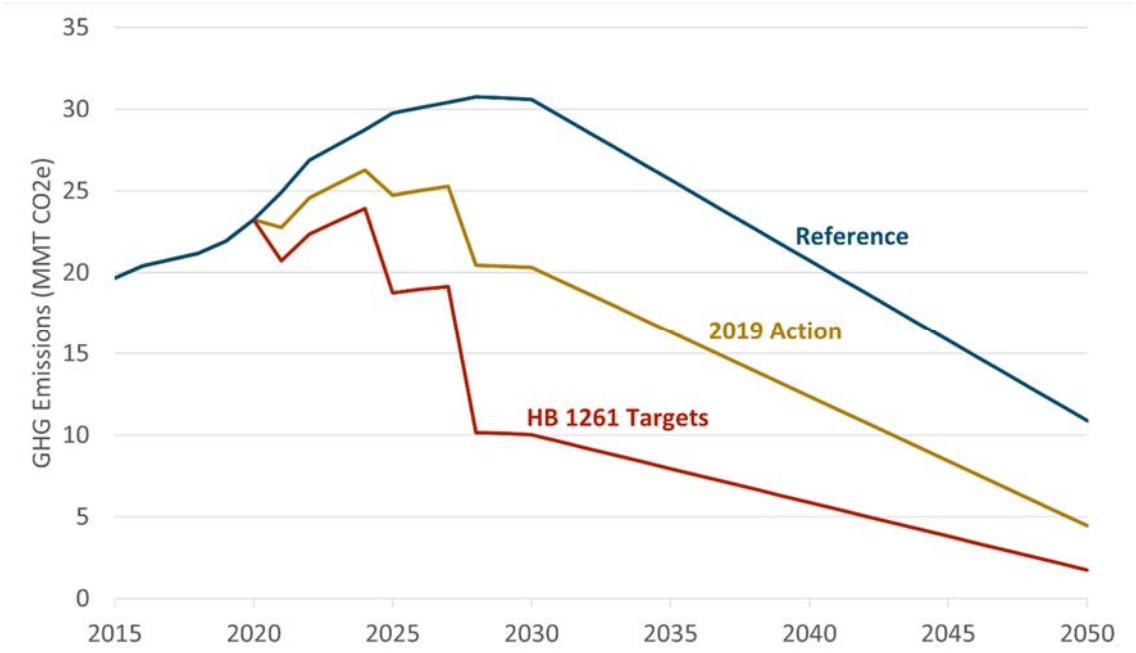
The clean electricity targets set in 2019 as part of HB 19-1261, along with additional commitments from Colorado utilities, form the backbone of deep decarbonization by directly reducing electricity generation emissions and indirectly enabling greater emission reductions elsewhere through the electrification of buildings, transportation, and industry. The clean electricity targets modeled by E3 assume that Xcel Energy and Tri-State's share of load is met with carbon-free resources by 2050, while other utilities must meet an emissions reduction of 80% below 2005 levels by 2050. This is likely a conservative assumption; other utilities will also be transitioning towards zero carbon generation. In fact, Platte River Power Authority already has adopted a resource plan to achieve a 90% reduction by 2030, and Holy Cross Energy has committed to zero carbon emissions by 2030.

Figure 26: Electricity Generation through 2030 in 2019 Action Scenario (left) and HB19-1261 Targets Scenario (right)



Minimizing the release of methane from the oil and gas industry is essential to achieving the state's goals, as these make up the largest source of non-combustion emissions in the state. Oil and gas production is assumed to be the same between the three scenarios, with emission reductions coming from reducing methane emissions leaks in upstream operations and the downstream distribution system. The forecasts of production emissions and leak rates were set on the high side of potential outcomes for planning purposes. Greater leak rate reductions or less production would drive deeper reductions. Methane is a short-lived but potent climate pollutant, making it a priority for the state to mitigate impacts in the next ten years. Oil and gas emission reduction measures are estimated to be low cost, approximately $4/tonne CO2e relative to the Reference scenario (for comparison, the social cost of damages caused by carbon emissions is over $50/ton). In the near term action recommendations developed by the state agencies, a rulemaking is proposed in 2021 to achieve deeper emissions reductions from the oil and gas sector than are contained in this illustrative scenario.

Figure 27: Methane Emissions in Colorado's Oil and Gas Sector by Scenario



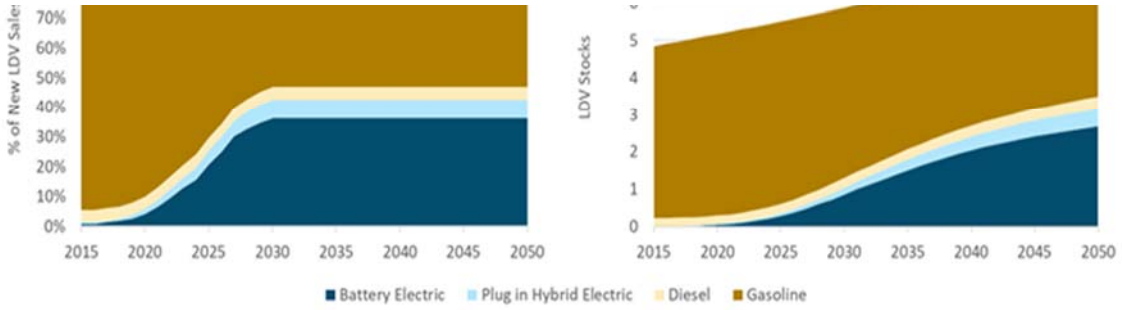
Energy efficiency in residential and commercial buildings is a no-regrets action in the near term. E3's analysis assumes a transition to 100% sales of high efficiency appliances and technologies in buildings, which in turn reduce pollution and costs. Widespread adoption of energy efficiency improvements in the buildings sector, however, is contingent on continued advancement of building energy codes, utility incentive and technical assistance programs, building performance standards, consumer education, and other actions. Building efficiency measures are estimated to save $54/tonne CO2e (i.e., cost savings) relative to the Reference scenario in 2030. Because of the challenges in achieving widespread changes to buildings over relatively short timeframes, the near term action recommendations assume smaller emissions reductions from the building sector between now and 2030 than are shown in the illustrative HB-1261 Targets Scenario.

Vehicle and building electrification are very effective at reducing pollution, but their adoption will take time to ramp up. Electric passenger vehicles and trucks are more efficient at converting energy to miles traveled,

and the electricity they use is increasingly clean, so they reduce pollution relative to internal combustion engine vehicles. In the illustrative scenario that achieves the HB 19-1261 targets, E3 assumes a ramp up in the sales of zero emission vehicles to 70% by 2030, which is a significant departure from adoption today. This level of transformation will require continued effort from the state to remove barriers to consumer adoption, install robust EV charging infrastructure, and plan the electricity grid to accommodate new levels of electrification. Light duty vehicle electrification is expected to be very affordable by 2030, E3 estimates cost savings of $172/tonne CO2e in 2030 relative to the Reference scenario. Medium and heavy duty electrification may take additional time to ramp up— E3's analysis assumes a 40% sales share of zero-emission trucks by 2030.

One criticism that was raised by a number of stakeholders during the public process has been a concern that the 2019 Action Scenario assumes a higher level of light duty EV adoption under current policy than is required by state ZEV regulations, and that the HB-1261 Targets Scenario assumes a perhaps too aggressive increase in EV uptake over the next decade. The numbers included in the 2019 Action Scenario were not arbitrary— they are normalized to the goals in the state EV plan, and are very similar to market projections that were developed for the Energy Office by Navigant Consulting as part of the ZEV rulemaking at the AQCC in 2019. However, in order to respond to this concern, for the purposes of the near term action recommendations, the state agency analysis assumes much lower adoption of EVs by 2030 under current policy, and then proposes additional actions to achieve emissions reductions from transportation.

Figure 28: Vehicle Stock Rollover



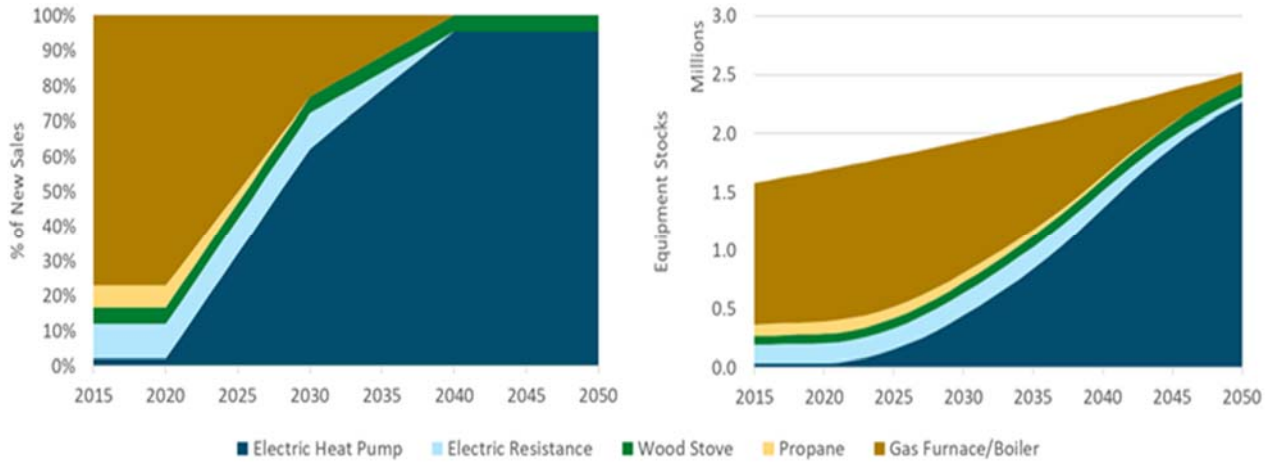
MDV and HDV electrification is currently estimated in the E3 model to be more expensive ($114/tonne CO2e in 2030), which indicates that technology costs may need to continue to decline- and in some cases or operating conditions may need to be changed- to maximize benefits of truck and bus electrification. However, given the trends that we are seeing of declining battery costs, and lifecycle cost savings already possible in certain segments of the medium and heavy duty vehicle market, this is likely too conservative, as these vehicles will be initially deployed in those industry segments where they are most cost effective.

Electric water heaters and space heating can provide an efficient alternative to fossil devices, but are less widespread in Colorado. E3 assumes a 60% sales share of electric heat pumps in space heating and water heating by 2030, which will require moving quickly to identify least-cost early adopters and investments in heat pump technology to bring down costs for a diverse set of buildings. Building electrification is estimated to cost $55/tonne CO2e relative to the Reference scenario.

It is important to emphasize that there are still substantial uncertainties about the ultimate pathway towards building decarbonization. While the HB-1261 Targets Scenario focused on electrification, there is some potential for other technology pathways to achieve the 2050 targets— such as mixing green hydrogen into the natural gas distribution system, or the

potential for air capture of carbon dioxide as a feedstock for synthetic methane. While studies in California have found that electrification is likely the lowest cost option, there are still questions about the lowest cost pathways in a cold weather state such as Colorado, as well as about the scalability and costs of the other technology pathways. For this reason, we recommend that the Roadmap support a broad suite of near term no-regrets strategies (including building efficiency, electrification, use of bio methane and hydrogen, and reduction of methane leaks), and that further stakeholder engagement and analytical work is needed to explore longer term pathways. We also note that the near term action recommendations assume a smaller reduction in emissions from the buildings sector (20% rather than 37%) than are shown in the illustrative HB-1261 Targets Scenario, to reflect the long lead times necessary to achieve significant changes in the building stock.

Figure 29: Heating Appliance Rollover in HB 1261 Targets Scenario



It will be important to slow the growth of vehicle miles traveled by providing better alternatives to driving, by encouraging telecommuting, by factoring GHG pollution into the transportation planning process, and by making wiser land use decisions. Even with the adoption of zero emissions vehicles, there will be at least three decades to come with internal

combustion engines still on the road, and there are many other co-benefits associated with lower levels of vehicle miles traveled.

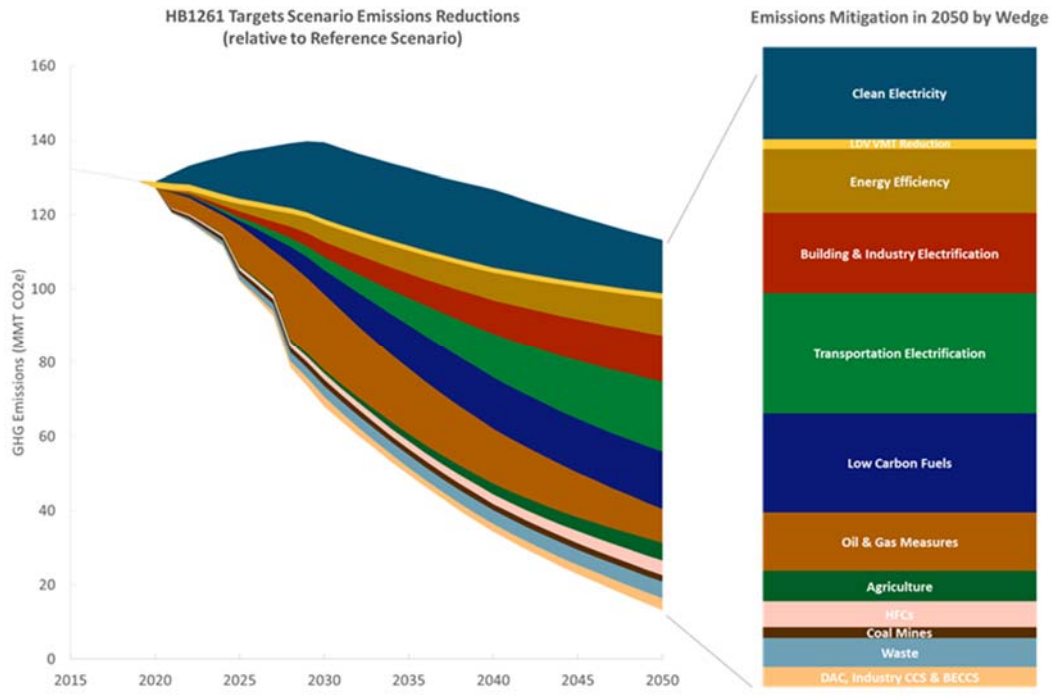
Low carbon fuels will likely play a role as biofuels and hydrogen are shown to be necessary to reduce emissions in sectors that are difficult to decarbonize, such as some industrial processes and some portions of the heavy duty vehicle sector. E3's analysis finds that low-carbon fuels are essential after 2030, but that the role of ethanol, biodiesel, biogas, advanced biofuels, and hydrogen, will need to start ramping up between 2025 and 2030. Promising near term opportunities in Colorado include biogas from waste sources in Colorado, ethanol with carbon capture and storage, and renewable diesel for transportation. Low-carbon fuels range in costs ($168 - $395/tonne CO2e) based on feedstock, conversion process, and delivery of fuel. There are unaddressed questions in a number of areas about the indirect land use impacts of some types of biofuels, and about policy tradeoffs between investments in ZEV infrastructure and incentives and investments in biofuels, which need additional stakeholder and analytical work.

Natural and working lands play a crucial role in the state's low-carbon future. The total carbon flux between the atmosphere and Colorado's natural and working lands sector is currently unquantified. As a result, with the exception of specific agricultural emissions identified in the technical appendix available on the State of Colorado website, the natural and working lands sector is not explicitly modeled in PATHWAYS. **However, natural and working lands have an important role to play in achieving the state's emission targets, in addition to the fundamental value they provide in support of the lives and collective resilience of all Coloradoans**. In addition to identifying near term emission reduction strategies, developing a comprehensive natural and working lands carbon inventory is a key near term priority for Colorado, because it is critical for monitoring and verifying land management activities, policies, and programs that may increase or decrease carbon sequestration over time.

LEADERSHIP AND INNOVATION REQUIRED TO MEET 2050 GHG GOAL

All sectors have an important role to play in emissions reductions if the state is to reach 90% reductions by 2050. There are clear early priorities for the state to make progress towards 2025 and 2030 targets, but achieving the state's science-based 2050 goals will require effort across all sectors of the economy. Figure 29 below shows a potential breakdown of emissions reduction by sector. E3's modeling is only one possible path that Colorado can take to meet the 2050 goal.

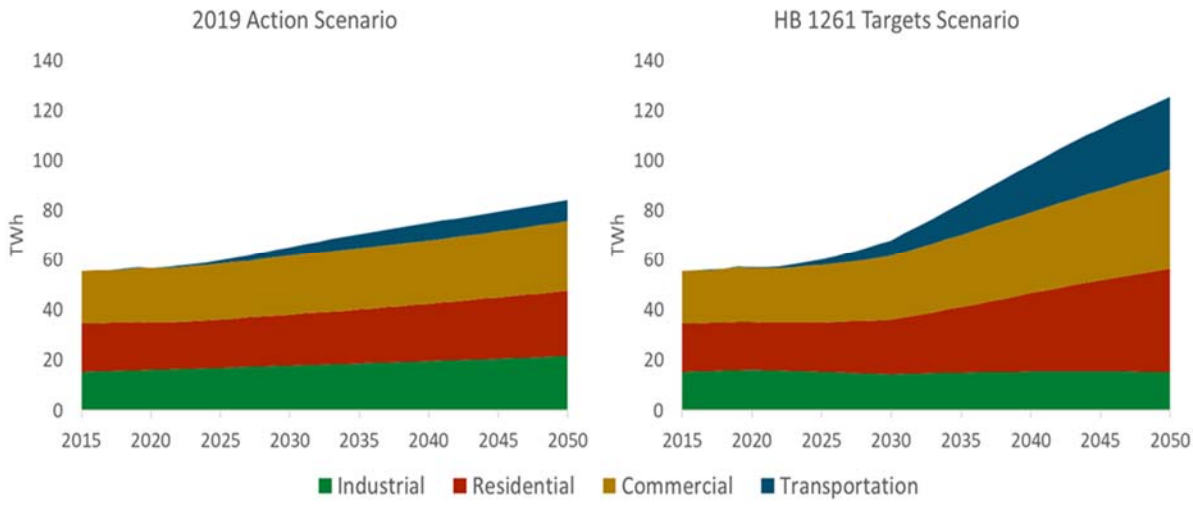
Figure 30: GHG Emissions Reductions by Measure in the HB19-1261 Targets Scenario



Electrification is the largest driver of demand-side emissions reductions by 2050. Widespread electrification in buildings and transportation, along with some electrification in the industrial sector, leads to total electric load more than doubling by 2050 in the HB-1261 Targets

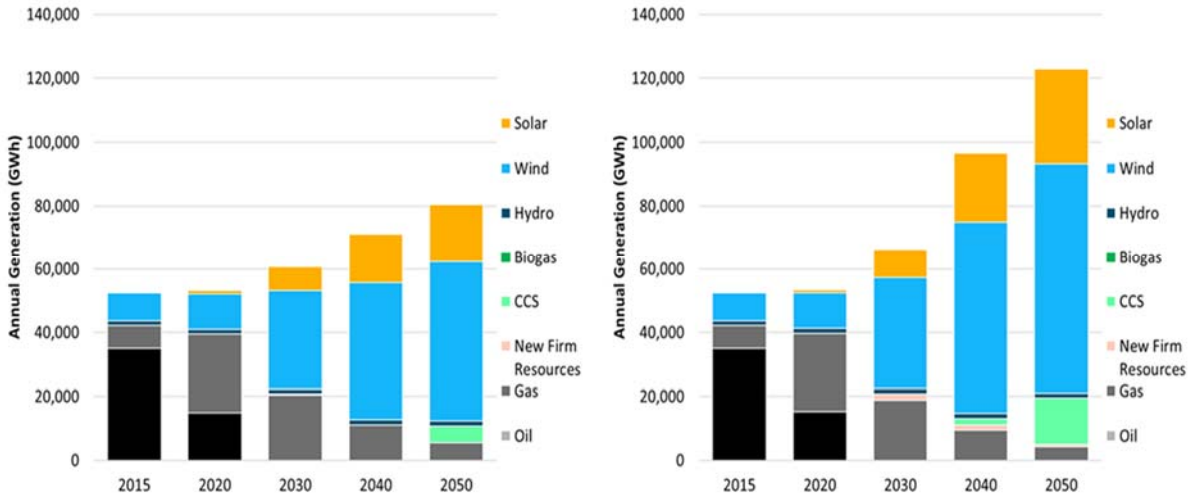
Scenario. Electrification, along with energy efficiency, is crucial to reducing emissions as Colorado's population is projected to grow at more than twice the national rate over the next 30 years. Consumers, influenced by state and federal policy, will drive the pace of adoption for new passenger vehicles and appliances, which in turn determines a large share of the emissions from buildings and transportation.

Figure 31: Total Electricity Demand by Sector and Scenario



The vision for a decarbonized future in Colorado requires two key transformations in the electricity sector: (1) a need to serve increasing electricity demands due to population growth and electrification of fossil devices, and (2) a need to significantly reduce emissions from coal and natural gas generation by developing new renewable resources. This two-fold challenge will require significant wind and solar resource development in the state. This level of development offers opportunities to reduce pollution and create local jobs, but will also require careful land-use planning across the state.

Figure 32: Electricity Generation in 2019 Action (left) and HB19 1261 Targets Scenario (right)



Firm dispatchable capacity is crucial to a reliable electricity system at high levels of renewables. At high levels of wind and solar deployment, it becomes increasingly important to have sufficient electric generating capacity that can be dispatched when winds are not blowing and the sun is not shining. Current battery storage can help by moving this power within the day, but as we approach 2050, the electricity system will also need to be able to function for multi-day periods without significant renewable output. While the vast majority of generation is projected to come from wind and solar, these infrequent periods will require firm dispatchable electric resources, which could include fossil methane (with or without CCUS), bioenergy, use of renewables to produce hydrogen combined with hydrogen combustion, nuclear power, or a future long-duration energy storage technology. It is unclear what the best technological solution will be for this challenge, so Colorado will work with electric utilities to ensure that a full suite of low or zero-carbon technologies can compete to fill that role.

Supplying reliable energy to heat homes in winter is essential and requires careful planning, especially after 2030.

To reduce emissions in Colorado's buildings, a significant effort will be required to achieve greater efficiency in new appliances and building envelopes, in addition to strategic electrification of appliances like stoves (including induction), space heaters and water heaters. A subset of homes and businesses are cost effective to electrify today, but with consumer adoption and innovation building electrification is expected to become increasingly cost competitive by 2030 and beyond.

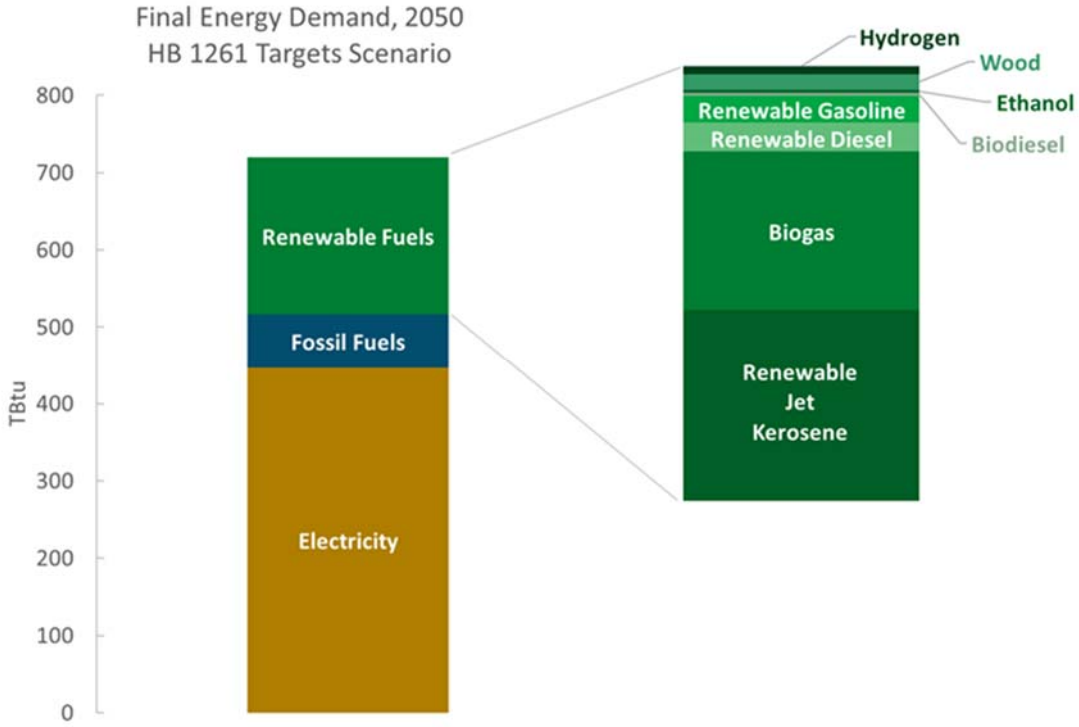
One key consideration for building electrification is the need to reliably heat homes in the winter in Colorado, which requires careful electric sector planning if we shift to primarily electric space heating. E3's analysis indicates that Colorado could shift from a summer peaking to a winter peaking system with the levels of adoption in the HB-1261 Targets Scenario. Continued research into cold climate air source electric heat pumps and barriers to electrification in Colorado's buildings will be essential to the transition. Winter peak heat impacts can be further mitigated through load flexibility in space heating and a balanced mix of technologies (such as ground source heat pumps and combustible fuel backup).

Low-carbon fuels will be necessary to decarbonize sectors that are difficult to electrify

E3's analysis finds the most optimal uses for low-carbon fuels in 2050 are in decarbonizing aviation fuel, remaining diesel consumption in transportation, and remaining natural gas use in industry. While some low-carbon fuels are used to decarbonize the remaining non-electric fuel demand in buildings and passenger vehicles, these constitute a small fraction of energy demand in those sectors. Low-carbon fuels can be sourced from sustainable biofuels (e.g., methane captured from landfills, agricultural wastes, forest thinnings) or can be produced by improving current processes (e.g., ethanol production with CCUS). Low-carbon fuels can also be produced through electricity for fuels like hydrogen and synthetic fuels. A significant

advanced biofuels or electrolytic fuels market will take time to develop in Colorado and neighboring regions, so it will be essential for Colorado to invest in research and development towards furthering these different low-carbon fuel options. New technologies, including electric aircraft, also have the potential to revolutionize this area.

Figure 33: Total Final Energy Demand in 2050 by Fuel in the HB19-1261 Targets Scenario



Reaching 90% GHG reductions will require significant transformation of the oil and gas sector, mainly by reducing upstream and downstream operation leak rates.

The oil and gas sector is a significant source of pollution in Colorado and production has been growing since 2005 (at least until the industry downturn starting in early 2020). A key strategy will be identifying and reducing leak rates in both upstream operations and downstream distribution of oil and gas. E3's HB-1261 Targets Scenario assumed a reduction in upstream leak rate from 4% in 2005 to 0.25% in 2050 and a downstream leak

rate reduction from 0.5% in 2005 to 0.15% in 2050. These reductions reflect realistic targets consistent with SB 19-181 and the goals of leading oil and gas companies.

Strategic deployment of carbon capture utilization and sequestration can reduce pollution in key sectors.

Carbon capture technology is not new, but large scale deployment has been slow especially without an aggressive mandate to reduce emissions or economic incentive. Carbon capture is most cost-effective and appropriate in applications with a pure and concentrated stream of CO2 or significant non-combustion process emissions that would not be avoided from fuel switching. Prime candidates for CCUS in Colorado include ethanol production facilities, central gas processing operations, and cement manufacturing. This is in addition to the carbon sequestration potential of Natural and Working Lands.

An example of a CCUS project in development is a joint venture between Lafarge-Holcim and Oxy Low Carbon venture to capture CO2 from the Holcim cement plant in Florence, Colorado. The project just received a $1.5 million federal grant to complete feasibility work for a project that would remove two million tons of CO2 per year from the cement manufacturing and natural gas fired steam generator. The CO2 would then be placed into a nearby pipeline and then injected underground to sequester the carbon.

Continued engagement with these industries will be needed to determine the appropriate sites and timing of CCUS deployment, in addition to the proximity to appropriate carbon sequestration and utilization opportunities. Further work will also be necessary to assess and address any regulatory barriers to capture and sequester carbon in the state. It is anticipated that a CCUS Task Force will be established to assist the state to evaluate the legal and technical steps toward implementation of CCUS.

Strategic efforts in the natural and working lands sector will be necessary to further reduce associated GHG pollution, and protect and enhance the ability for Colorado's lands to sequester carbon from the atmosphere.

Long-term priority actions include enhancing land conservation and reducing the conversion of native grassland, forests, and pastureland to cropland, energy development, or urban and suburban development. Land conservation should complement sustainable land use planning efforts to reduce transportation and other emissions associated with development. Additional key strategies include reforestation and afforestation of wildfire burn scars, urban and suburban areas, and wind breaks in agricultural landscapes, while acknowledging that these practices must be equitable and adaptive to ongoing climate change and the availability of water resources. Additionally, increases in place-appropriate practices such as cover cropping and cropland nutrient management will achieve substantial emissions reductions from the agricultural sector, and the pace and scale of forest management must be increased substantially to maintain forest health and reduce wildfire severity.

PRIOR ACTIONS TO REDUCE GHG POLLUTION

Because of early actions and commitments to addressing the climate crisis, Colorado has made significant progress on a transition to renewable energy, electric vehicles, and reducing GHG pollution. This work would not have been possible without a strong partnership among the General Assembly, public interest groups, private sector leaders, local governments and the public.

Earlier Climate Plans

In 2007 Governor Bill Ritter, Jr., released the *Colorado Climate Action Plan: A Strategy to Address Global Warming*. The plan concluded that the scientific evidence for human-caused climate was clear. Governor Ritter called global warming, "Our generation's greatest environmental challenge."[xlv] The plan also described three principal roles for state government: enacting bridge strategies that immediately reduce greenhouse gas pollution while we pursue technologies to generate cleaner energy; providing leadership to ensure that long-term solutions, such as renewable energy, are fully developed and broadly implemented; and preparing the state to adapt to those climate changes that cannot be avoided.

The plan established a goal of an 80% reduction in greenhouse gas pollution by 2050 from 2005 levels. To make progress towards this goal, the 2007 plan established a goal of increasing renewable energy and reducing GHG pollution from electric utilities by 20% by 2020. The plan also called on state agencies to partner with research institutions and industry to develop ways to prevent methane leakage from oil and gas drilling; established goals for diverting waste from landfills; directed state government to reduce energy consumption in state buildings and vehicles; and sought to develop a

workforce that would make Colorado a leader in the emerging new energy economy.

In 2014, Governor Hickenlooper released a *Colorado Climate Plan* that identified a number of opportunities to reduce greenhouse gas emissions at the agency level and recommended a number of actions to help improve Colorado's ability to adapt to future climate change impacts and to increase the levels of preparedness of Colorado's state agencies. In 2017, Governor Hickenlooper signed an executive order committing the state to further climate action, including reducing statewide greenhouse gas emissions 26% by 2025 from 2005 levels. Governor Hickenlooper issued an updated Climate Plan in 2018, which identified opportunities to mitigate greenhouse gas emissions and promoted state policy recommendations and actions that increase Colorado's level of preparedness for impacts of a changing climate.

Clean Energy & Efficiency Legislation & Regulatory Actions

Colorado has taken significant legislative and regulatory action to reduce GHG pollution. In 2004, Colorado voters passed Amendment 37, which set a renewable energy target of 10% by 2020 for investor-owned utilities. The legislature has amended the RPS several times, including adopting changes that expanded the requirement for behind the meter generation, increasing the renewable energy target to 30% by 2020 for investor-owned utilities, and establishing renewable energy targets for rural electric cooperatives and municipal utilities.[xlvi]

Colorado adopted legislation in 2007 that created an energy efficiency resource standard by requiring the Public Utilities Commission to establish energy and demand savings goals for regulated gas and electric utilities. In 2017 the law was extended to require regulated utilities to offer electric efficiency programs through 2028. As part of the update to the EERS, the PUC is required to set goals of at least 5% peak demand reduction and 5% energy savings by 2028.

In 2010, the state adopted the Clean Air Clean Jobs Act, which required regulated utilities to file with the PUC plans to reduce emissions from coal-fired power plants. Xcel Energy filed a plan addressing 900 megawatts (MW) of coal-fired generation and the PUC ultimately approved a plan to retire 597 MW of coal-fired generation.[xlvii]

In 2014, Colorado became the first state to adopt regulations to reduce methane emissions from both new and existing oil and gas well operations. The regulations have served as a model for subsequent federal and state regulations in the sector. In 2018, the Colorado Air Pollution Control Division determined that in the intervening years following the implementation of the regulations (2015-2017) the number of methane leaks had fallen by 52%.

In 2014, as part of the settlement of litigation around a State Implementation Plan to reduce Regional Haze, the owners of the Nucla coal-fired power plant agreed to accelerate the retirement date for the plant to 2022. The agreement was later amended to include the early retirement of a second coal-fired plant, Craig 1 in 2025. The updated plan was approved by the state Air Quality Control Commission on December 15, 2016, and approved by the Environmental Protection Agency on July 5, 2018. Ultimately, the Nucla plant was retired more than two years earlier than the date set out in the settlement.

In 2016, Xcel Energy filed an electric resource plan with the PUC. During the proceeding, Xcel and more than 20 different groups joined together to present the PUC with the Colorado Energy Plan- an agreement that proposed to retire two coal-fired power plants and replace them with 1,100 MW of new wind generation and 700 MW of solar, while saving customers a projected $200 million. The Colorado Energy Plan proposed to retire Comanche unit 1 (325 MW) in 2022, 11 years ahead of schedule, and to retire Comanche unit 2 (335 MW) in 2025, a decade ahead of schedule. According to analysis submitted with the plan, Xcel Energy will cut its carbon

emissions from electricity generation 60% by late 2025 from 2005 levels. The plan was projected to create nearly 2,000 jobs and add $203.6 million in GDP statewide. The PUC approved the plan in 2018.

In 2018, the AQCC adopted the Colorado Low Emission Automobile Regulation (CLEAR) in response to efforts at the federal level to roll back vehicle emission standards. CLEAR established low-emission vehicle standards for light-duty and medium-duty vehicles in Colorado beginning with the 2022 model year. CLEAR is projected to reduce GHG pollution by more than 30 million tons cumulatively between 2022 and 2031, compared to a scenario in which federal standards are relaxed, and to provide net savings to Colorado drivers through reduced fuel costs due to greater vehicle efficiency.

PROGRESS UNDER POLIS ADMINISTRATION

Renewables Roadmap

In June of 2019, Governor Polis released the *Roadmap to 100% Renewable Energy by 2040 and Bold Climate Action*, which included a number of key priorities and strategies, including growing green jobs and saving consumers money; modernizing the Public Utilities Commission; promoting Energy Efficiency; putting more zero emission vehicles and commuting options on Colorado roads; moving toward zero emission buildings; supporting local commitment to 100% renewable energy; and ensuring a just and equitable transition for all of Colorado. Since the release of the 2019 Roadmap, the state has taken a number of important steps towards the identified priorities. This Roadmap builds on that work.

Recent Legislation

In 2019, the General Assembly passed and Governor Polis signed into law 14 pieces of clean energy and climate legislation, including the Climate Action Plan, which established GHG pollution reduction goals. Other legislation required local jurisdictions to adopt one of the three most recent versions of the International Energy Conservation Code (IECC); created pathways for electric utilities to invest in clean energy; modernized the Public Utilities Commission; adopted new energy efficiency standards for appliances; and required investor-owned utilities to invest in electrifying transportation.

While COVID-19 impacted many climate and clean energy priorities for the 2020 legislative session, Colorado continued pushing forward by creating a new Air Quality Enterprise (SB20-204) to protect air quality and advance air

monitoring research, adding staff to the Air Pollution Control Division to address stationary source emissions, increasing fines and reporting requirements for air quality violations (HB 20-1143 and HB 20-1265), increasing the availability of new all-electric cars and trucks in Colorado, and supporting greater consumer choice in the future (SB20-167).

Electricity

Electricity has historically been the largest single source of greenhouse gas pollution in Colorado, driven primarily by emissions from coal-fired power plants. A lesser portion of emissions come from natural gas power plants. However, pollution from electricity has been trending downwards for the last 15 years, driven by public policy and by changes in technology and economics. As wind and solar have been deployed on a large scale, their cost has come down dramatically through a combination of technical improvements, economies of scale, and advances in forecasting and the ability to cost effectively integrate renewable energy into the grid. This has led to new wind and solar generation often being less expensive than continuing to operate existing coal-fired power plants.

In the last two years, the clean energy transition has accelerated. The administration's strategy for the electricity sector has been to focus on achieving deep reductions in pollution (at least 80% by 2030) enabled by the declining cost of wind, solar, and storage, while using the expertise of utility boards and the PUC to ensure this transition is accomplished in a way that maintains reasonably priced electricity and the reliability of the system. While many of these plans were voluntarily developed by the utilities, a variety of state regulatory structures will allow these plans to be made enforceable, including placing announced coal plant retirements into enforceable State Implementation Plans (SIPs) for reducing regional haze or through the Clean Energy Plan approval processes.

Xcel Energy, the largest utility in the state, made a voluntary commitment to reduce GHG pollution by 80% below 2005 levels by 2030; SB 19-236 built on this voluntary commitment by requiring Xcel Energy to submit a Clean Energy Plan to the PUC that will achieve an 80% carbon reduction by 2030. Xcel is required to file its Clean Energy Plan in March 2021. This plan will build on an approved plan that will retire the Comanche 1 and 2 coal units (totaling 660 MW) in Pueblo roughly a decade early and replace them with a combination of wind, solar, and storage. As part of its transition to clean electricity generation, Xcel Energy agreed with the Evraz steel mill to construct a 250 MW solar plant on the mill's grounds—the largest behind the meter project in the country. This project will provide low cost, clean electricity at a reliable price, which enabled Evraz to announce a $480 million improvement to the Pueblo mill, including a guarantee of 1,000 jobs.[xlviii]

Xcel Energy also signed a settlement agreement with the City of Boulder to end a 10-year dispute over whether Boulder will form a municipal electric utility. Boulder voters approved the agreement in the 2020 election, which sets pre-2030 GHG emissions targets, committing Xcel Energy to greenhouse gas pollution reductions of 52% by 2022, 61% by 2024 and 67% by 2027. In January, 2021, Xcel Energy announced plans for the early retirement of two additional coal plants, Hayden Unit 1 in 2028 and Hayden Unit 2 in 2027.

The combination of SB 19-236 and HB 19-1261 creates strong incentives for other utilities to reduce their pollution. Under part of SB 19-236, any utility is permitted to file a Clean Energy Plan that reduces carbon emissions by 80% by 2030 with the PUC. If a utility's CEP meets this reduction target and is approved by the PUC, the AQCC grants the utility a "safe harbor" from additional regulation of carbon emissions through 2030. The administration has encouraged utilities to voluntarily adopt energy plans that will achieve these goals and to file CEPs as a mechanism to achieve deep pollution

reductions and a quick transition to renewables. The state will continue to coordinate with utilities and report annually to the AQCC regarding their intent to file and implement CEPs.

The state's other electric utilities with coal plants have announced plans to retire coal-fired generation and replace it with renewable energy and storage. The state's second largest utility, Tri-State Generation and Transmission, historically has been reliant on coal-fired generation including the Nucla plant and three coal-fired units located in Craig, Colorado. The three Craig Station units total 1,285 MW. Prior to 2019, Tri-State did not submit its resource plans to the PUC for approval. With the passage and signing of SB 19-236, Tri-State must now get approval of its Electric Resource Plan from the PUC. While Craig Unit 1 (427 MW) was scheduled for retirement in 2025, Craig unit 2 (410 MW) was anticipated to stay in operation through 2039 and Craig unit 3 (448 MW) was projected to run through 2044.[xlix] In 2019, new leadership at Tri-State worked with the administration and a variety of stakeholders to develop a new "Responsible Energy Plan," which commits to closing all Colorado coal-fired generation by 2030, and commits to closing the mines associated with those plants. As a result of these closures, the plan reduces emissions from generation located in Colorado by 90% and emissions from generation serving Colorado load by 70% (this reflects the fact that some electricity used in Colorado comes from coal generation in Wyoming). At the time the plan was announced, Tri-State's CEO described the "green dividend," in which low cost solar and wind would allow the company to make these changes without negatively impacting ratepayers — in fact, they project an 8% decrease in wholesale electricity prices over the next three years. Tri-State also selected developers to add 1,000 MW of wind and solar in five locations across the state. More recently, Tri-State submitted a resource plan to the PUC in December 2020 that targets an 80% reduction in emissions from the generation that serves load in Colorado.

Colorado Springs Utilities, the state's third largest utility, which serves Colorado Springs and is governed by the city, is also making voluntary efforts to reduce its reliance on coal-fired generation. In June 2020, the City Council, acting as the utility board, voted to retire the Drake coal-fired unit by 2023, roughly 12 years ahead of schedule, and to retire the Ray Nixon plant by 2030. The plan presented to the board calls for 500 MW of wind power generation capacity, 150 MW of solar, and more than 400 MW of battery storage, reducing GHG pollution by 80% by 2030. Colorado Springs Utilities has announced that it will submit this as a clean energy plan to the PUC.

The Platte River Power Authority (PRPA), the fourth largest utility in the state, provides power to the municipal utilities serving Estes Park, Longmont, Loveland, and Fort Collins. In fall of 2020, the PRPA board voted to approve an electric resource plan that includes retiring the Rawhide coal plant by 2030, years ahead of schedule, and adding 400 megawatts of renewable generation. PRPA's analysis shows that the plan will reduce greenhouse gas pollution by 90% by 2030. PRPA has committed to submitting this as a clean energy plan to the PUC.

Holy Cross Energy, one of the largest rural cooperatives that is not a wholesale customer of Tri-State, announced in December of 2020 that it is committing to 100% carbon free generation by 2030. This builds upon its previous adopted plan to achieve 70% by 2030, which it now anticipates achieving in 2021, and represents a new bar for utility ambition in decarbonization. Holy Cross has also announced its intent to file its plan as a clean energy plan with the PUC.

In the fall of 2019, Black Hills Energy filed voluntarily with the PUC to amend its current electric resource plan. In its filing, Black Hills stated that its goal was to add up to 200 MW of new renewable resources while saving money for its customers by avoiding burning fossil methane. At the time this

Roadmap was developed the case was still before the PUC. In January 2021 Black Hills announced its intent to file a clean energy plan that will achieve an 80% pollution reduction by 2030.

In addition to the work the state is doing with utilities to reach deep pollution reduction, the State Land Board is providing opportunities for renewable energy development on state lands. The State Land Board has signed renewable energy leases for projects that will increase installed production capacity on State Trust Land to 520 MW, enough energy to power 150,000 homes in Colorado, and generate revenue for Colorado's public schools.

One important benefit flowing from the rapid transition towards clean electricity is that it magnifies the pollution reduction, public health, and other benefits of electrification in other sectors, such as cars and buildings.

Transportation

In 2020, transportation overtook electricity generation as the largest source of greenhouse gas pollution in Colorado, consistent with the trend nationwide. That is why the state is working to develop policies and strategies that will reduce emissions in this sector by making cars, trucks, and buses cleaner, by reducing the number of miles traveled, and by helping local governments invest in infrastructure to reduce the need to drive.

Colorado's EV Plan

In 2020, the Colorado Energy Office updated the state's EV plan. The plan presents a framework for transitioning vehicles in Colorado, setting a goal of increasing the number of light-duty cars and trucks to 940,000 by 2030. In support of the goal, the plan also calls for transitioning medium-duty (MDV) and heavy-duty (HDV) vehicles to zero emission vehicles; undertaking a gap analysis to identify the type and number of charging stations needed across the state to meet the state's vehicle electrification goals; and for state government agencies lead by example.

Shortly after taking office, one of Governor Polis' first executive orders, Executive Order B 2019-002, "Supporting a Transition to Zero-Emission Vehicles," committed the state to a large-scale transition to zero emission vehicles and identified several key initiatives in support of this goal. The order directed CDPHE to develop a rule to establish a zero emission vehicle program under Section 177 of the Clean Air Act, including proposing adoption of the rule to the AQCC by May 2019, and requiring consideration of adoption by October 30, 2019. It also required CDPHE and its partner agencies to revise the state's Volkswagen Settlement Beneficiary Mitigation Plan to direct all remaining funds to transportation electrification projects, a process that was completed by September of 2019. Finally, Executive Order B 2019-002 laid the foundation for a number of subsequent bills and initiatives over the course of 2019 and 2020 in support of greater transportation electrification.

The AQCC adopted Low Emission Vehicle Standards on November 16, 2018. In August 2019, the AQCC subsequently adopted Zero Emission Vehicle

Standards. With that decision, Colorado became the first state in nearly a decade to adopt a ZEV regulation and the first ever to do so with support of automakers. State agencies negotiated an approach that created incentives for early deployment of ZEVs, which resulted in the associations representing 99% of auto sales supporting the proposed rule. These regulations start with model years 2022 and 2023 vehicles, respectively, and will allow Colorado to continue making progress on improving the sustainability of its transportation system despite federal government inaction and the roll back of nationwide emissions standards. In particular, the ZEV standard will require auto manufacturers to make a greater number and variety of clean vehicles available to Colorado consumers. Colorado's program also contains a provision that allows manufacturers to earn early action credit against their requirement by making EVs available as early as the 2021 model year. The early action credit could result in Colorado being one of the first states to receive electrified SUVs and trucks. Finally, Colorado's ZEV program also establishes a process for tracking and increasing the percentage of ZEVs on the road in the years to come.

A ZEV program is just one strategy needed to help the state reach its goal of 940,000 EVs by 2030. A 2019 analysis conducted by Navigant for the Colorado Energy Office looked at three different EV growth scenarios and found that while the ZEV program is critical to ensuring increased model availability, achievement of the state's goal will also require a significant and long term utility investment in charging infrastructure and a multi-year consumer education and awareness campaign. The analysis also stated that continuation of the state Innovative Motor Vehicle Credit, albeit at a lower level, would be needed through at least 2025 to achieve the State's 2030 goal.

The Colorado Legislature passed several new laws in 2019 that support transportation electrification. The actions taken under these statutes will reinforce one another and the goals and strategies of the Colorado

Department of Transportation's Clean Transportation Plan and the updated *Colorado Electric Vehicle Plan 202*0. CDOT has enhanced its focus on electrification of transit fleets and is supporting zero emission vehicle adoption throughout the state through consumer education, investment in charging infrastructure programs, and additional measures to reduce emissions. CDOT is working to expand multimodal options through its intercity bus service, Bustang, as well as the continued development and construction of mobility hubs – transportation centers that emphasize multimodal options. In addition, CDOT continues to support local transit agencies across the state, which provide critical transportation services and driving alternatives to diverse populations throughout the state.

SB 19-077, one of the bills passed in the 2019 legislative session, supports vehicle electrification for Colorado homes and business, including vehicle and transportation fleets. The statute requires Colorado's two investor-owned electric utilities, Black Hills and Xcel Energy, to file plans with the Public Utilities Commission for how they will invest in vehicle electrification and requires utilities to include in those plans investments that serve historically disadvantaged communities. The statute authorizes the utilities to provide electric vehicle charging as a service to customers, allows the utilities to provide incentives to customers, and to support customers' investments in charging infrastructure. To ensure that there is competition in the EV charging marketplace, the law requires the utilities to apply to the Public Utilities Commission to build facilities to support EVs.

In May 2020, Xcel Energy and Black Hills Energy submitted their first Transportation Electrification Plans to the PUC. Xcel Energy's 3-year $130 million proposal included a wide range of programs for residential customers in single-family and multi-family homes as well as programs for small and

Equity in Xcel's TEP

In the PUC case addressing Xcel's TEP, the state advocated for using the Equity Framework as a key tool for identifying impacted communities and for how utilities should engage with identified communities to better understand their goals and interests in vehicle electrification. CEO also advocated that the framework and outreach should be used to help determine how funds should be allocated.

large businesses. Xcel's plan proposed funding for advisory services and research and innovation for projects such as electrification of shared mobility, optimization solutions for fleets, and electrification of school buses. In December 2020, the PUC voted to approve a $110 transportation electrification plan for Xcel that includes investment in new electric vehicle infrastructure, residential home charging, and programs to support electrification of vehicle fleets and multi-family homes. The Commission provided emphasis on support for programs that benefit lower income households and communities impacted by transportation pollution, including $2.2 million to support electrification of buses and $5million for rebates for customers who qualify based on income to purchase electric vehicles. to ensure that the benefits of electrification are broadly shared.

The Black Hills Energy Ready EV plan would offer rebates for installation of charging stations to single and multifamily residences, businesses, governments, and nonprofits. Black Hills Energy also proposes customer and auto dealership outreach and education. Both Xcel Energy and Black Hills Energy have proposed expanded offerings for lower-income customers, in order to support an equitable transition to electrified transportation.

Other supporting measures passed in 2019 included HB 19-1159, which extended existing income tax credits for the purchase or lease of alternative fuel vehicles (including EVs) through 2025, while ratcheting them down over time. HB 19-1159 also allows Transportation Network Companies, like Lyft and Uber, that offer leased EVs to their drivers under short term rental programs to claim the full tax credit. This last provision helped Lyft deploy 200 Kia Niro EVs in Denver in November 2019, the single largest EV deployment made by a TNC to date. Concurrently, HB 19-1198 modified the

statute governing the electric vehicle grant fund to allow fees collected on EV registrations to be used for administrative costs associated with making charging station grants and to offset charging station operating costs. HB 19-1298 established signage procedures and penalties for non-charging vehicles parked in designated EV charging spots to safeguard access to public charging infrastructure, including those EV stations funded using the grant funds addressed above.

Finally, SB 19-239 directed CDOT to examine the environmental, congestion, and social impacts of technological and business model changes related to commercial vehicles and convene a stakeholder working group to develop recommendations on how best to mitigate these impacts, including via a potential fee structure. CDOT released its findings in fall 2019, setting the stage for future efforts aimed at electrifying these emerging commercial vehicle types before they worsen air quality and increase GHG emissions over the longer-term.

In 2020, the General Assembly passed SB 20-167, which allows EV manufacturers to sell directly to customers if they only make EVs and have no franchised dealers. This will help to increase the availability of new all-electric cars and trucks in Colorado and will support greater consumer choice.

In July 2020 the state announced the launch of a Colorado Clean Trucking Strategy aimed at formulating a cohesive and comprehensive plan to reduce the air quality and GHG impacts of the medium and heavy duty vehicle sector. Reducing pollution from M/HD vehicles is particularly important because M/HD vehicles are major sources of nitrogen oxide pollution, which contributes to ozone formation. The particulate emissions from diesel vehicles have serious health impacts, especially in disproportionately impacted communities. Transitioning to much cleaner and zero emissions trucks in one of the most important strategies to simultaneously address GHG pollution and local air pollution.

To advance the Clean Trucking Strategy, Colorado is working in partnership with the Colorado Motor Carriers Association and vehicle manufacturers, electric utilities, environmental advocacy groups, environmental justice communities, and local governments. The state held three public meetings between August and October 2020, bringing more than 200 attendees from across the state into the Clean Truck conversation. The state is pursuing a wide-ranging strategy that will include evaluating a potential ZEV regulation for medium and heavy duty vehicles, potential new regulations of nitrogen oxide emissions from trucks, voluntary vehicle efficiency improvements, utility infrastructure investments, integration of electrification considerations in highway infrastructure improvements, incentives for cleaner trucks, ZEV workforce development, and state government leadership by example.

At the same time that Colorado launched this internal state effort, it also signed on to a Memorandum of Understanding with 14 other states and the District of Columbia committing to work collaboratively to advance and accelerate the market for electric M/HD vehicles, including large pickup trucks and vans, delivery trucks, box trucks, school and transit buses, and big-rig long-haul delivery trucks. The goal of the multistate MOU is to ensure that 100 percent of all new M/HD vehicle sales will be zero emission vehicles by 2050 with an interim target of 30 percent zero emission vehicle sales by 2030.

The state has made progress in ensuring Coloradans can drive anywhere in Colorado in an EV and find a place to “fill-up” their battery. In April 2019, CEO issued a $10.33 million grant to ChargePoint to build high-speed charging stations in 34 communities along Colorado’s interstate as well as state and US highways. ChargePoint has partnered with a variety of public and private site hosts all over Colorado, with each location selected for its proximity to amenities and ability to ensure quick, convenient charging. Each site will allow two-to-four cars to charge at a time, and each site will be built

so that as more EVs begin driving on Colorado's roads, the number of vehicles that can charge and the charging speed can be expanded in a cost-effective way. In 2020, stations will open in Dinosaur, Salida, and Pagosa Springs as well as nine other locations. Twenty-two more stations are projected to come online by spring 2021. In addition, through the Charge Ahead Colorado grant program, the state has made awards for installation of more than one thousand community-based Level 2 and DC fast-charging stations at workplaces, multi-family housing, commercial facilities, and public parking lots and garages.

Outside of the vehicle electrification space, the state is also moving towards a strategy of better accounting and mitigation for the pollution impacts of infrastructure, and towards an approach that focuses on providing more mobility options to travelers, including transit and active mobility options like walking or biking. For example, as the state begins its community input process for the reconstruction of I-270, a highly trafficked thoroughfare that traverses Commerce City— an important environmental justice community —CDOT is pursuing a range of new strategies, previously unprecedented in the agency's approach, to better measure air quality impacts at the outset as a baseline for mitigation, and to work with the community to identify advanced mitigation options to incorporate into the project. This builds on lessons learned from evaluation of the Central I-70 project through Denver, and CDOT intends to carry these practices into other capacity projects moving forward.

CDOT and the Denver Regional Council of Governments have collaborated on a new model for making funding available to make urban arterial roadways into "safer main streets" for all modes of transportation including walking, transit, and biking— including through an allocation of more than $75 million dollars of current road and multimodal funds that are

in the process of being awarded competitively through this program. This is one of the highest priorities included in CDOT's 10-year infrastructure plan, "Your Transportation Plan," and will provide safety and multimodal transportation benefits to all Coloradans.

Importantly, CDOT is also working closely with the Front Range Rail Commission to accelerate completion of program options and a surface development plan for Front Range Rail, in conjunction with work to build demand and make anchor investments in transit along the I-25 corridor through a network of multimodal hubs along the corridor. Several of these mobility hubs are already funded and others would be funded as part of CDOT's 10-year plan, which will provide transit corridor rapid bus service as planning for Front Range Rail continues. Additionally, the administration is working to ensure that RTD funds completion of Northwest rail, consistent with the Fastracks plan adopted by voters in 2004. The project is projected to have ridership of 8,600-10,100 people daily on rail by 2025 according to the binding plan adopted by voters.

Buildings

While Colorado's electricity and transportation sectors are the top two sources of climate warming pollution, fuel use in residential, commercial, and industrial buildings is not far behind. Achieving the state's pollution reduction goals will require significant reductions in this sector. Integrating more energy efficiency with the expanded use of clean electricity as an alternative to burning fossil fuels in buildings could bring consumer cost savings, enhance electric grid operations, reduce GHG pollution, and improve indoor air quality. The state has taken a number of steps to advance building efficiency and is engaging in a variety of programs and strategies to decarbonize the built environment. It is also important to note that energy costs can be a significant burden for lower-income Coloradans; while the average household

spends approximately 2% of its income on energy, many low income households may spend more than 10% of their income on energy costs. It is important that building sector programs, including energy efficiency and solar programs that can reduce household energy costs, be designed to benefit these energy burdened households.

The Weatherization Assistance Program serves approximately 2,000 low income households per year out of roughly 500,000 eligible households. Participation in the program is based on income; the household income threshold for WAP qualification is approximately $35,000 per year. However, WAP-served households have a median income of about $13,000 per year. WAP served homes save an average of $350 per year, but savings can range from less than $100 to more than $800 depending on the energy efficiency and renewable energy measures installed in the home.[l] In addition to energy savings, weatherized homes reduce GHG pollution by 3,500 pounds of carbon-dioxide emissions each year. WAP installed measures go beyond energy savings and produce improved indoor environmental quality through air sealing and reduction of carbon-monoxide.

The state passed legislation in 2019 to expand the number of products covered under appliance efficiency standards (HB 19-1231) and updated the building energy code statute (HB 19-1260) to require local building codes to be at least as strong as one of the three most recent versions of the International Energy Conservation Code. The state supports local governments in adopting these codes by providing no-cost technical assistance and training to county and municipal building departments. In addition, to increase education and awareness of the benefits of newer energy codes, the CEO created an Energy Code Adoption Toolkit that details significant changes and provides a cost comparison between code editions, has examples of advanced codes, and includes code compliance checklists.

The state also supported the adoption of the 2021 IECC, which achieves an estimated 10% greater efficiency than the prior code. The 2021 IECC will be the first code in several cycles that has achieved this level of energy savings and puts codes on a path toward increasing efficiency and performance standards, setting the stage for future codes to enable new buildings to produce net zero emissions. Requirements in the draft 2021 IECC that buildings be pre-wired for future installation of electric appliances and EV charging infrastructure were unfortunately removed by the International Code Council board before publication despite the overwhelming support from state and local governmental voting members for these requirements. The state will still encourage local governments to adopt these requirements.

The Colorado Energy Office and the Division of Housing within the Colorado Department of Local Affairs worked with the Colorado Housing and Finance Authority to modify the 2020 Qualified Allocation Plan, which outlines criteria for awarding tax credits to developers and investors for affordable housing projects in Colorado. The updated criteria encourage developers to design housing that meets higher efficiency standards such as the U.S. Department of Energy's Zero Energy Ready Home or Passive House certifications. The update also includes electric vehicle ready parking space requirements, mandates energy-use intensity reporting, and adds criteria to assess the future retrofit needs of the building, ongoing utility costs, and housing density.

In 2020, the Colorado Energy Office funded a beneficial electrification potential study that estimates the technical, economic, and achievable potentials for BE in buildings in Colorado over the next ten years. The research identifies key technologies and sectors that can benefit from this transition. The report also analyzes market barriers that will impede electrification efforts and provides policy and program recommendations to accelerate the adoption of BE technologies. The report is available on the Colorado Energy Office website.

The Colorado Energy Office is also in the process of launching a commercial building benchmarking program. The program, when fully developed, will enable building owners to report energy use data to a statewide database. The program will work to modernize utility data protocols to improve customer access to building level energy data. Making whole building energy use data more transparent will also help identify cost-effective opportunities for energy efficiency and beneficial electrification upgrades.

CEO provides a number of commercial and residential financing programs that support Coloradans investing in energy efficiency and renewable energy to reduce pollution from the built environment and help customers save money. CEO manages a statewide residential energy upgrade loan program, called RENU, that provides low-interest financing to residential homeowners for energy efficiency and renewable energy improvements. With extended loan terms and the ability for borrowers with lower credit scores to qualify, RENU makes investing in energy upgrades more accessible to Coloradans. Eligible measures include insulation, air sealing, energy-efficient windows, efficient space conditioning and water heating equipment, heat pumps and heat pump water heaters, and solar PV systems. RENU has approximately 140 authorized contractors statewide that are qualified to offer this loan.

The state also has a Commercial Property Assessed Clean Energy financing tool that enables owners of eligible commercial and industrial buildings to finance up to 100% of energy efficiency, renewable energy and water conservation improvements. Financing is provided by private capital providers at competitive rates with repayment terms up to 25 years. Repayment of the financing occurs through a voluntary assessment on their property tax bill. Pending federal reforms, PACE for residential also can provide increased low-cost financing opportunities for investments like home solar.

The Energy Performance Contracting Program is an innovative financing model that enables state and local governments, school districts, special districts, and higher education institutions to make comprehensive energy and water efficiency facility improvements by using guaranteed utility savings to repay the costs of the upgrades over time. Colorado's energy performance contracting program provides the framework and technical assistance to help public facilities lower their annual utility and operations and maintenance costs and improve building performance.

In addition to providing direct access to funding, and in partnership with the Department of Energy and the Coalition for Green Capital, CEO supported the formation of the Colorado Clean Energy Fund to identify strategies for accelerating clean energy investment in Colorado. CCEF is a non-profit financial institution that seeks to increase clean energy deployment and investment in Colorado and operates on the "Green Bank" model pioneered successfully in other states. CCEF has identified a strong pipeline of projects that need investment and has developed the infrastructure to support these projects, but is in the process of raising capital to be able to fund these investments. As described in the near term action section, the administration is seeking $30 million in supplemental stimulus funding in the 2021 legislative session to capitalize the CCEF. The state is also seeking zero interest financing from the U.S. Department of Agriculture to support CCEF loans to support energy efficiency retrofits for low and moderate income households and C-PACE loans for small businesses in rural areas and just transition communities.

Colorado first adopted gas and electric energy efficiency requirements for investor owned utilities in 2007. An independent analysis concluded that Colorado home and business owners will save over $1.5 billion as a result of the efficiency investments made by Black Hills and Xcel Energy, or about $4 on their utility bill for every $1 spent by the utility. In addition to reducing

energy use and costs to consumers, the programs from the two utilities have reduced cumulative CO2 emissions during 2009-18 by 13 million metric tons.[li]

Oil and Gas

Colorado has a significant amount of oil and fossil methane production and has experienced sustained growth in production in the last decade. Despite the substantial growth in production, methane emissions from oil and gas operations are estimated to have generally remained flat between 2005 and 2015 due to increased regulatory requirements adopted by the AQCC that have led to a declining leak rate from the sector. Colorado has been a leader in developing environmental regulations for the oil and gas sector dating back to 2005 when the first system-wide tank regulations were enacted. Since adoption of that first set of regulatory requirements, Colorado has engaged in a series of rulemakings to reduce emissions from the oil and gas sector.

With rulemakings in 2006, 2008, 2014, 2016 and 2017, Colorado has adopted increasingly more stringent requirements on the oil and gas sector aimed at a wide range of sources including: oil storage tanks, glycol dehydrators, engines, gas-driven pneumatic devices, component leaks, and well-unloadings. In 2014, Colorado became the first state in the nation to directly regulate methane from oil and gas operations. During that same 2014 rulemaking, Colorado developed a new leak detection and repair program using optical gas imaging technology, which has since formed the basis for federal LDAR requirements for the oil and gas industry.

In 2019, the Colorado General Assembly passed SB 19-181, which strengthened the state's commitment to regulating emissions from the oil and gas industry by creating a statutory requirement for the AQCC to obtain emissions data from oil and gas operators and to minimize emissions in the sector. The AQCC promulgated the first in a planned series of regulations in December 2019, which included a requirement for annual GHG emissions reporting from the sector. The AQCC promulgated further regulations in September 2020 to require monitoring at all new wells and tighten emissions requirements for pre-production activities. Regulations stemming from additional AQCC rulemakings are expected to result in lower leak rates and declining emissions from the sector.

SB 19-181 also changed the mission of the Colorado Oil and Gas Conservation Commission. The statutory mission, as modified, directs the COGCC to regulate the development and production of oil and gas in a manner that protects public health, safety, and welfare, including protection of the environment and wildlife resources. The legislation also directed COGCC to update specific rule topics. On November 23, 2020, the COGCC completed a series of comprehensive rule changes to implement the agency's change in mission, address and evaluate cumulative emissions, including air emissions, and updated numerous rule provisions. These changes improve protection for people, wildlife, and the environment, and will also enhance AQCC and COGCC coordination to pursue emissions reductions moving forward.

Waste Diversion and Methane from Waste

The state, local governments, and the private sector have taken steps to reduce greenhouse emissions associated with waste generation in Colorado. Waste diversion can save energy and emissions and composting can reduce the formation and release of methane in landfills. Organic waste, including food waste and yard waste, is the largest contributor to landfills in Colorado and also produces methane when it decomposes in the landfills. As

the largest waste stream and a key contributor to GHG emissions, CDPHE has put an emphasis on reducing organic waste and finding beneficial methods to utilize these discarded materials.

While Colorado's municipal solid waste and industrial waste diversion rates remain lower than other states at 15.9% and 50.0% respectively, Colorado's waste diversion industry continues to reduce greenhouse gases. In 2019, recycling and composting in Colorado reduced greenhouse gas emissions by 1.92 million metric tons of CO2e, which is equivalent to removing 407,000 cars from the road for a year in Colorado or the energy use and emissions savings equivalent to 148,000 homes being removed from the grid for the year or conserving 2.34 million barrels of oil or 113 million gallons of gasoline. Because Colorado's recycling and waste diversion rates have been below the average of other states, recycling and waste diversion provide critical opportunities to reduce emissions.

In July 2020, the legislature adopted a key piece of legislation to advance recycling end markets in the state. SB 20-055 will support and grow recycling programs by addressing the lack of local end markets for recyclable materials. The bill directs CDPHE to:

- convene stakeholders to help shape the structure and governing guidance for a possible Recycling Market Development Center in the state;
- complete a literature review regarding producer responsibility programs and submit policy recommendations to legislature; and
- administer a statewide education campaign on recycling.

Expanding in-state recycling end markets further reduces GHG emissions by keeping materials here in Colorado, reducing transportation-related emissions.

Similarly, capture of methane associated with waste management in wastewater treatment plants, agriculture and other areas can create biogas that can be captured for use for heat, electricity generation or vehicle fuel. Twenty Colorado wastewater treatment plants put biogas to beneficial use, including Metro Wastewater District (electricity generation), South Platte Water Renewal Partners (injection into Xcel Energy gas pipelines), Grand Junction (biogas for vehicles), City of Longmont (biogas for vehicles), and City of Boulder (electricity generation). There is considerable opportunity remaining in the state to put biogas to beneficial use to reduce greenhouse gas emissions.

Natural and Working Lands

Colorado's natural and working lands include forests, grasslands, agricultural croplands and rangelands, wetlands, riparian areas and urban greenspaces. Natural and working lands are both sources of GHG pollution, including emissions from wildfires, agricultural equipment and fertilizer use, and serve as carbon sinks by holding or sequestering carbon in plants and soils. Natural and working lands, and agricultural producers in particular, are often the first to experience the impacts of climate change. Natural climate solutions aim to conserve, restore and improve lands and land management actions to avoid GHG emissions and increase carbon storage. Natural climate solutions present a unique opportunity to jointly address climate change mitigation and adaptation, and generate ecosystem benefits, while also sustaining working farms, forests and ranches. The generation of ecosystem market and supply-chain opportunities is another increasingly relevant tool to help accomplish agricultural emissions reductions and adaptations.

Vega State Park; Photo credit: Colorado Parks and Wildlife/Dustin Doskocil.

In 2018 Colorado signed on to the U.S. Climate Alliance's Natural and Working Lands Challenge, committing to managing natural and working lands to be resilient carbon sinks and to protect the communities, economies and ecosystems that depend on them.[lii] In 2020 state staff established an interagency Natural and Working Lands Task Force to address Colorado's commitment to improving inventory methods for land-based carbon flux; identify opportunities to reduce GHG pollution and increase resilient carbon sequestration; and advance programs, policies, and incentives to promote natural climate solutions. In partnership with The Nature Conservancy, state staff from the Colorado Department of Natural Resources, Colorado Department of Agriculture, and Governor's Office, are currently conducting a technical analysis to quantify the potential for specific strategies to contribute to the state's GHG reduction goals by 2050. This effort will be completed in 2021 and will identify priority pathways for land management

and inform strategic development of NWL policies, programs, and research agendas. This work complements ongoing and completed work by individual state agencies and partners.

In 2020 the Colorado State Forest Service published the Colorado Forest Action Plan, which is a strategic framework to address the conditions and trends in Colorado's forests[liii]. The Plan identifies priority natural climate solutions, including reducing the conversion of forests to other land cover types, particularly in the wildland-urban interface; improving forest management and productivity through climate-adaptive silviculture; sequestering carbon in sustainable wood products; enhancing equitable urban canopy cover; reducing the risk of uncharacteristic wildfires; and promoting the natural role of fire in ecological processes. The Forest Action Plan will be integrated into ongoing research, policy development and strategic planning for natural and working lands in Colorado.

Since 2015, Colorado Energy Office's Agricultural Energy Efficiency program has provided dedicated technical resources and services to agricultural producers across the state to identify and realize energy efficiency and renewable energy opportunities in their operations. These no-cost, turn-key services include preliminary renewable energy assessments and Type-II energy audits, evaluating energy efficiency opportunities, project cost estimates, payback periods, and a variety of funding mechanisms available to provide significant project cost coverage. The AgEE program also offers support services to help producers successfully complete the funding application process for each funding source. This soup-to-nuts approach removes the guesswork and many of the risks of deploying energy efficiency & renewable energy projects in agricultural operations. The AgEE program provides the necessary information, materials, and technical support, and simplifies the process for producers to capitalize on a variety of project cost coverage options, such as CDA's ACRE3 grants.

The ACRE3 program has been providing grant funding and technical assistance since 2007 to help Colorado agricultural producers reduce or offset their on-farm energy costs by installing high efficiency or renewable energy equipment within their operations. ACRE3 program services include detailed feasibility studies, engineering assistance, and technical support for project construction and commissioning. The program collaborates extensively with the CEO and the USDA-NRCS in providing these services to agricultural producers throughout the state. In addition to partnering with the CEO on the AgEE program, the ACRE3 program also provides services through a second initiative, the Irrigation Hydropower Partnership.

Through the AgEE program, ACRE3 provides funding and additional technical services for qualifying energy efficiency projects recommended through CEO's Type-II energy audit reports, along with technical services and project funding for solar electric, solar thermal, and geo-exchange projects. These projects significantly reduce the burden of energy costs for energy-intensive agricultural operations, such as dairies. The Irrigation Hydropower Partnership is an innovative initiative and partnership with the USDA-NRCS to modernize on-farm irrigation infrastructure, incorporating energy-recovery hydropower. The hydropower initiative prioritizes water-use efficiency improvements and water quality improvements in each of its projects. The hydropower initiative also allows farmers to install center pivot irrigation systems in remote, off-grid applications when the right combination of resources is available.

The ACRE3 program is also evaluating criteria to develop a new agrivoltaics initiative. These large-scale solar projects are designed to allow continued agricultural production underneath and around the solar arrays. Among the new criteria, CDA is reviewing strategies to promote social equity in agrivoltaics by incentivizing community solar gardens with allocations for lower-income subscribers.

While a meaningful proportion of Colorado's landscape is under various levels of local, state and federal protection, and more opportunities exist for public land conservation to address population and climate stressors, privately-owned natural and working lands present a significant conservation opportunity for services such as carbon storage, water quality, soil health, wildlife habitat protection, and safeguarding of local farming and ranching economies. Voluntary, private land protections such as conservation easements may help achieve regional climate and land use goals by preventing mass releases of GHGs through development activities. Research conducted as part of the Greener Fields project indicates that cutting farmland loss in California by 75 percent by 2050, or by 700,000 acres, would reduce GHG emissions the equivalent of taking 1.9 million cars off the road each year.[liv] Colorado's Conservation Easement and Great Outdoors Colorado programs offer financial and tax incentives for restricting development on private lands. In 2017, Colorado State University and the Colorado Natural Heritage Program reported that there are more than 2.5 million private acres protected under conservation easement.

Water Planning

The Colorado Water Plan is the state's framework for identifying solutions to water challenges. After completing the 2015 Water Plan, the Colorado Water Conservation Board began implementing actions and updating the underlying technical data that ultimately supports the next Water Plan (anticipated for completion in 2022). In 2019, the state released the *Analysis and Technical Update to the Water Plan* — a state of the art study of water supply and needs through 2050. As the first statewide supply analysis completed within the context of the Water Plan, the Technical Update estimates future supply gaps under five planning scenarios that incorporate the effects of climate change, population growth, and variable economic futures and societal values. The Technical Update generated a rich dataset that produced insights to statewide and regional impacts to agriculture, municipalities and the environment. The results support regional stakeholder groups in each of Colorado's eight major river basins and others to plan for near- and long-term adaptation actions. Recognizing that climate impacts deeply affect hydrology, water use, water quality, and related disasters such as flood, drought, and wildfire, the 2022 Water Plan update will continue to elevate climate science to the forefront of the state water planning.

Just Transition

Coal has played an important role in Colorado's economy, but with price declines among market competitors, technological advances, and environmental and public health imperatives, the move away from coal toward cleaner energy resources is already taking place and will only accelerate. While the transition to cleaner, lower-cost resources brings economic benefits to the state, the transition away from coal carries significant implications for Coloradans who work in the coal industry and the communities supported by the mines and power plants and those who work in them. As the state embraces the renewable-energy future, Colorado must

remain committed to partnering with and supporting these workers and communities. They powered Colorado's growth in the past and they should continue to share in its future prosperity.

In 2019, Colorado established the nation's first State Office of Just Transition (OJT) and a Just Transition Advisory Committee (JTAC) focused on providing support and resources to both communities and workers impacted by the energy system's transition away from coal.

The JTAC— composed of a diverse set of representatives ranging from impacted workers and communities, disproportionately impacted communities, economic development experts, elected officials, electric utilities, and state officials— is tasked with developing a Just Transition Plan for the state. In August 2020, the JTAC submitted a Draft Plan. Following evaluation of the draft plan and an extensive public input process, executive leadership from the Department of Labor and Employment and the Department of Local Affairs will submit a final Just Transition Plan to the Governor and General Assembly by December 31, 2020.

Climate Equity Framework

In addition to helping workers and communities affected by the clean energy transition, the state is developing a Climate Equity Framework to help ensure that Colorado's response to climate change is guided by principles of racial equity and economic justice. The framework outlines the state's plan to identify and meaningfully engage with communities who are disproportionately impacted by climate change, including people of color, Tribes, indigenous persons, lower-income people, historically

underrepresented groups, like rural and linguistically isolated communities, and those experiencing multiple environmental burdens. The framework lays out data mapping strategies to identify disproportionately impacted communities and provides best practices for equitable and authentic community engagement. It also outlines key opportunities for evaluating potential impacts of policies on disproportionately impacted communities, striving to reduce burdens and maximize benefits.

Informed by an advisory committee made up of equity, environmental justice, and community engagement experts and focus groups with members of disproportionately impacted communities, the Climate Equity Framework will inform long-term state outreach programs and shape how the state, with community input, develops and implements specific greenhouse gas reduction policies, rules, and regulations. The success of the framework depends, in part, on strong partnerships with community leaders and organizations across the state. The state recognizes that these important steps to help rebuild a more just and inclusive system will take time. This change requires a lasting commitment to constantly reexamine policies and processes, connect with and listen to community input and ideas, and elevate voices that have been underrepresented for far too long.

Greening Government

In December 2019, Governor Polis signed an executive order (Executive Order D 2019 016) focused on the state's commitment to reducing greenhouse gas pollution and making government operations more energy efficient and sustainable. This executive order builds on the state's prior greening government efforts and establishes new goals and directives for all State agencies and departments that will save taxpayer money and reduce the impact of state operations on the environment and public health. The executive order's goals center on reducing greenhouse gas emissions across state government by at least ten percent below 2014-15 levels by 2022-23. The executive order also highlights directives in several areas including utility

and fleet fuels management; energy efficiency and renewable energy; state fleet vehicle fuel efficiency and zero emission fleet vehicles; agency and department staffing and training directives; and leased facilities. To accomplish these goals, it establishes more targeted efforts in energy efficiency and energy conservation, increased telecommuting, renewable energy, and fleet management, including:

- Reducing energy consumption per square foot by 15 percent by the end of FY 2022-2023
- Increasing the percentage of renewable electricity consumed or purchased by state facilities to five percent by the end of FY 2022-2023
- Reducing greenhouse gas emissions from state fleet vehicles by 15 percent by the end of FY 2022-2023

Local Government Activities

In addition to state actions, numerous local governments throughout Colorado are implementing strategies to address climate change and its adverse impacts in their communities or are initiating planning to address the climate crisis. These communities range from the largest metropolitan centers to small mountain counties and represent the diverse economic and geographic aspects of Colorado. While the individual programs vary in size and scope, collectively they form a foundation that can be built on through continued collaboration and dedication to a common goal.

The City of Fort Collins Climate Action Plan tracks annual GHG emissions using 2005 as its baseline year. The community aims to reduce carbon dioxide emissions by 20% below 2005 levels by 2020 and 80% by 2030 with the goal of being carbon neutral by 2050. As of 2018, the community had reduced emissions 14%.

In 2018 Boulder County completed a *Greenhouse Gas Inventory and Emissions Reductions Strategies Report* with an updated inventory and new long-term emission reduction goals to reduce community GHG emissions 45% below 2005 levels by 2030 and 90% below 2005 levels by 2050. On January 1,

2020, the County began collecting a voter approved 0.125% sales tax, which will generate approximately $7.5 million per year for sustainability programs. The City of Boulder set a 100% renewable energy goal by 2030, and 100 megawatts of renewable energy generation by the same year. They have also set the target of reaching 80% community greenhouse gas emission reduction by 2050, and have a climate action plan tax on electricity consumption that funds climate programs.

The City and County of Denver adopted the *80X50 Climate Action Plan* with a goal of reducing greenhouse gas emissions 45% by 2030 and 80% by 2050 through the decarbonization of transportation, buildings, and the electricity grid. To reach those goals, the plan calls for reducing total community-wide greenhouse gas emissions 30 percent by 2025, making all new buildings net-zero by 2035 and achieving 100 percent renewable electricity in municipal facilities by 2025 and community-wide by 2030. In November, 2020 Denver voters approved measure 2A, which increases the Denver sales tax rate by 0.25% and is projected to generate approximately $36 million annually to invest in implementing the city climate plan.

Summit County has a plan to reduce community wide emissions 50% by 2030 and 80% by 2050. Many cities and counties throughout the state including Carbondale, Adams County, and Gunnison County have adopted similar plans with substantive goals on energy efficiency and renewable energy, sustainability measures, multi-modal transportation programs, energy efficient building codes, and waste reduction.

A $12 million Renewable and Clean Energy Challenge was launched in 2019 by the Department of Local Affairs to help spark efforts to reach Colorado's 2040 100% renewable energy goal. That challenge resulted in $1,175,456 in renewable planning projects and another $4,416,704 in renewable implementation awards across Colorado. Funds that remain from the Challenge are specifically earmarked for ongoing renewable and clean

energy projects. Projects must include renewable energy, energy efficiency, and energy conservation efforts, support innovations in renewable energy, achieve multiple objectives and/or serve those with the greatest need, develop plans, studies, and policies that further long-term, large-scale renewable energy generation and energy conservation. The governor's supplemental stimulus request to the legislature for the 2021 session would add $5 million to this fund.

Federal Government Activities

The November 2020 election significantly changes climate leadership at the federal level. While the composition of the United States Senate is still unclear at the time of this writing, the incoming Biden Administration has elevated climate action, environmental justice, and clean energy infrastructure investment as top priorities to build a more resilient and sustainable economy, and put the United States on a path to achieve net-zero emissions no later than 2050.

Colorado and a growing coalition of other states have taken significant steps over the past four years to reduce GHGs and other pollution while swiftly transitioning to renewable energy, despite not only lack of leadership at the federal level but in many cases active obstruction and rollback of critical environmental protections. While Colorado is not relying on or assuming specific federal activity to reach its state-based renewable energy and emissions reduction goals, the state welcomes partnership with the federal government to advance and broaden state momentum on climate action and re-engage the United States as a global leader on this critical issue. While not exhaustive, below are a few examples of opportunities to further partner with the federal government in the coming years:

Federal Stimulus Investment

Top of mind for all Coloradans is COVID-19's dire impact on our health and safety, our well-being, our economy and our economic security. Colorado

urges the federal government to prioritize immediate relief and public health protection measures. Looking toward future fiscal stimulus, the incoming Administration shares Colorado's perspective that fueling a strong economic recovery provides a significant opportunity to invest in clean energy infrastructure, innovation, and technology. This will ensure a more resilient, equitable and sustainable economy as the state progresses toward science-based emission reduction targets. In May 2020, Governor Polis issued a letter to the Colorado Congressional Delegation in which he outlined a number of opportunities for federal funding to support robust, long-term recovery through investments in key areas. Immediate areas for funding include transportation infrastructure, clean transportation technology, broadband, water infrastructure, energy efficiency, renewable energy, and lower-income weatherization. We will continue to engage the federal government to secure critical resources for Colorado.

Transportation Policy

The transportation sector is the top emitter of greenhouse gases both nationally and in Colorado, and is also a significant contributor to local air pollution that disproportionately impacts lower-wealth communities and communities of color. Regulations requiring improvements in vehicle efficiency or ZEV adoption are largely controlled at the federal level or through California's vehicle standards under Section 177 of the Federal Clean Air Act. While Colorado has already adopted both Low Emission Vehicle and Zero Emission Vehicle standards that increase each year through 2025 through California's waiver, the Trump administration engaged in a rulemaking (SAFE 1) to revoke California's waiver, as well as a rulemaking (SAFE 2) to roll back federal standards. Colorado is one of many states engaged in litigation to overturn the waiver revocation and restore state authority. President-elect Biden has committed to strengthening federal standards, and is expected to restore the California waiver in 2021. In addition, the Biden administration is likely to propose new car and new clean truck standards. As described in the

section on near term actions (page 58), the state intends to actively engage to provide input on the development of both the federal and California standards, and evaluate which standards are appropriate for Colorado.

HFC Transition

Phasing out HFCs is an important step toward meeting climate objectives. HFCs have a very high global warming potential and their use is projected to grow substantially without action to phase them out in products such as foams, refrigerants and aerosols. The state has led in this area through the AQCC's passage of HFC phase-out rules in May 2020. Further opportunities for phase out and capture of HFCs exist in the residential sector and in the maintenance and replacement of products using these substances. The state supports further efforts at the national level to achieve HFC phase-out and will evaluate opportunities to address remaining gaps.

Natural and Working Lands

The NRCS has partnered with CDA to financially support (75% match) up to six soil health and urban agricultural specialists over the next five years. NRCS also operates the Agricultural Conservation Easement Program, which partners with local land trusts and local governments to protect wetlands, grasslands and working farms and ranches.

President-elect Biden has indicated support for limiting greenhouse gas emissions both domestically and internationally from land use change, forests, and agriculture, as well as strengthening land conservation efforts. The Colorado Department of Natural Resources and Department of Agriculture will pursue federal partnerships on natural and working lands through federal funding opportunities such as the Regional Conservation Partnership Program (RCPP), Emergency Watershed Protection (EWP), and State and Private Forestry funding. In seeking to form the Agricultural Climate Resilience Office, CDA would create a structure to facilitate new opportunities and partnerships. President-elect Biden supports investing in agricultural

conservation programs for cover crops and other climate-smart practices, so there may be further opportunities for CDA to expand their programming with support from federal partners in the coming years.

ENDNOTES

1. The implementing rules may take into account other relevant laws and rules, as well as voluntary actions taken by local communities and the private sector, to enhance efficiency and cost-effectiveness, and shall be revised as necessary over time to ensure timely progress toward the 2025, 2030, and 2050 goals."
2. The Roadmap discusses emissions reduction in agriculture in the broader context of natural and working lands.
3. This resolution is available from the CDPHE website.
4. Technical appendices available on the Roadmap webpage describe the methodology that the state agencies used to model the emissions reductions associated with these actions.
5. https://www3.drcog.org/documents/archive/2004_FasTracks_Plan.pdf
6. Emissions reduction from the use of biogas in the residential, commercial, and industrial sector is included here and not reflected in the reductions in the Waste sector.
7. State staff set a minimum goal of sequestering 1MMT CO2e through agricultural soil health practices by 2030. Land use, land use change and forestry are not included in this analysis and current data is insufficient to inform broader emissions reduction goals across all natural and working lands. This number will be revised pending ongoing inventory improvements detailed in the Recommended Near Term Action Plan.
8. The emissions reductions associated with biogas use are shown in the residential. commercial, industrial category.
9. Fuel use from the industrial sector is included in the residential, commercial fuel use category.
10. In most cases, it is the utility, not the state, that initiates actions at the PUC.
11. Other major greenhouse gases include: Nitrous Oxide (N_2O) and fluorinated gases such as hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride.
12. Source: https://climate.nasa.gov/vital-signs/carbon-dioxide/
13. National Oceanic and Atmospheric Administration State Climate Series. Accessed at https://statesummaries.ncics.org/chapter/co/
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21. The 2017 Economic Contributions of Outdoor Recreation in Colorado. Southwick and Associates. July 23, 2018.
22. U.S. EPA, 2019, Section 12.5.4.
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24. House Bill 2019-1261. https://leg.colorado.gov/bills/hb19-1261

25. Senate Bill 19-96, https://leg.colorado.gov/bills/sb19-096
26. Heald, Sarah. Colorado 2015 Greenhouse Gas Inventory Update Including Projections to 2020 & 2030. State of Colorado, December 2019.
27. The modeling inputs and assumptions developed by E3 are available to download from the Roadmap webpage. The state modeling assumptions and data is available from the Roadmap webpage and the Colorado Department of Public Health and Environment website.
28. Emissions reduction from the use of biogas in the residential, commercial, and industrial sector is included here and not reflected in the reductions in the Waste sector.
29. State staff set a minimum goal of sequestering 1MMT CO2e through agricultural soil health practices by 2030. Land use, land use change and forestry are not included in this analysis and current data is insufficient to inform broader emissions reduction goals across all natural and working lands. This number will be revised pending ongoing inventory improvements detailed in the Recommended Near Term Action Plan on page 33.
30. The emissions reductions associated with biogas use are shown in the residential. commercial, industrial category.
31. Fuel use from the industrial sector is included in the residential, commercial fuel use category.
32. Source: https://www.trucking.org/economics-and-industry-data
33. https://usa.streetsblog.org/2019/02/08/minneapolis-and-seattle-have-achieved-the-holy-grail-for-sustainable-transportation/
34. The study is available from the Colorado Energy Office website, https://drive.google.com/file/d/11zczj8ieUzNbxMvlob9HJCctyzJGVYF3/view
35. See Decision No. C20-0770, Proceeding No. 20M-0439G
36. RNG in Transportation: Colorado Market Study, June 2019, available at https://drive.google.com/file/d/1oewEgxtchUJS60djChqQF8jsJxRETnNJ/view
37. https://www.colorado.gov/cowaterplan
38. https://www.coresiliency.com/
39. https://cpw.state.co.us/aboutus/Pages/StateWildlifeActionPlan.aspx
40. https://cwcb.colorado.gov/drought
41. https://csfs.colostate.edu/forest-action-plan/
42. Note: Washington SB 5981 and Oregon SB 1530 would have directed economy-wide cap-and-trade programs for those states. Costs are based on administrative costs and not the value of proceeds of actions, etc.
43. This number only includes CARB staff assigned to programs implementing California Assembly Bill 32, the Global Warming Solutions Act of 2006, and CA Health & Safety Code section 38566 (setting GHG reduction targets), and sections 39710-39723 (the Greenhouse Gas Reduction Fund). CARB has, along with other California agencies, hundreds of additional staff working on other aspects of climate change
44. GHG emissions in 2015 were estimated in the EPA's State Inventory Tool that uses national, regional, and state energy and activity data to calculate a greenhouse gas emissions inventory in a given year. This was supplemented with a detailed analysis of oil and gas fugitive emissions from the Colorado Air Pollution Control Division of the Department of Public Health and Environment.
45. *Colorado Climate Action Plan: A Strategy to Address Global Warming*, Governor Bill Ritter, Jr., November 2007.
46. Section 40-2-124(1)(c)(I)(E), C.R.S.
47. Decision No. C10-1328, Proceeding No. 10M-245E
48. https://www.chieftain.com/news/20200807/evraz-on-solid-ground-in-pueblo-with-new-rail-mill-project.
49. Source Tri-State filings PUC proceeding 20M-0218E.
50. Examples of measures include attic insulation, air infiltration sealing, high efficiency appliances, LED light bulbs, and rooftop solar photovoltaic systems; measure installation

is based on energy modeling and cost effectiveness. These installed measures produce a typical combined reduction of 20% in electricity and heating fuel bills for WAP homes.
51. Data taken from *Colorado Electric Utility Energy Efficiency Programs: A Success Story*. Southwest Energy Efficiency Project, 2019. https://www.swenergy.org/Data/Sites/1/media/aaa-documents-2019/fact-sheets/co-dsm-fact-sheet-2019.pdf
52. http://www.usclimatealliance.org/nwlchallenge
53. Colorado Forest Action Plan. Colorado State Forest Service, 2020.
54. https://www.google.com/url?q=https://farmlandinfo.org/publications/greener-fields-california-communities-combating-climate-change/&sa=D&ust=1608062215896000&usg=AOvVaw0VLHH75GFZfY8BiTKqTcnp

[x] In most cases, it is the utility, not the state, that initiates actions at the PUC.

BENEFICIAL ELECTRIFICATION IN COLORADO

Market Potential
2021-2030

FINAL REPORT

Prepared for
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1 Executive Summary

For the Colorado Energy Office (CEO), GDS Associates, Inc. (GDS) completed a modeling analysis of the market potential for beneficial electrification in Colorado. The project began in late December 2019 and ran through early March 2020. In the analysis, GDS explored the potential for beneficial electrification to offset greenhouse gas emissions from Colorado consumer's direct use of fossil fuels from 2021-2030. The focus of the study was on beneficial electrification in the residential and commercial building sector, with consideration for the industrial sector and non-road transportation sector. Electrification of transportation, which has been addressed in other studies, was not included in this study.

Beneficial electrification is an emerging trend across the United States. With the electricity sector making major movements in many states to reduce reliance on coal and other fossil fuels, electricity is being looked to as a solution for reducing the consumption of *other* fossil fuels—and their associated greenhouse gas emissions. Replacing equipment and appliances that burn natural gas, propane, fuel oil, gasoline, or diesel fuels, with energy-efficient electric technologies will reduce greenhouse gas emissions in the near term. As the grid continues to decarbonize, beneficial electrification will produce even greater reductions in greenhouse gas emissions over the long term.

Colorado is making major strides in decarbonizing its electricity sector and reducing greenhouse gas pollution. In December of 2018, Xcel Energy committed to reducing electricity-based carbon emissions to 80 percent of its 2005 emissions by 2030 and to generate 100 percent clean energy by 2050.[1] House Bill 1261, signed in May of 2019, commits Colorado in striving to achieve a 50 percent reduction in statewide greenhouse gas pollution by 2030 and 90 percent reduction by 2050.[2] In 2019, Governor Polis also signed Senate Bill 19-236,[3] modernizing the Public Utilities

[1] https://www.xcelenergy.com/environment/carbon_reduction_plan
[2] https://leg.colorado.gov/sites/default/files/2019a_1261_signed.pdf
[3] https://leg.colorado.gov/sites/default/files/2019a_236_signed.pdf

Commission (PUC), which helped pave the way for decreasing Colorado's carbon emissions from the electricity grid and other critical sources of emissions by codifying into law Xcel Energy's carbon-reduction commitment. The law also provides an opportunity for other utilities to develop and submit to the PUC for approval, clean energy plans that achieve a carbon dioxide emission reduction of 80 percent below 2005 levels by 2030. In addition, the legislation also requires a utility to use the social cost of carbon in its calculation of benefits associated with beneficial electrification plans.

In January 2020, Tri-State Generation & Transmission Association (Tri-State), an electric generation and transmission cooperative servicing Colorado and three other states, announced its Responsible Energy Plan, which commits the company to reducing carbon emissions from Colorado generating plants by 90 percent by 2030, with Colorado electricity sales having 70 percent lower emissions by 2030. Additionally, the Platte River Power Authority, which supplies power to four Colorado communities, has stated a goal of getting to 100 percent non-carbon energy mix by 2030.[4] With these commitments to develop a cleaner, carbon-free electrical system, Colorado is well on its way to leveraging beneficial electrification to further reduce emissions from Colorado's energy sector.

In the residential and commercial building sectors, Lawrence Berkeley National Laboratory (LBNL) estimates the technical potential for electrification to be "nearly 100% of all energy use."[5] Space heating and water heating are major end-uses for natural gas and propane in residential and commercial buildings. Cooking is also a large user of natural gas and propane in the commercial sector. The implication is that, with off-the-shelf technologies, there is no technical reason that nearly all of Colorado's use of natural gas or propane for space heating, water heating, and

[4] https://www.prpa.org/media-releases/platte-river-board-passes-energy-policy/
[5] Lawrence Berkeley National Labs. Electrification of Buildings and Industry in the United States. p. 15 http://ipu.msu.edu/wp-content/uploads/2018/04/LBNL-Electrification-of-Buildings-2018.pdf

cooking cannot be electrified over the long term, assuming the State enacts strong policy support to overcome market barriers.[6]

The primary technology opportunity to beneficially electrify space heating and water heating is through heat pumps. The current generation of heat pumps used for space heating are more efficient and work better at cold temperatures than those of only a decade ago. Heat pump water heaters have less history in the market but are commonly promoted through utility demand-side management programs, with efficiencies that substantially exceed those of electric resistance water heaters. This study finds both of these technologies to be viable options for early efforts to electrify current residential and commercial sector uses of natural gas and propane.

Electrifying the industrial sector will be more challenging than the residential or commercial sectors and will require research and innovation, in part due to the nature and diversity of processes and technologies employed. LBNL[7] cites a study by the Electric Power Research Institute (EPRI) indicating that by 2030, only 3.6 percent of the United States' industrial sector has technical potential for electrification, a stark contrast to residential and commercial buildings. Colorado has a diverse industrial sector, spanning companies associated with food processing, forestry, agriculture, paper products and wood products, and oil and gas, to name but a few.[8] Each of these industries has its own ways of utilizing fossil fuels in their processes. While some industrial facilities can benefit from the available technologies used in commercial buildings, the demand for high heat in many processes does not always lend itself to the use of heat pumps. In some cases, solutions other than electrification may be needed to mitigate greenhouse gas emissions. These include renewable natural gas or an electric-to-hydrogen solution that facilitates the use of combustion to achieve high temperatures.

[6] Market barriers that affect the technical adoption of electrification include issues such as electrical panel capacity limitations found in some homes or space constraints for installing electrification technology.
[7] Lawrence Berkeley National Labs. Electrification of Buildings and Industry in the United States. p. 20 http://ipu.msu.edu/wp-content/uploads/2018/04/LBNL-Electrification-of-Buildings-2018.pdf
[8] Colorado Energy Office (2017). Industrial Energy Efficiency and Distributed Generation Opportunities in Colorado. Prepared by Energetics.

Despite these challenges, many industrial processes and agricultural end-uses are good candidates for beneficial electrification. This includes the oil and gas industry which can electrify compressor stations and pumping equipment, and has the opportunity to reduce the direct venting of methane. For Colorado's natural gas industry, some end-uses, including those that currently direct-vent natural gas as part of their operation – can be electrified. The electrification of direct-vented natural gas for pipeline operations may have an important effect on Colorado's overall carbon footprint, with an example provided in a technology snapshot in Section 4.6.[9] Electric arc furnaces, ultraviolet sterilization, converting diesel well pumps to electric pumps, and a host of other opportunities exist for the industrial sector.

Non-road electrification also has potential in both the commercial and industrial sector. Non-road electrification describes transportation-related equipment that is not used on roads and highways. It covers the use of gasoline, diesel, or propane engines that provide services within a facility. One example is battery-powered forklifts that can be used in place of propane-powered forklifts. Another example is truck-stop electrification which avoids the need for highway-going delivery vehicles to operate their diesel engines to support heating and cooling needs while at a truck stop. Large gantry cranes can be electrified, avoiding the need for using diesel engines to raise and lower goods and materials. While difficult to quantify due to the diversity and lack of market data, the non-road technology area is an opportunity for electrification in the commercial and industrial sectors with available off-the-shelf technologies.

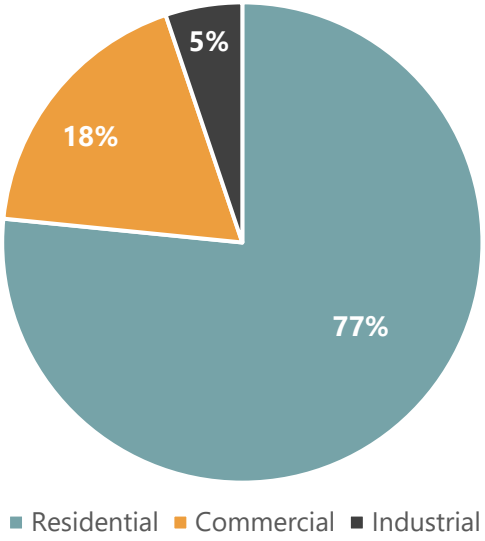
1.1 BENEFICIAL ELECTRIFICATION AND GREENHOUSE GAS EMISSIONS REDUCTION

Colorado has a high technical potential for beneficial electrification in the residential and commercial sectors between 2021 and 2030. While the achievable results are lower due to the expected adoption rate of electrification technologies, under the High Electrification scenario, we

[9] Direct emissions of methane have 21 times the effect on carbon emissions (CO2e) compared to combusting methane.

estimate that by the end of 2030, beneficial electrification can reduce natural gas consumption by over six percent and propane consumption just under ten percent. This would result in approximately 3.5 million tons less of carbon dioxide equivalent (CO2e)[10] emissions by the end of 2030 and would increase 2030 sales of electricity approximately two percent. The lifetime CO2e emissions reduction for electrification measures adopted by the end of 2030 is estimated to be approximately 16.2 million tons. Figure ES-1 illustrates the share of lifetime cumulative CO2e emissions reductions by sector in the High Electrification scenario for electrification measures that we forecast as being installed under the High Electrification scenario.[11]

FIGURE 1-1 SECTOR SHARES OF LIFETIME CUMULATIVE EMISSIONS REDUCTIONS FROM MEASURES INSTALLED BETWEEN 2021 AND 2030



The Moderate Electrification scenario forecasts approximately half the measure adoption and half the resulting emissions reductions as the High Electrification Scenario. The study assumes that adopters of electrification technologies continue to use the same or better electrification technologies into the future and therefore that CO2e reductions would continue beyond the useful lives of their initial electrification adoption.

[10] Carbon dioxide equivalent accounts for differing global warming potentials of gaseous emissions.
[11] The lifetime of electrification measures last beyond the 2021-2030 decade. As a result, the ongoing reduction in carbon emissions last beyond the decade, reflected in the lifetime cumulative emissions reduction.

Below we present our key findings and recommendations regarding beneficial electrification in Colorado that emerged from the analysis.

1.2 KEY FINDINGS AND RECOMMENDATIONS

Through this beneficial electrification study, the modeling and analysis led to several key findings and recommendations.

Table 1-1 summarizes the key findings and recommendations with an expanded discussion of each following.

TABLE 1-1 BENEFICIAL ELECTRIFICATION KEY FINDINGS AND RECOMMENDATIONS

Key Finding	Recommendation
Colorado has substantial market potential to develop beneficial electrification over the 2021-2030 decade and beyond.	Colorado should enact policies to encourage the adoption of beneficial electrification technologies, especially related to heat pumps for space heating and water heating.
Over the next ten years (2021 to 2030) Colorado has the potential to cumulatively reduce net carbon emissions by approximately 3.5 million tons of CO2e through beneficial electrification. For measures installed in this timeframe, the potential for net lifetime emissions reductions exceeds 16 million tons of CO2e.	To maximize emissions reductions, Colorado should adopt policies that ensure the decarbonization of the state's electricity grid while monitoring the pace of electrification to ensure that it is achieving a beneficial outcome for CO2e emissions.
Electrifying propane-fueled end uses is highly cost-effective.	Colorado should prioritize policies and efforts to electrify propane-fueled end-uses while creating general electrification opportunities and awareness.
Colorado can take advantage of the work that other regions in the U.S. have undertaken to improve heat pump technology and grow the market for electrification technologies. These efforts may allow Colorado to move from a fossil-fuel dominated energy market for space heating and water heating more quickly and with fewer challenges than others.	Colorado should leverage the program design and technology specifications already developed by other regions, states, and utilities. These include efforts in the Pacific Northwest and Northeastern United States.
There is limited market intelligence on fossil fuel end-uses and saturations that is publicly available. To-date, utility market saturation studies have not deeply investigated electrification opportunities.	Colorado should develop market intelligence and track the adoption of beneficial electrification over time to facilitate long-term market development efforts.
Capturing the full potential of beneficial electrification will require a fundamental transformation and long-term transition that will need to take place over multiple decades.	Colorado should take a coordinated market transformation approach toward beneficial electrification that includes electric utilities, local jurisdictions, the private sector, and the State in order to achieve the long-term decarbonization goal.

Below we expand on the key findings and recommendations presented in Table 1-1 adding discussion on the findings and context for the recommendations.

KEY FINDING NO. 1: ***Colorado has substantial opportunities to develop beneficial electrification over the 2021-2030 decade and beyond.***

From a technical standpoint, nearly all of Colorado's space heating and water heating services provided by fossil fuel could be converted to electricity. The residential market has the greatest opportunity for these technology changes to be cost-effective, based on the modified Total Resource Cost test[12] (mTRC) and social cost of carbon utilized in this study. Additionally, the residential market may be best positioned to develop programmatic solutions due to the sector's use of standardized technologies repeated from home to home. This standardization of technologies and repeated sales spread across the residential sector will enable tastes, preferences, and market practices to develop, growing the market for beneficial electrification.

The commercial sector is also well positioned to adopt beneficial electrification. Many of the same technologies found in the residential sector can be applied to the commercial sector, including water heating and space heating equipment. However, the diversity of heating and cooling systems, considerations of natural gas costs, and potential integration of technologies into more complex commercial systems may limit the potential over the next ten years relative to the residential sector.

The industrial sector is expected to have the least adoption of electrification opportunities relative to its fossil fuel loads. Diverse needs, including processes requiring high temperatures, limit the ability for heat pumps and related beneficial electrification technologies to provide an equivalent

[12] Colorado's mTRC is used by utilities for analyzing the cost effectiveness of energy efficiency measures and programs.

end-use service. Processes requiring a high temperature rise may be unsuitable for heat pumps, while any electrification from fossil fuels can require substantial industrial process overhauls or changes to the nature of a product.[13] Technology innovation may be needed to develop electrification solutions for the industrial sector. That said, there are technologies appropriate for industrial uses, such as industrial heat pumps as well as the technologies associated with the commercial sector for space heating and domestic water heating.

Non-road transportation solutions are an immediate opportunity for some electrification technologies. However, there is limited data on the current level of energy consumption for the diverse end-uses that fall within this category. This category includes propane-powered forklifts that can be converted to electricity, as well as truck-stop electrification in which diesel fuel used by parked trucks becomes electrified to provide necessary services. This category lends itself to standardized technologies that are becoming more common in the market. Technology standardization facilitates repeated sales that ease the marketing and adoption of technologies.

Propane users stand to benefit the most from adopting electrification technologies for space heating and water heating. The use of propane for space heating and water heating exhibits a high degree of cost-effectiveness for both the residential and commercial sectors due to the cost of propane relative to electricity. As an early first-step, encouraging beneficial electrification among propane users appears to be a key opportunity.

Table 1-2 below describes the 2030 annual CO2e reductions that are possible under the technical, economic, and two adoption scenarios (described further in the report). The 2030 results reflect a substantially greener grid (80 percent CO2 emissions reductions from 2005 levels). The level of annual reductions increases from 2021 to 2030, with higher annual reductions possible after 2030, assuming ongoing beneficial electrification technology adoption.

[13] https://www.energy.gov/sites/prod/files/2014/05/f15/heatpump.pdf

TABLE 1-2 CO2E REDUCTION POTENTIAL UNDER BENEFICIAL ELECTRIFICATION SCENARIOS

Potential Scenario	2030 Cumulative CO2e Reduction (short tons)
Technical Potential	31,147,459
Economic Potential	20,797,877
High Electrification	3,499,843
Moderate Electrification	2,085,315

In 2030, the technical potential for annual emissions reduction is approximately 30 percent of forecasted 2030 emissions associated with electricity production and the combustion of natural gas and propane in Colorado. Additional potential exists after 2030 and ongoing adoptions of beneficial electrification would continue to expand the reduction in CO2e emissions. Significantly, the High Electrification and Moderate Electrification emissions reductions pose minimal risk to Colorado's electrical infrastructure, leading to an approximate one to two percent increase in electricity consumption in 2030.

RECOMMENDATION NO. 1: ***Colorado should adopt policies to encourage beneficial electrification technologies, especially related to heat pumps for space heating and water heating. However, many other opportunities exist. Beneficial electrification efforts should include non-road technologies and be used to educate the market and stimulate the demand for electrifying the diverse non-road end-uses.***

KEY FINDING NO. 2: ***Over the next ten years (2021 to 2030) Colorado has the potential to reduce net carbon emissions by over 3.5 million tons of CO2e through beneficial electrification. As electrification adoptions increase, the net lifetime CO2e reduction of electrification measures installed by the end of 2030 is over 16 million tons of CO2e. The greatest opportunity can be expected in the second half of the decade, assuming that the first half is viewed as focusing on "market preparation" to drive higher adoption rates through 2030 and beyond.***

Our analysis assumes Colorado's electricity grid reduces its overall emissions by 80 percent in 2030 compared to a 2005 baseline and continues downward toward zero emissions in 2050. This base case emissions profile is combined with load forecasts without beneficial electrification to inform and emissions rates that the beneficial electrification scenarios will impact. The emissions reduction benefit is based on the emissions associated with the adoption of electrification technology less the emissions avoided by not utilizing fossil fuels for the same end use. For the State or an individual utility, if decarbonization does not occur, there is a risk that electrification may not be beneficial. However, under the scenarios, we found that the State can expect a general reduction in carbon emissions, even if the State or an individual utility only achieves a 50 percent reduction from 2005 electricity emissions. While Colorado is well positioned to utilize beneficial electrification to decrease emissions due to current legislation and utility plans, progress toward that goal will inform just how beneficial electrification ultimately is and what technologies are the most beneficial.

The High Electrification scenario envisions substantial market adoption of available and cost-effective beneficial electrification technologies. The study assumes an adoption rate based on the compound annual growth rates of heat pumps in the Pacific Northwest and the Northeastern U.S. as well as the adoption of plug-in hybrid and electric vehicles in Colorado. The Moderate Electrification scenarios find that adoption rates may be modest relative to overall natural gas sales, particularly in the 2021-2025 timeframe. Both scenarios assume that some level of programmatic effort will be made to transform the market over the decade, with the first five years being critical for market development and early deployment. By the end of the decade, both scenarios result in natural gas savings similar to mature natural gas energy efficiency programs, relative to the forecasted natural gas sales absent beneficial electrification.[14] The modeling found that the annual impact of beneficial electrification on natural gas consumption is between 0.4 percent (Moderate Electrification) and 1.1 percent (High Electrification) in 2030. This amounts to between 1.1 million dekatherms (Dth) and 3.4 million Dth in 2030, respectively for each of the two scenarios. In both scenarios, the assumed adoption rates will provide Colorado with an opportunity to observe the progress achieved toward reducing electricity emissions, minimizing

[14] Based on a review of ACEEE's 2019 State Energy Efficiency Scorecard, found at: https://www.aceee.org/sites/default/files/publications/researchreports/u1908.pdf

the risk that moving forward with electrification could lead to increases in carbon emissions. Given the large potential benefit of future electrification, early steps now will help pave the way while also not exposing the State to high risks in regard to carbon emissions. The opportunity exists to correct course should outcomes differ from expectations.

RECOMMENDATION NO. 2: ***To maximize emissions reductions, Colorado should adopt policies that ensure the decarbonization of the state's electricity grid while monitoring the pace of electrification to ensure that electrification is achieving a beneficial outcome for CO2e emissions.***

KEY FINDING NO. 3: ***The electrification of propane end-uses is highly cost effective. Natural gas prices reduce cost-effective electrification options compared to propane.***

In the case of propane space heating and water heating, we found that shifting from propane to electric technologies was cost-effective across nearly all modeled technology cases using the Colorado mTRC test and social cost of carbon. In the case of natural gas users, many, though fewer technology cases were found to be cost effective under the cost effectiveness testing. As a result, propane users were modeled to have a higher rate of adoption of electrification technologies than natural gas users.

There are many factors influencing the mTRC test, with the cost difference between propane and natural gas being the driver of differences in technology cost-effectiveness and subsequent adoption. As an example, natural gas prices for a high efficiency, 95 percent AFUE[15] furnace are approximately $4.00 per delivered MMBtu in Colorado. In contrast, propane prices result in

[15] AFUE refers to the Annual Fuel Utilization Efficiency, the measure of a furnace's efficiency in converting fuel to energy.

roughly $21.00 per delivered MMBtu for the same furnace. As beneficial electrification will increase electricity consumption while saving either propane or natural gas, electricity consumption costs must compete against the price of these fuels as a component of cost-effectiveness.

This study finds that based on current fuel prices, transitioning from natural gas to beneficial electrification requires benefits beyond just the difference in price between gas and electricity, such as air conditioner efficiency savings, to pass cost-effectiveness testing with a benefit to cost ratio greater than 1.0. By way of example, a high efficiency cold climate heat pump can achieve a winter-season COP[16] of approximately 3.5. All else held equal, the heat pump would need to deliver heat at a cost that is lower than a propane or natural gas alternative. The cost per delivered MMBtu of this example heat pump is roughly $8.20 based on Xcel Energy's residential winter electricity prices. This price of delivered heat is higher than the natural gas option but lower than the propane option. In addition, Colorado law, recognizing that lower carbon emissions is a social good, requires the use of a social cost of carbon when evaluating proposals from regulated electric utilities to implement beneficial electrification programs. Under this approach, the study finds that many opportunities for natural gas beneficial electrification are cost effective or nearly cost-effective when considering all costs and benefits. Indeed, some Colorado homes and businesses are choosing electrification options now, indicating value propositions not captured by energy economics alone.

In the case of propane, we found little difference between the technical and economic potential to beneficially electrify propane end-uses. For natural gas, there is a substantial technical potential to reduce natural gas consumption and associated carbon emissions from 2021 through 2030, though our analysis found less economic potential using Colorado's mTRC and social cost of carbon. As a result, the ultimate adoption of beneficial electrification and the associated offset of natural gas consumption forecasted for the next decade are lower than might otherwise occur

[16] The COP is the coefficient of performance and represents the amount of heat output relative to the amount of electricity required to operate the heat pump. A COP of 3.5 means a heat pump outputs 3.5 times the amount of energy required to operate the heat pump.

were natural gas prices higher. We also found that many beneficial electrification space heating measures only pass the cost effectiveness test when savings associated with air-conditioning efficiency are included in the analysis, suggesting an important link between beneficial electrification and ongoing efforts to increase energy efficiency in Colorado.

RECOMMENDATION NO. 3: ***Colorado should prioritize targeting residential and commercial propane customers for electrification due to the cost-effectiveness of electrifying many propane-fueled end-uses and the opportunity to save customers money and reduce greenhouse gas emissions. Experience with propane users should be leveraged to help inform efforts to build consumer awareness and to electrify natural gas end-uses. Colorado should help natural gas customers adopt cost-effective electrification technologies and support the development of technologies that may become cost-effective in the future.***

KEY FINDING NO. 4: ***Colorado can take advantage of the work that other regions in the U.S. have undertaken to improve heat pump technology, the market for heat pumps, and related electrification technologies. These efforts may allow Colorado to begin to move from a fossil-fuel dominated energy market for space heating and water heating with fewer challenges than others.***

While space-heating heat pumps have been in the marketplace since the 1970s, they are more common in warmer climates. Several efforts in the U.S., including those of the Northwest Energy Efficiency Alliance (NEEA) and its member utilities, as well as those by the Northeast Energy Efficiency Partnership (NEEP) and utilities in the Northeast, have led to technology and market adoption improvements over the last five years. NEEA has spent a decade working to improve ductless heat pump technologies and transforming the marketplace in the Pacific Northwest to encourage heat pump adoptions. NEEP has developed and promoted its cold-climate heat pump specification and supported efforts to grow the market availability of those cold-climate heat

pumps. While modest in market penetration,[17] both NEEA and NEEP regions are experiencing growing adoption of high-performance heat pumps. In only the last year, Massachusetts has helped manufacturers develop integrated controls that facilitate ductless heat pump integration with fossil fuel heating systems to allow for dual-fuel space heating.

With these regional efforts helping transform heat pump technology, Colorado can leverage similar program concepts and heat pump technological improvements to move its market toward adopting beneficial electrification technologies.

RECOMMENDATION NO. 4: ***Colorado should leverage the program design and technology specifications already developed by other regions, states, and utilities.***

KEY FINDING NO. 5: ***Colorado has limited publicly available market data on equipment saturation of fossil fuel end-uses. The available utility market saturation studies have not deeply investigated electrification opportunities.***

Market data is needed to understand the current state of beneficial electrification in Colorado and to inform long-term market progress tracking. While conducting research to support this project, GDS engaged with five Colorado electric utilities, three of which also have natural gas service territories. In reviewing the available data, GDS found that potential studies and market saturation studies provided limited or no perspective on the opportunity for beneficial electrification. Indeed, 4 CCR 723-4-4756(b) specifically prohibits natural gas utilities from promoting fuel switching to other fossil fuel derived energy sources as part of demand side management programs, negating

[17] The specific share of the market is unknown for both NEEA and NEEP regions. While program and general market sales counts are known, the overall market share of HVAC or water heating sales represented by electrification is not.

value in researching such opportunities. Further, beneficial electrification is a relatively recent phenomenon that has emerged as electric utilities have begun making substantial progress and planning to reduce CO2e emissions in their power supply. Finally, energy efficiency programs have generally focused on "like for like" energy savings, in terms of energy sources, with some exception for customer-sited renewable energy systems. In short, there has not been a compelling reason to investigate electrification opportunities, resulting in limited market information about the current status or historical market trends.

Our research found one exception—in 2015, Colorado Springs Utilities (CSU) investigated the potential for fuel switching in its DSM potential study.[18] However, in that study the fuel switching was focused on moving customers from electricity *to* natural gas, the opposite of beneficial electrification. The CSU study is a useful example illustrating just how recent the concept of beneficial electrification is for the utility industry. In discussions with each of the five utilities, GDS learned that they do not perceive that the Colorado marketplace is making large movements toward electrification, suggesting that any effort by individual customers, market actors, or local programs is nascent.

RECOMMENDATION NO. 5: ***Colorado should develop market intelligence and track the adoption of beneficial electrification over time to facilitate long-term market development efforts. Such an effort should be based on a statewide approach that develops consistency in market research and tracking efforts to facilitate programs and policy making that may come from diverse entities, such as utilities and state or local government.***

[18] CSU is a municipal utility, is not regulated by the Colorado Public Utilities Commission, and not subject to Gas Rule 4756(b).

KEY FINDING NO. 6: ***With a large portion of Colorado's natural gas and propane consumption driven by space heating and water heating needs, maximizing beneficial electrification will require policies that support market transformation. The industrial sector will require technology innovation that aligns with industrial sector practices and processes, many of which may be proprietary or customer-specific in use.***

The technical potential for beneficial electrification in Colorado's residential, commercial, or industrial buildings and processes is substantial. By the end of 2030, beneficial electrification could technically reduce carbon emissions associated with natural gas or propane consumption by approximately 47 percent and 49 percent for each fuel, respectively. However, without additional policy and program support, the impact over the next 10 years relative to the full technical potential for market adoptions and resulting emissions reductions, is likely to be minimal.

Achieving decarbonization goals through beneficial electrification requires a long-term view and persistent programmatic efforts to fundamentally shift market practices and preferences. Yet, near-term action will be crucial to set the stage for future success and to enable the sustained growth and compounding benefits of beneficial electrification. Colorado should support policy and program development, which may entail changing rules or regulations, addressing technology limitations, and market preferences.[19] NEEA's decade-long effort to transform the ductless heat pump market is illustrative and points to the need for a long-term commitment and coordination across organizations that can support beneficial electrification programs.

The experience of the renewable energy and energy efficiency industries provide important examples of the role that supportive policies can plan in transforming markets. Twenty years ago, utility-scale wind energy was just beginning to emerge. Today it is a major source of electricity. Similarly, only 10 years ago, the solar industry had only begun to mature, with major innovations and market adoptions driving what is now an increasingly common source of electricity. For

[19] GDS is conducting separate research into market barriers and policy options as a companion to this report.

energy efficiency, LED lamps serve as an example of rapid technology innovation and adoption, illustrating the potential that policy and programmatic efforts can have to drive rapid market adoption. Each of these examples serve to indicate the importance of the combination of policies and programs to drive the market. None of the changes occurred overnight. Beneficial electrification can be expected to succeed with a similar path.

KEY RECOMMENDATION NO. 6: ***Colorado should take a coordinated market transformation approach toward beneficial electrification. Such an effort should include at least Colorado's electric utilities, local jurisdictions, and the State in order to achieve the long-term decarbonization goal.***

2 Introduction

This study presents the results of a beneficial electrification market assessment. The study provides an estimate of technical, economic, and achievable potentials for Colorado to electrify buildings to reduce greenhouse gas emissions. The study framework is linked to recent Colorado legislation and utility plans that will see a substantial reduction in greenhouse gas emissions in the electricity sector over the coming decade (2021-2030).

2.1 BACKGROUND

Colorado is making substantial progress in decarbonizing its electricity sector. In 2019, Governor Polis signed landmark legislation (SB 19-236) to address avoiding the worst impacts of climate change.[20] This legislation mandated that electric utilities with over 500,000 customers reduce emissions by 80 percent of 2005 levels by 2030, with a target of 100 percent emissions reductions by 2050. Additionally, the legislation codified the concept of beneficial electrification as electrification of an end-use if that electrification:

- Reduces system costs for the utility's customers;
- Reduces net carbon dioxide emissions; or
- Provides for a more efficient utilization of grid resources.

The legislation also directed the Public Utilities Commission to apply a social cost of carbon (SCC) in the benefit-cost calculation of beneficial electrification programs and required public utilities to include SCC as a cost-effectiveness factor in electric resource planning.

As the state decarbonizes its electricity grid, Colorado has the opportunity to further reduce its carbon footprint by shifting other energy uses from fossil fuels to the cleaner grid. Quite simply, with a low-carbon electricity supply, converting end-uses of carbon emitting fuels to electricity provides a pathway for further carbon reductions. Beneficial electrification solves a major

[20] https://leg.colorado.gov/sites/default/files/2019a_236_signed.pdf

challenge of reducing the carbon footprint from the use of fossil fuels since it is difficult with current technologies to cost-effectively scale renewable forms of combustion fuels. Renewable natural gas and hydrogen could theoretically provide a renewable source of combustion fuels but are currently in a nascent market position or still in the research stage of development. Electricity, however, is widely available, has an existing distribution system, and in Colorado, is expected to substantially reduce its carbon footprint by 2030. Hence, electrification can offer a pathway to reducing the use of fossil fuels and their resulting carbon emissions.

Electricity can provide many of the same services that fossil fuels provide. It can heat spaces, processes, and water. It can provide an energy source for transportation. It may be able to reduce direct methane emissions in the oil and gas sector. In general, the uses of fossil fuels is via combustion. Heat from the combustion is used directly or indirectly in an engine. Electricity can be used to provide the same service in many cases.

With electrification technologies able to meet the needs for space heating and water heating in the residential and commercial building sectors, LBNL estimates that the technical potential for electrification in residential and commercial buildings is "nearly 100% of all direct energy use."[21] The implication for residential and commercial buildings is that, with off-the-shelf technologies, there is no technical reason that Colorado's use of natural gas or propane for space heating, water heating, and cooking cannot be electrified.

Heat pump technologies are available now for efficient, electrified space heating and water heating. Compared to electric resistance heating, heat pumps are able to provide heat between roughly two and four times the efficiency of electric resistance heating. As such, there is an efficiency component to beneficial electrification—converting electricity into heat using electric resistance would require two to four times as much electricity as using heat pumps.

[21] Lawrence Berkeley National Labs. Electrification of Buildings and Industry in the United States. p. 15 http://ipu.msu.edu/wp-content/uploads/2018/04/LBNL-Electrification-of-Buildings-2018.pdf

Moreover, heat pumps are improving. Once considered to be a "warm climate" heating option, heat pumps can now operate efficiently at cold outdoor temperatures. While all heat pumps have become more efficient over the decades, the advent of cold-climate heat pumps has ushered in a new era of high-performance technology. Cold-climate heat pumps are able to maintain substantial heating capacity at 5 degrees F and colder.[22] These heat pumps use cold outdoor air to add heat to a home, with an additional benefit of providing very efficient air-conditioning during the summer.

With heat pumps as a major driver of beneficial electrification opportunities, but keeping other technologies and sectors in mind, the CEO hired GDS to provide a market assessment of the potential for electrification to provide benefits to Colorado from 2021 through 2030, including economic benefits as well as carbon reduction benefits.

2.2 **STUDY GOALS**

The goals of the study were:

- Estimate the technical, economic, and achievable potentials for beneficial electrification in Colorado from 2021-2030
- Identify key technologies, sectors, or customer segments that may be able to benefit the most from beneficial electrification between 2021-2030
- Estimate the effect of beneficial electrification on fossil fuel and electricity sales as well as the net carbon emissions (CO2 equivalent) that could result from beneficial electrification
- Analyze the potential using the framework of utility demand-side-management potential studies and cost-effectiveness approaches
- Provide recommendations for CEO, Colorado utilities, or others to consider for next steps

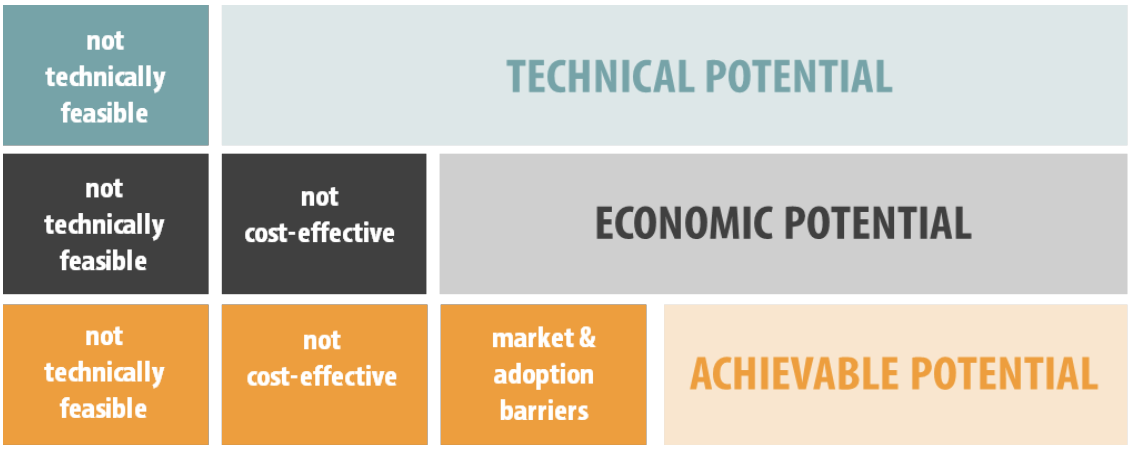
Below we summarize our results and explain the approaches used to draw our findings and recommendations.

[22] For more information, please see: https://www.energy.gov/eere/buildings/articles/cold-climate-air-source-heat-pumps-innovative-technology-stay-warm-winter or https://neep.org/ashp

3 Approach

GDS worked with CEO and Colorado utilities to gather information, data, and perspectives on the current state of electrification in Colorado. GDS also reviewed recent existing industry literature related to electrification opportunities and the historical adoption of electrification technologies. Combined with these resources, data from the U.S. Energy Information Administration (EIA) was used to forecast a Base Case use of natural gas, propane, and electricity from 2021 through 2030.[23] These data sources and analyses were then used to understand cost-effectiveness and model adoptions of beneficial electrification technologies using an energy efficiency potential study framework that follows the National Action Plan for Energy Efficiency (NAPEE)[24] and National Standard Practice Manual (NSPM)[25] general principles to determine potential estimates. Figure 3-1 illustrates the general framework that begins with technical potential, followed by economic, and achievable potentials.

FIGURE 3-1 RELATIONSHIP BETWEEN FORMS OF BENEFICIAL ELECTRIFICATION POTENTIAL



With this framework, we developed four scenarios across the residential, commercial, and industrial sectors, covering the technical, economic, and two achievable potentials—one for a

[23] The forecasts used in this model occurred before the COVID-19 pandemic.
[24] https://www.epa.gov/sites/production/files/2015-08/documents/napee_report.pdf
[25] https://nationalefficiencyscreening.org/national-standard-practice-manual/

High Electrification Scenario and the other for a Moderate Electrification Scenario—for beneficial electrification in Colorado.

The High Electrification Scenario was developed utilizing an adoption curve that would result in a maximum of 14 percent market penetration by 2030 for each individual technology case in residential and commercial buildings.[26] We based this curve on historical adoptions of heat pumps in the Pacific Northwest and the Northeastern United States, and electric vehicles in Colorado, and applied it to the residential and commercial sectors using a Bass-diffusion model[27]. We note that the 14 percent saturation rate is similar to an economy-wide target for electrification identified in a study commissioned by the Environmental Defense Fund with input from Western Resource Advocates that would see Colorado moving toward achieving its carbon reduction goals.[28] From 2021-2030, the total market adoption rate of beneficial electrification is less than 14 percent, reflecting that not all end-uses can be cost-effectively electrified, and some users may choose dual-fuel options that only partially offset fossil fuel consumption. For the commercial sector this is particularly evident for large natural gas boiler systems, for which cost-effective technology options were not identified. With fewer cost-effective technologies than the residential sector, particularly for space heating, less natural gas and propane commercial consumption is expected to be electrified by 2030. For the Moderate Electrification scenario, the study used the same general curve to set a maximum saturation of seven percent in 2030. Adoptions proceed at roughly half the pace of the High Electrification scenario.

For the industrial sector, a literature review was used to understand general electrification potential, with a linear adoption rate used to achieve a saturation rate of 1.2 percent by 2030 in the High Electrification scenario and 0.6 percent in the Moderate Electrification scenario. This is

[26] This adoption curve is an assumption that likely would vary by technology (e.g. space heating vs water heating), partial displacements of fossil fuels, and market condition (end-of-life replacements vs early replacements). There is limited historical precedent for electrification in recent times to inform specific adoption curves for what is, in many cases, newer technology.
[27] A Bass-diffusion curve is an S-shaped curve that describes how products and innovations are adopted by markets.
[28] Michael J Bradley & Associates, "Colorado's Climate Action Plan Emission Targets: Illustrative Strategies and GHG Abatement Potentials," February 18, 2020. Provided by Colorado Energy Office.

explained in more detail in the Industrial Sector section, but results in a lower cumulative adoption rate than either the residential or commercial sectors.

4 Results

In its analysis of Colorado's residential, commercial, and industrial sectors, GDS found that substantial technical and economic potential for beneficial electrification exists in Colorado. In the modeled adoption rates, GDS implicitly assumed the presence of policy and program support. The achievable potential from 2021 to 2030 is modest relative to the technical or economic potential, reflecting the current dominant position that fossil fuels have in Colorado for providing space heating and water heating. The industrial sector and non-road sector also have some potential, but with very limited market data and diverse challenges, our results suggest caution at assuming wide-spread and rapid electrification for industrial and non-road applications.

Table 4-1 describes our conclusions regarding the overall technical, economic and achievable potential impact of electrification on reducing the demand for natural gas and propane, as well as the impact on the state's electricity sales.[29] The technical and economic potential are substantial—by 2030, 47 percent of 2030 forecasted natural gas sales and 49 percent of forecasted propane sales were found to have technical potential to be electrified. The economic potential for natural gas is 31 percent of the forecasted Base Case 2030 natural gas sales, while the 2030 economic potential for propane is nearly the same as its technical potential, indicating high cost-effectiveness for electrifying propane end-uses. The effects on the sales of electricity indicate an increase in 2030 electricity sales of 20 percent under the technical potential scenario and 12 percent under the economically achievable scenario. However, we do not expect the full economic, much less the technical, potential to be achievable by 2030.

When considering adoptions of beneficial electrification, the results are less than the full economic potential. As described further in the report, the adoption rate of beneficial electrification will not result in all economically viable options to occur by 2030. Under the High Electrification scenario, overall natural gas sales in 2030 are expected to be reduced by 6.2 percent, while 2030 propane

[29] These terms are explained further in the report. The economic potential is based on the modified TRC cost effectiveness test as well as applying the social cost of carbon based on current Colorado law.

sales are expected to be reduced by 9.7 percent (indicating a greater rate of adoption by propane users). The Moderate Electrification scenario shows 2030 natural gas and propane sales being reduced to slightly more than half of the High Electrification scenario. The impact on electricity sales in either the High or Moderate Electrification scenarios is fairly minor - approximately two percent and one percent by 2030, respectively, over the Base Case.

This minor increase in electricity sales indicates similarly negligible effects on electricity grid capacity. One concern with rapid electrification adoption is the ability for the electricity grid to meet the demand. Our analysis finds that from 2021 to 2030, the adoption of beneficial electrification technologies is not likely to stress the current infrastructure and ability to deliver electricity. While additional renewable electricity resources will be needed to meet the additional demand to achieve decarbonization targets, the effect appears to be relatively minor over the next ten years.

TABLE 4-1 CUMULATIVE IMPACTS FROM BENEFICIAL ELECTRIFICATION

	NATURAL GAS SALES		PROPANE SALES		2030 NET CO2e REDUCTION[30]
Potential Scenario	2025 Reduction	2030 Reduction	2025 Reduction	2030 Reduction	Cumulative Short Tons
Technical Potential	24%	47%	24%	49%	31,147,459
Economic Potential	13%	31%	24%	48%	20,797,877
High Electrification	1.6%	6.2%	2.9%	9.7%	3,499,843
Moderate Electrification	1.1%	3.3%	2.1%	5.3%	2,085,318

[30] Technical and Economic Potential CO2e emissions reductions assume the same emissions rate as used in the High and Moderate Electrification adoption scenarios and implicitly assume adequate renewable electricity production would be added such that the average emissions rate would not change from the Base Case. The estimated Technical and Economic emissions impact should be viewed as indicators of CO2e reduction levels relative to the adoption scenarios.

RESULTS

Under these results are differing conclusions about technologies and contributions from the residential, commercial, and industrial sectors. For example, the residential sector shows a technical potential of reducing annual natural gas CO2e emissions by 74 percent of forecasted 2030 natural gas sales, while the commercial sector shows a 52 percent technical potential. Below, we summarize the current consumption of each fuel by sector—an important framework before describing the results from each of the sector-level analyses.

In terms of increased electricity consumption on the grid, we expect that there may be some increase in the winter peak. With Colorado being a summer-peaking state, over the next ten years, it is possible that the difference between the summer and winter peak will narrow due to electrification. The specific effect is uncertain and highly dependent on the nature of the measures that would ultimately be adopted. However, space heating is a major portion of the expected adoptions, suggesting some incremental growth to the winter peak during cold, winter nights.

While there may be some effect on peak electricity demands, electrification technologies can provide electric utilities with an opportunity to manage their loads. Over the next ten years, assuming greater penetrations of electrical water heating and space heating technologies, Colorado's electric utilities will be able to learn the specific effects of greater electrification and also consider options to test methods of control. Based on a recent LBNL study of demand response options,[31] the NEEP[32] identified methods by which heat pump water heaters and heat pumps used for space heating (and by extension air-conditioning) could provide utilities with load shaping or other demand response resources, noted in Table 4-2.

[31] Lawrence Berkeley National Laboratory, "Final Report on Phase 2 Results: 2025 California Demand Response Potential Study," March 1, 2017. http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442451541
[32] Northeast Energy Efficiency Partnership, "Northeastern Regional Assessment of Strategic Electrification," July 2017. https://neep.org/sites/default/files/Strategic%20Electrification%20Regional%20Assessment.pdf

TABLE 4-2 LOAD SHAPING OPPORTUNITIES FOR ELECTRIFICATION TECHNOLOGIES

Technology/Opportunity	Shape	Shed	Shift
Heat Pump Water Heaters	X	X	X
Heat Pump Space Heating	X	X	

The LBNL study describes each type of load shaping opportunity as:

- *Shape:* captures demand response that reshapes customer load profiles through price response or on behavioral campaigns—"load-modifying demand response"—with advance notice of months to days.
- *Shed:* describes loads that can be curtailed to provide peak capacity and support the system in emergency or contingency events—at the statewide level, in local areas of high load, and on the distribution system, with a range in dispatch advance notice times.
- *Shift:* represents demand response that encourages the movement of energy consumption from times of high demand to times of day when there is surplus of renewable generation. Shift could smooth net load ramps associated with daily patterns of solar energy generation.

Heat pumps clearly provide electric utilities with several load flexibility options. Although not considered as part of the modeling in this study, the ability to manage loads that emerge due to beneficial electrification will help minimize electricity grid impacts.

4.1 STATE-LEVEL BASE CASE AND ELECTRIFICATION ENERGY CONSUMPTION AND CARBON EMISSIONS

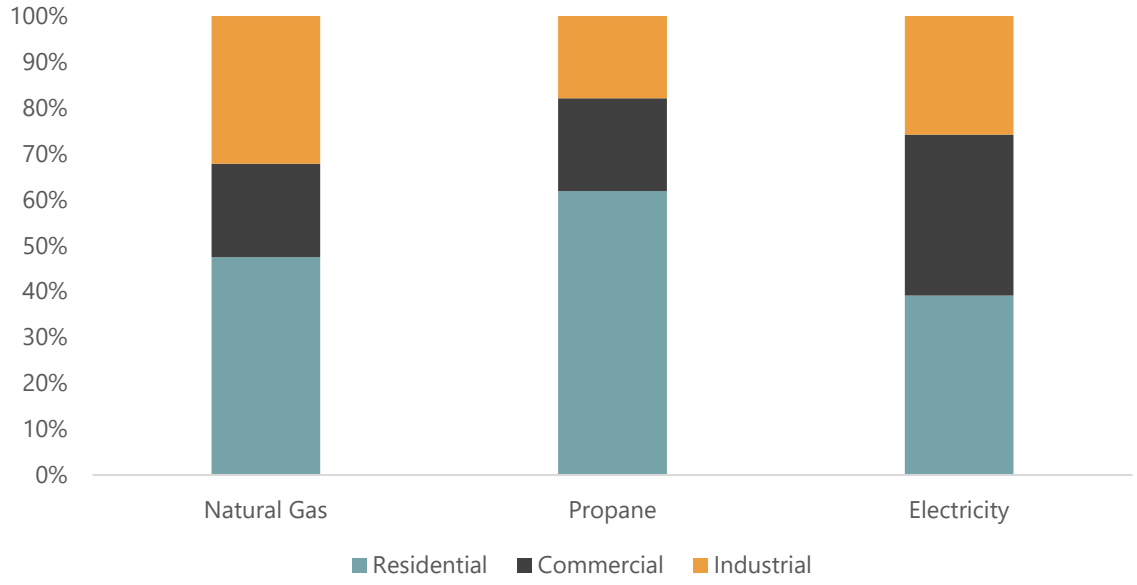
GDS developed forecasts of energy consumption for the residential, commercial, and industrial sectors for 2021 through 2030. These forecasts were based on a combination of data GDS received from several Colorado utilities and the use of forecasts from the EIA[33]. EIA forecasts for the Mountain region were calibrated to Colorado based on historical state-specific EIA data and the

[33] https://www.eia.gov/

expected growth in the residential and commercial sectors as shared by several Colorado utilities.[34]

Figure 4-1 illustrates the relative share that each sector is expected to contribute to the consumption of natural gas, propane, and electricity in 2030. The forecast represents a Base Case, which does not include the changes that would occur under the beneficial electrification scenarios. The relative shares are generally consistent throughout the forecast period.

FIGURE 4-1 SECTOR SHARE OF ENERGY CONSUMPTION IN 2030, BASE CASE



The residential sector is the highest consuming sector for each energy source. The industrial sector is the second highest consumer of natural gas but is third highest for propane and electricity. The relative shares of natural gas, propane, and electricity consumption across each sector as modeled for 2030 are nearly identical to the historical share of consumption in 2018 (based on EIA data).

[34] This data was considered confidential by some utilities and is not reported. For the industrial sector, GDS relied solely on calibrated EIA data to account for gas-transport customers whose sales were not provided to GDS. Overall propane consumption is forecasted to remain flat from 2021-2030. GDS did not attempt to account for self-generation of electricity by customers; solar PV, wind, combined heat and power, and other possible on-site electricity generation technologies are not incorporated directly in the modeling.

RESULTS

The 2030 share for electricity in the Base Case (absent electrification) indicates that the residential sector share of electricity consumption increases by four percent in 2030, compared to 2018, with two percent less share for each of the commercial and industrial sectors. Natural gas and propane sales indicate the same share of consumption between the 2018 historical consumption and 2030 modeled consumption.

In terms of the relative importance of beneficial electrification to impact natural gas and propane sales as well as carbon emissions, Figure 4-1 illustrates that the residential sector is critical, consuming the largest proportion of natural gas and propane.

Figure 4-2 illustrates the carbon emissions expected to come from each energy source during the Base Case forecast period. For the electricity sector, the forecast assumes that Colorado's CO2e emissions will achieve its 80 percent reduction from its 2005 baseline. In Figure 4-2, propane can be seen as having a fairly small share of the overall CO2e emissions, while the contribution from electricity steadily declines.[35]

[35] GDS assumed a linear decrease from CO2e emissions rates (CO2e per MWh) for electricity from 2018 through to forecast period.

FIGURE 4-2 FORECASTED SOURCES OF EMISSIONS, BY ENERGY SOURCE[36]

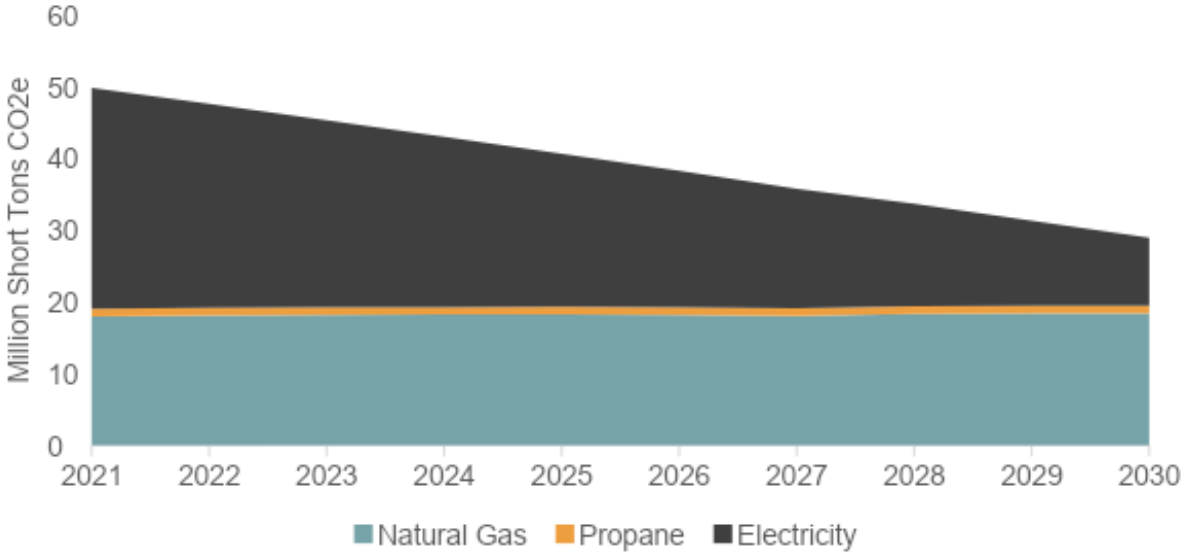
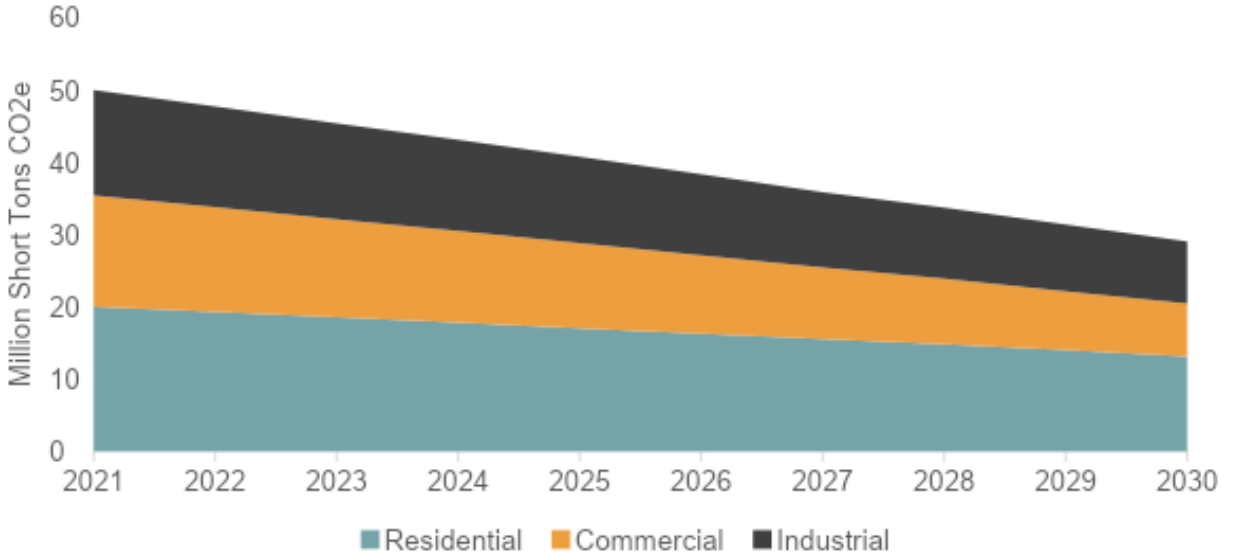


Figure 4-3 illustrates the contribution of CO2e from each sector in the Base Case, accounting for natural gas, propane, and electricity consumption. Overall emissions decrease, while the share from the commercial and industrial sectors appears to decrease more than the residential sector. The greater decrease for the commercial and industrial sectors is due to the relative share of residential natural gas and propane sales, while the commercial and industrial sectors use a relatively greater share of electricity compared to natural gas or propane, allowing the decreased carbon content of electricity to proportionally affect those sectors more than the residential sector.

[36] The change in electricity-based emissions in Figure 4-2 is based on the 80 percent reduction by 2030 scenario.

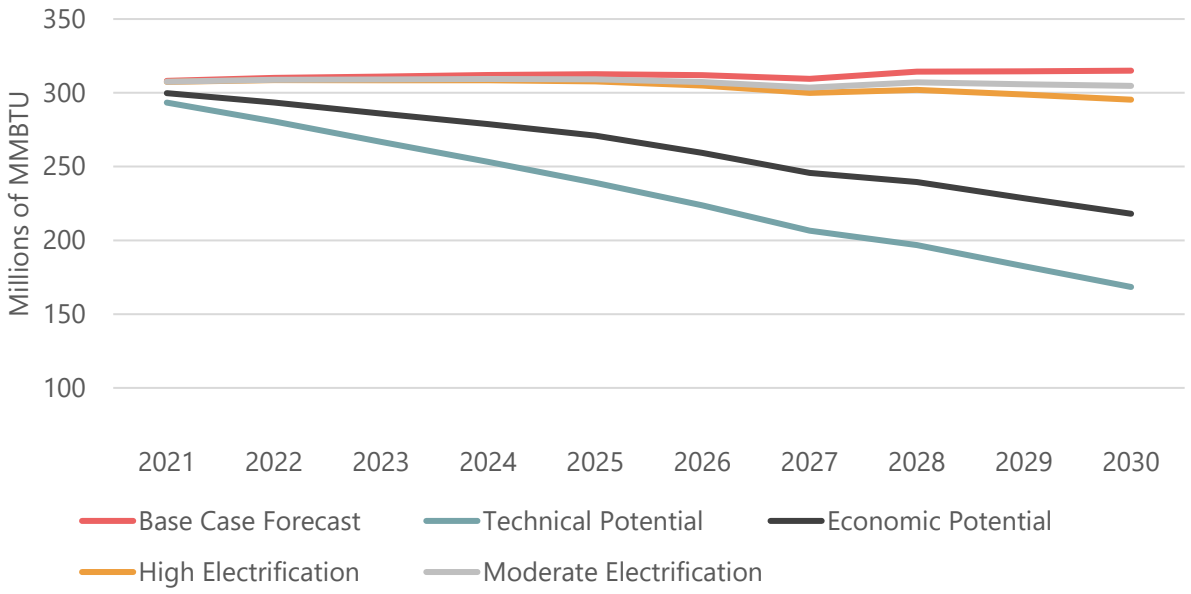
FIGURE 4-3 EXPECTED CARBON EMISSIONS FROM SECTORS 2021-2030



Given the relative share of carbon emissions and Base Case forecasts, the results presented in Figure 4-1 and Figure 4-3 indicate the importance of the residential sector and relative impact that residential beneficial electrification may have on Colorado's overall carbon emissions. This is not to say that only the residential sector matters, but rather that the residential sector may be important to focus on for future beneficial electrification efforts due to relatively higher shares of natural gas and propane consumption.

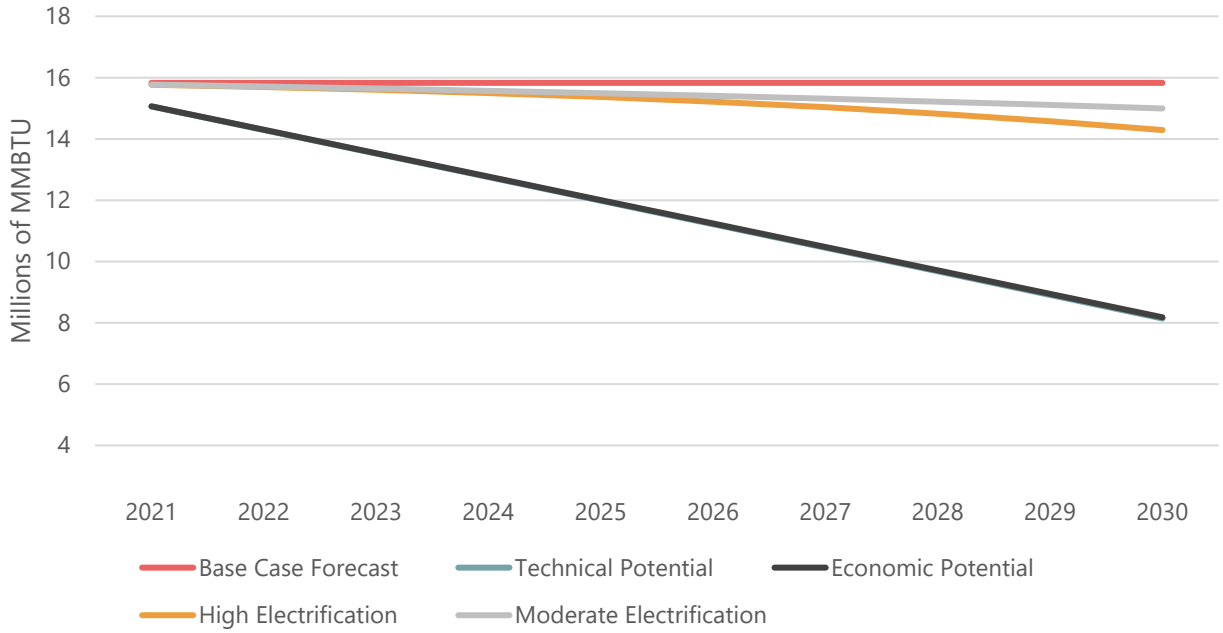
Figure 4-4 shows the cumulative effect of each scenario relative to the base case for Colorado natural gas sales.

FIGURE 4-4 COLORADO TOTAL NATURAL GAS SALES UNDER ELECTRIFICATION SCENARIOS



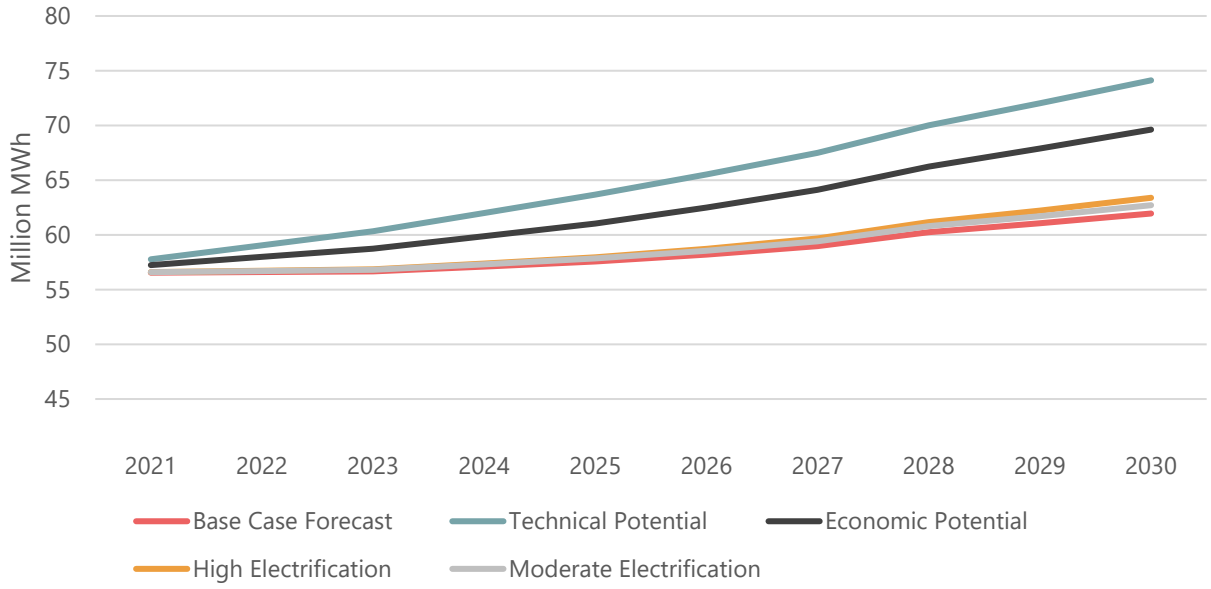
Similarly, in Figure 4-5, total propane sales are expected to decline, but at a greater rate than for natural gas. Additionally, the difference between the technical and economic scenarios shows little distinction, indicating that we found most conversions of propane end uses (primarily space heating and water heating) passed the cost-effectiveness test. As a result, the potential adoptions of electrification technologies are also expected to have a higher share than natural gas by 2030.

FIGURE 4-5 COLORADO TOTAL PROPANE SALES UNDER ELECTRIFICATION SCENARIOS



For electricity, sales are expected to increase over the Base Case. Figure 4-6 illustrates how each potential scenario is expected to affect total Colorado electricity sales. One can see that electric sales are expected to increase in the Base Case, with electrification having very minor effects in the High and Moderate Electrification scenarios. However, the economic and technical potentials exhibit a much higher effect on electricity sales by 2030, well above the forecasted Base Case.

FIGURE 4-6 COLORADO TOTAL ELECTRICITY SALES UNDER ELECTRIFICATION SCENARIOS



4.2 CARBON EMISSIONS SCENARIOS AND BENEFICIAL ELECTRIFICATION IMPACTS

GDS modeled carbon emissions effects of electrification using three scenarios to compare CO2e emissions from the electricity sector that describe potential statewide emissions or utility-specific emissions that may occur based on current utility plans. All assume some level of CO2e emissions intensity reductions from the 2005 and 2018 historical statewide average and were modeled using a linear reduction in emissions. Specific utilities can be expected to differ and the reduction in emissions can be expected to occur in steps as coal plants are retired or other forms of fossil fuel generation reduce their generation of electricity. The three scenarios are:

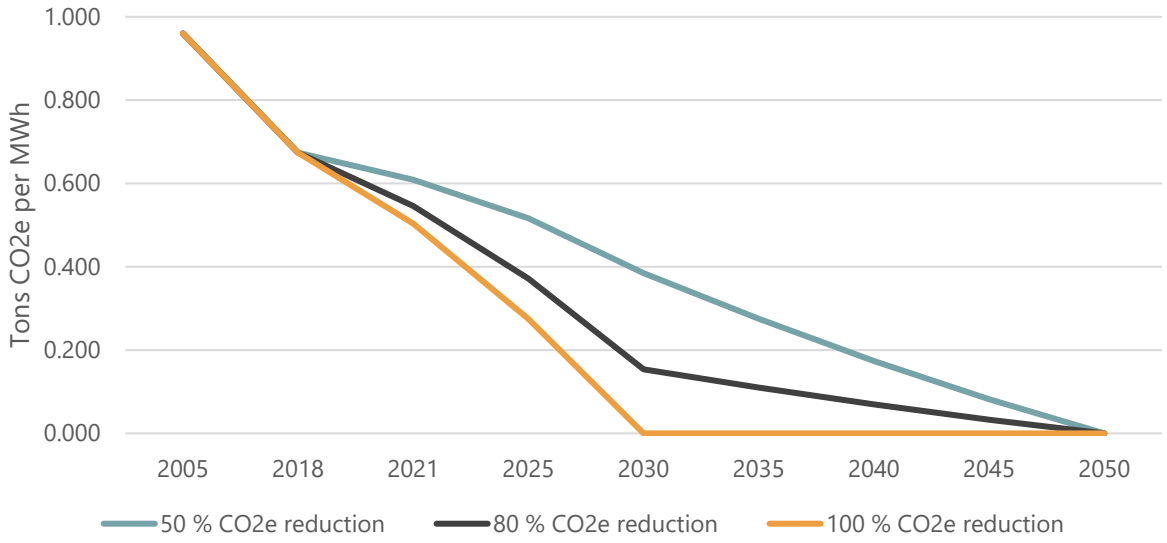
- 100 percent carbon reduction in 2030, retained through 2050
- 80 percent reduction in carbon in 2030, with a year on year decline to 2050 (the base case, or central case)
- 50 percent reduction in carbon in 2030, with a year on year decline to 2050

The 80 percent reduction scenario (the Base Case) mirrors Xcel Energy's commitment and the requirements in SB 19-236. It is also the carbon scenario we used to gauge cost-effectiveness of

beneficial electrification and subsequent statewide adoptions under the High Electrification and Moderate Electrification scenarios. The 50 percent reduction and 100 percent reduction by 2030 scenarios are used to create a possible range of emissions reductions that other utilities may achieve and to compare the relative carbon emissions impact should beneficial electrification take place under the High Electrification and Moderate Electrification scenarios.

To model the effect of electrification, GDS converted historical CO2e emissions from the electricity sector in an emissions rate (tons of CO2e per MWh) using historical 2005 and 2018 data from EIA. Figure 4-7 illustrates the relative emission rate effect from 2005 through 2050. The emissions rate assumptions are based on the Base Case electricity consumption forecast and historical EIA emissions data to arrive at the necessary total emissions reduction required to achieve the emissions rate in each carbon scenario, relative to the 2005 baseline total electricity sector emissions. With electrification, it is important to note that the increase in electricity sales will require additional investments in clean energy resources in order to avoid increasing overall CO2e emissions. Due to the relatively modest effect on electricity sales modeled in this study – an increase of 2.3 percent in the High Electrification Scenario and 1.2 percent in the Moderate Scenario, GDS did not reanalyze the underlying emissions rate required to achieve the gross emissions reduction under these scenarios.

FIGURE 4-7 ELECTRICITY EMISSIONS RATE (TONS CO2E PER MWH)



To understand the implication of the declining emissions in any of the carbon scenarios and the impact that electrification would have on net CO2e, GDS analyzed the minimum electricity efficiency required to achieve the same emissions output compared to an MMBtu of natural gas being combusted. In trading reductions in emissions from the combustion of fossil fuels for emissions from the electricity grid, a minimum efficiency in the new electrical equipment is needed to at least result in no net emissions increase. Most heat pumps have average heat delivery or removal efficiencies substantially above 100 percent, while electric resistance equipment typically has a heat delivery efficiency of approximately 100 percent. Other equipment or climate factors can vary the efficiencies relative to natural gas combustion, but in general, using a heat pump to deliver heat will result in fewer emissions from consumption of electricity than electric resistance heating. The analysis produced a snapshot of break-even efficiencies across the three scenarios. With 0.058 tons of CO2e emitted by combusting natural gas, the same amount of heat from an electrical appliance would need to produce the same or less CO2e.

Figure 4-8 illustrates the results of the analysis using lifetime emissions rates that may be experienced in Colorado should the above scenarios take place. The results do not exactly track the emissions scenarios as the lifetime emissions rate (tons CO2e per MWh) change. As a result

of ongoing decreases in electricity CO2e emissions, an electrical appliance installed at some point over the next decade would show progressively lower net emissions over the life of the product. Figure 4-8 indicates that as Colorado's electricity supply continues to reduce its carbon emissions, the efficiency of electrical equipment required to achieve a net carbon reduction is likewise reduced.

FIGURE 4-8 ELECTRICAL EFFICIENCY REQUIRED TO ACHIEVE BREAK-EVEN CO2E IMPACTS

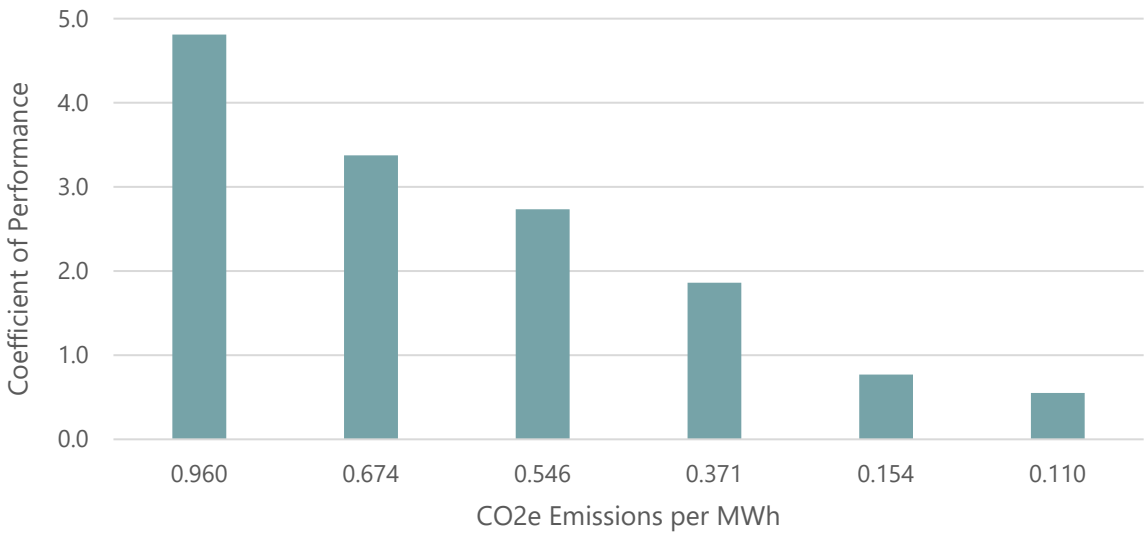


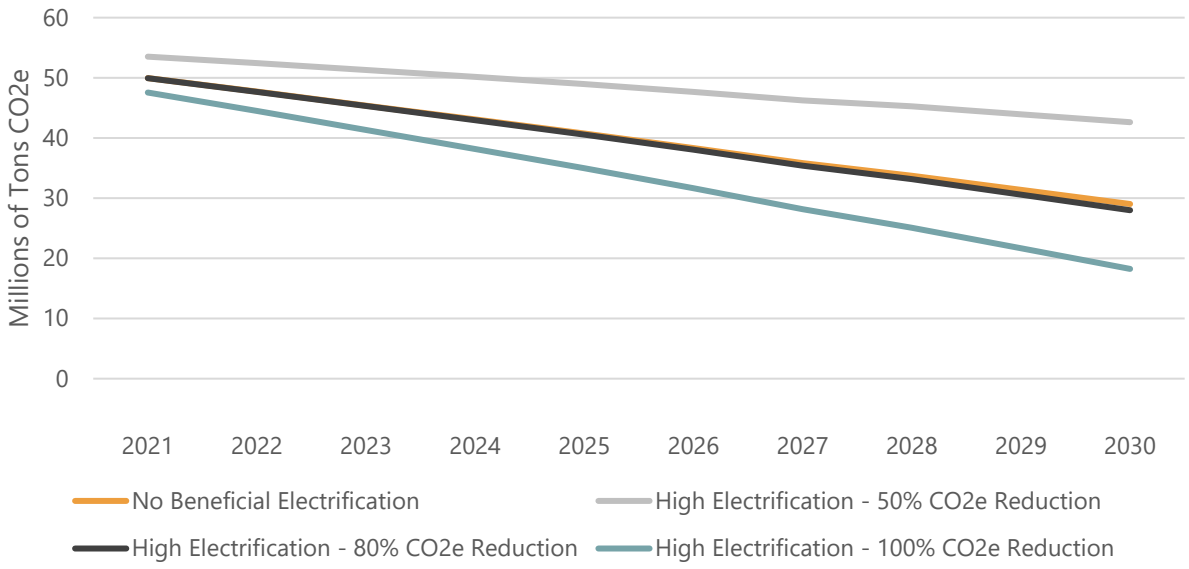
Figure 4-8 illustrates that were Colorado to maintain its 2005 electricity emissions rate (estimated at 0.960 tons of CO2e per MWh), a heat pump would require a coefficient of performance[37] (COP) well above even modern heat pumps—a COP of 4.8. The 2018 emissions rate (estimated at 0.674 tons of CO2e per MWh), were it to be constant for the life of an electrical appliance, allows for a COP of 3.4 as a break-even efficiency, a more realistic break-even number for modern heat pumps (though still high). GDS estimates that in 2021, the Colorado emissions rate will be 0.546 tons of CO2e per MWh in the Base Case, allowing a heat pump to achieve a COP of 2.7 were the emissions rate to be maintained over the life of the measure – an achievable efficiency for many cold-climate

[37] The coefficient of performance (COP) describes how much heat energy is provided by a heat pump relative to the amount of electrical energy input. It shows that a heat pump can provide an efficiency greater than 100 percent. In contrast, electric resistance heat is approximately 100 percent efficient, indicating a COP of 1.0.

heat pumps and strong indicator that with ongoing decarbonization of the electricity grid, electrification with heat pumps will be broadly beneficial.

Overall, the presence of beneficial electrification can have an important, though modest, effect on emissions over the 2021-2030 timeframe. The much larger effect is on the underlying decarbonization of the electricity grid. To understand the relative importance, GDS applied the assumptions regarding the adoption of beneficial electrification under the Base Case – an 80 percent reduction in electricity grid emissions – to the other two decarbonization scenarios. In all three cases, the combined statewide emissions from natural gas, propane, and electricity consumption decline. The minor difference between the High Electrification scenario and the Base Case illustrates that, regardless of the electricity decarbonization scenario, electrification poses limited risk in unintendedly increasing overall statewide carbon emissions over the next decade.

FIGURE 4-9 TOTAL CO2E FROM NATURAL GAS, PROPANE, AND ELECTRICITY CONSUMPTION



The more substantial benefit of electrification can be expected to occur after 2030. Indeed, our modeling indicates that the High Electrification Scenario could reduce Colorado's net cumulative emissions by over 3.5 million short tons of CO2e by the end of 2030, assuming the Base Case 80 percent reduction in CO2e. However, over the lifetime of the measures that would be installed by

the end of 2030, the reduction in emissions total over 16 million tons of CO2e.[38] While Figure 4-9 shows a smaller impact by 2030, reaching that level of electrification has substantial impacts beyond 2030 due to the ongoing emissions effects of measures installed from 2021 through 2030, all of which would be expected to continue operating and reducing net CO2e emissions beyond 2030.

Overall, the results for the High and Moderate Electrification scenarios model annual adoptions to approach or exceed current mature natural gas energy efficiency programs by 2030. The High Electrification scenario estimates that in 2030, that year's addition of beneficial electrification technology impacts approximately 1.1 percent of the estimated Base Case natural gas sales. The Moderate Electrification scenario estimates that 0.7 percent of 2030 natural gas sales are impacted by beneficial electrification technology being adopted in 2030. The Moderate Electrification Scenario aligns with Xcel Energy's 2019-2020 natural gas energy efficiency program targets.[39] Over the 2021-2030 decade, the beneficial electrification adoption model rises to these levels, with later years in the decade approximating a mature natural gas energy efficiency program and earlier years reflecting growth in market preparation, awareness, and acceptance.

Below we describe the details of each sector-level analysis with more granular breakouts that describe end-use or subsector estimates of beneficial electrification potential and adoptions.

4.3 END-USE SHARE OF ELECTRIFICATION

In our analysis and forecasting we found two key end-uses that can contribute to the vast majority of beneficial electrification impacts from 2021-2030—space heating and water heating in existing residential and commercial buildings. These two end-uses are key consumers of natural gas and propane, constituting 46 percent (space heating) and 31 percent (water heating) of fossil fuel

[38] This assumes that all further electrification efforts cease and only the equipment installed by the end of 2030 continues to operate—a conservative view. Emissions reduction would be far higher were electrification efforts to continue and grow.

[39] https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Regulatory%20Filings/DSM-Plan.pdf

reduction in the High Electrification scenario. New construction of residential and commercial buildings is also an important source of building electrification, covering 13 percent of fossil fuel savings. For new construction, the end-uses are dominated by space heating and water heating end-uses. Table 4-3 compares the results across end-uses in 2030.

TABLE 4-3 END USE CONTRIBUTIONS TO BENEFICIAL ELECTRIFICATION IN 2030 – HIGH ELECTRIFICATION SCENARIO

	MMBtu Savings in 2030	Percent of 2030 MMBtu Savings
Existing Residential and Commercial Buildings	17,111,844	81%
Space Heating	9,728,356	46%
Residential	6,972,454	33%
Commercial	2,755,902	13%
Water Heating	6,645,575	31%
Residential	5,451,695	26%
Commercial	1,193,880	6%
Other Existing Residential and Commercial End-Uses	737,913	3%
Residential and Commercial New Construction	2,854,502	13%
Industrial	1,231,554	6%
Total	**21,197,900**	**100%**

In addition to the construction of new buildings, we also expect that the industrial sector will adopt heat pumps for water heating and space heating. Modeling for the industrial sector did not attempt to break-out end uses.

Underpinning the analysis of beneficial electrification in Colorado are effects on end-uses for the residential, commercial, and industrial sectors. Below we describe the results for each sector's analysis, drawing out the more granular results that lead to the aggregated results presented above.

4.4 RESIDENTIAL SECTOR RESULTS

GDS analyzed the potential for beneficial electrification by investigating space heating, water heating, clothes dryers, and cooking end-uses. For existing homes, we modeled the cost-effectiveness and adoption of measures whether replaced at the end of their useful life or if a consumer decided to replace working equipment that still had one-third of its life remaining. The analysis also considered cost-effectiveness factors for all-electric new homes, multifamily dwellings, and if a low-income household adopted a beneficial electrification technology.[40] For multi-family homes, the EIA data did not indicate any presence of propane use. As such, multi-family homes were only modeled for natural gas savings.

At a high level, GDS found that many space heating and water heating beneficial electrification technologies are cost-effective. Additionally, we observed that there is not a major distinction between the mTRC results and the consideration of whether a household may be low-income or not. While there are some specific exceptions (described below, in the end-use category discussion), it leads to the conclusion that the non-energy benefit resource multiplier used for low-income households is not a major driver determining cost-effectiveness of beneficial electrification. This is not to say that low-income households may not receive higher non-energy benefits from electrification—simply that those benefits do not drive cost-effectiveness conclusions about any given technology or purchase condition. As a result, the overall potential for electrification is split between low-income and non-low-income proportional to the current population in Colorado.

Table 4-4 presents the results of our beneficial electrification achievable potential analysis for the residential sector for both the High Electrification and Moderate Electrification scenarios, differentiating results between low-income and non-low-income households. The new construction segment is included to add context to the relative percentages but was not

[40] Under the modified TRC test, low-income households received a multiplier of 1.5 of the value of gas savings, reflecting recent Colorado treatments of non-energy impacts. Non-low-income households receive a non-energy benefit multiplier of 1.2. This is described in the Technical Appendix.

differentiated by income category. Additionally, the modeling did not include new homes with propane in the forecast of new construction electrification opportunities. For natural gas, low-income households have an opportunity to provide between 20 and 25 percent of the fossil fuel energy savings potential by the end of the decade.

TABLE 4-4 CUMULATIVE RESIDENTIAL POTENTIAL BY INCOME AND NEW CONSTRUCTION, 2030

	HIGH ELECTRIFICATION		MODERATE ELECTRIFICATION	
Household Type	**Natural Gas**	**Propane**	**Natural Gas**	**Propane**
Non-Low-Income	58%	79%	56%	79%
Low-Income	23%	21%	23%	21%
New Construction	19%	N/A	20%	N/A
Total	100%	100%	100%	100%
MMBtu reduced, 2030	14,452,607	1,171,196	7,551,499	636,751
Cumulative 2030 Total CO2e net reduction (short tons)[41]	2,567,351		1,537,356	
Measure Life Total CO2e net reduction (short tons)[42]	12,461,592		6,454,545	

We found that residential new construction using all electric homes could contribute to approximately 20 percent of natural gas electrification savings. The remaining 80 percent of savings come from existing homes, differentiated by their income categories in Table 4-4, above.

Table 4-5 presents the relative share of natural gas and propane savings by residential end-use. The study shows that space heating is the largest contributor to savings potential for both natural gas and propane homes, with water heating providing considerable savings opportunities. Our

[41] CO2e emissions are presented as the aggregate of propane and natural emissions using tons per MMBtu emissions factors. Those factors are 0.05849 MMBtu/ton of natural gas and 0.06775 MMBtu per ton of propane. Net emissions factor the changing electricity grid profile over time through 2030 using the Base Case emissions rate changes, found in the Technical Appendix.

[42] Measure life CO2e reductions are reductions associated with beneficial electrification measures installed through 2030, but with emissions effects counted for the life of the measures, which extend beyond 2030.

analysis finds that clothes dryers and cooking appliances can provide *some* electrification opportunities but are not major sources of electrification potential in either the High or Moderate Electrification scenarios. As noted above, new all-electric homes could provide approximately 20 percent of the residential sector's electrification potential for natural gas but are not considered for propane savings due to uncertainty regarding the expected number of propane heated new homes. This is not to say that new homes that would otherwise use propane cannot contribute electrification benefits, but rather could not be modeled with the available data across the ten-year period.

TABLE 4-5 CUMULATIVE RESIDENTIAL POTENTIAL BY END-USE AND NEW CONSTRUCTION, 2030

	HIGH ELECTRIFICATION		MODERATE ELECTRIFICATION	
Existing End-Uses	**Natural Gas**	**Propane**	**Natural Gas**	**Propane**
Clothes Dryers	0.4%	0.4%	0.4%	0.4%
Cooking	2%	3%	2%	3%
Space Heating	44%	56%	45%	56%
Water Heating	34%	40%	32%	40%
New Construction	19%	N/A	20%	N/A
Total	100%	100%	100%	100%
Cumulative MMBtu through 2030	14,452,607	1,171,196	7,551,499	636,751

The GDS modeling found that a substantial share of Colorado homes could be expected to adopt beneficial electrification in either the High Electrification or Moderate Electrification scenarios. For the High Electrification scenario, the modeling revealed the following approximate numbers across single family and multifamily dwellings:

- Over 142,000 homes adopting heat pumps for space conditioning
- Over 195,000 homes adopting heat pump water heaters
- Nearly 78,000 homes switching from gas or propane to induction cook tops
- Just over 27,000 homes adopting heat pump clothes dryers
- Just under 30,000 all-electric new homes, with about 80 percent being single family

While these counts are not specific expectations, they are the result of the modeling across multiple residential end-uses.

GDS analyzed the modeling results to draw out the relative savings coming from single family and multifamily homes. GDS was unable to obtain data to address the presence of propane in multifamily homes, and as explained above, new homes of any type. We modeled propane under the assumption that all existing propane homes were single-family existing homes. Table 4-6 describes the annual savings of natural gas between single-family and multi-family homes, reflecting the number of measures that were modeled to have been installed by the end of 2030.

TABLE 4-6 CUMULATIVE RESIDENTIAL POTENTIAL BY HOME TYPE, 2030

Home Type	High Electrification Natural Gas Only	Moderate Electrification Natural Gas Only
Existing Homes		
Single Family	66%	66%
Multi-Family	14%	14%
New Homes		
Single Family	15%	16%
Multi-Family	4%	4%
Total	**100%**	**100%**
Total Cumulative MMBtu	**14,452,607**	**7,551,499**

Below we describe our findings related to each end-use and present findings that reflect on nuances within each end use, home type, or income category.

4.4.1 Clothes Dryers

GDS modeled the opportunity for beneficial electrification to replace clothes dryers with either electric resistance clothes dryers or heat pump clothes dryers. We found the following:

- Heat pump clothes dryers were cost-effective across all scenarios with two exceptions: early replacement of natural gas clothes dryers in non-low-income single family or multi-family

households. These two exceptions were nearly cost-effective in 2021 and were found to be cost-effective by 2026.

- For propane (LP) [43] users, we only modeled the cost-effectiveness of clothes dryers for single family homes, but found any scenario to be highly cost-effective, implying cost-effectiveness for multi-family homes as well.
- We modeled electric resistance clothes dryers assuming an ENERGY STAR® certified clothes dryer was being installed. For those with a propane fueled clothes dryer, the electric resistance option was cost-effective, but less so than the heat pump clothes dryer.
- Electric resistance clothes dryers did not pass cost-effectiveness when replacing a natural gas-fired clothes dryer for any early-replacement scenario. For a natural gas dryer being replaced at the end of its useful life with an ENERGY STAR electric resistance clothes dryer, this measure passed cost-effectiveness, but by a very slim margin.

We attribute the analysis results to two major factors:

- Low prices for natural gas limit some opportunities, while higher cost LP makes any electrification of clothes dryers beneficial.
- Heat pump clothes dryers use substantially less electricity than electric resistance clothes dryers, creating lower impacts to the electric grid and reducing electricity consumption relative to electric resistance options. Being cost-effective for nearly all cases, heat pump clothes dryers may be the preferred beneficial electrification option over electric resistance dryers.

4.4.2 Cooking

GDS modeled the cost-effectiveness of using induction-style cooktops compared to cooktops that use natural gas or LP. In all cases, an induction cooktop was found to pass cost-effectiveness. While electric resistance cooktops are common, induction cooktops operate more efficiently and have many similar qualities in the cooking experience as natural gas or LP (e.g. temperature control). Induction cooktops also offer the safety of not having a hot surface by only creating heat

[43] Liquefied Petroleum

within the cookware, not on the stove itself. Due to these features, we assumed that the adoption of electric resistance cooktops was not the right comparison for electrification, with induction cook-tops the better option for considering adoption across the residential segment.

In short, induction cooktops offer a cost-effective beneficial electrification option that appears to be cost-effective for the residential market. It also offers an electrification benefit compared to electric resistance cooktops in addition to other non-energy factors, such as safety and, compared to electric resistance cooktops, an improved cooking experience. That said, electric resistance cooktops should not be fully rejected as an option for beneficial electrification, however, their adoption rate may be lesser than induction cooktops which offer greater non-energy benefits.

4.4.3 Existing Homes Swimming Pool Heating

Residential swimming pools are not common. However, for homes that heat their pools, pool heaters can be substantial consumers of energy. GDS analyzed the opportunity to switch residential pool heaters from natural gas heaters to heat pumps. This option was not found to be cost-effective. In this scenario, we assumed that pools were already taking advantage of other efficiency technologies, such as covers, reducing the heat loss from the pool. For a residence that heats a pool with LP, we expect that shifting to a heat pump would be cost-effective. However, without greater information on the current market saturation of LP-heated residential swimming pools we were unable to include such an analysis in the study to reach a conclusion about the technical, economic, or achievable potentials.

4.4.4 Existing Homes Water Heating

Water heating is the second highest consumer of natural gas or LP in a typical home. The opportunities for beneficial electrification include either using an electric resistance water heater, a very common and inexpensive type of water heater, or a heat pump water heater. Heat pump water heaters use approximately one-half to one-third of the electricity to heat water compared to an electric resistance water heater. GDS modeled both technologies to understand the relative cost-effectiveness and potential for beneficial electrification adoption. We considered the factors

of single family compared to multifamily options, as well as low-income and non-low-income households. We also considered the tradeoffs between electrifying tank-style water heaters and instantaneous fossil fuel-fired water heaters.

We found the following results:

- Heat pump water heaters were cost-effective in nearly all cases. The exception was for cost-effectiveness in 2021 for non-low-income homes (single family or multifamily) with natural gas tank-based water heaters (either replacing early or at the end of their useful life). By 2026, that exception was no longer the case and heat pump water heaters were cost-effective regardless of income type.
- Heat pump water heaters were cost-effective compared to instantaneous water heaters in all cases.
- Heat pump water heaters were highly cost-effective when compared to any type of LP water heating.
- Electric resistance water heaters were only cost-effective for LP users. They were not cost-effective for *any* natural gas scenario.

Overall, the results suggest that heat pump water heaters are a good option for beneficial electrification in the residential sector. Caution should be taken with electrifying using electric resistance water heaters due to cost-effectiveness consideration for natural gas users and potential impacts on the electricity grid. Electric resistance water heating technology is common and can be part of a utility's demand response program. Some speculate that electric resistance technology may be useful to consider as a medium of energy storage to utilize variable renewable power sources. Many of these same features can be found in heat pump water heaters, though with a lower time-sensitive effect and with greater sensitivity to cycling than with electric resistance technology. However, over the next ten years, the relatively modest adoption mitigates any near-term grid management considerations. Individual utilities may find different conclusions about the value of electric resistance water heaters based on their specific needs and the use of residential water heaters in demand response programs.

4.4.5Existing Homes Space Heating

GDS based its analysis of residential space heating cost-effectiveness on IECC Climate Zone 5 (CZ5), where fully 93.5 percent of Coloradoans live[44] as shown in Table 4-7 below. CZ5 spans most of the Front Range and eastern plains as well as six counties in the western half of the state. Climate zone 4 (CZ4) is located in the far south eastern portion of the state, with the central mountain region being made of up mostly Climate Zone 6 and 7 (CZ6 and CZ7), with several western counties also being in CZ6. There is limited information on the relative uses of LP compared to natural gas by climate zone, making it difficult to estimate the potential and adoption by climate zone. CZ5 is large enough that it can be used for representing the overall state.

TABLE 4-7 COLORADO 2018 POPULATION AND EXAMPLE LOCATIONS BY CLIMATE ZONE

IECC Climate Zone	2018 Population	Percent of CO Population	Example Cities or Counties
CZ4	36,398	0.6%	Otero, Baca, Las Animas
CZ5	5,324,653	93.5%	Denver, La Plata, Pueblo
CZ6	63,052	2.9%	Moffat, Chaffee, Conejos
CZ7	170,208	3.0%	Park, Jackson, Rio Grande

Other than total populations, GDS was unable to obtain information related to climate zone-based population factors. This includes the factors of low-income households, multifamily and single-family households, the amount of residential new construction in each climate zone, and the relative use of gas or LP in each climate zone. While state-level data was available for these factors, the use of CZ5 as the basis for cost-effectiveness allows for statewide factors to be applied to CZ5 to best represent an analysis of the statewide potential for beneficial electrification of space heating. GDS completed an analysis on the additional climate zones to analyze the relative effects of electrifying space heating in those climate zones, presented below.

[44] GDS combined information on county populations from the Colorado State Demography Office, Vintage 2018, prepared October 2019 and Pacific Northwest National Labs, "Guide to Determining Climate Regions by County," August 2015 https://www.energy.gov/sites/prod/files/2015/10/f27/ba_climate_region_guide_7.3.pdf

RESULTS

Within CZ5, GDS modeled over 136 combinations of technology and market considerations. For the technologies, these included:

- A home with a furnace being replaced with a cold-climate central heat pump
- A home with a boiler being replaced by a cold-climate central heat pump
- A minisplit-style heat pump providing 100 percent of space heating needs, compared to a furnace
- A dual-fuel home using a minisplit-style heat pump to partially offset a furnace
- A ground source heat pump to provide 100 percent of space heating (single-family only)

These five technology options were analyzed with break-outs across the following factors:

- Single-family and multi-family
- Low-income and non-low-income households
- Early replacements and end-of-life replacements of HVAC equipment
- Natural gas and LP
- Homes with and without air-conditioning

The combinations present many potential applications of heat pumps for space heating. In the case of the ground source heat pump, these were not analyzed for an existing multi-family building due to uncertainty regarding the potential logistics of installing such a system. This is not to say that such opportunities do not exist, simply that we were unable to reasonably model it for purposes of identifying the potential.

The analysis led to the following results:

- For LP users, all 40 space heating cases were found to be cost-effective. Quite simply, the cost of LP overcomes any other considerations for purposes of the cost-effectiveness test. The results are strongly positive, with the ground source heat pump exhibiting the lowest cost-effectiveness ratio (but still over 1.5 for a non-low-income household without air-conditioning)

RESULTS

- Natural gas heated homes *without air-conditioning* are not cost-effective for electrifying their space heat. The savings associated with improved air-conditioning efficiency are key to electrifying space heating
- Ground source heat pumps in single-family homes with natural gas heat and air conditioning achieve a benefit-cost ratio over 1.0 by 2026, regardless of the presence of air-conditioning. Their cost-effectiveness in multifamily buildings is unknown but may be cost-effective as the cost of the in-ground portion of the system and other associated expenses are spread across multiple households
- For natural gas heated homes *with air-conditioning*, all combinations of technologies were found to be cost-effective, with air-conditioning efficiency savings tipping the technology options into being cost-effective in contrast to their counterparts without air conditioning.
- Of the natural gas heated homes with air-conditioning, the *least* cost-effective scenario was found to be for the use of a minisplit heat pump to provide *supplemental* heat when a furnace needed to be replaced. This is due to the need to consider the cost of the furnace as a portion of the overall equipment cost. The implication is that when a furnace needs to be replaced, it is more cost-effective to simply install a heat pump instead of a furnace.

Overall, the analysis found that over 2021-2030, many existing Colorado homes could be changed to heat pumps under many technology and market conditions using the mTRC cost-effectiveness test and social cost of carbon. For homes without air-conditioning, electrification is not cost-effective, pointing out the critical link between the overall efficiency of a home's HVAC system and the linkage of electrification to efficiency considerations.

4.4.6 New Homes

GDS investigated the cost-effectiveness of new homes to be built with all-electric space heating, water heating, cooking, and other end-uses. We assumed that such a new home would be designed with an all-electric condition in mind, eliminating the need for natural gas supply as well as a natural gas meter. For both natural gas and LP, we further assumed that indoor piping was not included in the design or costs. Overall cost savings are found by not having to run any natural

gas piping by the host utility and that a builder would not have to charge for installing natural gas or LP pipes in the home. Due to data limitations, we did not forecast the potential of all-electric new homes that would otherwise be fueled by LP, but did conduct an economic analysis under the mTRC to understand the implications for LP savings.

Based on general industry research and anecdotal information provided from discussion with Colorado utilities, we assumed the following cost savings associated with an all-electric new home:

- $2,000 associated with utility and property installation of natural gas pipes and meters (natural gas homes only)
- $1,000 associated with installing indoor pipes to distribute natural gas or LP to end-uses

These cost savings reduce the incremental cost of electrification technologies—the same general technologies described above for existing homes, with the exception of a heat pump that only meets a portion of a home's space heating needs (and would therefore need a natural gas or propane supply). Should a new home be constructed to *partially* electrify, the cost conditions and considerations for a new home installing measures at the end of the existing measures useful lives would apply, a consideration we did not analyze separately for new homes.

The overall conclusions regarding new homes include:

- All-electric new single-family homes without air-conditioning (we expect a very rare likelihood) are not cost-effective for electrification unless the home would otherwise be heated with LP.
- We found that new multi-family homes heated with natural gas and without air-conditioning were slightly cost-effective. We expect this condition to be exceedingly rare. They were not included in the potential results.
- All-electric new homes with air-conditioning are cost-effective for single-family and multifamily homes. This is an area of substantial opportunity and represents 20 percent of the 2030 cumulative residential electrification potential. As with existing homes, it points to the importance of air-conditioner efficiency savings

For modeling the potential for all-electric residential new construction, we did not apply any potential to homes that would be served by LP, regardless of cost-effectiveness. The volume of residential LP consumption for existing homes is relatively small compared to natural gas. Further, GDS was unable to obtain data indicating a reasonable forecast for how many new homes may be constructed in Colorado that would be served by LP. As such, we elected to omit that potential in the estimate, but do find that they would be cost-effective due to the relative cost-effectiveness of all-electric homes that would otherwise use natural gas - an indication of a general opportunity.

4.4.7 Climate Zone Considerations for the Residential Sector

GDS analyzed how space heating results may differ across Colorado's climate zones. Rather than attempt to reanalyze all 136 combinations across three different climate zones, GDS tested the sensitivity to cost-effectiveness for a single natural gas measure that was cost-effective in CZ5. As noted above, nearly all technology and cases of single-family and multi-family homes were found to be cost-effective *if they had air-conditioning*.

We selected the case of a single family, non-low-income home, replacing their HVAC equipment early (1/3 of the useful life remaining). The electrification technology was a central heat pump providing 100 percent of space heating needs with a 16 seasonal energy efficiency rating (SEER) rating and 9.0 HSPF[45]. An early replacement is the *worst case scenario* from an economics standpoint, with the need to consider the full cost of the new equipment only being offset by the present value of the future expenditure of replacing the existing system. We found that there was little difference in the mTRC results, with results varying by +/- 0.02 across the climate zones.

The outcome of this climate zone analysis indicates that the results for CZ5 are generally applicable to all four of Colorado's climate zones. Given the prevalence of CZ5 for Colorado's population, the overall effect of differences in energy consumption are minor across the climate zone. There is some potential that system sizing may result in somewhat different cost elements, with system design considerations tailored to each climate zone being a consideration beyond

[45] HSPF (heating seasonal performance factor)

the scope of this study. In general, changes in system sizing will affect both the natural gas system and heat pump system, somewhat offsetting each other. While more research may be appropriate for the myriad housing conditions and locations found throughout Colorado, we believe that with the general results found for CZ5, the results are appropriate to apply broadly to Colorado's residential sector.

4.5 COMMERCIAL SECTOR RESULTS

GDS analyzed the potential for beneficial electrification in the commercial sector by investigating space heating, water heating, clothes dryers and commercial kitchen electrification opportunities, as well as swimming pool heating. GDS used the latest Commercial Buildings Energy Consumption Survey[46] to understand the relative share that major end-uses have for natural gas and propane energy consumption in commercial buildings. Table 4-8 describes the share of natural gas and propane consumption associated with major end-uses.

TABLE 4-8 END USE SHARES OF BUILDING ENERGY CONSUMPTION

End-Use	Natural Gas	Propane
Space Heating	55%	45%
Water Heating	14%	23%
Cooking	28%	26%
Clothes Dryers	2%	6%
Pool Heating	1%	1%

Space heating, water heating, and cooking are the largest uses for natural gas and propane. Below we describe the findings for each end-use. For new construction, our model applied the same factors as an end-of-life replacement option. There is no distinction in the energy or cost criteria for new construction, with GDS not applying cost savings associated with an "all-electric new commercial building" due to wide ranges of possibilities regarding natural gas connection costs and internal natural gas or LP piping.

[46] https://www.eia.gov/consumption/commercial/data/2012/ the West Mountain region was used for natural gas, while the propane share of end-use consumption used the West region.

RESULTS

Table 4-9 summarizes our results for the commercial sector's existing buildings electrification potential by end-use, with cumulative results in 2030. Electrifying space heating is the dominant opportunity - nearly two-thirds of the beneficial electrification opportunity is space heating. Natural gas water heating represents the next largest opportunity, making up 28 percent of the estimated natural gas savings electrification adoptions. Commercial cooking equipment makes up the balance of natural gas savings at approximately seven percent of the reduction in natural gas consumption.

For propane customers, space heating is also the dominant opportunity due to the relative cost-effectiveness of electrifying space heating for commercial building propane users. Water heating also provides a substantial share of the propane savings. Due to measure cost-effectiveness, switching from propane cooking equipment to electricity makes up 15 percent of the share of propane savings.

TABLE 4-9 CUMULATIVE ANNUAL SAVINGS FOR EXISTING COMMERCIAL BUILDINGS, 203047

	HIGH ELECTRIFICATION		MODERATE ELECTRIFICATION	
Commercial End-Use	**Natural Gas**	**Propane**	**Natural Gas**	**Propane**
Existing Buildings				
Clothes Dryers	0%	1%	0%	1%
Cooking	7%	15%	7%	15%
Pool Heating[48]	0%	1%	0%	1%
Water Heating	28%	27%	28%	27%
Space Heating	65%	57%	65%	57%
Total MMBtu Existing Buildings	1,761,613	331,353	957,746	180,149
Cumulative 2030 Total CO2e net reduction (short tons)	970,422		618,766	
Measure Life Total CO2e net reduction (short tons)[49]	2,968,221		1,575,106	

For new commercial buildings GDS only modeled natural gas buildings. No information was available about the potential for new commercial buildings that would use propane. To arrive at the underlying natural gas consumption of new commercial buildings, we utilized Xcel Energy's forecast of new commercial accounts and applied the average 2018 natural gas consumption of existing commercial accounts to approximate how much natural gas the forecasted accounts would use.[50] This volume of natural gas was extrapolated to the state level by using the share of commercial natural gas sales associated with Xcel Energy and assuming the share and growth over the decade would apply across the state.

[47] Column totals may not add to 100 percent due to rounding
[48] We do not present a section on swimming pool heating. While it was found to be cost effective to switch from a LP swimming pool heater to a heat pump it was not so for natural gas.
[49] Measure life CO2e reductions are reductions associated with beneficial electrification measures installed through 2030, but with emissions effects counted for the life of the measures, which extend beyond 2030.
[50] This forecast was developed prior to COVID-19. The near and long-term effects of COVID-19 on energy markets are not reflected in this study or its approach.

RESULTS

To analyze the potential for electrifying commercial natural gas end-uses, the same existing building measures and shares of natural gas end-use loads were assumed. To model the cost-effectiveness of specific measures, we treated each measure and its incremental cost as equivalent to an "end of useful life replacement" as analyzed with existing buildings. We did not model the potential for "all-electric" commercial buildings due to uncertainty about the technical opportunity, market decisions, and cost factors associated with avoiding the expense of connecting to a natural gas supply.

The results for new commercial buildings show opportunities for the adoption of electrification technologies and natural gas savings. Some caution is warranted at over-interpreting the results. In either the High or Moderate Electrification scenario, a modest shift in the number of new commercial buildings adopting beneficial electrification could alter the results. Using the adoption curve that was applied to existing commercial buildings, a total of 52,962 MMBtu of natural gas savings in the High Electrification scenario and 28,794 MMBtu in the Moderate Electrification scenario emerged. The specific end uses indicated opportunities for cooking, water heating, and space heating. However, the end-use break-down may be less useful than the overall savings effect (these are discussed in the end-use sections, below).

GDS took a data-driven approach to modeling the opportunity for beneficial electrification in the commercial sector. However, there are multiple factors that may influence beneficial electrification that cannot be easily modeled, such as the willingness for the commercial sector to electrify more of its load. Additionally, utility forecasts for new commercial accounts may differ from our assumption about the new commercial building natural gas load (in the Base Case). As a result, this forecast provides a projection for the adoption of electrification technologies, though individual and commercial segment decisions may drive different outcomes.

Below we discuss our findings for each of the commercial building end-uses.

4.5.1 Clothes Dryers

For clothes dryers, smaller units were used to model performance under the assumption that the existing natural gas or LP equipment would be replaced at the end of its useful life (the most cost-advantageous option from an economic perspective). Clothes dryers are estimated to contribute to approximately two percent of the appliance end-use category's natural gas use and six percent of propane use. Overall, clothes dryers are a relatively small contributor to natural gas or LP consumption but do have opportunities for electrification. These include electric resistance clothes dryers and heat pump clothes dryers, with heat pump clothes dryers being a relatively recent technology available in the U.S. market. For clothes dryers we assume that the relative energy consumption ratios between natural gas or LP dryers and electric resistance or heat pump clothes dryers represents a reasonable performance and incremental cost that can be generally applied to smaller and larger clothes drying technology. As such, the conclusions regarding cost-effectiveness may apply to larger institutional clothes dryers. That said, larger commercial laundry equipment may be difficult to electrify (e.g. institutional clothes dryers) and likely has much smaller market presence for LP users. Market data and technology information related to electrifying large institutional clothes dryers were not available for this study.

We found the following:

- Neither electric resistance nor heat pump clothes dryers are cost-effective compared to natural gas clothes dryers.
- For LP users, selecting a new heat pump or electric resistance clothes dryer is cost-effective and are viable beneficial electrification options.

For LP fueled clothes dryers, we expect that the market for clothes dryers tends to emphasize the smaller models of clothes dryers that were modeled, rather than large institutional clothes dryers that might be found in hotels or other institutional settings. Further research may be warranted to understand the potential for electrifying natural gas clothes dryers in institutional settings.

4.5.2 Cooking Equipment

Cooking in the commercial sector is a large consumer of energy. Approximately 28 percent of natural gas and 26 percent of propane use in the commercial sector is associated with cooking equipment. GDS modeled a variety of commercial cooking equipment based on current ENERGY STAR options for commercial cooking equipment. The measures include griddles, ovens, fryers, and steam cookers. For early replacement options, we assumed a commercial kitchen would replace a standard efficiency unit with an ENERGY STAR electric unit. For end-of-life or new construction equipment, we compared the ENERGY STAR natural gas unit performance to an ENERGY STAR electric equivalent.

We found the following:

- Switching from LP to electricity is cost-effective for each case of cooking equipment we analyzed. However, replacing a combination oven before the end of its useful life (or as new construction) marginally passes the mTRC test, suggesting some caution.
- For natural gas commercial customers, steam cookers are cost-effective for both early replacement and end of useful life (or new construction) installations. A combination oven replaced at the end of its useful life was also cost-effective for natural gas users.
- For natural gas customers, installing an ENERGY STAR electric version of a griddle, convection oven, or fryer was not cost-effective. Neither was the installation of a combination oven being replaced before the end of its useful life.

While GDS included all cost-effective measures in its estimate of the economic, High Electrification, and Moderate Electrification potentials, some caution may be warranted for some cooking measures. Many commercial chefs prefer to cook with natural gas and LP. The benefits include careful control of heat and general familiarity with how the equipment will affect food. While GDS applied its adoption rate approach to the cost-effective commercial cooking measures, overcoming hurdles related to current practices and familiarity may be key to achieving adoptions. While this is true of all beneficial electrification measures, it may be particularly important for

cooking due to the direct engagement by professionals in using natural gas and LP equipment for their trade.

4.5.3 Water Heating

Water heating for domestic uses is a large consumer of natural gas and propane in the commercial sector. Approximately 14 percent of natural gas and 23 percent of propane consumption in the commercial sector is associated with heating water. We modeled the opportunity for beneficial electrification to impact water heating by focusing on commodity tank-based and instantaneous natural gas or LP water heaters to compare to heat pump water heaters and electric resistance water heaters. These commodity water heaters are estimated to consume 94 percent of the commercial market's water heating energy use.[51] Larger systems that rely on boilers were not considered due to uncertainty regarding cost and technology applicability.

We found that:

- Replacing LP water heaters with either electric resistance or heat pump water heaters was cost-effective in all combinations of the baseline water heating equipment. Whether an LP water heater would be replaced with an electric option at the end of its useful life or before, electrification was beneficial.
- For natural gas users considering a heat pump water heater, the analysis found that all were cost-effective whether the baseline technology was a tank-style or instantaneous gas water heater being replaced before or at the end of its useful life.
- For electric resistance water heaters that would displace natural gas, the only condition that would pass cost-effectiveness testing would be if an existing instantaneous natural gas water heater were at the end of its useful life.

The implication of these results points to heat pump water heaters as being broadly applicable across natural gas and LP users in the commercial sector. The same conditions exist for a new

[51] https://www.eia.gov/consumption/commercial/data/2012/

commercial building, under which we assumed the same conditions as a water heater being replaced at the end of its useful life.

Some caution is warranted regarding promoting electric resistance water heaters under beneficial electrification; the cost-effective conditions are not universal. Some utilities include these water heaters in their demand response program as they can offer a form of thermal energy storage. Additionally, there is speculation that with high penetration of variable renewable energy systems on the electricity grid, electric resistance water heaters may be able to be used to absorb excess renewable energy, using the water heater as a method of thermal storage. Our analysis did not include these considerations in modeling electric resistance water heaters.

4.5.4 Space Heating

The commercial sector is diverse in the size and nature of its space heating equipment. To model space heating, several types of fossil fuel systems were modeled to represent general conditions in the commercial building market. From these, GDS developed options for electrification that included replacing smaller residential-sized equipment, packaged roof-top equipment, and systems often found in larger facilities, such as those using central boilers. For smaller systems, we analyzed both early replacements and end-of-life replacements. In the case of roof-top dual fuel packaged systems, we assumed an end-of-life replacement at the time the air-conditioner failed. Larger central systems with boilers were considered for end-of-life replacements. We acknowledge that the analysis does not capture all possible forms of space heating in commercial buildings. New technologies are emerging, such as large variable refrigerant flow systems, which may be suitable for new construction. At this point, the costs and design considerations are not generalizable enough to the broad commercial sector. Further research may be warranted for the commercial sector to understand customer or building-type-specific designs. To address the ongoing innovation in heat pump space heating equipment and diversity of the commercial sector, GDS assumed that cost-effective solutions would be available and adopted over the decade, allowing the share of commercial space heating to experience electrification potential and adoptions not reflected in specific technology cases.

RESULTS

As with the residential sector, we focused on climate zone five (CZ5). As described in the residential space heating section, above, CZ5 is home to 93.5 percent of Coloradoans. We assume that a similar level of commercial activity takes place in CZ5, making it a key area for beneficial electrification cost-effectiveness analysis. We did analyze climate zones 4, 6, and 7 for the same technologies and include a discussion on the results, below. However, for purposes of forecasting the statewide technical, economic, and High and Moderate Electrification scenarios, we only applied the results of CZ5.

We modeled 12 packages of space heating technologies and market conditions for both natural gas and LP. For natural gas, we also applied a generalized cost-effective assumption to space heating heat pumps (LP technology cases were generally cost-effective). These technology packages are listed below, in Table 4-10.

TABLE 4-10 COMMERCIAL SECTOR SPACE HEATING TECHNOLOGY PACKAGES

Baseline Technology	Electrification Technology
Central Air-Forced Furnace with DX cooling[52]	Central Heat Pump – 100% heating
Central Air-Forced Furnace with DX cooling	Central Heat Pump – 80% heating displacement
Central Air-Forced Furnace with DX cooling	Minisplit Heat Pump – partial displacement
Central Air-Forced Furnace with DX cooling	Ground Source Heat Pump – 100% heating
Roof-top unit with DX cooling and gas heat	Dual fuel heat pump with furnace – 60 MBH heat pump, 150 MBH furnace
3,500 MBH (thousand Btu per hour) boiler with 200 ton central water cooled chiller	200 ton water source heat pump with 2,800 MBH boiler
1,750 MBH boiler with hot water radiators, no cooling load	Ductless heat pumps with partial displacement (80%) of heat with cooling load added
3,500 MBH boiler with 200 tons DX cooling	Ground source heat pump
80% AFUE natural gas furnace	Generalized heat pump displacing 100% of natural gas use (COP = 2.5)
80% AFUE natural gas furnace	Generalized heat pump displacing 85% of natural gas use (COP = 3.0)

These are examples of many types of possible baseline technologies that could be found in the commercial sector and are potentially electrifiable. Within the commercial sector, packaged roof-top units (RTUs) are very common. EIA estimates that 42 percent of commercial sector space heating use comes from packaged systems. Our modeling of the roof-top unit being converted to a dual-fuel heat pump with partial displacement is meant to analyze an off-the-shelf technology that is broadly applicable to the commercial sector. These measure mixes are intended to capture the overall trade-offs of operational conditions and cost factors that may generally be available by electrifying commercial space heating. They should not be thought of as specific recommendations or the only possible mix of technologies. The generalized heat pump option captures the assumption that cost-effective adoptions will occur over the decade.

[52] DX cooling refers to "direct expansion" cooling. Direct expansion cooling is a common style of air conditioning. Refrigerant in pipes is used to directly cool air. It is found in residential and commercial air conditioners. The alternative approach is to use a chiller in which water or coolant is first chilled by the refrigerant before conditioning the air.

Our modeling revealed the following results:

- For natural gas, only one specific technology passed the cost-effectiveness test: a minisplit heat pump introduced at the end of an air-conditioner's useful life. In this scenario, the existing furnace continues to provide space heat at the coldest temperatures, while the minisplit heat pump is sized to provide space cooling. As an end-of-life replacement for the air conditioner, this measure nearly passes cost-effectiveness.
- The packaged dual fuel roof-top unit (RTU) nearly passes cost-effectiveness for natural gas displacement when replacing an end-of life RTU. As noted above, packaged systems are very common in the commercial sector and worthy of further research and technology development.
- In contrast to natural gas, most instances of the commercial heating measures using LP were cost-effective, for all end-of-life or early replacement conditions. The exceptions were the large boiler systems. We expect that those are exceedingly rare for LP users, though have no market data to confirm whether that is the case.
- Air-conditioning savings matter. Moving to a modern cold climate high performance heat pump offers air-conditioning energy savings to the commercial sector, just as it does the residential sector. This points out the important linkage between the electrification of space heating and air-conditioning energy efficiency. In all the scenarios, base-case air conditioners were assumed to have a SEER of 13, with modern heat pumps having substantially higher SEER ratings, particularly minisplit heat pumps.

4.5.5 Climate Zone Considerations for the Commercial Sector

GDS modeled the above technologies for all four of Colorado's IECC climate zones. Xcel Energy's Denver equivalent full load hours were scaled to these climate zones by the ratio of heating degree days and cooling degree days (base 65) for the La Junta weather station (CZ4), Eagle weather station (CZ6), and Aspen weather station (CZ7). The technical specification of the equipment were not changed, nor were the market prices. It is possible that in some cases, heating loads may require larger heat pumps or air-conditioners, a scope of analysis outside this project. The purpose

of the analysis was to investigate the relative performance one might expect and the cost-effectiveness results to identify if any climate zone indicated different results.

The following observations were found for the technology-specific packages:

- For CZ4, the dual fuel RTU became cost-effective, as did the partial displacement central heat pump (end-of-life), and both cases of partial displacement minisplit heat pumps (end-of-life and early replacement). The ground source heat pump replacing a boiler also became cost-effective. In general, CZ4 exhibited the greatest opportunity for space heating technology compared to other climate zones.
- For CZ6, the ductless minisplit providing partial heating displacement, and installed to replace an air conditioner at the end of its life was cost-effective (as with CZ5). No other natural gas systems were found to be cost-effective for CZ6. Otherwise for LP users, the same pattern as with CZ5 emerged.
- For CZ7, the results were the same as CZ5 and CZ6.

For commercial space heating, the low cost of natural gas creates a challenge for heat pumps to overcome cost-effectiveness limitations. It appears that one option is broadly applicable for commercial customers using natural gas—replacing an air-conditioner with a minisplit heat pump at the end of its useful life and using it to partially displace space heating. As a flexible technology, partial displacement minisplit heat pumps may be the best target for commercial sector electrification in the near-term. We saw that other forms of partial displacement were nearly cost-effective. The dual fuel RTU heat pump is an opportunity that may be appropriate for some cases and worthy of further investigation. Overall, large boiler systems will likely be challenging for beneficial electrification. These technology-specific observations do not discount the possibility that specific commercial customers or use-cases cannot be cost-effective. Anecdotal reports indicate some adoptions of heat pump technologies beyond what was modeled here. For this study, the anecdotal cases are challenging to extrapolate to a state-wide level. The generalized assumption that cost-effective heat pump options exist for the commercial sector and will be

adopted during the next decade captures the opportunity and adoptions that cannot be detailed at the technology-specific level.

We also found a clear opportunity for the commercial sector: LP users can broadly benefit from space heating heat pumps. This is true in any climate of the four climate zones and only excludes larger boilers and institutional settings. As such, LP users may be an important group within the commercial sector to promote space heating with heat pumps. Their early adoptions may help improve cost-effectiveness and lead to adoptions by natural gas users.

Additional electrification opportunities exist in the commercial sector, though were not specifically modeled. These include forklift electrification, truck stop electrification, airport tug electrification, and other end-uses not associated with the major end-uses we modeled. To help illustrate potential beneficial electrification opportunities, GDS developed a technology snapshot to describe one case—truck-stop electrification.

4.5.5.1 Technology Snapshot – Truck Stop Electrification

Long haul trucks, commonly class 8 trucks, typically idle for several hours a day (up to 16 hours) at truck stops or rest areas to comply with federal regulations on the number of hours that can be driven in a single day. The impact of burning one to two gallons of diesel fuel per hour has negative effects on the operating and maintenance costs of the diesel engine, as well as leading to environmental emissions. Each gallon of avoided diesel fuel combustion avoids about 135g/hr of NOx emissions and approximately 33.8 lbs[53] of CO2e during idling each hour. With the advent of anti-idling technologies and legislation (in some states) to prohibit idling, the shore power industry has developed two different technologies that are being used and demonstrated across the country:

1 Off-board systems, sometimes called stationary systems, are permanently installed at truck stops. They can be designed so that no special equipment is needed on the truck. A driver

[53] Assumes 0.0810 tons of CO2e per gallon of combusted diesel fuel, based on Climate Registry protocols and 1.5 gallons per hour consumed.

simply pulls into a designated parking spot, reaches out to an air hose and control module hanging from an overhead gantry, and inserts them into a special window template. An alternative off-board system design may require some equipment on the truck as well as on the ground. With off-board systems, the truck stop owner makes the capital investment and recoups its investment by selling services— electricity, Internet, entertainment—to the professional driver.

2 On-board systems, sometimes called mobile technologies, are installed on the truck. They generally comprise an inverter to convert 120-volt power, an electrical HVAC system, and the hardware to plug into "shore power" electrical outlets at truck stops. Some on-board systems use batteries that can either be charged by the main engine during driving, or plugged in during stops. With on-board systems, the truck owner makes the capital investment and maintains the equipment. The perceived advantage is that a driver can stop and use his or her system anywhere there is shore power.

FIGURE 4-10 EXAMPLE OF OFF-BOARD TRUCK STOP ELECTRIFICATION

Photo courtesy of US Department of Energy

Of the estimated 5,000+ truck stops in the United States, less than four percent are outfitted with the shore power electrification technology of either type. In Colorado, our research revealed only two truck stops that were registered as having shore power capability,[54] presenting a large technical potential for projects that would bridge the gap between reducing the idling of diesel vehicles today and preparing for the zero emission vehicles of the future. As the economics are the most common barrier for

[54] Based on a personal communication with the owner of allstays.com

implementation, overcoming economic hurdles is the primary challenge to drive the shore power market forward.

To maximize investments in shore power, project planning and design should include sufficient power supply infrastructure to support electric vehicle charging equipment for medium and heavy-duty vehicle applications such as transformer upgrades, trenching and conduit runs. This future-proofing of projects will enable a more economical transition to charging infrastructure as the freight sector transitions to battery electric vehicles over the next decade.[55]

4.6 INDUSTRIAL SECTOR RESULTS

The industrial sector poses a challenge for electrification, but also some opportunities. LBNL[56] cites a study by EPRI indicating that by 2030, only 3.6 percent of the United States' industrial sector has technical potential for electrification, a stark contrast to residential and commercial buildings. LBNL found that "some processes have no existing or currently available replacement," as well a lack of data regarding current industry practices and on how well new technologies will work as replacements, and uncertainty regarding the status of existing equipment that has been amortized. Two fundamental challenges are 1) the diversity and industry-specific uses for natural gas, and 2) the low cost of natural gas. From an economic standpoint, the low cost of natural gas poses a hurdle that limits the economic viability and ultimate adoptions of electrification in the industrial sector.

Nevertheless, there are opportunities. The industrial sector in Colorado is diverse. Colorado hosts a wide range of industries with substantial aggregate energy consumption. From a recent CEO report,[57] these include (among many):

- Petroleum and Coal Products

[55] The Alternative Fuels Data Center provides resources on electric vehicle charging: https://afdc.energy.gov/fuels/electricity.html.
[56] Lawrence Berkeley National Labs, "Electrification of Buildings and Industry in the United States." March 2018, p. 20 http://ipu.msu.edu/wp-content/uploads/2018/04/LBNL-Electrification-of-Buildings-2018.pdf
[57] CEO, "Industrial Energy Efficiency and Distributed Generation Opportunities in Colorado." June 2017.

- Food Processing
- Nonmetallic Mineral Products
- Chemicals
- Paper Products
- Primary Metals
- Wood Products
- Beverage Products
- Plastics and Rubber

Each of these industry types have their own specialized processes, some of which may have potential for electrification. We do expect that many of the same space heating and domestic water heating technologies from the commercial sector would apply to industrial buildings, but that their underlying share of natural gas or propane consumption is minor relative to their use of these fuels for processes.

In theory, the *technical potential* for the industrial sector is very high. LBNL (2018, p. 43) notes a number of electrification technology opportunities. These include:

- Electrolytic reduction in nonferrous metal (excluding aluminum)
- Induction heating (metal fabrication)
- Electric boilers (widespread opportunities)
- Resistance heating and melting (glass industry)
- Direct Arc Melting (iron and steel)
- Industrial process heat pumps (food, pulp and paper, and chemicals)

Other opportunities include:

- Replacing fossil fuel powered well pumps with electric pumps
- Oil and gas industry uses of methane for pumps and controls
- Ultra-violet sterilization
- Pasteurization

- Agricultural uses of power-take offs (from tractors and other on-farm equipment)

However, in 2018 EPRI concluded that "the heterogeneity of applications and individual processes makes comprehensive modeling of the industrial sector difficult."[58] As such, GDS approached the industrial sector potential for electrification from 2021-2030 with caution. Our general approach was to assume that the technical potential reflected 3.6 percent of 2030 industrial sector natural gas and propane energy consumption, referencing LBNL's 2018 estimate. LBNL further notes that approximately 2.3 percent of direct energy consumption (e.g. natural gas or propane) is a "realistic" potential. Our approach was to use the "realistic" potential as a metric for the economic potential, with the economic potential being approximately 63 percent of the technical potential.

In terms of adoption rates under the High or Moderate Electrification scenarios, we approximated a 2030 cumulative adoption. The High Electrification adoption rate was selected as half the economic potential, or 1.15 percent of natural gas and propane consumption in 2030. The Moderate Electrification scenario halved this amount again, arriving at 0.575 percent of the technical potential. For all scenarios, the annual savings percentages were extrapolated backwards in a linear fashion to 2021. For example, across the decade, we estimate that 0.36 percent of the cumulative technical potential each year (one-tenth of 3.6 percent).

This approach is conservative in modeling the potential for beneficial electrification in the industrial sector. Given the uncertainty of the availability and applicability of electrification technologies to Colorado's industrial sector, this conservative approach avoids overstating the potential of any scenario. That said, we acknowledge the conservative nature of the approach. It is possible that individual companies or industry groups may embrace electrification technologies. The result may be that higher levels of electrification are reached.

[58] EPRI, "U.S. National Electrification Assessment," April 2018, p. 36.

A second uncertainty of the industrial sector electrification efforts is the nature of the technologies that may be adopted and their effect on electricity or carbon emissions. The use of industrial heat pumps with high COPs will have greater effects on reducing carbon emissions than technologies that use electric resistance heating. To model the carbon effects of the industrial sector, we reviewed the performance of technologies for the commercial sector, noting the relationship between reductions in natural gas or propane MMBtu relative to increases in electricity consumption. These ratios (e.g. natural gas MMBtu reduction per kWh increase) were applied to the reduction in MMBtu in the industrial sector to develop an estimate of increases in electricity sales and the subsequent impact on net carbon emissions.

The end results are shown in Table 4-11, below.

TABLE 4-11 INDUSTRIAL SECTOR ELECTRIFICATION IMPACTS

	NATURAL GAS		PROPANE	
Potential	2025 Percent Sales	2030 Percent Sales	2025 Percent Sales	2030 Percent Sales
Base Case Forecast	100%	100%	100%	100%
Technical Potential	1.8%	3.6%	1.8%	3.6%
Economic Potential	1.2%	2.3%	1.2%	2.3%
High Electrification	0.6%	1.2%	0.6%	1.2%
Moderate Electrification	0.3%	0.6%	0.3%	0.6%
Base Case MMBtu	101,494,500	101,418,513	2,836,562	2,836,562
High Electrification MMBtu reduction	599,904	1,198,933	16,310	32,620
Moderate Electrification MMBtu reduction	299,952	599,467	8,155	16,310

RESULTS

Table 4-12 illustrates the 2030 impact of the estimated industrial sector electrification adoptions under each adoption scenario. While expected to be modest relative to the residential or commercial sector, the adoptions show incremental progress in what may be a challenging sector to electrify in the near term.

TABLE 4-12 INDUSTRIAL SECTOR NET CO2E IMPACTS

Scenario	HIGH ELECTRIFICATION	MODERATE ELECTRIFICATION
Cumulative 2030 Total CO2e net reduction (short tons)	381,967	190,983
Measure Life Total CO2e net reduction (short tons)[59]	841,793	410,818

The resulting savings from electrification in the industrial sector are approximately one-third that of the commercial sector. The specific nature of what electrification technologies may be adopted are uncertain, but based on our literature review, it appears that there are many viable options. That said, some caution is warranted due to the low price of natural gas and potential that large capital investments may dampen enthusiasm. However, as with the commercial sector, the motivations and sources of savings may be dependent on individual decisions and technologies that are near a tipping point for cost-effectiveness. At the least, some of the heat pump technologies for space heating and water heating are applicable to the commercial sector and may prove to be relatively low-hanging-fruit that would drive industrial sector electrification over the next ten years.

GDS did not directly estimate the potential for the oil and gas segment to contribute to electrification and CO2e emissions reductions. The oil and gas segment provides a specific opportunity for CO2e emissions reductions unavailable to other industrial segments. Direct emissions of methane occur in some segment end-uses. Electrifying the end-uses will remove the direct emissions and a source of a potential greenhouse gas. To help illustrate potential beneficial

[59] Measure life CO2e reductions are reductions associated with beneficial electrification measures installed through 2030, but with emissions effects counted for the life of the measures, which extend beyond 2030.

electrification opportunities in the oil and gas segment, GDS developed a technology snapshot to describe a specific opportunity with potentially large CO2e reduction impacts.

4.6.1.1 Technology Snapshot – Converting Gas Pneumatic Pumps to Electric Pumps

Natural gas facilities often use gas pneumatic pumps to circulate glycol as part of the dehydration process to prepare gas for pipeline transport. Pneumatic pumps -also called "energy exchange" or kimray pumps- operate by tapping into the energy in compressed natural gas, which is convenient and readily available at natural gas facilities. However, the technology results in the venting of methane into the atmosphere. It is possible to eliminate the methane emissions by converting to electric glycol pumps. For facilities located near accessible grid power, the conversion is relatively straightforward and most often economical with a payback period typically under two years and often much shorter.

According to an EPA report[60], electrifying a typical glycol pump in a dehydration system can result in a methane emission reduction of 18,000 MMBtu annually. At an approximate upfront cost of $9,000 and a value of $2.75/mcf vented methane, the payback period is slightly over two months to complete the electrification retrofit (not counting cost of bringing electricity to the location). The exact impact of replacing a given pump depends upon the size of the pump, how it's operated within the specific facility, and the cost of connecting to an electrical energy source. It is possible that methane emission regulations in Colorado may require all facilities with access to grid electricity to electrify all gas pneumatic pumps in the fall of 2020.

Direct methane emissions have a global warming potential (GWP) of 21, meaning that a ton of vented methane has 21 times the global warming effect as emitting a ton of carbon dioxide. With 18,000 MMBtu of methane being directly emitted from a typical glycol pump, the equivalent carbon dioxide emissions amounts to 22,113 tons of CO2e *per year*. In contrast, combusting that same amount of natural gas would emit 1,053 tons of CO2e *per year*. Converting to electrical pumps and generating the electricity directly from methane would result in a net reduction of

[60] https://www.epa.gov/sites/production/files/2016-06/documents/ll_glycol_pumps3.pdf

21,060 tons of CO2e *per year*. In terms of electrification benefits, a single typical glycol pump could reduce CO2e emissions over ten years by over 220,000 tons. Due to the GWP of methane, the cost-effectiveness (using the mTRC) of such conversions could be very high, though without specific costs associated with locations and pump conditions, somewhat speculative. The major uncertainty is the cost of bringing electricity to the pumps, which may be in remote areas. Extending power lines, using natural gas-powered generators, or solar photovoltaic systems with battery back-up may be viable options, but would also increase the cost of the electrification.

5 Conclusions

This study finds that there are substantial opportunities for beneficial electrification to reduce greenhouse gas emissions in Colorado over the next decade and beyond. These opportunities exist due to Colorado electric utilities' commitments to invest in clean energy generation and reduce emissions of greenhouse gases substantially from historical levels by 2030 and beyond. Beneficial electrification aligns with the State's long-term greenhouse gas emission policy goals and utility plans to reduce the carbon intensity of electricity supplies.

The study modeling and results indicate that a long-term, market transformation approach is needed to shift end-uses from fossil fuel combustion (or direct methane emissions) to low-carbon electricity. Colorado has a high saturation of natural gas and propane heating systems in its buildings and industrial processes and replacing those technologies in existing building stock will take time.

Our modeling suggests that over the next decade, beneficial electrification in buildings can move from a market position punctuated by anecdotal experience to one that begins to capture substantial market share. By the end of the decade, we forecast that beneficial electrification can rise to meet or exceed the performance of established and mature natural gas demand side management programs in terms of natural gas savings. The actual results will depend on a blend of policies, programs, and market acceptance of beneficial electrification technologies.

Within Colorado's residential and commercial buildings, space heating and water heating have the highest potential to drive the benefits of beneficial electrification. Leveraging advances in cold climate heat pumps and heat pump water heaters will contribute to favorable market experiences. For propane users, the cost savings of shifting to electricity can be an early source of success that can further market development that will extend to natural gas users. New construction markets pose another substantial opportunity for early success. Avoiding the expense of installing fossil

fuel equipment and infrastructure for new homes or businesses can also eliminate the need for future retrofits.

In closing, we reiterate the summary of our key findings and recommendations provided in the Executive Summary. These findings and recommendations help "set the table" for Colorado to move forward with beneficial electrification efforts, with an eye toward near-term market preparation and development in the first half of the decade, with ever greater shares of market deployment continuing through 2030.

TABLE 5-1 BENEFICIAL ELECTRIFICATION KEY FINDINGS AND RECOMMENDATIONS

Key Finding	Recommendation
Colorado has substantial market potential to develop beneficial electrification over the 2021-2030 decade and beyond.	Colorado should enact policies to encourage the adoption of beneficial electrification technologies, especially related to heat pumps for space heating and water heating.
Over the next ten years (2021 to 2030) Colorado has the potential to cumulatively reduce net carbon emissions by approximately 3.5 million tons of CO2e through beneficial electrification. For measures installed in this timeframe, the potential for net lifetime emissions reductions exceeds 16 million tons of CO2e.	To maximize emissions reductions, Colorado should adopt policies that ensure the decarbonization of the state's electricity grid while monitoring the pace of electrification to ensure that it is achieving a beneficial outcome for CO2e emissions.
Electrifying propane-fueled end uses is highly cost-effective.	Colorado should prioritize policies and efforts to electrify propane-fueled end-uses while creating general electrification opportunities and awareness.
Colorado can take advantage of the work that other regions in the U.S. have undertaken to improve heat pump technology and grow the market for electrification technologies. These efforts may allow Colorado to move from a fossil-fuel dominated energy market for space heating and water heating more quickly and with fewer challenges than others.	Colorado should leverage the program design and technology specifications already developed by other regions, states, and utilities. These include efforts in the Pacific Northwest and Northeastern United States.

CONCLUSION

Key Finding	Recommendation
There is limited market intelligence on fossil fuel end-uses and saturations that is publicly available. To-date, utility market saturation studies have not deeply investigated electrification opportunities.	Colorado should develop market intelligence and track the adoption of beneficial electrification over time to facilitate long-term market development efforts.
Capturing the full potential of beneficial electrification will require a fundamental transformation and long-term transition that will need to take place over multiple decades.	Colorado should take a coordinated market transformation approach toward beneficial electrification that includes electric utilities, local jurisdictions, the private sector, and the State in order to achieve the long-term decarbonization goal.

6 Technical Appendix

FORECAST DATA ASSUMPTIONS

GDS developed general assumptions for the State of Colorado by review of past Colorado utility potential studies and IRP filings. The Xcel 2016 DSM Potential Study provided values for discount rates, electric and fossil fuel adders, and line losses while the Xcel IRP filing was used to estimate statewide Reserve Margin Multiplier levels. Finally, the Social Cost of Carbon was determined from a 2016 EPA technical support document. The following tables show the values used for modeling discounts, adders, and losses and energy forecast baselines and sources for natural gas, propane and electricity.

Input	Value	Source
Inflation Rate (%):	2.30%	US Inflation Forecast
Electric Nominal Discount Rate (%):	6.78%	Xcel 2016 DSM Potential Study
Fuel Nominal Discount Rate (%):	6.59%	Xcel 2016 DSM Potential Study
Cost of Carbon Nominal Discount Rate (%)	5.37%	2016 EPA Social Cost of Carbon Tech. Support Doc.
Fossil Fuel NEI Adder:	1.20	Public Service of Colorado 2019-2020 DSM Plan
LI Benefits NEI Adder:	1.50	Public Service of Colorado 2019-2020 DSM Plan

Line Losses	Summer On Peak (%)	Summer Off Peak (%)	Winter On Peak (%)	Winter Off Peak (%)	Summer Demand	Winter Demand	T&D	Reserve Margin Multiplier
Residential	1.12	1.10	1.12	1.10	1.03	1.03	1.0769	1.163
Commercial	1.12	1.10	1.12	1.10	1.03	1.03	1.0650	1.163
Source	*Xcel Plan*	*Xcel Plan*	*Xcel Plan*	*Xcel Plan*	*Xcel Plan*	*Xcel Plan*	*Xcel Plan*	*Xcel IRP*

ADOPTION RATE ASSUMPTIONS

GDS developed four scenarios across the residential, commercial, and industrial sectors, covering the technical, economic, and two achievable potentials for beneficial electrification in Colorado. For the achievable potentials, a High Electrification Scenario was developed, with a residential adoption curve that resulted in a maximum of 14 percent market penetration by 2030 for an individual technology case. This curve is informed by historical adoptions of heat pumps in the Pacific Northwest and Northeastern United States, and electric vehicles in Colorado.

	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030
Incremental Annual										
High-NG	0.55%	0.67%	0.81%	0.98%	1.17%	1.40%	1.66%	1.96%	2.30%	2.67%
High-LP	0.55%	0.67%	0.81%	0.98%	1.17%	1.40%	1.66%	1.96%	2.30%	2.67%
Mid-NG	0.52%	0.57%	0.62%	0.67%	0.73%	0.79%	0.85%	0.92%	0.99%	1.06%
Mid-LP	0.52%	0.57%	0.62%	0.67%	0.73%	0.79%	0.85%	0.92%	0.99%	1.06%
Cumulative Annual										
High-NG	0.55%	1.22%	2.03%	3.01%	4.18%	5.58%	7.24%	9.20%	11.50%	14.17%
High-LP	0.55%	1.22%	2.03%	3.01%	4.18%	5.58%	7.24%	9.20%	11.50%	14.17%
Mid-NG	0.52%	1.09%	1.71%	2.38%	3.10%	3.89%	4.74%	5.65%	6.64%	7.70%
Mid-LP	0.52%	1.09%	1.71%	2.38%	3.10%	3.89%	4.74%	5.65%	6.64%	7.70%

Forecasts

GDS worked with the CEO and Colorado utilities to gather information, data, and perspectives on the current state of electrification in Colorado. These state resources were combined with data from the Energy Information Administration (EIA) and the Propane Education & Research Council (PERC) to forecast a base case use of natural gas, propane, and electricity from 2021 through 2030. Historical Colorado energy use by sector for 2013-2018 were used to determine a baseline energy forecast. Growth indices taken from the U.S. Energy Information Administration 2020 Annual Energy Outlook[1] were used to forecast annual growth for each fuel type and sector.

The following tables list values for energy forecast sales and customers for electricity, natural gas, and propane.

[1] https://www.eia.gov/outlooks/aeo/

ELECTRICITY BASE CASE

Retail sales (Mwh)	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030
Residential	19,663,681	19,880,830	20,088,855	20,443,050	20,801,323	21,262,597	21,837,660	22,672,644	23,457,055	24,228,919
Commercial	21,089,770	20,986,231	20,879,031	20,922,724	21,020,690	21,142,410	21,277,220	21,573,950	21,615,293	21,706,789
Industrial	15,791,796	15,734,165	15,694,081	15,737,257	15,746,280	15,788,408	15,852,168	16,004,264	15,986,093	16,014,024
Total	56,545,247	56,601,227	56,661,967	57,103,030	57,568,293	58,193,415	58,967,048	60,250,857	61,058,442	61,949,732

Retail Electric sales (Consumers)	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030
Residential	2,430,417	2,457,833	2,485,784	2,513,922	2,541,897	2,569,683	2,597,264	2,624,744	2,651,886	2,678,589
Commercial	288,176	290,027	291,904	293,779	295,629	297,452	299,245	301,021	302,762	304,467
Industrial	16,038	16,054	16,071	16,196	16,328	16,506	16,725	17,089	17,318	17,571
Total	2,734,631	2,763,914	2,793,759	2,823,898	2,853,854	2,883,641	2,913,234	2,942,855	2,971,967	3,000,627

NATURAL GAS BASE CASE

Retail sales (MMBtu)	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030
Residential	146,529,498	147,137,743	147,093,603	147,551,682	147,211,627	147,489,466	148,165,873	149,306,111	149,097,087	149,470,376
Commercial	63,770,213	63,716,627	63,863,080	64,321,647	63,961,875	63,817,009	63,808,621	64,387,137	64,162,577	64,116,730
Industrial	97,805,866	99,265,434	99,998,829	100,218,194	101,494,500	100,660,706	97,492,635	100,706,436	101,323,615	101,418,513
Total	308,105,576	310,119,804	310,955,512	312,091,523	312,668,002	311,967,182	309,467,129	314,399,684	314,583,279	315,005,618

Retail Natural Gas sales (Consumers)	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030
Residential	1,858,461	1,880,478	1,901,854	1,922,970	1,943,986	1,964,841	1,985,516	2,006,047	2,026,254	2,046,050
Commercial	153,595	153,617	153,721	153,887	154,031	154,161	154,272	154,361	154,430	154,476
Industrial	9,955	10,104	10,178	10,200	10,330	10,246	9,923	10,250	10,313	10,323
Total	2,022,011	2,044,199	2,065,753	2,087,058	2,108,347	2,129,248	2,149,712	2,170,658	2,190,997	2,210,848

Retail sales (MMBtu)	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030
Commercial - Existing	63,749,204	63,676,856	63,764,598	64,132,970	63,694,028	63,476,909	63,406,018	63,932,090	63,665,077	63,588,139
Commercial – Cumulative New Construction	21,008	39,771	98,482	188,677	267,847	340,101	402,602	455,047	497,500	528,590
Commercial - Total	63,770,213	63,716,627	63,863,080	64,321,647	63,961,875	63,817,009	63,808,621	64,387,137	64,162,577	64,116,730

Propane

Retail sales (MMBtu)	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030
Residential	9,790,714	9,790,714	9,790,714	9,790,714	9,790,714	9,790,714	9,790,714	9,790,714	9,790,714	9,790,714
Commercial	3,202,570	3,202,570	3,202,570	3,202,570	3,202,570	3,202,570	3,202,570	3,202,570	3,202,570	3,202,570
Agriculture	183,004	183,004	183,004	183,004	183,004	183,004	183,004	183,004	183,004	183,004
Industrial (Non-Forklift)	1,281,028	1,281,028	1,281,028	1,281,028	1,281,028	1,281,028	1,281,028	1,281,028	1,281,028	1,281,028
Cylinder Markets	640,514	640,514	640,514	640,514	640,514	640,514	640,514	640,514	640,514	640,514
Internal Combustion	732,016	732,016	732,016	732,016	732,016	732,016	732,016	732,016	732,016	732,016
Total	15,829,846	15,829,846	15,829,846	15,829,846	15,829,846	15,829,846	15,829,846	15,829,846	15,829,846	15,829,846

Retail Propane sales (Consumers)	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029	Year 2030
Residential	171,763	171,763	171,763	171,763	171,763	171,763	171,763	171,763	171,763	171,763
Commercial	12,137	12,137	12,137	12,137	12,137	12,137	12,137	12,137	12,137	12,137
Agriculture	2,774	2,774	2,774	2,774	2,774	2,774	2,774	2,774	2,774	2,774

Industrial (Non-Forklift)	3,369	3,369	3,369	3,369	3,369	3,369	3,369	3,369	3,369	3,369
Cylinder Markets	8,746	8,746	8,746	8,746	8,746	8,746	8,746	8,746	8,746	8,746
Internal Combustion	3,568	3,568	3,568	3,568	3,568	3,568	3,568	3,568	3,568	3,568
Total	202,357	202,357	202,357	202,357	202,357	202,357	202,357	202,357	202,357	202,357

Source. Sales and Consumer forecasts from the Annual Retail Propane Sales Report U.S. Odorized Propane Sales by State and End-Use Sector Reporting Year 2017 via the Propane Education & Research Council Published Report February 2019

AVOIDED COSTS

GDS utilized a blend of utility reported data, EIA reported information, and utilization of professional subscription services that aggregate FERC data to develop the avoided costs of energy for the implementation of electrification technologies, replacing the liquid or gas fueled versions of the equipment by end use. These avoided costs do not attempt to account for self-generation of electricity by customers – solar PV, wind, combined heat and power, and other possible on-site electricity generation technologies. The following table presents the energy and capacity values used in the electrification model.

Electric Avoided Cost Type	Unit	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Summer On Peak Energy	($/kwh)	0.041	0.044	0.047	0.051	0.053	0.055	0.057	0.060	0.063	0.065
Summer Off-Peak Energy	($/kwh)	0.041	0.044	0.047	0.051	0.053	0.055	0.057	0.060	0.063	0.065
Winter On Peak Energy	($/kwh)	0.041	0.044	0.047	0.051	0.053	0.055	0.057	0.060	0.063	0.065
Winter Off-Peak Energy	($/kwh)	0.041	0.044	0.047	0.051	0.053	0.055	0.057	0.060	0.063	0.065
Summer Generation Capacity	($/kW-YR)	92.04	93.84	95.76	97.68	99.60	101.64	103.68	105.72	107.88	110.04
Winter Generation Capacity	($/kW-YR)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avoided Transmission Capacity	($/kW-YR)	11.53	11.76	11.99	12.23	12.48	12.73	12.98	13.24	13.51	13.78
Avoided Distribution Capacity	($/kW-YR)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MEASURE ASSUMPTIONS

Measure consumption and savings data were developed using a combination of standard algorithms, industry reports, primary research, utility provided information and reports, as appropriate. Measure cost estimates leverage data in regional technical reference manuals and other national or regional databases such as the NREL Residential Efficiency Measures Database.[2] Measure saturation estimates primarily leverage from the EIA Residential Energy Consumption Surveys (CBECS and RECS), but also include utility-provided saturation data.[3] End-use load share of natural gas and propane are included in the body of the report. The following tables provide measure assumptions for the residential, commercial, industrial, agricultural, and transportation sectors used in this study. For the industrial sector, the measure level assumptions were not used to directly forecast the industrial beneficial electrification scenarios or cost-effectiveness.

[2] https://remdb.nrel.gov/
[3] https://www.eia.gov/consumption

RESIDENTIAL MEASURES

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
1	Appliances	Heat Pump Dryer - NG Baseline - Early Replacement	SF	NLI	$56	2.4	274	0.98
2	Appliances	Heat Pump Dryer - NG Baseline - Market Opp	SF	NLI	($101)	2.4	274	1.44
3	Appliances	Heat Pump Dryer - NG Baseline - Early Replacement	MF	NLI	$56	2.4	274	0.98
4	Appliances	Heat Pump Dryer - NG Baseline - Market Opp	MF	NLI	($101)	2.4	274	1.44
5	Appliances	Heat Pump Dryer - LP Baseline - Early Replacement	SF	NLI	$56	0	274	3.00
6	Appliances	Heat Pump Dryer - LP Baseline - Market Opp	SF	NLI	($101)	0	274	3.77
7	Appliances	Electric Clothes Dryer - NG Baseline - Early Replacement	SF	NLI	($82)	2.4	474	0.75
8	Appliances	Electric Clothes Dryer - NG Baseline - Market Opp	SF	NLI	($240)	2.4	474	1.01
9	Appliances	Electric Clothes Dryer - NG Baseline - Early Replacement	MF	NLI	($82)	2.4	474	0.75
10	Appliances	Electric Clothes Dryer - NG Baseline - Market Opp	MF	NLI	($240)	2.4	474	1.01
11	Appliances	Electric Clothes Dryer - LP Baseline - Early Replacement	SF	NLI	($82)	0	474	2.02
12	Appliances	Electric Clothes Dryer - LP Baseline - Market Opp	SF	NLI	($240)	0	474	2.28
13	Appliances	Heat Pump Dryer - NG Baseline - Early Replacement	SF	LI	$56	2.4	274	1.06
14	Appliances	Heat Pump Dryer - NG Baseline - Market Opp	SF	LI	($101)	2.4	274	1.53
15	Appliances	Heat Pump Dryer - NG Baseline - Early Replacement	MF	LI	$56	2.4	274	1.06
16	Appliances	Heat Pump Dryer - NG Baseline - Market Opp	MF	LI	($101)	2.4	274	1.53
17	Appliances	Heat Pump Dryer - LP Baseline - Early Replacement	SF	LI	$56	0	274	3.57
18	Appliances	Heat Pump Dryer - LP Baseline - Market Opp	SF	LI	($101)	0	274	4.43
19	Appliances	Electric Clothes Dryer - NG Baseline - Early Replacement	SF	LI	($82)	2.4	474	0.80
20	Appliances	Electric Clothes Dryer - NG Baseline - Market Opp	SF	LI	($240)	2.4	474	1.05
21	Appliances	Electric Clothes Dryer - NG Baseline - Early Replacement	MF	LI	($82)	2.4	474	0.80
22	Appliances	Electric Clothes Dryer - NG Baseline - Market Opp	MF	LI	($240)	2.4	474	1.05

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
23	Appliances	Electric Clothes Dryer - LP Baseline - Early Replacement	SF	LI	($82)	0	474	2.38
24	Appliances	Electric Clothes Dryer - LP Baseline - Market Opp	SF	LI	($240)	0	474	2.63
25	Cooking	Induction Cooktop - NG baseline	SF	NLI	($163)	4.1	126	1.09
26	Cooking	Induction Cooktop - NG baseline	SF	NLI	($402)	4.1	126	1.63
27	Cooking	Induction Cooktop - NG baseline	MF	NLI	($163)	4.1	123	1.08
28	Cooking	Induction Cooktop - NG baseline	MF	NLI	($402)	4.1	123	1.62
29	Cooking	Induction Cooktop - LP baseline	SF	NLI	($163)	0	126	4.60
30	Cooking	Induction Cooktop - LP baseline	SF	NLI	($402)	0	126	5.14
31	Cooking	Induction Cooktop - NG baseline	SF	LI	($163)	4.1	126	1.18
32	Cooking	Induction Cooktop - NG baseline	SF	LI	($402)	4.1	126	1.72
33	Cooking	Induction Cooktop - NG baseline	MF	LI	($163)	4.1	123	1.17
34	Cooking	Induction Cooktop - NG baseline	MF	LI	($402)	4.1	123	1.71
35	Cooking	Induction Cooktop - LP baseline	SF	LI	($163)	0	126	5.52
36	Cooking	Induction Cooktop - LP baseline	SF	LI	($402)	0	126	6.06
37	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/CAC baseline - Early Replacement	SF	NLI	$647	62.2	4,562	1.45
38	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/CAC baseline - Market Opp	SF	NLI	($507)	62.2	4,562	1.47
39	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/CAC baseline - Early Replacement	MF	NLI	$369	35.4	2,600	1.45
40	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/CAC baseline - Market Opp	MF	NLI	($289)	35.4	2,600	1.47
41	HVAC	16 SEER / 9.0 hspf ASHP - LP furnace/CAC baseline - Early Replacement	SF	NLI	$647	0	4,562	3.65
42	HVAC	16 SEER / 9.0 hspf ASHP - LP furnace/CAC baseline - Market Opp	SF	NLI	($507)	0	4,562	3.82

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
43	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/CAC baseline - Early Replacement	SF	NLI	$3,026	62.2	2,941	1.11
44	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/CAC baseline - Market Opp	SF	NLI	$1,504	62.2	2,941	1.16
45	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/CAC baseline - Early Replacement	MF	NLI	$1,725	35.4	1,677	1.11
46	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/CAC baseline - Market Opp	MF	NLI	$857	35.4	1,677	1.16
47	HVAC	16 SEER / 9.0 hspf DFHP - LP furnace/CAC baseline - Early Replacement	SF	NLI	$647	0	2,941	3.15
48	HVAC	16 SEER / 9.0 hspf DFHP - LP furnace/CAC baseline - Market Opp	SF	NLI	$1,504	0	2,941	2.73
49	HVAC	Ductless HP - whole house - NG furnace/CAC baseline - Early Replacement	SF	NLI	$1,211	62.2	3,974	1.67
50	HVAC	Ductless HP - whole house - NG furnace/CAC baseline - Market Opp	SF	NLI	$57	62.2	3,974	1.76
51	HVAC	Ductless HP - whole house - NG furnace/CAC baseline - Early Replacement	MF	NLI	$690	35.4	2,265	1.67
52	HVAC	Ductless HP - whole house - NG furnace/CAC baseline - Market Opp	MF	NLI	$32	35.4	2,265	1.76
53	HVAC	Ductless HP - whole house - LP furnace/CAC baseline - Early Replacement	SF	NLI	$1,211	0	3,974	4.22
54	HVAC	Ductless HP - whole house - LP furnace/CAC baseline - Market Opp	SF	NLI	$57	0	3,974	4.68
55	HVAC	Ductless HP - supplemental - NG furnace/CAC baseline - Early Replacement	SF	NLI	$1,875	62.2	2,514	1.71
56	HVAC	Ductless HP - supplemental - NG furnace/CAC baseline - Market Opp	SF	NLI	$5,441	62.2	2,514	1.03
57	HVAC	Ductless HP - supplemental - NG furnace/CAC baseline - Early Replacement	MF	NLI	$1,069	35.4	1,433	1.71

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
58	HVAC	Ductless HP - supplemental - NG furnace/CAC baseline - Market Opp	MF	NLI	$3,101	35.4	1,433	1.03
59	HVAC	Ductless HP - supplemental - LP furnace/CAC baseline - Early Replacement	SF	NLI	$1,875	0	2,514	3.81
60	HVAC	Ductless HP - supplemental - LP furnace/CAC baseline - Market Opp	SF	NLI	$5,441	0	2,514	2.43
61	HVAC	GSHP - NG furnace/CAC baseline - Early Replacement	SF	NLI	$7,937	62.2	3,421	0.91
62	HVAC	GSHP - NG furnace/CAC baseline - Market Opp	SF	NLI	$6,783	62.2	3,421	0.90
63	HVAC	GSHP - LP furnace/CAC baseline - Early Replacement	SF	NLI	$7,937	0	3,421	2.30
64	HVAC	GSHP - LP furnace/CAC baseline - Market Opp	SF	NLI	$6,783	0	3,421	2.39
65	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/AC baseline - Early Replacement	SF	NLI	($538)	62.2	4,562	1.74
66	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/AC baseline - Market Opp	SF	NLI	($2,039)	62.2	4,562	1.77
67	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/AC baseline - Early Replacement	MF	NLI	($307)	35.4	2,600	1.74
68	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/AC baseline - Market Opp	MF	NLI	($1,162)	35.4	2,600	1.77
69	HVAC	16 SEER / 9.0 hspf ASHP - LP boiler/AC baseline - Early Replacement	SF	NLI	($538)	0	4,562	4.30
70	HVAC	16 SEER / 9.0 hspf ASHP - LP boiler/AC baseline - Market Opp	SF	NLI	($2,039)	0	4,562	4.32
71	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/No AC baseline - Early Replacement	SF	NLI	$3,026	62.2	5,644	0.60
72	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/No AC baseline - Market Opp	SF	NLI	$2,570	62.2	5,644	0.62
73	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/No AC baseline - Early Replacement	MF	NLI	$1,725	35.4	3,217	0.60

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
74	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/No AC baseline - Market Opp	MF	NLI	$1,465	35.4	3,217	0.62
75	HVAC	16 SEER / 9.0 hspf ASHP - LP furnace/No AC baseline - Early Replacement	SF	NLI	$3,026	0	5,644	2.39
76	HVAC	16 SEER / 9.0 hspf ASHP - LP furnace/No AC baseline - Market Opp	SF	NLI	$2,570	0	5,644	2.48
77	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/No AC baseline - Early Replacement	SF	NLI	$3,026	62.2	4,024	0.46
78	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/No AC baseline - Market Opp	SF	NLI	$4,581	62.2	4,024	0.40
79	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/No AC baseline - Early Replacement	MF	NLI	$1,725	35.4	2,293	0.46
80	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/No AC baseline - Market Opp	MF	NLI	$2,611	35.4	2,293	0.40
81	HVAC	16 SEER / 9.0 hspf DFHP - LP furnace/No AC baseline - Early Replacement	SF	NLI	$3,026	0	4,024	1.82
82	HVAC	16 SEER / 9.0 hspf DFHP - LP furnace/No AC baseline - Market Opp	SF	NLI	$4,581	0	4,024	1.59
83	HVAC	Ductless HP - whole house - NG furnace/No AC baseline - Early Replacement	SF	NLI	$3,590	62.2	5,056	0.67
84	HVAC	Ductless HP - whole house - NG furnace/No AC baseline - Market Opp	SF	NLI	$3,134	62.2	5,056	0.70
85	HVAC	Ductless HP - whole house - NG furnace/No AC baseline - Early Replacement	MF	NLI	$2,046	35.4	2,882	0.67
86	HVAC	Ductless HP - whole house - NG furnace/No AC baseline - Market Opp	MF	NLI	$1,786	35.4	2,882	0.70
87	HVAC	Ductless HP - whole house - LP furnace/No AC baseline - Early Replacement	SF	NLI	$3,590	0	5,056	2.68
88	HVAC	Ductless HP - whole house - LP furnace/No AC baseline - Market Opp	SF	NLI	$3,134	0	5,056	2.80

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
89	HVAC	Ductless HP - supplemental - NG furnace/No AC baseline - Early Replacement	SF	NLI	$1,875	62.2	3,596	0.70
90	HVAC	Ductless HP - supplemental - NG furnace/No AC baseline - Market Opp	SF	NLI	$5,441	62.2	3,596	0.47
91	HVAC	Ductless HP - supplemental - NG furnace/No AC baseline - Early Replacement	MF	NLI	$1,069	35.4	2,050	0.70
92	HVAC	Ductless HP - supplemental - NG furnace/No AC baseline - Market Opp	MF	NLI	$3,101	35.4	2,050	0.47
93	HVAC	Ductless HP - supplemental - LP furnace/No AC baseline - Early Replacement	SF	NLI	$1,875	0	3,596	2.79
94	HVAC	Ductless HP - supplemental - LP furnace/No AC baseline - Market Opp	SF	NLI	$5,441	0	3,596	1.87
95	HVAC	GSHP - NG furnace/No AC baseline - Early Replacement	SF	NLI	$10,316	62.2	4,503	0.41
96	HVAC	GSHP - NG furnace/No AC baseline - Market Opp	SF	NLI	$9,860	62.2	4,503	0.42
97	HVAC	GSHP - LP furnace/No AC baseline - Early Replacement	SF	NLI	$10,316	0	4,503	1.62
98	HVAC	GSHP - LP furnace/No AC baseline - Market Opp	SF	NLI	$9,860	0	4,503	1.66
99	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/No AC baseline - Early Replacement	SF	NLI	$1,841	62.2	5,644	0.73
100	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/No AC baseline - Market Opp	SF	NLI	$1,038	62.2	5,644	0.79
101	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/No AC baseline - Early Replacement	MF	NLI	$1,050	35.4	3,217	0.73
102	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/No AC baseline - Market Opp	MF	NLI	$592	35.4	3,217	0.79
103	HVAC	16 SEER / 9.0 hspf ASHP - LP boiler/No AC baseline - Early Replacement	SF	NLI	$1,841	0	5,644	2.88
104	HVAC	16 SEER / 9.0 hspf ASHP - LP boiler/No AC baseline - Market Opp	SF	NLI	$1,038	0	5,644	3.10

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
105	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/CAC baseline - Early Replacement	SF	LI	($2,039)	62.2	4,562	1.87
106	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/CAC baseline - Market Opp	SF	LI	($507)	62.2	4,562	1.56
107	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/CAC baseline - Early Replacement	MF	LI	$369	35.4	2,600	1.54
108	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/CAC baseline - Market Opp	MF	LI	($289)	35.4	2,600	1.56
109	HVAC	16 SEER / 9.0 hspf ASHP - LP furnace/CAC baseline - Early Replacement	SF	LI	$647	0	4,562	4.28
110	HVAC	16 SEER / 9.0 hspf ASHP - LP furnace/CAC baseline - Market Opp	SF	LI	($507)	0	4,562	4.49
111	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/CAC baseline - Early Replacement	SF	LI	$3,026	62.2	2,941	1.17
112	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/CAC baseline - Market Opp	SF	LI	$1,504	62.2	2,941	1.22
113	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/CAC baseline - Early Replacement	MF	LI	$1,725	35.4	1,677	1.17
114	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/CAC baseline - Market Opp	MF	LI	$857	35.4	1,677	1.22
115	HVAC	16 SEER / 9.0 hspf DFHP - LP furnace/CAC baseline - Early Replacement	SF	LI	$647	0	2,941	3.65
116	HVAC	16 SEER / 9.0 hspf DFHP - LP furnace/CAC baseline - Market Opp	SF	LI	$1,504	0	2,941	3.19
117	HVAC	Ductless HP - whole house - NG furnace/CAC baseline - Early Replacement	SF	LI	$1,211	62.2	3,974	1.78
118	HVAC	Ductless HP - whole house - NG furnace/CAC baseline - Market Opp	SF	LI	$57	62.2	3,974	1.88
119	HVAC	Ductless HP - whole house - NG furnace/CAC baseline - Early Replacement	MF	LI	$690	35.4	2,265	1.78

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
120	HVAC	Ductless HP - whole house - NG furnace/CAC baseline - Market Opp	MF	LI	$32	35.4	2,265	1.88
121	HVAC	Ductless HP - whole house - LP furnace/CAC baseline - Early Replacement	SF	LI	$1,211	0	3,974	4.95
122	HVAC	Ductless HP - whole house - LP furnace/CAC baseline - Market Opp	SF	LI	$57	0	3,974	5.52
123	HVAC	Ductless HP - supplemental - NG furnace/CAC baseline - Early Replacement	SF	LI	$1,875	62.2	2,514	1.80
124	HVAC	Ductless HP - supplemental - NG furnace/CAC baseline - Market Opp	SF	LI	$5,441	62.2	2,514	1.08
125	HVAC	Ductless HP - supplemental - NG furnace/CAC baseline - Early Replacement	MF	LI	$1,069	35.4	1,433	1.80
126	HVAC	Ductless HP - supplemental - NG furnace/CAC baseline - Market Opp	MF	LI	$3,101	35.4	1,433	1.08
127	HVAC	Ductless HP - supplemental - LP furnace/CAC baseline - Early Replacement	SF	LI	$1,875	0	2,514	4.40
128	HVAC	Ductless HP - supplemental - LP furnace/CAC baseline - Market Opp	SF	LI	$5,441	0	2,514	2.83
129	HVAC	GSHP - NG furnace/CAC baseline - Early Replacement	SF	LI	$7,937	62.2	3,421	0.97
130	HVAC	GSHP - NG furnace/CAC baseline - Market Opp	SF	LI	$6,783	62.2	3,421	0.96
131	HVAC	GSHP - LP furnace/CAC baseline - Early Replacement	SF	LI	$7,937	0	3,421	2.70
132	HVAC	GSHP - LP furnace/CAC baseline - Market Opp	SF	LI	$6,783	0	3,421	2.82
133	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/AC baseline - Early Replacement	SF	LI	($538)	62.2	4,562	1.85
134	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/AC baseline - Market Opp	SF	LI	($2,039)	62.2	4,562	1.87
135	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/AC baseline - Early Replacement	MF	LI	($307)	35.4	2,600	1.85

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
136	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/AC baseline - Market Opp	MF	LI	($1,162)	35.4	2,600	1.87
137	HVAC	16 SEER / 9.0 hspf ASHP - LP boiler/AC baseline - Early Replacement	SF	LI	($538)	0	4,562	5.03
138	HVAC	16 SEER / 9.0 hspf ASHP - LP boiler/AC baseline - Market Opp	SF	LI	($2,039)	0	4,562	5.05
139	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/No AC baseline - Early Replacement	SF	LI	$3,026	62.2	5,644	0.67
140	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/No AC baseline - Market Opp	SF	LI	$2,570	62.2	5,644	0.70
141	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/No AC baseline - Early Replacement	MF	LI	$1,725	35.4	3,217	0.67
142	HVAC	16 SEER / 9.0 hspf ASHP - NG furnace/No AC baseline - Market Opp	MF	LI	$1,465	35.4	3,217	0.70
143	HVAC	16 SEER / 9.0 hspf ASHP - LP furnace/No AC baseline - Early Replacement	SF	LI	$3,026	0	5,644	2.90
144	HVAC	16 SEER / 9.0 hspf ASHP - LP furnace/No AC baseline - Market Opp	SF	LI	$2,570	0	5,644	3.01
145	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/No AC baseline - Early Replacement	SF	LI	$3,026	62.2	4,024	0.51
146	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/No AC baseline - Market Opp	SF	LI	$4,581	62.2	4,024	0.45
147	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/No AC baseline - Early Replacement	MF	LI	$1,725	35.4	2,293	0.51
148	HVAC	16 SEER / 9.0 hspf DFHP - NG furnace/No AC baseline - Market Opp	MF	LI	$2,611	35.4	2,293	0.45
149	HVAC	16 SEER / 9.0 hspf DFHP - LP furnace/No AC baseline - Early Replacement	SF	LI	$3,026	0	4,024	2.21
150	HVAC	16 SEER / 9.0 hspf DFHP - LP furnace/No AC baseline - Market Opp	SF	LI	$4,581	0	4,024	1.94

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
151	HVAC	Ductless HP - whole house - NG furnace/No AC baseline - Early Replacement	SF	LI	$3,590	62.2	5,056	0.75
152	HVAC	Ductless HP - whole house - NG furnace/No AC baseline - Market Opp	SF	LI	$3,134	62.2	5,056	0.79
153	HVAC	Ductless HP - whole house - NG furnace/No AC baseline - Early Replacement	MF	LI	$2,046	35.4	2,882	0.75
154	HVAC	Ductless HP - whole house - NG furnace/No AC baseline - Market Opp	MF	LI	$1,786	35.4	2,882	0.79
155	HVAC	Ductless HP - whole house - LP furnace/No AC baseline - Early Replacement	SF	LI	$3,590	0	5,056	3.26
156	HVAC	Ductless HP - whole house - LP furnace/No AC baseline - Market Opp	SF	LI	$3,134	0	5,056	3.39
157	HVAC	Ductless HP - supplemental - NG furnace/No AC baseline - Early Replacement	SF	LI	$1,875	62.2	3,596	0.79
158	HVAC	Ductless HP - supplemental - NG furnace/No AC baseline - Market Opp	SF	LI	$5,441	62.2	3,596	0.53
159	HVAC	Ductless HP - supplemental - NG furnace/No AC baseline - Early Replacement	MF	LI	$1,069	35.4	2,050	0.79
160	HVAC	Ductless HP - supplemental - NG furnace/No AC baseline - Market Opp	MF	LI	$3,101	35.4	2,050	0.53
161	HVAC	Ductless HP - supplemental - LP furnace/No AC baseline - Early Replacement	SF	LI	$1,875	0	3,596	3.39
162	HVAC	Ductless HP - supplemental - LP furnace/No AC baseline - Market Opp	SF	LI	$5,441	0	3,596	2.27
163	HVAC	GSHP - NG furnace/No AC baseline - Early Replacement	SF	LI	$10,316	62.2	4,503	0.46
164	HVAC	GSHP - NG furnace/No AC baseline - Market Opp	SF	LI	$9,860	62.2	4,503	0.47
165	HVAC	GSHP - LP furnace/No AC baseline - Early Replacement	SF	LI	$10,316	0	4,503	1.96
166	HVAC	GSHP - LP furnace/No AC baseline - Market Opp	SF	LI	$9,860	0	4,503	2.01

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
167	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/No AC baseline - Early Replacement	SF	LI	$1,841	62.2	5,644	0.82
168	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/No AC baseline - Market Opp	SF	LI	$1,038	62.2	5,644	0.88
169	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/No AC baseline - Early Replacement	MF	LI	$1,050	35.4	3,217	0.82
170	HVAC	16 SEER / 9.0 hspf ASHP - NG boiler/No AC baseline - Market Opp	MF	LI	$592	35.4	3,217	0.88
171	HVAC	16 SEER / 9.0 hspf ASHP - LP boiler/No AC baseline - Early Replacement	SF	LI	$1,841	0	5,644	3.49
172	HVAC	16 SEER / 9.0 hspf ASHP - LP boiler/No AC baseline - Market Opp	SF	LI	$1,038	0	5,644	3.75
173	Pools	Heat Pump Pool Heater - NG Baseline - Early Replacement	SF	NLI	$1,841	17.6	318	0.48
174	Pools	Heat Pump Pool Heater - NG Baseline - Market Opp	SF	NLI	$1,250	17.6	318	0.68
175	Water Heating	Heat Pump Water Heater - NG Tank Baseline - Early Replacement	SF	NLI	$968	28.6	1,641	0.93
176	Water Heating	Heat Pump Water Heater - NG Tank Baseline - Market Opp	SF	NLI	$793	28.6	1,641	1.00
177	Water Heating	Heat Pump Water Heater - NG Tank Baseline - Early Replacement	MF	NLI	$968	26.6	1,526	0.91
178	Water Heating	Heat Pump Water Heater - NG Tank Baseline - Market Opp	MF	NLI	$793	26.6	1,526	0.97
179	Water Heating	Heat Pump Water Heater - LP Tank Baseline - Early Replacement	SF	NLI	$968	0	1,641	4.01
180	Water Heating	Heat Pump Water Heater - LP Tank Baseline - Market Opp	SF	NLI	$793	0	1,641	4.29
181	Water Heating	Heat Pump Water Heater - NG Instantaneous Baseline - Early Replacement	SF	NLI	$667	19.9	1,641	1.12
182	Water Heating	Heat Pump Water Heater - NG Instantaneous Baseline - Market Opp	SF	NLI	$499	19.9	1,641	1.20
183	Water Heating	Heat Pump Water Heater - NG Instantaneous Baseline - Early Replacement	MF	NLI	$667	18.5	1,526	1.09

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
184	Water Heating	Heat Pump Water Heater - NG Instantaneous Baseline - Market Opp	MF	NLI	$499	18.5	1,526	1.18
185	Water Heating	Heat Pump Water Heater - LP Instantaneous Baseline - Early Replacement	SF	NLI	$667	0	1,641	4.56
186	Water Heating	Heat Pump Water Heater - LP Instantaneous Baseline - Market Opp	SF	NLI	$499	0	1,641	4.90
187	Water Heating	Electric Water Heater - NG Tank Baseline - Early Replacement	SF	NLI	$357	28.6	5,197	0.51
188	Water Heating	Electric Water Heater - NG Tank Baseline - Market Opp	SF	NLI	$245	28.6	5,197	0.52
189	Water Heating	Electric Water Heater - NG Tank Baseline - Early Replacement	MF	NLI	$357	26.6	4,833	0.50
190	Water Heating	Electric Water Heater - NG Tank Baseline - Market Opp	MF	NLI	$245	26.6	4,833	0.51
191	Water Heating	Electric Water Heater - LP Tank Baseline - Early Replacement	SF	NLI	$357	0	5,197	2.17
192	Water Heating	Electric Water Heater - LP Tank Baseline - Market Opp	SF	NLI	$245	0	5,197	2.22
193	Water Heating	Electric Water Heater - NG Instantaneous Baseline - Early Replacement	SF	NLI	$56	19.9	5,197	0.57
194	Water Heating	Electric Water Heater - NG Instantaneous Baseline - Market Opp	SF	NLI	($113)	19.9	5,197	0.60
195	Water Heating	Electric Water Heater - NG Instantaneous Baseline - Early Replacement	MF	NLI	$56	18.5	4,833	0.57
196	Water Heating	Electric Water Heater - NG Instantaneous Baseline - Market Opp	MF	NLI	($113)	18.5	4,833	0.61
197	Water Heating	Electric Water Heater - LP Instantaneous Baseline - Early Replacement	SF	NLI	$56	0	5,197	2.33
198	Water Heating	Electric Water Heater - LP Instantaneous Baseline - Market Opp	SF	NLI	($113)	0	5,197	2.39
199	Water Heating	Heat Pump Water Heater - NG Tank Baseline - Early Replacement	SF	LI	$968	28.6	1,641	1.05

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
200	Water Heating	Heat Pump Water Heater - NG Tank Baseline - Market Opp	SF	LI	$793	28.6	1,641	1.13
201	Water Heating	Heat Pump Water Heater - NG Tank Baseline - Early Replacement	MF	LI	$968	26.6	1,526	1.03
202	Water Heating	Heat Pump Water Heater - NG Tank Baseline - Market Opp	MF	LI	$793	26.6	1,526	1.10
203	Water Heating	Heat Pump Water Heater - LP Tank Baseline - Early Replacement	SF	LI	$968	0	1,641	4.88
204	Water Heating	Heat Pump Water Heater - LP Tank Baseline - Market Opp	SF	LI	$793	0	1,641	5.22
205	Water Heating	Heat Pump Water Heater - NG Instantaneous Baseline - Early Replacement	SF	LI	$667	19.9	1,641	1.25
206	Water Heating	Heat Pump Water Heater - NG Instantaneous Baseline - Market Opp	SF	LI	$499	19.9	1,641	1.34
207	Water Heating	Heat Pump Water Heater - NG Instantaneous Baseline - Early Replacement	MF	LI	$667	18.5	1,526	1.22
208	Water Heating	Heat Pump Water Heater - NG Instantaneous Baseline - Market Opp	MF	LI	$499	18.5	1,526	1.32
209	Water Heating	Heat Pump Water Heater - LP Instantaneous Baseline - Early Replacement	SF	LI	$667	0	1,641	5.53
210	Water Heating	Heat Pump Water Heater - LP Instantaneous Baseline - Market Opp	SF	LI	$499	0	1,641	5.94
211	Water Heating	Electric Water Heater - NG Tank Baseline - Early Replacement	SF	LI	$357	28.6	5,197	0.57
212	Water Heating	Electric Water Heater - NG Tank Baseline - Market Opp	SF	LI	$245	28.6	5,197	0.58
213	Water Heating	Electric Water Heater - NG Tank Baseline - Early Replacement	MF	LI	$357	26.6	4,833	0.57
214	Water Heating	Electric Water Heater - NG Tank Baseline - Market Opp	MF	LI	$245	26.6	4,833	0.58
215	Water Heating	Electric Water Heater - LP Tank Baseline - Early Replacement	SF	LI	$357	0	5,197	2.64
216	Water Heating	Electric Water Heater - LP Tank Baseline - Market Opp	SF	LI	$245	0	5,197	2.70

Measure #	End Use	Electrification Measure	Home Type	Income Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
217	Water Heating	Electric Water Heater - NG Instantaneous Baseline - Early Replacement	SF	LI	$56	19.9	5,197	0.64
218	Water Heating	Electric Water Heater - NG Instantaneous Baseline - Market Opp	SF	LI	($113)	19.9	5,197	0.67
219	Water Heating	Electric Water Heater - NG Instantaneous Baseline - Early Replacement	MF	LI	$56	18.5	4,833	0.64
220	Water Heating	Electric Water Heater - NG Instantaneous Baseline - Market Opp	MF	LI	($113)	18.5	4,833	0.67
221	Water Heating	Electric Water Heater - LP Instantaneous Baseline - Early Replacement	SF	LI	$56	0.0	5,197	2.83
222	Water Heating	Electric Water Heater - LP Instantaneous Baseline - Market Opp	SF	LI	($113)	0	5,197	2.89
223	New Construction	New Electric Home - NG/CAC Baseline	SF	All	($3,034)	95.6	9,923	1.36
224	New Construction	New Electric Home - LP/CAC Baseline	SF	All	($3,063)	0	9,913	3.61
225	New Construction	New Electric Home - NG/CAC Baseline	MF	All	($2,839)	90.5	7,568	1.56
226	New Construction	New Electric Home - NG/No AC Baseline	SF	All	$43	95.6	11,005	0.69
227	New Construction	New Electric Home - LP/ No AC Baseline	SF	All	$14	0	10,995	2.93
228	New Construction	New Electric Home - NG/No AC Baseline	MF	All	($1,085)	90.5	8,185	1.02

COMMERCIAL MEASURES

Measure #	End Use	Baseline Measure	Electrification Measure	Electrification Measure Details	Replacement Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
1	Appliances - NG	NG Clothes Dryer	Electric Resistance Dryer	4.0 CEF	EOL	$0	32.1	5,025	0.72
2	Appliances - NG	NG Clothes Dryer	Heat Pump Dryer	6.0 CEF	EOL	$2,109	32.1	2,513	0.68
3	Appliances - LP	LP Clothes Dryer	Electric Resistance Dryer	4.0 CEF	EOL	$0	32.1	5,025	2.30
4	Appliances - LP	LP Clothes Dryer	Heat Pump Dryer	6.0 CEF	EOL	$2,109	32.1	2,513	2.17
5	Water Heating - NG	Tank-style	Electric Resistance	92% UEF	EOL	($355)	27.0	5,066	0.67
6	Water Heating - NG	Tank-style	Electric Resistance	92% UEF	ER	($413)	24.0	5,066	0.62
7	Water Heating - NG	Instantaneous	Electric Resistance	92% UEF	EOL	($1,405)	27.5	5,066	1.16
8	Water Heating - NG	Instantaneous	Electric Resistance	92% UEF	ER	($1,836)	17.5	5,066	0.97
9	Water Heating - NG	Tank-style	Heat Pump Water Heater	High Efficiency Heat Pump Water Heater	EOL	$649	27.0	1,578	1.28
10	Water Heating - NG	Tank-style	Heat Pump Water Heater	High Efficiency Heat Pump Water Heater	ER	$577	24.0	1,578	1.18
11	Water Heating - NG	Instantaneous	Heat Pump Water Heater	High Efficiency Heat Pump Water Heater	EOL	($401)	27.5	1,607	3.03
12	Water Heating - NG	Instantaneous	Heat Pump Water Heater	High Efficiency Heat Pump Water Heater	ER	($867)	17.5	1,151	3.29
13	Water Heating - LP	Tank-style	Electric Resistance	92% UEF	EOL	($355)	27.0	5,066	2.09
14	Water Heating - LP	Tank-style	Electric Resistance	92% UEF	ER	($413)	24.0	5,066	1.88
15	Water Heating - LP	Instantaneous	Electric Resistance	92% UEF	EOL	($1,405)	27.5	5,066	3.04
16	Water Heating - LP	Instantaneous	Electric Resistance	92% UEF	ER	($1,836)	17.5	5,066	2.16
17	Water Heating - LP	Tank-style	Heat Pump Water Heater	High Efficiency Heat Pump Water Heater	EOL	$649	27.0	1,578	4.37
18	Water Heating - LP	Tank-style	Heat Pump Water Heater	High Efficiency Heat Pump Water Heater	ER	$577	24.0	1,578	4.04
19	Water Heating - LP	Instantaneous	Heat Pump Water Heater	High Efficiency Heat Pump Water Heater	EOL	($401)	27.5	1,578	9.35

Measure #	End Use	Baseline Measure	Electrification Measure	Electrification Measure Details	Replacement Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
20	Water Heating - LP	Instantaneous	Heat Pump Water Heater	High Efficiency Heat Pump Water Heater	ER	($867)	17.5	1,578	6.45
21	Pools - NG	Pool Heater	Heat Pump Pool Heater	COP = 3; assume demand controlled to avoid peak	ER	$1,486	29.4	2,586	0.81
22	Pools - LP	Pool Heater	Heat Pump Pool Heater	COP = 3; assume demand controlled to avoid peak	ER	$1,486	29.4	2,586	2.73
23	CZ5 Space Heating - NG	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Central ASHP Heat Pump - 100% displacement	Cold Climate ASHP with at least 50 kBtu/h capacity at 5F. 2.5 weighted average heating COP. 18 SEER for cooling	ER	$8,678	67.1	11,298	0.63
24	CZ5 Space Heating - NG	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Central ASHP Heat Pump - 100% displacement	Cold Climate ASHP with at least 50 kBtu/h capacity at 5F. 2.5 weighted average heating COP. 18 SEER for cooling	EOL	$9,329	72.6	11,298	0.66
25	CZ5 Space Heating - NG	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Central ASHP Heat Pump - partial displacement	5 Ton Cold Climate ASHP with at least 60 kBtu/h capacity at 47F. 2.5 weighted average COP. 18 SEER.	ER	$4,016	53.7	7,957	0.73
26	CZ5 Space Heating - NG	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Central ASHP Heat Pump - partial displacement	5 Ton Cold Climate ASHP with at least 60 kBtu/h capacity at 47F. 2.5 weighted average COP. 12.8 IEER	EOL	$3,244	58.1	7,957	0.83
27	CZ5 Space Heating - NG	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Ductless Heat Pump - partial displacement	Mini-Split Heat Pump 3 tons cooling, 18 SEER and 9 HSPF	ER	$1,788	40.3	5,284	0.94
28	CZ5 Space Heating - NG	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Ductless Heat Pump - partial displacement	Mini-Split Heat Pump 3 tons cooling, 18 SEER and 9 HSPF	EOL	$1,016	43.6	5,284	1.09
29	CZ5 Space Heating - NG	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	GSHP - Full Displacement	GSHP <135,000 19EER	ER	$34,917	67.1	6,844	0.31

Measure #	End Use	Baseline Measure	Electrification Measure	Electrification Measure Details	Replacement Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
30	CZ5 Space Heating - NG	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	GSHP - Full Displacement	GSHP <135,000 19EER	EOL	$35,568	72.6	6,844	0.32
31	CZ5 Space Heating - NG	Commercial Forced Air (RTU) with Dx cooling and gas heating (average 10 ton cooling, 200 MBH heating)	Heat pump RTU (Average 10 ton cooling, 60 MBH heat pump, 150 MBH gas-fired) Partial displacement	11.5 EER cooling, 2.92 average COP heating	EOL	$6,000	71.3	13,704	0.92
32	CZ5 Space Heating - NG	200 ton central water-cooled chiller/ 3,500 MBH boiler, 4-pipe terminal units	200 ton combined WHSPs, and 2,800 MBH condensing boiler	23.2 EER cooling, 4.7 COP heating WSHPs	EOL	$422,200	2,424.5	230,324	0.62
33	CZ5 Space Heating - NG	1750 MBH Central boiler - hot water radiation, no cooling	Ductless Heat Pump - partial displacement	Cold Climate ASHP with at least 24 MBH capacity at 5F. 3.1 average COP. 13 IEER	EOL	$475,791	1,385.4	173,351	0.27
34	CZ5 Space Heating - NG	3,500 MBH central hot water boiler, 20 ton RTUs, hot water heat, DX cooling	20 ton GSHP RTUs, vertical well field	Ground loop, 21.3 EER, 3.8 COP	EOL	$595,325	3,463.5	353,330	0.86
35	CZ5 Space Heating - LP	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Central ASHP Heat Pump - 100% displacement	Cold Climate ASHP with at least 50 kBtu/h capacity at 5F. 2.5 weighted average heating COP. 18 SEER for cooling	ER	$8,678	67.1	11,298	1.50
36	CZ5 Space Heating - LP	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Central ASHP Heat Pump - 100% displacement	Cold Climate ASHP with at least 50 kBtu/h capacity at 5F. 2.5 weighted average heating COP. 18 SEER for cooling	EOL	$9,329	72.6	11,298	1.57
37	CZ5 Space Heating - LP	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Central ASHP Heat Pump - partial displacement	5 Ton Cold Climate ASHP with at least 60 kBtu/h capacity at 47F. 2.5 weighted average COP. 18 SEER.	ER	$4,016	53.7	7,957	1.66
38	CZ5 Space Heating - LP	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Central ASHP Heat Pump - partial displacement	5 Ton Cold Climate ASHP with at least 60 kBtu/h capacity at 47F. 2.5 weighted average COP. 12.8 IEER	EOL	$3,244	58.1	7,957	1.90

Measure #	End Use	Baseline Measure	Electrification Measure	Electrification Measure Details	Replacement Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
39	CZ5 Space Heating - LP	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Ductless Heat Pump - partial displacement	Mini-Split Heat Pump 3 tons cooling, 18 SEER and 9 HSPF	ER	$1,788	40.3	5,284	1.97
40	CZ5 Space Heating - LP	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Ductless Heat Pump - partial displacement	Mini-Split Heat Pump 3 tons cooling, 18 SEER and 9 HSPF	EOL	$1,016	43.6	5,284	2.32
41	CZ5 Space Heating - LP	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	GSHP - Full Displacement	GSHP <135,000 19EER	ER	$34,917	67.1	6,844	0.73
42	CZ5 Space Heating - LP	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	GSHP - Full Displacement	GSHP <135,000 19EER	EOL	$35,568	72.6	6,844	0.78
43	CZ5 Space Heating - LP	Commercial Forced Air (RTU) with Dx cooling and gas heating (average 10 ton cooling, 200 MBH heating)	Heat pump RTU (Average 10 ton cooling, 60 MBH heat pump, 150 MBH gas-fired) Partial displacement	11.5 EER cooling, 2.92 average COP heating	EOL	$6,000	71.3	13,704	1.48
44	CZ5 Space Heating - LP	200 ton central water-cooled chiller/ 3,500 MBH boiler, 4-pipe terminal units	200 ton combined WHSPs, and 2,800 MBH condensing boiler	23.2 EER cooling, 4.7 COP heating WSHPs	EOL	$422,200	2,424.5	230,324	1.60
45	CZ5 Space Heating - LP	1750 MBH Central boiler - hot water radiation, no cooling	Ductless Heat Pump - partial displacement	Cold Climate ASHP with at least 24 MBH capacity at 5F. 3.1 average COP. 13 IEER	EOL	$475,791	1,385.4	173,351	0.88
46	CZ5 Space Heating - LP	3,500 MBH central hot water boiler, 20 ton RTUs, hot water heat, DX cooling	20 ton GSHP RTUs, vertical well field	Ground loop, 21.3 EER, 3.8 COP	EOL	$595,325	3,463.5	353,330	1.79
119	Cooking - NG	Convection Oven	ENERGY STAR Commercial electric convection (retrofit)	Energy Star Electric Convection Oven	ER	$383	80.2	10,122	0.63
120	Cooking - NG	Convection Oven	ENERGY STAR Commercial electric convection (EOL)	Energy Star Electric Convection Oven	EOL	($595)	67.3	10,122	0.61
121	Cooking - NG	Combination Oven	ENERGY STAR Commercial electric combination (retrofit)	Energy Star Combination Electric Oven	ER	$17,110	103.5	11,914	0.29
122	Cooking - NG	Combination Oven	ENERGY STAR Commercial electric combination (EOL)	Energy Star Combination Electric Oven	EOL	($8,537)	70.0	11,914	1.22

Measure #	End Use	Baseline Measure	Electrification Measure	Electrification Measure Details	Replacement Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
123	Cooking - NG	Steam Cooker	ENERGY STAR Commercial electric steam cooker (retrofit)	Energy Star Electric Steam Cooker	ER	($5,490)	200.1	7,632	2.91
124	Cooking - NG	Steam Cooker	ENERGY STAR Commercial electric steam cooker (EOL)	Energy Star Electric Steam Cooker	EOL	($14,997)	94.7	7,632	3.03
125	Cooking - NG	Griddle	ENERGY STAR Commercial electric griddle (retrofit)	Energy Star Electric Griddle	ER	$2,175	115.5	13,905	0.70
126	Cooking - NG	Griddle	ENERGY STAR Commercial electric griddle (EOL)	Energy Star Electric Griddle	EOL	$293	102.4	13,905	0.72
127	Cooking - NG	Fryer	ENERGY STAR Commercial electric fryer (retrofit)	Energy Star Electric Fryer	ER	$10,171	158.1	15,063	0.58
128	Cooking - NG	Fryer	ENERGY STAR Commercial electric fryer (EOL)	Energy Star Electric Fryer	EOL	$8,289	107.4	15,063	0.43
129	Cooking - LP	Convection Oven	ENERGY STAR Commercial electric convection (retrofit)	Energy Star Electric Convection Oven	ER	$383	80.2	10,122	2.18
130	Cooking - LP	Convection Oven	ENERGY STAR Commercial electric convection (EOL)	Energy Star Electric Convection Oven	EOL	($595)	67.3	10,122	1.96
131	Cooking - LP	Combination Oven	ENERGY STAR Commercial electric combination (retrofit)	Energy Star Combination Electric Oven	ER	$17,110	103.5	11,914	1.01
132	Cooking - LP	Combination Oven	ENERGY STAR Commercial electric combination (EOL)	Energy Star Combination Electric Oven	EOL	($8,537)	70.0	11,914	2.41
133	Cooking - LP	Steam Cooker	ENERGY STAR Commercial electric steam cooker (retrofit)	Energy Star Electric Steam Cooker	ER	($5,490)	200.1	7,632	8.23
134	Cooking - LP	Steam Cooker	ENERGY STAR Commercial electric steam cooker (EOL)	Energy Star Electric Steam Cooker	EOL	($14,997)	94.7	7,632	5.55
135	Cooking - LP	Griddle	ENERGY STAR Commercial electric griddle (retrofit)	Energy Star Electric Griddle	ER	$2,175	115.5	13,905	2.42
136	Cooking - LP	Griddle	ENERGY STAR Commercial electric griddle (EOL)	Energy Star Electric Griddle	EOL	$293	102.4	13,905	2.49
137	Cooking - LP	Fryer	ENERGY STAR Commercial electric fryer (retrofit)	Energy Star Electric Fryer	ER	$10,171	158.1	15,063	1.99

Measure #	End Use	Baseline Measure	Electrification Measure	Electrification Measure Details	Replacement Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
138	Cooking - LP	Fryer	ENERGY STAR Commercial electric fryer (EOL)	Energy Star Electric Fryer	EOL	$8,289	107.4	15,063	1.48
139	NC Appliances - NG	ES Electric Clothes Dryer 4.0 CEF replacing NG Clothes Dryer	Electric Resistance Dryer	4.0 CEF	NC	$0	32.1	5,025	0.72
140	NC Appliances - NG	ES Heat PumpClothes Dryer 6.0 CEF replacing NG Clothes Dryer	Heat Pump Dryer	6.0 CEF	NC	$2,109	32.1	2,513	0.68
141	NC Appliances - LP	ES Electric Clothes Dryer 4.0 CEF replacing LP Clothes Dryer	Electric Resistance Dryer	4.0 CEF	NC	$0	32.1	5,025	2.30
142	NC Appliances - LP	ES Heat PumpClothes Dryer 6.0 CEF replacing LP Clothes Dryer	Heat Pump Dryer	6.0 CEF	NC	$2,109	32.1	2,513	2.17
143	NC Water Heating - NG	Tank-style	Electric Resistance	92% UEF	NC	($355)	24.0	5,066	0.61
144	NC Water Heating - NG	Instantaneous	Electric Resistance	92% UEF	NC	($1,405)	17.5	5,066	0.87
145	NC Water Heating - NG	Tank-style	Heat Pump Water Heater	High Efficiency Heat Pump Water Heater	NC	$649	24.0	1,578	1.14
146	NC Water Heating - NG	Instantaneous	Heat Pump Water Heater	High Efficiency Heat Pump Water Heater	NC	($401)	17.5	1,578	2.08
147	NC Water Heating - LP	Tank-style	Electric Resistance	92% UEF	NC	($355)	24.0	5,066	1.86
148	NC Water Heating - LP	Instantaneous	Electric Resistance	92% UEF	NC	($1,405)	17.5	5,066	2.06
149	NC Water Heating - LP	Tank-style	Heat Pump Water Heater	High Efficiency Heat Pump Water Heater	NC	$649	24.0	1,578	3.89
150	NC Water Heating - LP	Instantaneous	Heat Pump Water Heater	High Efficiency Heat Pump Water Heater	NC	($401)	17.5	1,578	6.07
151	NC CZ5 Space Heating - NG	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Central ASHP Heat Pump - 100% displacement	Cold Climate ASHP with at least 50 kBtu/h capacity at 5F. 2.5 weighted average heating COP. 18 SEER for cooling	NC	$9,329	72.6	11,298	0.66
152	NC CZ5 Space Heating - NG	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Central ASHP Heat Pump - partial displacement	5 Ton Cold Climate ASHP with at least 60 kBtu/h capacity at 47F. 2.5 weighted average COP. 12.8 IEER	NC	$3,244	58.1	7,957	0.83

Measure #	End Use	Baseline Measure	Electrification Measure	Electrification Measure Details	Replacement Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
153	NC CZ5 Space Heating - NG	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Ductless Heat Pump - partial displacement	Mini-Split Heat Pump 3 tons cooling, 18 SEER and 9 HSPF	NC	$1,016	43.6	5,284	1.09
154	NC CZ5 Space Heating - NG	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	GSHP - Full Displacement	GSHP <135,000 19EER	NC	$35,568	72.6	6,844	0.32
155	NC CZ5 Space Heating - NG	Commercial Forced Air (RTU) with Dx cooling and gas heating (average 10 ton cooling, 200 MBH heating)	Heat pump RTU (Average 10 ton cooling, 60 MBH heat pump, 150 MBH gas-fired) Partial displacement	11.5 EER cooling, 2.92 average COP heating	NC	$6,000	71.3	13,704	0.92
156	NC CZ5 Space Heating - NG	200 ton central water-cooled chiller/ 3,500 MBH boiler, 4-pipe terminal units	200 ton combined WHSPs, and 2,800 MBH condensing boiler	23.2 EER cooling, 4.7 COP heating WSHPs	NC	$422,200	2,424.5	230,324	0.62
157	NC CZ5 Space Heating - NG	1750 MBH Central boiler - hot water radiation, no cooling	Ductless Heat Pump - partial displacement	Cold Climate ASHP with at least 24 MBH capacity at 5F. 3.1 average COP. 13 IEER	NC	$475,791	1,385.4	173,351	0.27
158	NC CZ5 Space Heating - NG	3,500 MBH central hot water boiler, 20 ton RTUs, hot water heat, DX cooling	20 ton GSHP RTUs, vertical well field	Ground loop, 21.3 EER, 3.8 COP	NC	$595,325	3,463.5	353,330	0.86
159	NC CZ5 Space Heating LP	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Central ASHP Heat Pump - 100% displacement	Cold Climate ASHP with at least 50 kBtu/h capacity at 5F. 2.5 weighted average heating COP. 18 SEER for cooling	NC	$9,329	72.6	11,298	1.57
160	NC CZ5 Space Heating LP	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Central ASHP Heat Pump - partial displacement	5 Ton Cold Climate ASHP with at least 60 kBtu/h capacity at 47F. 2.5 weighted average COP. 12.8 IEER	NC	$3,244	58.1	7,957	1.90
161	NC CZ5 Space Heating LP	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	Ductless Heat Pump - partial displacement	Mini-Split Heat Pump 3 tons cooling, 18 SEER and 9 HSPF	NC	$1,016	43.6	5,284	2.32
162	NC CZ5 Space Heating LP	Central Forced Air Furnace with DX cooling (Average 65 kBtu/h)	GSHP - Full Displacement	GSHP <135,000 19EER	NC	$35,568	72.6	6,844	0.78

Measure #	End Use	Baseline Measure	Electrification Measure	Electrification Measure Details	Replacement Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
163	NC CZ5 Space Heating LP	Commercial Forced Air (RTU) with Dx cooling and gas heating (average 10 ton cooling, 200 MBH heating)	Heat pump RTU (Average 10 ton cooling, 60 MBH heat pump, 150 MBH gas-fired) Partial displacement	11.5 EER cooling, 2.92 average COP heating	NC	$6,000	71.3	13,704	1.48
164	NC CZ5 Space Heating LP	200 ton central water-cooled chiller/ 3,500 MBH boiler, 4-pipe terminal units	200 ton combined WHSPs, and 2,800 MBH condensing boiler	23.2 EER cooling, 4.7 COP heating WSHPs	NC	$422,200	2,424.5	230,324	1.60
165	NC CZ5 Space Heating LP	1750 MBH Central boiler - hot water radiation, no cooling	Ductless Heat Pump - partial displacement	Cold Climate ASHP with at least 24 MBH capacity at 5F. 3.1 average COP. 13 IEER	NC	$475,791	1,385.4	173,351	0.88
166	NC CZ5 Space Heating LP	3,500 MBH central hot water boiler, 20 ton RTUs, hot water heat, DX cooling	20 ton GSHP RTUs, vertical well field	Ground loop, 21.3 EER, 3.8 COP	NC	$595,325	3,463.5	353,330	1.79
215	NC Cooking - NG	Convection Oven	ENERGY STAR Commercial electric convection (EOL)	Energy Star Electric Convection Oven	NC	($595)	67.3	10,122	0.61
216	NC Cooking - NG	Combination Oven	ENERGY STAR Commercial electric combination (EOL)	Energy Star Combination Electric Oven	NC	($8,537)	70.0	11,914	1.22
217	NC Cooking - NG	Steam Cooker	ENERGY STAR Commercial electric steam cooker (EOL)	Energy Star Electric Steam Cooker	NC	($14,997)	94.7	7,632	3.03
218	NC Cooking - NG	Griddle	ENERGY STAR Commercial electric griddle (EOL)	Energy Star Electric Griddle	NC	$293	102.4	13,905	0.72
219	NC Cooking - NG	Fryer	ENERGY STAR Commercial electric fryer (EOL)	Energy Star Electric Fryer	NC	$8,289	107.4	15,063	0.43
220	NC Cooking - LP	Convection Oven	ENERGY STAR Commercial electric convection (EOL)	Energy Star Electric Convection Oven	NC	($595)	67.3	10,122	1.96
221	NC Cooking - LP	Combination Oven	ENERGY STAR Commercial electric combination (EOL)	Energy Star Combination Electric Oven	NC	($8,537)	70.0	11,914	2.41
222	NC Cooking - LP	Steam Cooker	ENERGY STAR Commercial electric steam cooker (EOL)	Energy Star Electric Steam Cooker	NC	($14,997)	94.7	7,632	5.55
223	NC Cooking - LP	Griddle	ENERGY STAR Commercial electric griddle (EOL)	Energy Star Electric Griddle	NC	$293	102.4	13,905	2.49

Measure #	End Use	Baseline Measure	Electrification Measure	Electrification Measure Details	Replacement Type	Electrification Incremental Cost	Baseline MMBtu / Yr	Electrification kWh / Yr	mTRC + SCC Cost Effectiveness
224	NC Cooking - LP	Fryer	ENERGY STAR Commercial electric fryer (EOL)	Energy Star Electric Fryer	NC	$8,289	107.4	15,063	1.48
225	NC Pools - NG	Pool Heater	Heat Pump Pool Heater	COP = 3; assume demand controlled to avoid peak	ER	$1,486	29.4	2,586	0.81
226	NC Pools - LP	Pool Heater	Heat Pump Pool Heater	COP = 3; assume demand controlled to avoid peak	ER	$1,486	29.4	2,586	2.73

INDUSTRIAL, AGRICULTURAL, TRANSPORTATION

Measure #	End Use	Measure	Efficiency	Replacement Type	Electrification Incremental Cost	Baseline Usage MMBtu / Yr	Efficient Baseline Usage kWh / Yr
1	NRE	Electric Forklift	Conventional charge electric forklift replacing class 5 ICE forklift	ER	$10,200	190.3	31,468
2	NRE	Transport/Truck Refrigeration Unit (TRU)	Electric TRU (eTRU) - Replace diesel powered TRU with eTRU	ER	$4,000	240.0	14,991
3	NRE	Truckstop Electrification (TSE) Plug-in/Shore Power Connection	One shorepower connection (50A) (Onboard equipment)	ER	$6,500	528.3	22,213
4	O&G	Convert gas pneumatic controls to instrument air	Compressed air pneumatic instruments	ER	$60,000	20,000.0	175,200
5	O&G	Replace gas-fired pipeline compressors with electric	Electric pipeline compressors - replacement	ER	$6,000,000	302,000.0	20,000,000
6	O&G	New pipeline electric compressors instead of gas-fired	Electric pipeline compressors - new	EOL	$500,000	302,000.0	20,000,000
7	O&G	New dual drive compressors instead of gas-fired only	Dual-fuel pipeline compressors	EOL	$1,500,000	302,000.0	10,000,000
8	O&G	Gas pneumatic kimray pump to electric (impacts per pump)	Electric Kimray Pump	ER	$10,000	5,000.0	20,000
9	O&G	Replace gas-assisted glycol pump with electric (impacts per pump)	Electric glycol pump	ER	$9,000	18,000.0	41,600
10	Irrigation	HE electric irrigation pumping plant	Electric Irrigation	ER	-$10,000	1,395.0	59,978

Measure #	End Use	Measure	Efficiency	Replacement Type	Electrification Incremental Cost	Baseline Usage MMBtu / Yr	Efficient Baseline Usage kWh / Yr
11	Irrigation	HE electric irrigation pumping plant	Electric Irrigation	ER	-$10,000	1,668.0	59,978
12	Manure Handling	Electric manure pumping	Electric Manure Handling	ER	$25,000	278.0	5,475
13	Manure Handling	Electric alley scrapers	Electric Manure Handling	ER	$20,000	695.0	19,710
14	Livestock Feeding	Electric feed mixer	Electric Feed Mixing	ER	$175,000	139.0	216,810
15	Livestock Feeding	Electric feed pusher	Electric Feed Pushing	ER	$50,000	139.0	964
16	Steel Melting	Electric Arc Furnace (475 kWh/ton)	Electric Steel Furnace	EOL	$0	1,736,000.0	294,500,000
17	Steel Melting	Electric Induction Furnace (567 kWh/ton)	Electric Steel Furnace	EOL	$200,000	868,000.0	175,770,000

CARBON MODELING ASSUMPTIONS

Carbon model assumptions were based on four sources of data and information:

- Climate Registry Protocols
- EIA data regarding electric utility carbon emissions to set the 2005 and 2018 Colorado baseline emissions factors
- CO2e emissions factors for the electricity sector with percentage reductions from the 2005 baseline were calculated for each of the three scenarios, all of which resulted in 100% emissions reductions by 2050. Reductions were linear from the 2018 baseline to 2030 and then linear from 2030 to 2050
    - 50% reduction in emissions by 2030
    - The Base Case of 80% emissions reductions by 2030
    - 100% reduction in emissions by 2030
- The valuation of CO2e emissions utilized the SB-236 value of $46 per short ton in 2020, escalating at rates based on the 2016 EPA Technical Guidance document referenced in the report. These values were converted to nominal values using the EPA's 3 percent central case and general inflation rate noted above.

CARBON MODELING FACTORS

Emissions Factor	2005	2018	2020	2025	2030	2035	2040	2045	2050
Electricity (tons per MWh)									
100 percent in 2030	0.9602218	0.6737547	0.5591039	0.2748268	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
80 percent in 2030 - base case	0.9602218	0.6737547	0.5871733	0.3714093	0.1538599	0.1100277	0.0694625	0.0326852	0.0000000
50 percent in 2030	0.9602218	0.6737547	0.6292775	0.5162830	0.3846498	0.2750694	0.1736563	0.0817130	0.0000000
NG Emissions Factor (CO2 tons/MMBTU)	0.058488	0.058488	0.058488	0.058488	0.058488	0.058488	0.058488	0.058488	0.058488
Propane Emissions Factor (CO2 tons/MMBTU)	0.067747	0.067747	0.067747	0.067747	0.067747	0.067747	0.067747	0.067747	0.067747
Distillate Fuel Oil #2 (CO2e tons/MMBTU)	0.081039	0.081039	0.081039	0.081039	0.081039	0.081039	0.081039	0.081039	0.081039
Motor Gasoline (CO2 tons/MMBTU)	0.078121	0.078121	0.078121	0.078121	0.078121	0.078121	0.078121	0.078121	0.078121
Annual Cost of Carbon ($ per Ton) - nominal	N/A	N/A	$ 46.00	$ 66.29	$ 95.53	$ 136.33	$ 194.54	$ 273.56	$ 384.66

BENEFICIAL ELECTRIFICATIO IN COLORADO

Market Potential
2021-2030

Prepared for

COLORADO ENERGY OFFICE

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Market Barriers and Policy Recommendations

FINAL REPORT

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1 Executive Summary

1.1 OVERVIEW

This report summarizes the findings and recommendations GDS Associates, Inc. (GDS) for a beneficial electrification market barrier and policy analysis study commissioned by the Colorado Energy Office (CEO). This report is a companion to a beneficial electrification modeling report.[1] The modeling report estimated the potential for residential, commercial, and industrial building electrification from 2021-2030 to help Colorado meet its greenhouse gas emissions reduction goals. This market barriers and policy report presents additional information on the current market challenges to beneficial electrification in Colorado and presents recommendations for policy options to help overcome those barriers or other challenges to beneficial electrification, laying the foundation for achieving the potential over the next decade and beyond.

The key findings and recommendations that emerged from this study reflect the combination of two primary sources of data: in-depth interviews with a range of stakeholders in Colorado and literature reviews identifying the status of electrification policies in Colorado and other states. GDS wants to thank the interviewed stakeholders for their time and contribution to the research, which shed invaluable light on the many perspectives related to Colorado's electrification market and policies.

As a note to the reader – although beneficial electrification is a general term, it has a specific definition in Colorado statute, which was added in 2019 in Senate Bill 236.[2] The statute defines beneficial electrification as changing the "energy source powering an end use from a nonelectric source to an electric source, including transportation, water heating, space heating, or industrial processes, if the change:

- Reduces system costs for the utility's customers;
- Reduces net carbon dioxide emissions; or
- Provides for a more efficient utilization of grid resources."

In other states, different terms are also used to convey the same core concept. When using the term "beneficial electrification" this report refers to the Colorado statute definition (described in the Introduction section). Other terms – electrification, strategic electrification, and energy optimization, are used to reflect a jurisdiction's perspective or otherwise used to convey the general concept of electrification in which energy-using technologies are converted from fossil fuels to electricity in a goal to reduce greenhouse gas emissions.

The following key findings and recommendations summarize the results of GDS' research into the current state of the market for beneficial electrification in Colorado and key policy recommendations for the State to consider.

[1] GDS Associates, Inc. *Beneficial Electrification in Colorado, Market Potential 2021-2030.* Prepared for the Colorado Energy Office, June 2020.
[2] C.R.S. 40-3.2-106(6)(a), https://leg.colorado.gov/sites/default/files/2019a_236_signed.pdf

1.2 FINDINGS AND RECOMMENDATIONS

Below we summarize the key findings and recommendations that emerged from interviews with Colorado stakeholders and our literature reviews. The findings include a summary of market barriers which may impede beneficial electrification in the building sector and policy recommendations that the State of Colorado should consider implementing to overcome these barriers. The policy recommendations are intended to lay a foundation from which the beneficial electrification markets and programs can grow. As the market for beneficial electrification grows, new or evolving opportunities may warrant the development of additional policies and programs. We discuss these additional themes and policy considerations in Section 3, Interview Results.

Market Barriers Summary

Throughout our stakeholder interviews, GDS found many common themes and observations regarding market barriers to beneficial electrification in Colorado buildings. Market barriers represent conditions in a marketplace that prevent or limit outcomes from what may be optimal or are otherwise reflected in policy goals. For beneficial electrification the barriers cover aspects related to current market conditions and behaviors that limit market development and growth. The market barriers are interrelated and create challenges for rapidly expanding beneficial electrification for residential and commercial buildings absent policy and programmatic support. Below we provide a short summary, with more detail provided for each in the body of the report.

Market Barrier #1: Limited consumer awareness and demand

Interviews revealed a view that Colorado's residential and commercial building owners are not familiar with heat pumps for space heating and water heating. The lack of awareness leads to low interest or demand for products. Additionally, poor experience with prior electric technologies or myths about heat pumps may also hinder demand. Finally, the high upfront cost of heat pumps and other electrification technologies compared to traditional gas or propane equipment can hinder demand regardless of the potential long-term financial and health benefits.

Market Barrier #2: Limited product availability

Heat pumps are not common in Colorado. Interview respondents repeatedly relayed challenges for consumers who seek to have heat pumps installed, only to learn at the time of purchase, interview respondents indicated that the available stock of heat pumps was limited or unavailable. The lack of readily available supply creates lost opportunities to grow the heat pump market, particularly when homeowners or businesses must make a quick decision when faced with the need to replace failing existing equipment.

Market Barrier #3: Marketplace reluctance to promote or sell heat pumps

Interview respondents reported that many HVAC or plumbing contractors actively discourage or simply do not sell heat pump technologies. This reluctance may be due to outdated perspectives on heat pump performance, a lack of expertise on how to design and install systems or concerns over installing and servicing unfamiliar technology. For new construction, home builders may be reluctant to consider all-electric options since consumers desire features such as gas ranges and gas log fireplaces.

Market Barrier #4: Workforce limitations

Several interview respondents raised the issue of contractor shortages for both skilled and unskilled workers in Colorado's HVAC and plumbing workforce. High turnover in the trades as well as the fact that the available workforce is focused on traditional fossil fuel space heating and water heating technologies

exacerbates this challenge. When combined with limited equipment supply and unfamiliar technologies, workforce limitations may also increase prices of electrification retrofits relative to what a more mature market would offer.

Market Barrier #5: Uncertainty with the Regulatory Framework Related to Fuel Switching
In our interviews, respondents regularly brought up a perception that utility promotion of fuel switching is prohibited or otherwise discouraged. One clear example is Colorado Public Utilities Commission (PUC) rule, 4 CCR 723-4-4756(b), which prohibits natural gas utilities from incorporating fuel switching away from natural gas in their energy efficiency programs. There is a perception that utilities regulated by the PUC cannot promote fuel switching and, by extension, beneficial electrification. However, our research did not identify any other specific limitations or prohibitions.

Market Barrier #6: Energy Efficiency Program Focus and Messaging
Colorado's investor-owned and other utilities have primarily focused energy efficiency messaging on "like for like" energy savings; the fuel switching messaging is uncommon. The success of energy-efficiency programs and messaging has been to reinforce traditional space heating and water heating technologies.

Market Barrier #7: Some of the existing residential and commercial building stock may not be able to easily integrate heat pumps.
Interview respondents noted that many of Colorado's buildings, particularly homes, may not have adequate electrical infrastructure (e.g. service panels or wiring) or may need duct work or other improvements to integrate heat pumps. In some cases, heat pump water heaters may be too large to install in the location of existing water heating equipment. Without adequate electricity infrastructure in a home or business or a need to address air distribution or other infrastructure limits, the additional complexities can increase installation costs or may require additional skillsets that are not typically required when addressing retrofits would otherwise use a system similar to the one already in place.

Market Barrier #8: Electricity market price signals or programs at the wholesale or retail level may not adequately capture the potential value of heat pump technologies or other electrification technologies.
Some of our interview respondents expressed that electricity markets in Colorado may not have pricing structures that capture or enable the value of beneficial electrification technologies. Many electrification technologies have the ability to enable load control, load shifting or otherwise adjusting use patterns in response to utility demand or price signals. Respondents noted that this can include long term wholesale contracts that may not value short-term shifts in demand (e.g. hourly or narrow peaks) as well as retail rates with demand charge structures that do not link to utility controllable loads.

Market Barrier #9: Uncertainty in rules related to HB 19-1261[3], a driver of statewide decarbonization efforts, creates risk for electric utilities to utilize beneficial electrification to meet greenhouse gas reduction goals.
While HB 19-1261 set targets for reducing statewide greenhouse gas (GHG) emissions relative to a 2005 baseline, the rules for allocating baseline emissions to different portions of Colorado's economy are not settled. With beneficial electrification being a potential means of reducing economy-wide GHG emissions, electric utilities may be reluctant to promote beneficial electrification due to the risk that it would increase their emissions beyond what they would otherwise need to reduce relative to their share of the 2005 baseline. Even without utility-sponsored programs, beneficial electrification creates risk to electric utilities unless there is a mechanism to account for their emissions targets while crediting others with emissions

[3] https://leg.colorado.gov/sites/default/files/2019a_1261_signed.pdf

reductions. Additionally, rules related to accounting and tracking emissions reduction that involve two parties (e.g. a gas utility and an electric utility) are needed to track compliance and allocate GHG emissions reductions. With rules in place, electric utilities or others can plan for and promote beneficial electrification as appropriate.

Market Barrier #10: Electricity rate structures may not envision or allocate costs in a manner that reflects a high penetration of beneficial electrification technologies.
Current electricity rate designs may not reflect the opportunities that beneficial electrification technologies can bring to utilities' or customers' load management or control options. Additionally, the structure and approach to demand charges may not reflect how heat pumps or other electrification technologies impact the utility system. For example, demand charges set without regard to time of use potentially penalize winter or nighttime energy demand. As a result, current electricity pricing may limit load management program opportunities and the ability of utilities or customers to fully capture the value that beneficial electrification technologies can bring, potentially inflating operating costs from what may otherwise be possible. Current rates and wholesale contracts may also not reflect the resource mix and penetration of electrification technologies in the future, limiting adoption in the present.

Policy Recommendations

GDS developed the following policy recommendations based on interviews with stakeholders, research into other States' electrification policies, and current policies that affect electrification in Colorado. The policies reflect opportunities to not only overcome the market barriers, summarized above, but also to expand beneficial electrification and reduce Colorado's greenhouse gas emissions. These policies are presented as a general order of priority and selected to address near-term needs to expand the market for beneficial electrification in Colorado.

Policy Recommendation #1: Either through legislation and subsequent rulemaking, or directly through rulemaking, the PUC should establish clear rules for regulated utilities to promote beneficial electrification.
Beneficial electrification cannot become a substantial portion of electricity demand-side management programs without a clear regulatory framework. To the degree the PUC requires legislation to take action, the Legislature should build from SB 19-236 and HB 19-1261 and establish a foundation for the PUC to act. The existing legislative definition of beneficial electrification should be used as the cornerstone, with a clear framework for related to quantifying net greenhouse gas emissions impacts a key consideration. Additionally, the PUC should consider programmatic features that allow for program participation equity across ratepayers, including low- or moderate-income homeowners or renters, and hard to reach businesses.

Policy Recommendation #2: Colorado should establish clear greenhouse gas emissions baselines and accounting practices to support rules associated with HB 19-1261 and incorporate beneficial electrification into those rules.
Utilities will need a standard practice for quantifying greenhouse gas emissions reductions to track the long-term carbon reduction effects of electrification. The State should establish rules with simplified emissions reductions metrics for the myriad small electrification measures that may be installed via utility programs. For example, attempting to quantify each individual heat pump installation's impacts would be burdensome. These rules and metrics will enable electric utilities to plan and track their performance relative to their responsibilities under HB 19-1261. General principles and metrics will facilitate electrification and can be updated periodically based on electricity grid emissions factors or updates to

the impacts of electrification equipment. This process would be similar to how energy efficiency goals are tracked and credited today. Doing so will enable Colorado's electric utilities to plan for beneficial electrification, contribute to reductions in statewide greenhouse gas emissions, and equitably track the reductions in greenhouse gas emissions associated with beneficial electrification.

Recommendation #3: The PUC should update cost-effectiveness calculation approaches used by utilities in their energy efficiency programs, integrated resource plans, and other decision making.
The current formulation of the modified Total Resource Cost (mTRC) test was designed to support energy efficiency programs and follows standard industry practice. Even with utility integrated resource plans filed with the PUC incorporating a social cost of carbon, the formulation does not fully address beneficial electrification. Updating the role of non-energy benefits in the formulation of the costs and benefits will help address the trade-offs of shifting from fossil fuels to electricity. For example, health and safety considerations for fuel switching, such as improvements to indoor air quality, are not explicitly addressed in the current formulation. Factors to ensure that low- or moderate-income customers receive no-cost electrification measures should also ensure that program outcomes do not lead to increased operating costs for these customers. The PUC may want to consider whether the avoided costs used in the current formulation of the mTRC test reflect the avoided costs associated with reductions in greenhouse gas emissions. For natural gas, this might include the cost of alternatives to fossil fuel natural gas, such as renewable natural gas, as one component of the avoided natural gas cost. Finally, the PUC should consider the treatment of net savings for beneficial electrification and whether the current immature state of the market and future growth should receive a net to gross ratio of 1.0.

Policy Recommendation #4: The State should coordinate with a broader set of stakeholders interested in advancing beneficial electrification.
Coordination with utilities, advocates, market actors, and others will help drive consistency in how the many stakeholders in beneficial electrification work together to develop the market. Coordination can take many forms. One that may be needed in the near term includes establishing a long-term market tracking mechanism so that utilities and the State can monitor electrification progress across diverse utilities and industries. A second opportunity in the near-term is to support Colorado organizations seeking to address the market barriers above – there is risk of many small and disparate efforts not achieving a scale that will enable beneficial electrification to meet Colorado's greenhouse gas emissions reduction goals. These organizations could include trade associations, utilities, local governments, clean energy advocates, product manufacturers, distributors, developers, workforce representation, or organizations that bring them all together. Supporting existing organizations and coordinating efforts will help facilitate the sharing of lessons learned, reduce potential redundancy, and develop consistent messaging that will create a resilient network to promote beneficial electrification into the future.

Policy Recommendation #5: The State of Colorado should develop workforce development initiatives focused on beneficial electrification.
Colorado has a high demand and possible shortage of heating, ventilation, and air conditioning (HVAC) and plumbing industry workers. Beneficial electrification will require workers with new skill sets and an understanding of technology. Leveraging the existing workforce education infrastructure and trades, the State should ensure that electrification becomes a part of technical training apprenticeships, and professional licensure. The State should also support the integration of electrification and energy concepts into school curriculums and utility trade partnership programs. Training efforts to develop knowledge and skills for architects, engineers, builders, and associated trades are particularly important to promote beneficial electrification in the new construction market and to ensure quality design and installation practices and high efficiency electrified buildings.

Policy Recommendation #6: The Colorado Energy Office (CEO) should promote advanced building energy codes and support local jurisdictions with crafting energy codes to address electrification readiness in new construction or otherwise.

As a home-rule state, Colorado's local jurisdictions adopt building codes. While HB 19-1260[4] requires local jurisdictions to adopt one of the latest three editions of the International Energy Conservation Code (IECC) upon updating or adopting any other building code, those codes do not directly address electrification. Further, whereas some Colorado jurisdictions are leaders in adopting more advanced energy codes, many others need guidance and consistency in developing their own codes. The CEO can build from its current Energy Code Adoption Toolkit[5] to address building electrification opportunities, similar to the guidance provided for electric vehicle (EV) ready ordinances.

Policy Recommendation #7: The State should prioritize electrification in its own buildings, leading by example and helping develop the marketplace.

The State has considerable purchasing power and can demonstrate its leadership and help develop the marketplace by electrifying its own buildings. Incorporating beneficial electrification into its High-Performance Certification Program and updating purchasing policies to favor the appropriate installation of heat pumps or heat pump water heaters into its own buildings will create demand that can have effects into the broader marketplace. Influencing stocking practices at distributors and creating successful examples for others to learn from will help create awareness and experience in the marketplace. As a consideration, the State could incorporate the social cost of carbon into its own purchasing economic criteria.

Recommendation #8: The Colorado Legislature should consider implementing legislation to develop beneficial electrification funds or goals for electric utilities and funding for State-sponsored programming. Electric utilities should participate at an equivalent level with programmatic expenditures used to facilitate program participation by low- and moderate-income households and small businesses.

Beneficial electrification in buildings is unlikely to substantially increase its market share over the coming decade without considerable programmatic support. Other states have developed utility-sponsored programs to support the market with incentives, technical support, and related market development activities. In our research, the establishment of goals to support electrification predominated, with utility program funding emerging from the goals. In our interviews with utilities, concern over a system benefits charge primarily focused on issues of equivalency and consistency across the multiple utilities in Colorado. While investor-owned utilities may be able to develop programs via PUC rulemaking, unregulated utilities have no such mechanism. But even for regulated utilities, the lack of legislated goals leads to uncertainty and the possibility for inconsistency. Whether via goals or funding, a legislated system benefits charge ensures that all Colorado ratepayers contribute to and have access to beneficial electrification programs, while equivalent goals create consistency in outcome expectations. To ensure equity across the diversity of the residential and nonresidential customer base, a requirement that a percentage of funds be spent on low- or moderate-income and hard-to-reach small businesses will enable a broad range of program participation and avoid customers with particular demographic or firmographic challenges from being left behind. The legislature may want to consider a "ramp-in" to either funding or goals, with early expectations reflecting the reality that the current market requires preparation, with higher levels of

[4] https://leg.colorado.gov/sites/default/files/2019a_1260_signed.pdf

[5] https://energyoffice.colorado.gov/climate-energy/energy-policy/building-energy-codes/energy-code-adoption-toolkit

spending or goal expectations supporting a more robust market later in the decade. A system benefits charge or goal could be structured as a percent of retail revenue or sales, similar to Vermont. Vermont uses goals, with an increasing expectation for achievements over time, ramping from two percent of retail electricity sales in 2017 to 12 percent in 2032. Any goals or funding should also be treated as separate from energy efficiency programs in order to retain the value those programs offer.

In the next section we provide an introduction to this study and a background on Colorado's current policies that relate to beneficial electrification.

2 Introduction

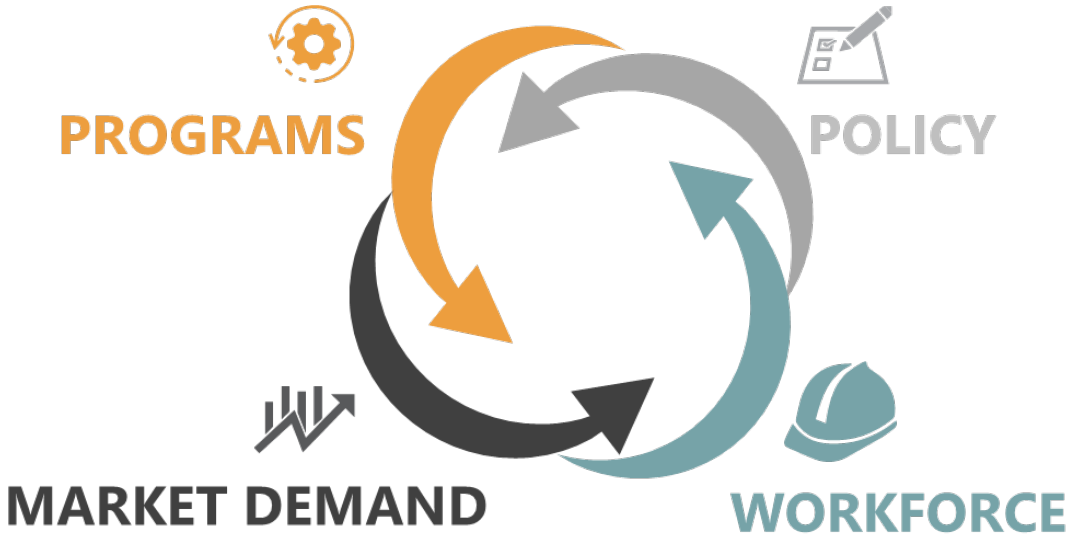
This report presents the results of research into beneficial electrification market barriers and policy related to Colorado's residential and commercial buildings. The purpose of the report is to present the key market barriers for Colorado that were identified through our research and policy recommendations that the State should consider implementing. The study builds from a market assessment in which GDS modeled the potential for and adoption impacts of beneficial electrification that could occur over the next decade (2021-2030). Both the modeling study and this report take into account legislation passed in 2019 and publicly announced utility plans that will result in a substantial reduction in greenhouse gas emissions in the electricity sector over the next ten years and beyond.[6]

To complete the study GDS relied on two major sources of information.

1) Interviews with Colorado representatives from investor-owned, municipal, and cooperative utilities, a power supplier, clean energy advocacy organizations, income-qualified energy efficiency service providers, an efficiency trade association, and sustainability staff from two cities
2) A literature review of current policies in states with the most advanced beneficial electrification policies and programs

In order to drive beneficial electrification in Colorado, GDS identified four major factors that interact to affect the market for beneficial electrification. As shown in Figure 2-1, Colorado will need to tackle the combination of market demand with workforce development, beneficial electrification policies, and programs.

Figure 2-1 Interrelated Drivers of Beneficial Electrification



[6] The modeling report developed a base case that assumed an 80 percent reduction in greenhouse gas emissions from electric utilities in 2030 from a 2005 baseline, and achieving a 100 percent emissions reduction in 2050, aligning with SB 19-236 and Xcel Energy's carbon-reduction commitment.

The set of market barriers, program ideas, and policy recommendations presented in this report are meant to provide a set of issues and next steps for Colorado to consider in its development of the beneficial electrification market. There is no one solution, but a mix of solutions that will be necessary to meet the challenge. No single government or market actor action will resolve the challenges. Indeed, even for states with advanced electrification policies, those policies are evolving over time. Colorado can also expect its own markets and policies to evolve over the coming decade, too.

Below we present a summary of Colorado's recent legislative background and policy context for beneficial electrification. Discussions related to Colorado's marketplace for beneficial electrification are presented in our summary of interview results. Lastly, we provide summaries of beneficial electrification policies in four other states. The combination of interview results and policy research led to the development of the key market barriers and policy recommendations presented in the Executive Summary.

2.1 BACKGROUND AND COLORADO'S POLICY CONTEXT

Colorado is making substantial progress in decarbonizing its electricity sector. In 2019, Governor Polis signed landmark legislation (SB 19-236) to address avoiding the worst impacts of climate change.[7] This legislation mandated that electric utilities with over 500,000 customers reduce emissions by 80 percent of 2005 levels by 2030, with a target of providing customers with 100 percent clean energy by 2050. Additionally, the legislation codified the concept of beneficial electrification as electrification of an end-use if that electrification:

- Reduces system costs for the utility's customers;
- Reduces net carbon dioxide emissions; or
- Provides for a more efficient utilization of grid resources.

The legislation also directed the Colorado Public Utilities Commission (PUC) to apply a social cost of carbon (SCC) in the benefit-cost calculation of beneficial electrification programs and required public utilities to include SCC as a cost-effectiveness factor in electric resource planning.

As the state decarbonizes its electricity grid, Colorado has the opportunity to further reduce its carbon footprint by shifting other energy uses from fossil fuels to the cleaner grid. Quite simply, with a low-carbon electricity supply, converting end-uses of carbon emitting fuels to electricity provides a pathway for further carbon reductions. Beneficial electrification solves a major challenge of reducing the carbon footprint from the use of fossil fuels since it is difficult with current technologies to cost-effectively scale renewable forms of combustion fuels. Renewable natural gas and hydrogen could theoretically provide a renewable source of combustion fuels but are currently in a nascent market position or still in the research stage of development. Electricity, however, is widely available, has an existing distribution system, and in Colorado, is expected to substantially reduce its carbon footprint by 2030. Hence, electrification can offer a pathway to reducing the use of fossil fuels and their resulting carbon emissions.

Colorado has a complex energy landscape. A majority of its residents are served by two investor-owned utilities – Xcel Energy and Black Hills Energy, with each providing both electricity and natural gas service. Colorado also has a large land area served by 22 rural electric cooperatives that purchase electricity from wholesale power suppliers. There are also more than 25 public power utilities, some of which also provide

[7] https://leg.colorado.gov/sites/default/files/2019a_236_signed.pdf

multiple commodity services including electricity, natural gas, or water. Only investor-owned utilities are regulated by the Colorado Public Utilities Commission. Across the patchwork of energy utilities, electricity and natural gas service territories do not consistently overlap, resulting in two utilities serving a single customer in many cases. Outside of utilities, propane marketers sell and deliver propane to consumers and businesses for space heating, water heating, and other end uses.

Against this backdrop, Colorado utilities have administered demand-side management programs for many years. While investor-owned utilities are mandated to provide these programs, both municipal and cooperative utilities offer programs to their customers. Further, Colorado utilities, and its homes and businesses have made substantial investments in renewable energy, doubling net renewable energy generation to 25 percent between 2010 and 2019.[8] Much more is expected over the next ten years and beyond. The combination of utility- and customer-owned renewable generation and Colorado's experience in delivering energy efficiency services provides a strong foundation for beneficial electrification.

In addition to SB 19-236, Colorado has two recent legislative drivers that influence rules and other policies that can affect beneficial electrification. House Bill 19-1261, signed in May of 2019, commits Colorado to achieve a 50 percent reduction in statewide greenhouse gas pollution by 2030 and 90 percent reduction by 2050, relative to a 2005 baseline.[9] The rules for implementing this economy-wide goal are under development. Unlike SB-19-236 and the mandate for utilities with over 500,000 customers to reduce carbon emission by 80 percent by 2030, this legislation covers all utilities whether regulated by the PUC or not and irrespective of size or energy supply services.

In 2019, Colorado also strengthened its building energy code requirements for local jurisdictions. While local governments still retain jurisdiction over how and when to adopt building codes, HB 19-1260 requires that local jurisdictions adopt one of the three most recent versions of the International Energy Conservation Code (IECC) published by the International Code Council when they make any other building code changes.[10] Local jurisdictions can amend or strengthen the selected IECC code version so long as it does not reduce the energy efficiency outcomes of the code. Additionally, for State funded or owned buildings using 25 percent or more of State funds, the buildings must conform to the State's High-Performance Certification Program.[11] This program also requires that for such buildings undergoing renovations exceeding 25 percent of the building's value, the building must achieve the highest possible Leadership in Energy and Environmental Design (LEED) certification.

Current PUC rules may limit the ability for investor-owned utilities to promote fuel switching, and therefore beneficial electrification, within their energy efficiency and other demand side management programs. In our interviews with utilities and other stakeholders, GDS regularly heard about a "prohibition to fuel switching." These programs impact both natural gas and electricity consumption, but our interviews indicated limited fuel switching measures being offered. Rule 4 CCR 723-4-4756(b) prohibits natural gas utilities regulated by the PUC from promoting fuel switching to other fossil fuel derived energy sources as part of demand side energy programs. Interview respondents were unaware of any other rule, settlement, or regulatory barrier to fuel switching. This uncertainty regarding investor-owned utility prohibitions against fuel switching is an area for regulatory clarification or for new rules to ensure that

[8] https://www.eia.gov/state/?sid=CO
[9] https://leg.colorado.gov/sites/default/files/2019a_1261_signed.pdf
[10] https://energyoffice.colorado.gov/climate-energy/energy-policy/building-energy-codes
[11] https://www.energycodes.gov/adoption/states/colorado

beneficial electrification can be promoted in demand-side management programs. No such limitation exists for cooperative or municipal utilities, which are not regulated by the PUC.

Notwithstanding Rule 4 CCR 723-4-4756(b), these major energy laws, regulations, and policies serve as the foundation that can drive beneficial electrification in Colorado.

In the next section of the report we present the results of interviews with Colorado stakeholders regarding beneficial electrification, the state of the market, and barriers to electrification, as well as policy and programmatic actions that the State should consider supporting.

3 Stakeholder Interview Results

To understand Colorado's market barriers to beneficial electrification and gain perspectives on possible policy solutions or future program considerations, GDS interviewed stakeholders from March through May of 2020. These stakeholders came from a wide range of backgrounds and professions, totaling 24 individuals representing their organizations or as representatives of associations. The range of perspectives included:

- Clean energy advocates
- Colorado cities
- Investor-owned utilities
- Cooperative utilities
- Municipal utilities
- Trade associations
- Low-income energy service providers

All respondents had experience with beneficial electrification bringing experience and perspectives ranging from market or program engagement, utilities and policy. The focus of the discussions was on beneficial electrification related to residential and commercial buildings and the challenges or opportunities to drive greenhouse gas emissions reductions via beneficial electrification. The following interview summaries combine the results, retain anonymity for respondents, and are organized by major topic area. Starting with marketplace challenges, the results move to utility considerations, with policy and program considerations included throughout.

3.1 COLORADO MARKETPLACE CHALLENGES TO BENEFICIAL ELECTRIFICATION

A major topic for the interviews was to explore how respondents viewed the current Colorado marketplace for beneficial electrification and challenges for expansion. GDS identified several universal themes, plus a few other commonly mentioned topics. We discuss each below.

3.1.1 Limited Consumer Awareness and Demand

Every interview resulted in discussion around the current state of Colorado's residential and commercial consumers and their perceptions or awareness of beneficial electrification technology or concepts. Respondents indicated that there is a very low market penetration and awareness of beneficial electrification technologies for buildings –particularly heat pumps, heat pump water heaters, and induction cooktops. While most respondents indicated that *some* electrification was happening in residential and commercial buildings, demand was tepid.

One interview respondent noted that building electrification technologies suffer from an issue similar to electric vehicles – customers do not have a sense of how much energy a product may use and cannot easily convert from more familiar fossil-fuel ratings (e.g. miles per gallon) to make a comparison of what an electrified technology would consume. The absence of an intuitive understanding or at least familiarity with modern beneficial electrification technology is a substantial market barrier to overcome.

Our interview respondents noted that most people simply do not know about the available technology and associated benefits. Additionally, market messages from the past may dampen enthusiasm. For example, our respondents made the following general comments:

- People may think of heat pumps as only working in warmer climates; they are unaware of modern cold-climate technology
- Gas cooking is popular and viewed as superior to traditional electric stoves, with induction cooktops being associated with stoves using electric resistance technology, rather than as a distinct cooking experience
- Consumers may not be aware of the negative health impacts gas cooking can have on their indoor air quality

Perhaps the largest barrier identified by respondents related to consumer habits. Quite simply, people will tend to stick with what they are familiar with, particularly if there is no additional social attribute to drive value. Respondents indicated that space heating and water heating equipment is often not at the top of people's minds. When equipment breaks down, they certainly become aware. However, furnaces, heat pumps, and water heaters otherwise tend to be ignored.

Additionally, the initial cost of equipment is a major barrier. Heat pumps and heat pump water heaters are expensive items for a household or business. Moreover, the availability of capital to invest in a new technology can be an impediment to consumer demand. In general, it will be cheaper to replace a natural gas furnace with another furnace rather than install a heat pump. Household budgets, particularly for low- and moderate-income consumers may not allow for purchasing a heat pump, even if the operating costs of the system decrease. While upfront cost is a traditional barrier to energy efficiency, it may be magnified for beneficial electrification due to consumer or contractor uncertainty regarding operating costs or performance.

As a specific challenge, all our respondents touched on the market for new construction, particularly for new homes. While some noted that there are builders expressing interest in "all-electric" construction, most were viewed as preferring to focus on traditional fossil fuel space heating, water heating, and cooking. Even for buildings willing to the install heat pumps for space heating and water heating, the perceived desirability of natural gas for cooking can overcome cost considerations for extending gas service to new homes. Interview respondents viewed the new construction market as being cautious.

Finally, current and historical market messages may work against driving consumer interest and demand. Respondents spoke of a reluctance by contractors to offer beneficial electrification technologies, or to actively recommend against them. Explored further below, contractors are a key delivery channel for space heating and water heating technologies. Without endorsement by contractors and supported by other positive messaging, homes and businesses may be reluctant to make a change. The view was that, without obvious demand by homebuyers or a desire to differentiate their homes, builders would be cautious about adopting electrification technologies.

Respondents indicated that any future programs will need to develop broad public awareness campaigns with consistent messaging regarding the benefits of beneficial electrification technologies in order to build familiarity and to overcome consumer reluctance. Additionally, programs will likely need to provide significant incentives and/or financing to overcome limitations to -capital availability. Overcoming electrification reluctance by builders was viewed as a crucial program element in avoiding the need for future electrification retrofits and capturing the benefits of designing a home for beneficial electrification from the start.

3.1.2 Marketplace Barriers

Interview respondents spoke to the current marketplace for beneficial electrification technologies, noting several key barriers related to the available supply of equipment or contractor practices.

Space conditioning (heating or cooling) and water heating equipment are usually installed by contractors. These contractors typically get their products from distributors, who keep stock on-hand, ready for contractors to make sales. The distributors purchase equipment from manufacturers. For space heating and water heating, this supply chain is crucial to delivering beneficial electrification technologies for Colorado's residential and commercial buildings. Indeed, the most successful energy efficiency programs leverage this supply chain to achieve savings. They key to the supply chain is to ensure that product is available when a consumer is ready to purchase it.

Nearly all our respondents touched on concerns that beneficial electrification technologies may be poorly stocked or stocked with less desirable equipment. Distributors will stock the volume and type of equipment they think will sell. With Colorado's market dominated by natural gas and propane consuming furnaces and water heaters, electrification technologies have limited available shelf-space.

Further compounding the challenge is the nature of purchase decisions. Typically, one will replace a water heater or furnace when it fails. While some consumers will plan ahead and anticipate replacements, "replace on failure" opportunities require quick action to ensure a home is kept warm or cool, and hot water is available. Energy efficiency programs can drive some early replacement sales if energy savings or other value propositions are significant enough to warrant changes. However, equipment must be available at the time a consumer is ready to make a purchase. Even for a consumer ready to install a heat pump or water heater, absent the right equipment being available, the consumer will make an alternative purchase and create a lost opportunity for beneficial electrification. A cycle emerges in which the lack of equipment leads to a lack of sales which leads to a lack of perceived demand which returns to a lack of equipment.

Our respondents also commonly referenced concerns about how contractors may be reluctant to promote or install heat pumps for space conditioning or water heating. Several common themes emerged:

- Contractors may be faced with an unfamiliar technology and be reluctant to learn or risk customer satisfaction. Their lack of confidence leads to a lack of promotion or direct discouragement of beneficial electrification technologies
- Contractors are comfortable with selling and installing fossil fuel technologies and have a natural tendency to take a simpler sales pathway compared to the risk of losing a sale by promoting a different technology that a competitor may not
- Prices may be inflated for heat pump technology due to the lack of familiarity and need to manage risk in the event the installed equipment fails to perform. Higher than necessary prices may also drive their customers to favor less expensive fossil fuel technology.
- Retrofitting a heat pump into a home or business may add complexity and time to a job or require a skill set their firm does not possess or practice. For example, adding a wire run to serve a heat pump with electricity adds time, cost, specific skills, and complexity to a job that can be easily resolved with a fossil fuel system, simply replacing what was already installed.

These issues are all very natural marketplace behaviors but combine to create a supply chain for building owners interested in beneficial electrification technologies that limits the ability for Colorado to scale up

the market without programmatic assistance. Challenges related to contractors are also explored in the next topic related to Colorado's workforce.

3.1.3 Workforce Challenges

In every interview we conducted, respondents raised the issue of workforce challenges. These challenges were described in two primary forms:

- a high demand and short supply of HVAC, plumbing, and other associated trades across Colorado's economy, and
- a shortage of workers skilled in heat pump and other beneficial electrification technology installation

These two workforce challenges describe a bottleneck in the supply chain for beneficial electrification, though also for any market relying on workers in the building trades. Respondents described a tight marketplace for labor, with contracting firms competing to attract talent. The effect of this limited labor pool is to drive up the cost of having equipment installed (beneficial electrification or otherwise). It also has the effect of limiting the ability for contractors to develop new product lines and services, including beneficial electrification.

In addition to a tight labor market, our respondents indicated that the skill and knowledge base within the existing labor market directly limits the ability to ramp-up beneficial electrification market share. Quite simply, there is a gap in Colorado's workforce when it comes to awareness, knowledge, and skills associated with specifying, selling, installing, and servicing heat pumps and other beneficial electrification technologies. The effect is that firms that may consider offering beneficial electrification cannot do so or must take on risk with selling and installing equipment their labor force is unfamiliar with.

Our respondents indicated that this issue is an essential concern and should be a part of any program or set of programs. Existing energy efficiency programs have worked with the trades and may be a channel to promote awareness, training, and best practices to build the workforce. However, some respondents indicated that a much broader effort is needed, incorporating Colorado's technical schools, education policies, and approach to developing the next generation of Colorado's HVAC, plumbing, construction, and related industries' workforce.

3.1.4 Past Energy Efficiency Program Messaging

Colorado has a history of strong utility energy efficiency programs. Investor-owned utilities, cooperative utilities, and municipal utilities have offered energy efficiency programs for many years. These programs have worked with customers and supply chains to develop products, services, and marketing to promote energy savings. Many of our interview respondents indicated that the messages coming from these programs was positive but may have created a general concern over fuel switching or electrification.

A primary example relates to heating fuels. As noted above, gas utilities regulated by the PUC are prohibited from promoting fuel switching away from natural gas. Historically, electrification options were not viewed as desirable due to cost and performance compared to natural gas. Cold-climate heat pumps and heat pump water heaters are relatively new technologies compared to the options for energy efficiency. Our respondents indicated that the traditional messages related to heat pumps or other electrical heating have created an understanding within the marketplace that using electricity for space heating or water heating is less desirable than high efficiency fossil fuel equipment.

The messaging to customers, contractors, and others in the marketplace have shaped perceptions of electrification equipment. Additionally, incentives for programs have generally been structured as a "like for like" option, with fuel switching not being incentivized. For some technologies, incentives are available, but based on the assumption that a customer was already going to use electrical technology, potentially limiting the incentive by only incentivizing the incremental difference to a more efficient technology.

Our interview respondents all spoke of a need to shift messaging. One challenge is balancing the need to promote efficiency messaging while adding the beneficial electrification message. Effectively communicating the concept of beneficial electrification will add a level of complexity to consumer and trade ally communications. Additionally, some respondents expressed apprehension over how aggressively beneficial electrification should be promoted due to uncertainty regarding customer economics or possible experiences in an immature market.

While some of our utility respondents indicated offering incentives for electrification technologies and promoting them to customers, all indicated limited uptake. Utilities and other respondents spoke of a need to develop consistent messaging related to beneficial electrification, suggesting a need to coordinate across utilities and markets to avoid creating confusion.

3.1.5 Uncertainty Related to Electrification in Regulations

During the interviews, two areas of regulatory uncertainty emerged. These areas are:

- Prohibitions against fuel switching for investor-owned utilities
- Uncertainty regarding appropriate funding levels
- Uncertainty regarding the treatment of beneficial electrification in response to HB 19-1261.

These points of uncertainty have an important market barrier component. Utility demand-side management programs are a part of the marketplace. Absent certainty, energy efficiency programs may continue, but beneficial electrification programs may be limited.

As part of the interviews, GDS requested information related to prohibitions to fuel switching in legislation or rules. Municipal utilities and cooperative utilities indicated no legislative or regulatory hurdles to promoting fuel switching or beneficial electrification. Indeed, some of these utilities actively promoted heat pumps and other electrification technologies. For investor-owned utilities, Rule 4 CCR 723-4-4756(b) prohibits a natural gas utility from claiming savings in its demand-side management programs by having customers switch from natural gas to another energy source. However, there was a collective view that promoting fuel switching was generally prohibited for investor-owned utilities, a view shared by multiple interview respondents, including non-utility representative respondents. When asked to provide the rules, settlements, legislation, or other descriptions of fuel switching prohibition, only Rule 4 CCR 723-4-4756(b) was provided.

Regardless of the details related to fuel switching prohibitions, there appears to be a general view that investor-owned utilities may not be able to promote beneficial electrification within their demand-side management programs. Utility energy efficiency programs are an important element in markets for building HVAC and plumbing services and technologies, as well as helping shape the market for new building construction. Our respondents indicated that the PUC should clarify the status of fuel switching or beneficial electrification. Absent the PUC having the authority to do so (a point of uncertainty), respondents suggested that the Colorado legislature should establish the clarity or explicitly authorize the PUC to do so.

A second issue associated with regulatory uncertainty ties to potential program funding levels or goals. Whether a utility is regulated by the PUC or not, beneficial electrification programs will require adequate funding to grow the market and capture the benefits that beneficial electrification can bring. Our interview respondents all made this general observation but offered different perspectives on the issues associated with program funding. These perspectives included:

- A need to develop financing or rebate-style programs to overcome capital availability limitations by customers or to address other market barriers
- The need to ensure that income-limited households and small businesses can participate
- An interest to consider equity *among utilities* to ensure comparative funding levels (e.g. percent of retail revenue) such that all Colorado ratepayers can participate and would experience similar rate effects of funding
- Considerations for an electric utility's natural market incentive to increase electricity sales, suggesting a difference from current energy efficiency programs which create a reduction in revenue
- The ability to link energy efficiency to beneficial electrification efforts in order to continue progress with energy efficiency and leverage it for beneficial electrification, as appropriate, with beneficial electrification operating as a parallel effort to energy efficiency

The lack of certainty regarding funding levels or goals that drive funding limits the electric utility market's ability to move forward in a consistent and assertive manner. Some of our interview respondents suggested this uncertainty could be addressed through establishing statewide funding or goals, while others indicated it could be addressed in the regulatory context of HB 19-1261.

A third area of regulatory uncertainty stems from yet unsettled rules related to HB 19-1261, which developed statewide targets for greenhouse gas emissions reductions, seeking a 50 percent reduction in 2030 from 2005 levels. All our electric utility respondents indicated that without rules addressing electrification, they faced risks that beneficial electrification could create a penalty due to increased emissions driven by increased electricity consumption. While electrification may reduce emissions associated with fossil fuels, there was no mechanism or accounting system to "hold harmless" an electric utility whose emissions would otherwise increase even though net greenhouse gas emissions would decrease.

HB 19-1261 requires the Colorado Air Quality Control Commission (AQCC) to promulgate rules to achieve the reductions targeted in the law.[12] Our respondents suggested a need for the rules to allow for crediting electric utilities with emissions reductions achieved through beneficial electrification or at least be held harmless as more fossil fuel consumption shifts to electricity sources. While Colorado's electric utilities are on a path to substantially reduce carbon emissions, increasing loads through electrification has the potential to increase their own emissions. Despite a net emissions reduction within Colorado as a whole, without an emissions crediting or accounting system, an electric utility and its ratepayers will need to make additional investments due to the choices of others and risk not meeting its GHG emissions targets.

In discussing how these rules might address the challenge that beneficial electrification poses to electric utilities under HB 19-1261, several key recommendations emerged:

- A need for a standardized and simple accounting system to address emissions impacts associated with beneficial electrification measures. Beneficial electrification will result in hundreds of

[12] https://www.denverlawreview.org/dlr-online-article/implementation-of-hb-1261

thousands of small purchases. An efficient accounting system that credits the energy and emissions impacts similar to how energy efficiency programs claim savings will be needed. Respondents viewed it as essential to avoid measure or premise-level accounting for these small transactions.

- Electric utilities will need to know their specific emissions reduction targets from the 2005 baseline in order to take action and track progress to meeting targets.
- The AQCC HB 19-1261 rules should be incorporated into utility integrated resource plans, along with the expected changes in energy loads associated with beneficial electrification.

3.1.6 Many Buildings May Not Be Able to Easily Integrate Electrification Technologies

Nearly all our interview respondents indicated that many residential and commercial buildings may have challenges integrating heat pumps and other beneficial electrification technologies. The primary concern related to having an adequately sized electric service panel within the building. This affects both existing buildings and new buildings. In many cases, homes or businesses may need to upgrade electric infrastructure to accommodate the additional electricity demand, adding cost and complexity to potential electrification projects. For new construction, this issue was linked to current building codes and the creation of lost opportunities that could exist for decades to come.

For existing buildings, the state of whole-building energy efficiency was viewed as a challenge. Poorly insulated buildings or buildings with high rates of air leakage mean that heat pumps will need to be larger than otherwise needed, adding cost to the project. Additionally, buildings with inefficient shells may create peak conditions that could lead to suboptimal customer experiences – at very cold temperatures even cold-climate heat pumps may have a challenge responding to rapid swings in the demand for heat. Respondents linked this issue to the ongoing need for energy efficiency programs to help improve whole-building performance. Effectively, a well-designed building or one that has had its shell improved will be better able to integrate a heat pump for space heating while also minimizing the additional electric load on the building.

Respondents that touched on challenges for larger buildings indicated that in some cases heat pumps were very difficult to integrate. For example, buildings designed with large centralized heating systems would require large centralized heat pumps, an expensive and non-typical retrofit option. Others mentioned that water heaters designed for small utility closets may only be able to use electric resistance technology due to space constraints hindering heat pump water heaters. While certainly not a universal issue, the respondents pointed out that in some cases and with current technology and building designs, overcoming technical challenges could be technically accomplished, but only at substantial cost. In cases faced with such a challenge, early adoption of beneficial electrification may not be realistic.

Solutions suggested by the respondents included a mix of possible program options:

1) Using advanced building codes to promote building designs that improve the performance of or ease the integration of beneficial electrification technologies,
2) Promoting whole building energy efficiency and "electrification ready" designs and upgrades. Respondents indicated a possible mix of utility demand-side management programs as well as financing programs through on-bill financing or property assessed clean energy (PACE) style financing
3) Leveraging local programs to incentivize electrified or electric-ready building designs.

3.1.7 Electricity Contracts and Rate Designs Do Not Capture Electrification Opportunities

Interview respondents familiar with electricity utility wholesale contracts and customer rate designs indicated that current approaches did not always align with widespread beneficial electrification. Respondents identified a need to develop new approaches or considerations in wholesale contracts and retail rates to optimize the marketplace for beneficial electrification.

The specific issues and concerns varied across respondents. The collective set of concerns point a need for a review of Colorado's electricity markets and how wholesale contracts and retail rates may need to evolve to reflect the changes beneficial electrification may bring. These changes include when and how utility or customer peak loads occur, the structure of demand charges, or the value of having controllable electric loads. The issues overlap and create risks or uncertainty for electric customers and limit utility tariff benefits. The challenges and opportunities include:

- Utilities with low thresholds for triggering demand charge tariffs create a risk for substantially higher electricity bills if customers electrify their loads. This is primarily a risk for smaller commercial customers whose peak winter loads could increase through the use of heat pumps for space heating.
- Setting demand-ratchet tariffs based on 15-minute intervals creates a risk that a single 15-minute period of high demand can increase costs for a month or year. Transient start-up loads may also trigger a higher demand charge than if demand charges were set over a longer time period. Ideally these would align with solar and storage time periods to facilitate customer optimization across several clean energy technologies.
- A lack of critical peak pricing spreads out the peak-demand window for time-of-use rates and reduces the value of short-term load management options available to customers or utilities.
- Long-term bi-lateral wholesale contracts may not have adequate pricing variability or time sensitivity to facilitate load management programs. The wholesale price signal may not be adequate to justify robust and comprehensive load management programs that would help mitigate peak load management.
- A lack of "all electric" rate categories and load management programs reduce the value proposition for customers to consider all-electric buildings and provide their beneficial electrification technologies as a load management asset.

In general, respondents who discussed wholesale contracts and rates indicated that the current electricity marketplace was not adequately capturing the value that electrification technologies could offer, thereby creating risk to those customers who do electrify and dampening demand by reducing the possible benefits of those who might consider electrifying or promoting electrification.

3.1.8 Low- and Moderate-Income Households May Not Be Able to Participate in the Beneficial Electrification Market

All interviews touched on the subject of low- and moderate-income Colorado residents, with many touching on challenges serving rural residences. To varying degrees, they raised concerns about the ability of these households to capture benefits associated with beneficial electrification. Further, respondents were concerned that over time, low- and moderate-income households may end up burdened with covering a disproportionate share of stranded costs for a natural gas system that others have exited. While

stranded costs are a long-term issue, the more pressing concern relates to enabling customers with limited incomes to participate in the market. For propane customers, the economic benefits can be substantial, reducing customers' energy burden. However, without access to capital or programs providing substantial cost coverage, many respondents felt that these households would be unable to afford the up-front costs. This issue may also extend to hard-to-reach small businesses.

Under the assumption that ratepayers from electric utilities would fund a beneficial electrification program, our respondents felt that households with limited income should be able to participate as a simple point of equity. Two respondents intimately familiar with low-income energy efficiency programs also pointed out challenges to watch if programs supporting customers emerges. First, energy efficiency technologies should ensure lower operating costs for a household – this may require a careful consideration of total energy cost savings, including air-conditioning and overall efficiency than may be considered now in programs focused on only energy efficiency. However, for homes without air conditioning the savings that modern heat pumps can bring to the total project economics are unavailable. In our modeling report, air-conditioner efficiency improvements were an important part of making a measure cost effective. Additionally, the limited funds available to each household from Colorado's Weatherization Assistance Program (WAP) may not be able to cover the full range of electrical system, building shell upgrades *and* heat pumps or water heating systems. Carefully balancing available utility funding with WAP funding can optimize opportunities for low-income households but may require an expansion in available funding. On-bill financing, which leverages utility capital, may be another option for improving access to energy efficiency and beneficial electrification for any household, but especially those with a limited income.

Second, there was a view that the program infrastructure and staff may not be well versed and familiar with the details of installing a heat pump or making a home "electrification ready." Some respondents felt it might be better to focus on building shell improvements and incrementally work toward getting homes ready for electrification as a programmatic stepping-stone, though some service providers are well versed in the technologies and challenges, and have completed installations of heat pumps in low-income households in the recent past.

All respondents indicated the need to not leave limited-income households or hard-to-reach small businesses behind as beneficial electrification moves forward. Most suggested that current income-qualified energy efficiency programs could be leveraged to include beneficial electrification. However, the issues of electrification will require new creativity in program designs, coordination across funding and delivery services, and care to not increase energy burdens on low-income households over what energy efficiency alone would provide.

In the case of rural residents, particularly limited-income rural residents, respondents expressed concerns that the market barriers to beneficial electrification were magnified, other than perhaps for customers who could reap the cost savings associated with electrifying propane end uses. Programs should work to ensure broad coverage of households (and businesses) in rural areas of Colorado.

In the next section of this report we discuss policy solutions that other states have pursued in supporting electrification efforts as a means to mitigate climate change.

3.2 POLICIES IN OTHER STATES

GDS investigated electrification policies in several states that have taken a lead on promoting electrification. California, Vermont, Massachusetts, and New York have each crafted policy directions to help move their energy markets forward to utilize electrification as a means of reducing future greenhouse gas emissions. Each state is unique in its marketplace, history, approach to regulations, and the policy options. Together they provide useful frameworks and examples of opportunities for Colorado to consider.

One theme that GDS identified across several of the states is coordination between state and local governments, utilities, demand-side management programs, and market actors. In particular, coordination appears to play a key role in shifting utility programs from focusing largely on the efficient use of energy to one that considers the overall use efficiency and carbon impact across energy sources. In some cases the coordination extends to linking state-enacted building codes with a larger effort to increase efficiency and drive electrification. Additionally, in California and New York, state facilities are being viewed as an important component to drive markets and emissions reductions.

Below we summarize electrification-related policies from each of the four states to serve as possible examples for Colorado to consider. GDS used the policy experiences of these states to inform our recommendations for Colorado.

3.2.1 California

California has long been a leader in clean energy development, including renewable energy, energy efficiency, and fuel economy standards. 2018 legislation requires that 60 percent of California's electricity be generated from clean energy sources by 2030 and 100 percent by 2045 (SB 100).[13] The California Energy Commission is tasked with assessing how the State's facilities can reduce carbon emissions by 40 percent from 1990 levels by 2030. Fuel substitution rules have recently been updated to reflect the benefits that electrification can have for ratepayers and to reduce carbon emissions.

Fuel substitution – the substitution of either electricity for natural gas or natural gas for electricity (regulated fuels) has been allowed as part of California's utility energy efficiency programs. In 2019, the California Public Utilities Commission (CPUC) updated its three-pronged test in response to petitioner concerns that the rule in place at the time did not address changes in the electricity production fuel mix or broader greenhouse gas emissions, as well as needing clarity in terms of application of the rule.[14] The rule was updated to address many of the petitioners' concerns and provides a framework for regulated fuel substitutions. The three-pronged test was modified to:

- No longer require that fuel substitution measures pass cost-effectiveness at the measure level, with cost-effectiveness reflected in a program administrator's overall energy efficiency portfolio
- A net-to-gross ratio of 1.0 is assumed until a net-to-gross evaluation is conducted, thereafter applying the net-to-gross ratio within the overall energy efficiency portfolio
- Require that for utility programs driving fuel substitution, the ratepayers of the fuel being substituted to (e.g. electricity in the case of beneficial electrification) fund the fuel substitution. The ratepayers funding the fuel substitution then have the energy savings accrue to them. The original fuel's energy savings goals are then reduced by the amount of fuel savings

[13] https://www.sacbee.com/news/politics-government/capitol-alert/article218128485.html
[14] https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M310/K053/310053527.PDF

- Clarified that the baseline condition of the measure would follow the same logic as used for the original fuel's baseline – that could be a code baseline, industry standard practice, or existing conditions.

The approach taken in California helps to clarify rules associated with utility-funded electrification efforts for natural gas fuel substitution by electricity consuming measures. It clearly indicates that an electric utility and its ratepayers pay for the fuel substitution, but also gain the benefits, establishes standard baseline and net-to-gross practices, and indicates how fuel substitution fits within the cost-effectiveness framework. The fuel substitution rule has additional provisions that were retained. These include:

- The program must not increase source-BTU consumption[15] (the California Energy Commission establishes the heat rates used for this comparison)
- The program must not adversely impact the environment, with the rule referencing residual emissions factors established in the avoided cost rule.

The fuel substitution rule did not directly address fuel switching from non-regulated fuels (e.g. propane or fuel oil), but referenced a separate proceeding related to building decarbonization (R. 19-01-011).[16] As of this report, the proceedings are still underway but have led to a proposal of several building decarbonization pilot programs.

3.2.2 Vermont

In 2015, Vermont enacted a renewable energy standard (RES) that integrated a renewable energy performance standard with distributed renewable energy resources and options for compliance based on "Energy Transformation."[17] The legislation requires electric distribution utilities to retire renewable energy credits (RECS) and associated attributes equal to 55 percent of annual retail electricity sales starting in 2017 (Tier 1). The percentage rises to 75 percent of retail sales in 2032. Distribution utilities are also required to retire RECs associated with distributed generation technologies (nameplate capacity less than 5 MW) equal to one percent of their retail sales (Tier 2). Eligible systems must have been commissioned after June 30, 2015. Finally, under "Energy Transformation," electric distribution utilities are required to either achieve fossil fuel savings or retire distributed renewable energy system credits equal to two percent of retail sales in 2017, rising to 12 percent by 2032 (Tier 3). For all three tiers, utilities have an option to pay an Alternative Compliance Charge. Small municipal utilities (less than 6,000 retail customers) had a two-year delay, to 2019, to meet the requirements.[18]

The Tier 3 Energy Transformation requirements affect electrification. Electric distribution utilities can meet their obligations in several ways, including weatherizing buildings, installing air-source or geothermal heat pumps, biomass heating systems, and other high efficiency heating systems, switching industrial processes from fossil fuel to electric, increasing the use of biofuels, or deploying electric vehicles and charging infrastructure. In this set of options for utilities to consider, electrification of fossil fuel resources enables crediting toward RES obligations. Utilities can earn credits toward Tier 3 obligations via MWh credits derived from a conversion from fossil fuel savings to electricity equivalency. Electric utilities

[15] Source BTU consumption refers to consumption at the point the energy source is produced, not consumed. For example, the energy source for natural gas is typically the point of combustion, while for electricity is the power system.
[16] https://www.cpuc.ca.gov/BuildingDecarb/
[17] https://publicservice.vermont.gov/renewable_energy/state_goals
[18] https://legislature.vermont.gov/statutes/section/30/089/08005

can meet a given year's goal by booking the lifetime of energy savings of Tier 3 projects in the year they were installed. The achievements toward Tier 3 goals then resets each year. Utilities have an option to pay $0.06 per kWh to meet their Tier 3 obligations as an alternative to implementing projects.

Vermont's implementation of programs and initiatives related to electrification are conducted by several types of entities. This includes Efficiency Vermont, the statewide energy efficiency program, the Clean Energy Development Fund[19], focused on wood heating and overseen by the Department of Public Service, and programs offered by utilities themselves. The three groups coordinate incentives and programs that can be used to help meet overall state clean energy goals and reduce greenhouse gas emissions from fossil fuels. Incentives are available for heat pumps and other electrification technologies.

3.2.3 Massachusetts

In 2018 the State of Massachusetts enacted Chapter 227 of its 2018 bills, stemming from its House of Representatives bill 4857.[20] Among the bill's provisions included language related to strategic electrification. The law expanded what was allowed within utility energy efficiency and load management plans and programs to include strategic electrification. Along with energy storage and other active demand management strategies, strategic electrification is described as "measures that are designed to result in cost-effective reductions in greenhouse gas emissions through the use of expanded electricity consumption while minimizing ratepayer cost."[21] The law clearly defined strategic electrification in the context of reducing greenhouse gas emissions via increasing electricity consumption. When combined with managing ratepayer cost, this legislation is similar to Colorado's current definition of beneficial electrification.

In late 2018, the State of Massachusetts published its Comprehensive Energy Plan (CEP).[22] The CEP identified a number of policy directions leveraging "investments made in the clean energy sector through electrification," with a key goal to "increase electrification of the thermal sector by providing program incentives for air source heat pumps for heating through Mass Save." Mass Save is Massachusetts's statewide energy efficiency collaborative in which all investor-owned utilities participate. Secondly, the CEP seeks to "drive market/consumer demand for energy efficiency measures and fuel switching." This policy notes that "buildings are long-term assets and choices made in building construction today" have long-term impacts that last decades.

Since that time, Massachusetts's investor-owned electric utilities have introduced measures into their demand-side management programs to incentivize heat pumps for space heating and water heating. The programs have been limited to consumers who would otherwise have used fuel oil or propane as an energy source. In various analyses of cost effectiveness, switching from natural gas to electricity has not been found to be cost effective. As such different incentive offers are available to customers based on their existing equipment and energy uses. Higher incentives are available for customers under "energy

[19] https://publicservice.vermont.gov/sites/dps/files/documents/Renewable_Energy/CEDF/Reports/FY20_Program%20Plan%20and%20Program%20Allocations%20FINAL.pdf
[20] https://malegislature.gov/Laws/SessionLaws/Acts/2018/Chapter227
[21] Accessed from https://malegislature.gov/Bills/190/H4857
[22] https://www.mass.gov/service-details/massachusetts-comprehensive-energy-plan-cep

optimization" incentives targeting electric resistance, fuel oil, and propane using customers, reflecting greater cost effectiveness and a different baseline condition than natural gas users.[23]

Massachusetts also addresses the market for new construction via utility programs (Mass Save) and energy codes. Under Mass Save, new homes receive incentives based on their expected energy performance as determined by a home energy rater. Homes with electricity, natural gas, propane, and fuel oil are all eligible for incentives. Market-based baselines are used to estimate the level of savings, which are all above energy code requirements. Natural gas homes receive their own baseline, while customers choosing other energy sources use a blended baseline assuming a mix of electric, propane, and fuel oil site-based energy consumption efficiencies.[24]

Massachusetts offers two options for energy code adoption by local jurisdictions – a base code and a more stringent stretch code. Local jurisdictions must at least adopt the base code, typically the latest version of the IECC codes or ASHRAE 90.1. The Department of Energy Resources develops a companion stretch code that local jurisdictions can choose to adopt in order to facilitate higher levels of energy efficiency in new construction. Increasing the base code and stretch code is one tool being used to encourage electrification within the new construction market. With increasing building performance standards, the stretch code can drive builders to consider high efficiency cold-climate heat pumps or heat pump water heaters as the efficiency gains over baseline equipment can typically lower a HERS-based performance easier with a heat pump than with a high efficiency furnace. Hence, codes and code policy to promote more stringent building designs are seen as a tool to drive the new construction market toward electrification technologies.

3.2.4 New York

The State of New York has been a leader in energy efficiency, setting aggressive reductions in greenhouse gas emissions, and leveraging beneficial electrification. Recently passed greenhouse gas emissions targets envision a 40 percent reduction in statewide emissions by 2030 and 85 percent by 2050, relative to a 1990 baseline.[25] In 2018, the New York State Research and Development Authority (NYSERDA) and the Department of Public Service issued a report outlining broad policy approaches that link energy efficiency programs with energy resource planning, building codes, and electrification, titled New Efficiency: New York.[26] An overall Btu reduction goal was set as a means of moving all markets toward increasing efficiency and greenhouse gas emissions reductions. From these goals, utilities proposed their own programs and targets.

The New Efficiency: New York plan identifies the following key drivers that relate either directly or indirectly to electrification:

- Lead by example and leverage the State's purchasing and decision making in its own facilities to catalyze market development and adoption, while generating cost savings

[23] https://www.masssave.com/rebates
[24] http://ma-eeac.org/wordpress/wp-content/uploads/MA19X02-B-RNCBL_ResBaselineOverallReport_Final_2020.04.01_v2.pdf
[25] https://www.nytimes.com/2019/06/18/nyregion/greenhouse-gases-ny.html
[26] https://www.nyserda.ny.gov/About/Publications/New-Efficiency

- Build a skilled workforce and promoting training for New York workers to accelerate energy efficiency [and by extension, electrification] investments
- Drive energy efficiency and carbon reduction through energy codes and appliance standards
- Improve access for low- to moderate-income consumers
- Develop fuel neutral programs to drive deep energy retrofits and manage challenges in fuel and energy supplies during winter months.[27] The Commission is recommended to address issues associated with the potential scale of cost-effective cross-fuel programs as well as the criteria for determining cost-effectiveness relative to carbon reductions and the benefit cost analysis framework.

The plan also outlines several crucial elements related specifically to beneficial electrification. These include:

- Developing "separate accounting of goals and progress outside of an electricity efficiency sub-target" within the larger Btu reduction goal
- Supporting heat pump adoption to decarbonize heating and cooling
- Utilizing codes and technology to deliver efficient electrification

In January 2020, the Department of Public Service published rules to implement the targets outlined by the carbon reduction legislation and the New Efficiency: New York plan.[28] The Department's rules acknowledged the overlapping roles of the State and utilities in achieving the outcomes. The ruling set targets for utilities, with separate gas and electric targets for each utility (gas and electric, respectively). The utility plans that were approved in the ruling note the prior and expected ongoing collaboration between the utilities and NYSERDA on efficiency and electrification.

[27] Some areas of New York experience gas supply constraints
[28] http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7b06B0FDEC-62EC-4A97-A7D7-7082F71B68B8%7d

4 Conclusions

Colorado is well positioned to leverage beneficial electrification for residential and commercial buildings to mitigate GHG emissions. Two foundational laws – SB 19-236 and HB 19-1261 – ensure an electricity grid that will continue to reduce emissions and set targets for GHG pollution reductions across Colorado's economy. Rules and plans emerging from this legislation will chart a course for beneficial electrification efforts over the next decade and beyond. The legislation alone, however, does not ensure that beneficial electrification will be a major contributor to Colorado's efforts to reduce GHG emissions. To realize the full potential that beneficial electrification offers will require additional policies, leadership, and coordinated approaches to stimulate the market and overcome barriers.

GDS Associates' research identified key market barriers that policy or programmatic efforts need to overcome in order to drive beneficial electrification in residential and commercial buildings. These include:

- Limited market awareness by consumers and contractors
- Potential lack of capital to cover upfront costs
- Workforce labor availability and knowledge/skills
- Limited product availability and sales efforts by market actors
- A lack of clarity or consensus on regulated utilities to offer beneficial electrification fuel switching programs or measures
- Challenges related to current building infrastructure that increase the cost or complexity of installing beneficial electrification technology
- An electricity market that does not send price signals that encourage rate design or load control techniques, reducing the value of electrification technologies
- Uncertainty regarding the rules related to HB 19-1261
- A lack of consistent marketing messages to promote and educate the marketplace regarding beneficial electrification

These market barriers can be addressed with policies and programs. The policy recommendations presented in this report will aid the transition to an economy with no net carbon emissions. These include:

- Clarifying fuel switching rules related to beneficial electrification
- Implementing rules related to HB 19-1261 that consider how to manage increased electricity loads and net carbon metrics for electric utilities or others promoting beneficial electrification
- Developing workforce development policies and programs that expand consumer options for implementing beneficial electrification
- State support for localities seeking to implement advanced building codes
- The State leading by example in its own purchasing policies
- Updates to the PUC's cost-effectiveness tests to account for beneficial electrification
- Developing a statewide approach to ensure consistent, equitable, and adequate utility program funding
- The State coordinating and supporting the set of stakeholders engaged in beneficial electrification to develop a network of resilient market actors, long-term market tracking and consistent messaging

Taken together, these policies will help advance Colorado's beneficial electrification marketplace over the next ten years. Colorado should expect that policies and initiatives may need updating based on market responses or unanticipated challenges. If implemented, this initial set of recommendations will help move the market forward and enable Colorado to identify the next evolution of beneficial electrification policies and programs.

BENEFICIAL ELECTRIFICATION IN COLORADO

Market Barriers and Policy Recommendations

FINAL REPORT

prepared for

COLORADO ENERGY OFFICE

July 2020

prepared by

GDS Associates, Inc.
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SENATE BILL 21-246

BY SENATOR(S) Fenberg, Bridges, Buckner, Danielson, Gonzales, Hansen, Jaquez Lewis, Lee, Moreno, Pettersen, Priola, Story, Winter; also REPRESENTATIVE(S) Valdez A. and Froelich, Bernett, Bird, Cutter, Duran, Gonzales-Gutierrez, Gray, Hooton, Jackson, Jodeh, Kennedy, Kipp, McCormick, Michaelson Jenet, Mullica, Ricks, Sirota, Titone, Woodrow.

CONCERNING MEASURES TO ENCOURAGE BENEFICIAL ELECTRIFICATION, AND, IN CONNECTION THEREWITH, DIRECTING THE PUBLIC UTILITIES COMMISSION AND COLORADO UTILITIES TO PROMOTE COMPLIANCE WITH CURRENT ENVIRONMENTAL AND LABOR STANDARDS AND MAKING AN APPROPRIATION.

Be it enacted by the General Assembly of the State of Colorado:

SECTION 1. Legislative declaration. (1) The general assembly finds, determines, and declares that:

(a) Colorado is and should remain a national leader in energy infrastructure innovation, creating family-sustaining jobs in the clean energy economy, and environmental stewardship;

(b) It is in the public interest and the policy of the state of Colorado

Capital letters or bold & italic numbers indicate new material added to existing law; dashes through words or numbers indicate deletions from existing law and such material is not part of the act.

to reduce greenhouse gas emissions. For that reason, it is critical that the electric utility sector be evaluated and regulated holistically so that investment can be compared and directed across fuel types to account for cost variance associated with asset procurement and operation as well as the public health and environmental costs of greenhouse gas emissions, energy efficiency, and electric infrastructure reliability accrued over the life cycle of an asset.

(c) Legislation adopted in 2007 directed the public utilities commission to establish electricity and natural gas energy savings targets, clarify parameters for cost-benefit analysis, and provide financial incentives to public utilities that meet or exceed specified goals for energy savings. The resulting demand-side management programs, also known as DSM programs, have provided substantial economic and environmental benefits for consumers, businesses, and utilities at modest cost.

(d) The public utilities commission's administration of DSM programs has appropriately effectuated legislative intent and has created a precedent for the deployment of programs to support customers using clean electricity to power high-efficiency appliances that provide space and water heating, cooking, and clothes drying in homes and businesses, as well as for certain industrial processes;

(e) Technology advancement can further advance cost-effective greenhouse gas emission reductions in the oil and gas, industrial, and building sectors, and electrification of customer end uses can be a pathway to reducing greenhouse gas emissions from these sectors and improving air quality;

(f) Fossil gas and petroleum products will contribute to supplying Colorado's energy needs for many years to come; nonetheless, transitioning to clean electric homes and businesses is a critical strategy for improving public health and safety, saving energy, creating family-sustaining jobs, and helping the state meet its greenhouse gas emission-reduction targets;

(g) Colorado has significant potential for replacing fossil gas with clean electricity; and

(h) Clean heat from appliances such as electric heat pumps, heat pump water heaters, and induction stoves will help Colorado reduce

greenhouse gas pollution and has potential to help improve indoor air quality and health and safety in buildings.

(2) The general assembly further declares its intent that the public utilities commission approve beneficial electrification plans for the purpose of incentivizing residential, commercial, and industrial utility customers to implement beneficial electrification projects voluntarily, without applying coercion or discriminatory treatment to customers that decline any incentives that may be offered to them.

SECTION 2. In Colorado Revised Statutes, 38-33.3-106.7, **amend** (1)(b)(IV) and (1)(b)(V); and **add** (1)(b)(VI) as follows:

38-33.3-106.7. Unreasonable restrictions on energy efficiency measures - definitions. (1) (b) As used in this section, "energy efficiency measure" means a device or structure that reduces the amount of energy derived from fossil fuels that is consumed by a residence or business located on the real property. "Energy efficiency measure" is further limited to include only the following types of devices or structures:

(IV) An energy-efficient outdoor lighting device, including without limitation a light fixture containing a coiled or straight fluorescent light bulb, and any solar recharging panel, motion detector, or other equipment connected to the lighting device; ~~and~~

(V) A retractable clothesline; AND

(VI) A HEAT PUMP.

SECTION 3. In Colorado Revised Statutes, 40-1-102, **amend** (5)(a); and **add** (1.2) and (12) as follows:

40-1-102. Definitions. As used in articles 1 to 7 of this title 40, unless the context otherwise requires:

(1.2) (a) "BENEFICIAL ELECTRIFICATION" MEANS CONVERTING THE ENERGY SOURCE OF A CUSTOMER'S END USE FROM A NONELECTRIC FUEL SOURCE TO A HIGH-EFFICIENCY ELECTRIC SOURCE, OR AVOIDING THE USE OF NONELECTRIC FUEL SOURCES IN NEW CONSTRUCTION OR INDUSTRIAL APPLICATIONS, IF THE RESULT OF THE CONVERSION OR AVOIDANCE IS TO:

(I) REDUCE NET GREENHOUSE GAS EMISSIONS OVER THE LIFETIME OF THE CONVERSION OR AVOIDANCE; AND

(II) REDUCE SOCIETAL COSTS OR PROVIDE FOR MORE EFFICIENT UTILIZATION OF GRID RESOURCES.

(b) "BENEFICIAL ELECTRIFICATION" DOES NOT INCLUDE:

(I) RETAIL DISTRIBUTED GENERATION, AS DEFINED IN SECTION 40-2-124 (1)(a)(VIII); OR

(II) AN ENERGY STORAGE SYSTEM, AS DEFINED IN SECTION 40-2-130 (2)(a).

(5) (a) "Cost-effective", with reference to a natural gas or electric demand-side management program, A BENEFICIAL ELECTRIFICATION PROGRAM, or ~~related~~ ANY measure RELATED TO EITHER A DEMAND-SIDE MANAGEMENT OR BENEFICIAL ELECTRIFICATION PROGRAM, means having a benefit-cost ratio greater than one.

(12) "TECHNICAL SUPPORT DOCUMENT" MEANS THE 2016 TECHNICAL SUPPORT DOCUMENT OF THE FEDERAL INTERAGENCY WORKING GROUP ON SOCIAL COST OF GREENHOUSE GASES, ENTITLED "TECHNICAL UPDATE OF THE SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866".

SECTION 4. In Colorado Revised Statutes, 40-3.2-106, **amend** (1) introductory portion, (1)(d), and (5); and **repeal** (6) as follows:

40-3.2-106. Costs of pollution in utility planning - definitions - rules. (1) The commission shall require an electric public utility subject to commission jurisdiction to consider the SOCIAL cost of carbon dioxide emissions AND THE SOCIAL COST OF METHANE EMISSIONS, as set forth ~~pursuant to subsection (4)~~ IN SUBSECTIONS (4) AND (5) of this section, when determining the cost, benefit, or net present value of any plan or proposal submitted in one of the following proceedings:

(d) A plan or application for transportation electrification UNDER SECTION 40-5-107 or ANY other ~~forms~~ FORM of beneficial electrification, INCLUDING BENEFICIAL ELECTRIFICATION IN BUILDINGS.

(5) The commission shall apply a THE SOCIAL cost of carbon dioxide AND THE SOCIAL COST OF METHANE emissions to the nonenergy benefits for programs that are defined to be beneficial electrification.

(6) ~~As used in this section:~~

~~(a) "Beneficial electrification" means a utility's change in the energy source powering an end use from a nonelectric source to an electric source, including transportation, water heating, space heating, or industrial processes, if the change:~~

~~(I) Reduces system costs for the utility's customers;~~

~~(II) Reduces net carbon dioxide emissions; or~~

~~(III) Provides for a more efficient utilization of grid resources.~~

~~(b) "Technical support document" means the 2016 technical support document of the federal interagency working group on social cost of greenhouse gases, entitled "Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866".~~

SECTION 5. In Colorado Revised Statutes, **add** 40-3.2-105.6 and 40-3.2-109 as follows:

40-3.2-105.6. Labor standards for beneficial electrification projects. (1) THIS SECTION APPLIES TO ALL NECESSARY MECHANICAL, PLUMBING, AND ELECTRICAL WORK PERFORMED IN CONNECTION WITH A PROJECT UNDERTAKEN PURSUANT TO A BENEFICIAL ELECTRIFICATION PROGRAM UNDER THIS ARTICLE 3.2 AND FOR WHICH A CUSTOMER OF AN INVESTOR-OWNED ELECTRIC UTILITY APPLIES FOR A REBATE DIRECTLY FROM THE UTILITY.

(2) WHEN PRACTICABLE, THE UTILITY MAY ASSIGN ITS OWN EMPLOYEES TO PERFORM THE WORK, SUBJECT TO STATE LICENSING REQUIREMENTS AND ALL APPLICABLE STATE AND LOCAL RULES, CODES, AND STANDARDS.

(3) (a) THE UTILITY SHALL OBTAIN FROM THE COLORADO DEPARTMENT OF LABOR AND EMPLOYMENT AND SHALL MAKE USE OF A LIST,

REFERRED TO IN THIS SECTION AS THE "CERTIFIED CONTRACTOR LIST", CONTAINING THE NAMES AND CONTACT INFORMATION OF:

(I) QUALIFIED CONTRACTORS THAT PARTICIPATE IN APPRENTICESHIP PROGRAMS THAT ARE REGISTERED WITH THE UNITED STATES DEPARTMENT OF LABOR'S EMPLOYMENT AND TRAINING ADMINISTRATION OR WITH A STATE APPRENTICESHIP COUNCIL RECOGNIZED BY THE UNITED STATES DEPARTMENT OF LABOR; AND

(II) QUALIFIED MECHANICAL, ELECTRICAL, AND PLUMBING CONTRACTORS THAT MEET THE GRADUATION STANDARDS SPECIFIED IN SECTION 24-92-115 (1)(a)(II).

(b) THE UTILITY SHALL PUBLISH THE CERTIFIED CONTRACTOR LIST ON ITS WEBSITE AND INCLUDE OR REFERENCE THE LIST IN ALL OF THE UTILITY'S RELEVANT MARKETING MATERIAL FOR BENEFICIAL ELECTRIFICATION PROGRAMS.

(c) AS A CONDITION FOR CUSTOMER PARTICIPATION IN BENEFICIAL ELECTRIFICATION PROGRAMS WHERE A REBATE IS PAID DIRECTLY TO THE CUSTOMER AFTER INSTALLATION IS COMPLETE, EACH INVESTOR-OWNED ELECTRIC UTILITY SHALL REQUIRE ITS RESIDENTIAL CUSTOMERS TO VERIFY THAT THEY USED LICENSED ELECTRICIANS AND PLUMBERS OR PROPERLY SUPERVISED APPRENTICES ON ALL PLUMBING AND ELECTRICAL WORK PERFORMED BY A CONTRACTOR ON RESIDENTIAL INSTALLATIONS THAT QUALIFY FOR A BENEFICIAL ELECTRIFICATION REBATE.

(4) THE FOLLOWING REQUIREMENTS APPLY TO BENEFICIAL ELECTRIFICATION PROJECTS IN NEW OR EXISTING INDUSTRIAL, COMMERCIAL, OR MULTIFAMILY RESIDENTIAL BUILDINGS:

(a) FOR PLUMBING, MECHANICAL, OR ELECTRICAL PROJECTS UNDERTAKEN BY A COMMERCIAL OR INDUSTRIAL CUSTOMER IN A BUILDING THAT CONTAINS TWENTY THOUSAND SQUARE FEET OR MORE OF CONDITIONED FLOOR SPACE AND FOR WHICH A REBATE IS TO BE PROVIDED DIRECTLY TO THE CUSTOMER AS PART OF A BENEFICIAL ELECTRIFICATION PROGRAM, THE UTILITY SHALL CONDITION PAYMENT OF THE REBATE ON THE CUSTOMER'S EXCLUSIVE USE OF CONTRACTORS FROM THE CERTIFIED CONTRACTOR LIST UNLESS THE WORK IS DONE BY EMPLOYEES OF THE UTILITY.

(b) (I) FOR PLUMBING, MECHANICAL, OR ELECTRICAL PROJECTS THAT INVOLVE THE BENEFICIAL ELECTRIFICATION OF CENTRAL BUILDING SYSTEMS IN A MULTIFAMILY BUILDING THAT CONTAINS TWENTY THOUSAND SQUARE FEET OR MORE OF CONDITIONED FLOOR SPACE AND FOR WHICH A REBATE IS TO BE PROVIDED DIRECTLY TO THE BUILDING OWNER AS PART OF A BENEFICIAL ELECTRIFICATION PROGRAM, THE UTILITY SHALL CONDITION PAYMENT OF THE REBATE ON THE BUILDING OWNER'S EXCLUSIVE USE OF CONTRACTORS THAT PARTICIPATE IN APPRENTICESHIP PROGRAMS REGISTERED WITH THE UNITED STATES DEPARTMENT OF LABOR'S EMPLOYMENT AND TRAINING ADMINISTRATION OR WITH A STATE APPRENTICESHIP COUNCIL RECOGNIZED BY THE UNITED STATES DEPARTMENT OF LABOR FOR ANY NECESSARY PLUMBING OR ELECTRICAL WORK. IF THE CONTRACTOR CHOSEN BY THE BUILDING OWNER IS NOT ON THE CERTIFIED CONTRACTOR LIST, THE UTILITY SHALL REQUIRE ANOTHER METHOD OF VERIFYING COMPLIANCE WITH THIS SUBSECTION (4)(b).

(II) THIS SUBSECTION (4)(b) DOES NOT APPLY TO A BENEFICIAL ELECTRIFICATION PROJECT THAT IS LIMITED TO IN-UNIT WORK IN A MULTIFAMILY BUILDING, AS UNDERTAKEN BY THE OWNER OR TENANT OF THE MULTIFAMILY BUILDING OR UNIT.

40-3.2-109. Beneficial electrification plans for electric utilities - definition - rules - recovery of costs - report. (1) **Definition.** AS USED IN THIS SECTION, "BENEFICIAL ELECTRIFICATION PLAN" OR "PLAN" MEANS AN ELECTRIC UTILITY'S PLAN TO INCREASE BENEFICIAL ELECTRIFICATION IN THE RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL SECTORS FOR PURPOSES OTHER THAN TRANSPORTATION.

(2) (a) THE COMMISSION SHALL ALLOW AN INVESTOR-OWNED ELECTRIC UTILITY TO IMPLEMENT COST-EFFECTIVE BENEFICIAL ELECTRIFICATION PLANS THAT SUPPORT VOLUNTARY CUSTOMER ADOPTION OF BENEFICIAL ELECTRIFICATION MEASURES.

(b) ON OR BEFORE JULY 1, 2022, AND THEREAFTER AS DIRECTED BY THE COMMISSION, BUT NO LESS FREQUENTLY THAN EVERY THREE YEARS, AN INVESTOR-OWNED ELECTRIC UTILITY SHALL FILE WITH THE COMMISSION AN APPLICATION FOR A BENEFICIAL ELECTRIFICATION PLAN FOR REGULATED ACTIVITIES TO SUPPORT BENEFICIAL ELECTRIFICATION. BENEFICIAL ELECTRIFICATION PLANS MAY BE COMBINED WITH OTHER DEMAND-SIDE MANAGEMENT STRATEGIC ISSUES OR TRANSPORTATION ELECTRIFICATION

PLANS, AS APPLICABLE, BUT A BENEFICIAL ELECTRIFICATION PLAN MUST, AT A MINIMUM:

(I) INCLUDE PROPOSED PROGRAMS TO ADVANCE BENEFICIAL ELECTRIFICATION FOR RESIDENTIAL AND COMMERCIAL CUSTOMERS. PLANS MAY ALSO INCLUDE PROGRAMS TO ADVANCE BENEFICIAL ELECTRIFICATION FOR INDUSTRIAL CUSTOMERS.

(II) INCLUDE PROGRAMS TARGETED TO LOW-INCOME HOUSEHOLDS OR DISPROPORTIONATELY IMPACTED COMMUNITIES, WITH AT LEAST TWENTY PERCENT OF THE TOTAL BENEFICIAL ELECTRIFICATION PROGRAM FUNDING TARGETED TO PROGRAMS THAT SERVE LOW-INCOME HOUSEHOLDS OR DISPROPORTIONATELY IMPACTED COMMUNITIES;

(III) INCLUDE BUDGETS; TARGETED NUMBERS OF INSTALLATIONS; PROJECTED FUEL SAVINGS; PROJECTED COST-EFFECTIVENESS CALCULATIONS, INCLUDING THE SOCIAL COST OF METHANE AND CARBON DIOXIDE EMISSIONS AND AN APPROPRIATE SOCIAL DISCOUNT RATE IN THE COST-BENEFIT ANALYSIS; PROJECTED REDUCTIONS IN GREENHOUSE GAS EMISSIONS; AND OTHER INFORMATION DEEMED RELEVANT BY THE COMMISSION FOR THE PLAN AS A WHOLE AND FOR EACH PROGRAM INCLUDED IN THE PLAN;

(IV) DEMONSTRATE THAT THE UTILITY WILL, TO THE GREATEST EXTENT PRACTICABLE, SERVE INCREMENTAL LOAD ATTRIBUTABLE TO BENEFICIAL ELECTRIFICATION WITH GENERATION THAT CAN BE REASONABLY EXPECTED TO HAVE A CARBON INTENSITY NO HIGHER THAN THE AVERAGE CARBON INTENSITY FOR ALL GENERATION IN THE UTILITY'S PORTFOLIO;

(V) INCLUDE INCENTIVES TO FACILITATE BENEFICIAL ELECTRIFICATION, WITH PROGRAMS TARGETED TOWARD NEW AND EXISTING BUILDING MARKETS. PRODUCTS ELIGIBLE FOR INCENTIVES MUST BE CERTIFIED UNDER THE FEDERAL ENERGY STAR PROGRAM, AS DEFINED IN SECTION 6-7.5-102 (15), OR A SUCCESSOR PROGRAM IF THAT CERTIFICATION IS AVAILABLE, IN PRODUCT CATEGORIES FOR WHICH SUCH CERTIFICATION EXISTS.

(VI) INCLUDE AN OUTREACH PLAN FOR ENGAGEMENT WITH CUSTOMERS IN LOW-INCOME HOUSEHOLDS AND DISPROPORTIONATELY IMPACTED COMMUNITIES TO DEVELOP PROGRAMS TO SUPPORT THOSE CUSTOMERS IN EVERY PHASE OF THE UTILITY'S BENEFICIAL ELECTRIFICATION

PROGRAMS, INCLUDING THROUGH INCENTIVES OFFERED TO MULTIFAMILY BUILDINGS OCCUPIED IN FULL OR IN PART BY LOW-INCOME HOUSEHOLDS; AND

(VII) INCLUDE DOCUMENTATION AND DATA TO SHOW THAT THE UTILITY'S BENEFICIAL ELECTRIFICATION PLAN IS CONSISTENT WITH MAINTAINING THE RELIABILITY OF THE ELECTRIC GRID.

(3) THE COMMISSION AND INVESTOR-OWNED ELECTRIC UTILITIES SUBJECT TO COMMISSION JURISDICTION SHALL:

(a) INCORPORATE INTO THE COST-BENEFIT ANALYSIS OF BENEFICIAL ELECTRIFICATION PLANS AND PROGRAMS:

(I) THE SOCIAL COSTS OF CARBON DIOXIDE AND METHANE EMISSIONS, INCLUDING THE AVOIDED CARBON DIOXIDE EMISSIONS FROM THE DIRECT COMBUSTION OF FOSSIL FUEL IN APPLIANCES OR INDUSTRIAL EQUIPMENT THAT IS REPLACED WITH ELECTRICITY;

(II) THE AVOIDED UPSTREAM EMISSIONS OF METHANE FROM THE PRODUCTION AND DELIVERY OF FOSSIL FUEL TO THE APPLIANCE OR EQUIPMENT;

(III) THE INCREMENTAL CARBON DIOXIDE EMISSIONS FROM GENERATION OF ELECTRICITY; AND

(IV) THE INCREMENTAL LOAD ATTRIBUTABLE TO BENEFICIAL ELECTRIFICATION;

(b) USE THE METHODOLOGY DEFINED IN SECTION 40-3.2-106 (4) TO DETERMINE THE COST OF CARBON DIOXIDE EMISSIONS;

(c) BASE THE COST OF METHANE EMISSIONS ON THE MOST RECENT ASSESSMENT OF THE GLOBAL SOCIAL COST OF METHANE DEVELOPED BY THE FEDERAL GOVERNMENT, USING A DISCOUNT RATE OF TWO AND ONE-HALF PERCENT OR LESS; EXCEPT THAT, BEGINNING ON THE EFFECTIVE DATE OF THIS SECTION, THE COMMISSION SHALL USE A SOCIAL COST OF METHANE OF NOT LESS THAN ONE THOUSAND SEVEN HUNDRED FIFTY-SIX DOLLARS PER SHORT TON. THE COMMISSION SHALL MODIFY THE SOCIAL COST OF METHANE BASED ON ESCALATION RATES OF THE 2020 BASE COST BY AN AMOUNT THAT

IS EQUAL TO OR GREATER THAN THE ESCALATION RATES ESTABLISHED IN THE ADDENDUM TO THE TECHNICAL SUPPORT DOCUMENT AND SHALL USE A DISCOUNT RATE THAT DOES NOT EXCEED THE LESSER OF TWO AND ONE-HALF PERCENT OR ANY LOWER VALUE ESTABLISHED BY THE MOST RECENT AVAILABLE SUCCESSOR TO THE TECHNICAL SUPPORT DOCUMENT.

(d) INCLUDE UPSTREAM LEAKAGE OF METHANE EMISSIONS IN THE EXTRACTION, PRODUCTION, AND TRANSPORTATION OF FOSSIL GAS IN THE COST-BENEFIT ANALYSIS IF THE AIR QUALITY CONTROL COMMISSION DETERMINES AN ESTIMATE FOR UPSTREAM METHANE LEAKAGE.

(4) NOTWITHSTANDING ANY OTHER PROVISION OF LAW, THE COMMISSION SHALL ALLOW AN ELECTRIC UTILITY TO OFFER INCENTIVES TO ITS CUSTOMERS TO REPLACE GAS APPLIANCES WITH HIGH-EFFICIENCY ELECTRIC APPLIANCES.

(5) (a) THE COMMISSION SHALL ALLOW AN ELECTRIC UTILITY TO RECOVER ITS PRUDENTLY INCURRED COSTS, ON A CURRENT BASIS, FOR IMPLEMENTATION OF APPROVED BENEFICIAL ELECTRIFICATION PROGRAMS.

(b) THE COMMISSION MAY PROVIDE AN ELECTRIC UTILITY AN OPPORTUNITY TO EARN INCENTIVES FOR EXCEEDING BENEFICIAL ELECTRIFICATION TARGETS OR EMISSION-REDUCTION PERFORMANCE TARGETS THAT THE COMMISSION HAS ESTABLISHED FOR THE BENEFICIAL ELECTRIFICATION PLAN. FOR PURPOSES OF IMPLEMENTING THIS SUBSECTION (5)(b), THE COMMISSION MAY CONSIDER INCENTIVE MECHANISMS TO PROMOTE THE ADVANCEMENT OF THE UTILITY'S BENEFICIAL ELECTRIFICATION PROGRAMS, WHICH MAY INCLUDE:

(I) AN INCENTIVE RATE OF RETURN ON BENEFICIAL ELECTRIFICATION INVESTMENTS;

(II) AN INCENTIVE TO ALLOW THE UTILITY TO ACCELERATE DEPRECIATION;

(III) AN INCENTIVE TO ALLOW THE UTILITY TO RETAIN A PORTION OF THE NET ECONOMIC BENEFITS OF BENEFICIAL ELECTRIFICATION;

(IV) AN INCENTIVE TO ALLOW THE UTILITY TO COLLECT THE COST OF BENEFICIAL ELECTRIFICATION PROGRAMS THROUGH A RIDER OR COST

ADJUSTMENT CLAUSE; OR

(V) ANY OTHER INCENTIVE MECHANISM THE COMMISSION DEEMS APPROPRIATE.

(6) (a) BY APRIL 1, 2024, AND THEREAFTER AS DETERMINED BY THE COMMISSION BUT NO LESS FREQUENTLY THAN EVERY SIX YEARS, AN INVESTOR-OWNED ELECTRIC UTILITY SHALL FILE AN APPLICATION FOR A BENEFICIAL ELECTRIFICATION STRATEGIC ISSUES FILING THAT PROPOSES A TEN-YEAR BENEFICIAL ELECTRIFICATION TARGET AND OBJECTIVE CRITERIA FOR MEASURING PROGRESS TOWARD ATTAINMENT OF THE TARGET, WHICH CRITERIA MAY INCLUDE THE LEVEL OF SUBSTITUTION OF RENEWABLE SOURCES FOR FOSSIL FUEL OR THE LEVEL OF REDUCTION IN GREENHOUSE GAS EMISSIONS. THE COMMISSION SHALL APPROVE OR AMEND AND APPROVE THE UTILITY'S APPLICATION, TAKING INTO ACCOUNT THE UTILITY'S POTENTIAL FOR COST-EFFECTIVE BENEFICIAL ELECTRIFICATION, THE STATE'S GREENHOUSE GAS POLLUTION REDUCTION TARGETS, AND THE POTENTIAL FOR BENEFICIAL ELECTRIFICATION TO REDUCE GREENHOUSE GAS EMISSIONS.

(b) THE BENEFICIAL ELECTRIFICATION STRATEGIC ISSUES FILING MAY BE COMBINED WITH OTHER DEMAND-SIDE MANAGEMENT STRATEGIC ISSUES OR RELATED FILINGS AS APPROPRIATE, AND AN INVESTOR-OWNED GAS UTILITY MAY FILE WITH THE COMMISSION AN APPLICATION FOR A BENEFICIAL ELECTRIFICATION PLAN FOR REGULATED ACTIVITIES TO SUPPORT BENEFICIAL ELECTRIFICATION AS PART OF SUCH A PROCEEDING OR AS A SEPARATE APPLICATION. A BENEFICIAL ELECTRIFICATION PLAN FILED BY AN INVESTOR-OWNED GAS UTILITY IS ELIGIBLE FOR THE SAME TREATMENT AS A BENEFICIAL ELECTRIFICATION PLAN FILED BY AN INVESTOR-OWNED ELECTRIC UTILITY PURSUANT TO THIS SECTION.

(7) THE ELECTRIC UTILITY OR OTHER ENTITY COMMISSIONING A BENEFICIAL ELECTRIFICATION PROJECT SHALL ENSURE COMPLIANCE WITH THE LABOR STANDARDS SET FORTH IN SECTION 40-3.2-105.6.

(8) EACH ELECTRIC UTILITY THAT IMPLEMENTS A BENEFICIAL ELECTRIFICATION PLAN SHALL SUBMIT TO THE COMMISSION AN ANNUAL REPORT DESCRIBING THE BENEFICIAL ELECTRIFICATION PROGRAMS IMPLEMENTED UNDER THE PLAN AND DOCUMENTING:

(a) PROGRAM EXPENDITURES, ENERGY SAVINGS, INCREMENTAL

ADDITIONAL ELECTRIC LOAD ATTRIBUTABLE TO APPROVED BENEFICIAL ELECTRIFICATION PROGRAMS, AND INCREMENTAL ADDITIONAL GREENHOUSE GAS EMISSIONS ASSOCIATED WITH BENEFICIAL ELECTRIC LOAD ATTRIBUTABLE TO APPROVED BENEFICIAL ELECTRIFICATION PROGRAMS;

(b) ASSUMED AVOIDED GREENHOUSE GAS EMISSIONS FROM OTHER SECTORS RESULTING FROM APPROVED BENEFICIAL ELECTRIFICATION PROGRAMS;

(c) SOCIETAL COSTS AND BENEFITS OF APPROVED BENEFICIAL ELECTRIFICATION PROGRAMS AS WELL AS THE TECHNIQUES USED TO CALCULATE THOSE IMPACTS;

(d) COMPLIANCE WITH THE LABOR STANDARDS SET FORTH IN SECTION 40-3.2-105.6; AND

(e) ANY OTHER INFORMATION THAT THE COMMISSION REQUESTS.

(9) MUNICIPALLY OWNED ELECTRIC UTILITIES, COOPERATIVE ELECTRIC ASSOCIATIONS, AND WHOLESALE ELECTRIC COOPERATIVES, AS DEFINED IN SECTION 40-2-134, IN COLORADO ARE ENCOURAGED TO:

(a) DEVELOP BENEFICIAL ELECTRIFICATION PLANS AS ADDRESSED IN THIS SECTION AND TRANSPORTATION ELECTRIFICATION PROGRAMS PURSUANT TO SECTION 40-5-107 THAT HELP THEIR CUSTOMERS INVEST IN BENEFICIAL ELECTRIFICATION IN BUILDINGS AND TRANSPORTATION;

(b) ACCOUNT FOR THE SOCIAL COST OF CARBON DIOXIDE AND METHANE EMISSIONS, SET TOTAL ENERGY SAVINGS AND GREENHOUSE-GAS-EMISSION-REDUCTION GOALS, AND IMPLEMENT BENEFICIAL ELECTRIFICATION PROGRAMS FOR THEIR CUSTOMERS;

(c) INCLUDE A BENEFICIAL ELECTRIFICATION PLAN OR TRANSPORTATION ELECTRIFICATION PROGRAM AS PART OF A CLEAN ENERGY PLAN; AND

(d) PARTICIPATE IN STATEWIDE OR REGIONAL INITIATIVES TO INCREASE THE AVAILABILITY OF, DEVELOP THE MARKET FOR, AND SUPPORT CONTRACTOR TRAINING ON HIGH-EFFICIENCY ELECTRIC TECHNOLOGIES.

(10) IN IMPLEMENTING THIS SECTION, THE COMMISSION SHALL NOT REQUIRE THE REMOVAL OF GAS-FUELED APPLIANCES OR EQUIPMENT FROM ANY EXISTING STRUCTURE OR BAN THE INSTALLATION OF GAS SERVICE LINES TO ANY NEW STRUCTURE.

SECTION 6. In Colorado Revised Statutes, 22-43.7-107, **amend** (2)(e) as follows:

22-43.7-107. Public school facility construction guidelines - establishment by board - use. (2) The public school facility construction guidelines must identify and describe the capital construction, renovation, and equipment needs in public school facilities and means of addressing those needs that will provide educational and safety benefits at a reasonable cost. In preparing the guidelines, the board shall address the following considerations:

(e) Consultation with the incumbent electric utility regarding energy efficiency; beneficial electrification, as defined in ~~section 40-3.2-106 (6)(a)~~ SECTION 40-1-102 (1.2); and renewable distributed generation opportunities;

SECTION 7. Appropriation. (1) For the 2021-22 state fiscal year, $168,448 is appropriated to the department of regulatory agencies for use by the public utilities commission. This appropriation is from the public utilities commission fixed utility fund created in section 40-2-114 (1)(b)(II), C.R.S. To implement this act, the commission may use this appropriation as follows:

(a) $128,548 for personal services, which amount is based on an assumption that the commission will require an additional 1.6 FTE; and

(b) $39,900 for operating expenses.

(2) For the 2021-22 state fiscal year, $73,351 is appropriated to the department of labor and employment for use by the division of employment and training. This appropriation is from the general fund and is based on the assumption that the department will require an additional 0.9 FTE. To implement this act, the division may use this appropriation for assembling and maintaining a certified contractor list.

SECTION 8. Act subject to petition - effective date. This act

takes effect at 12:01 a.m. on the day following the expiration of the ninety-day period after final adjournment of the general assembly; except that, if a referendum petition is filed pursuant to section 1 (3) of article V of the state constitution against this act or an item, section, or part of this act within such period, then the act, item, section, or part will not take effect unless approved by the people at the general election to be held in November 2022 and, in such case, will take effect on the date of the official declaration of the vote thereon by the governor.

Leroy M. Garcia
PRESIDENT OF
THE SENATE

Alec Garnett
SPEAKER OF THE HOUSE
OF REPRESENTATIVES

Cindi L. Markwell
SECRETARY OF
THE SENATE

Robin Jones
CHIEF CLERK OF THE HOUSE
OF REPRESENTATIVES

APPROVED June 21, 2021 at 3:10pm
(Date and Time)

Jared S. Polis
GOVERNOR OF THE STATE OF COLORADO

Denver's Net Zero Energy (NZE) New Buildings & Homes Implementation Plan

January 2021

DENVER
CLIMATE ACTION, SUSTAINABILITY & RESILIENCY

nbi new buildings institute

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ABBREVIATIONS

ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers
BMS – Building management system
Buildings – All Commercial Buildings (commercial, industrial, multifamily)
CASR –Denver's Office of Climate Action, Sustainability, and Resiliency
CPD – Denver's Community Planning and Development
Cx – Commissioning
DGC – Denver Green Code
DR – Demand response
Enclosure Cx – Enclosure commissioning
EUI – Energy Use Intensity
EV – Electric Vehicle
GHG – Greenhouse gas
Homes – All Single-family dwellings (attached and detached)
HOST - Denver's Department of Housing Stability
HVAC – Heating, ventilation, and air conditioning
IAQ – Indoor air quality
IECC – International Energy Conservation Code
ICC – International Code Council
LCC – Lifecycle cost
MBCx – Monitoring based commissioning
M&V – Measurement and verification
NZE – Net zero energy
pEUI – Predictive Energy Use Intensity
PV – Photovoltaics
REC – Renewable Energy Credit
RTU – Roof top unit
TOU – Time-of-use
VRF – Variable Refrigerant Flow

EXECUTIVE SUMMARY

Introduction

Climate change is not only the single greatest public health and environmental threat of our time, it is one of the biggest challenges. From local impacts such as worsening air quality and increasing frequency of extreme heat, to global impacts like reductions in food supply and sea level rise, the effects will be felt in Denver and around the world. Buildings and homes represent 64% of Denver's 2019 greenhouse gas (GHG) emissions and are a key component to addressing climate change.

Cities can bend the curve on atmospheric carbon because they are responsible for over 70 percent of GHG emissions globally. Denver can implement effective strategies that will help guide our city to a climate-safe future in a way that works for all of our businesses and residents. These strategies will also clean our air and water, make our communities more resilient, improve our health, and preserve the quality of life in the city that we love.

> ***"Cities can bend the curve on atmospheric carbon because they are responsible for over 70 percent of GHG emissions globally."***

The objectives of Denver's Net Zero Energy New Buildings & Homes Implementation Plan (NZE Plan) are to help create clean energy jobs, drive economic recovery, and improve energy equity through enhancements to the Denver Building and Fire Code with the goal of all new buildings achieving net zero energy by 2030. The milestones to reach this goal are:

- Net zero energy, all-electric new homes in the 2024 Building Code
- Net zero energy, all-electric new buildings in the 2027 Building Code
- New buildings perform as designed with performance verification in the 2030 Building Code

These goals and this plan were developed with extensive input from the Net Zero Energy (NZE) Stakeholder Advisory Groups and community feedback.

> ***"The objectives of Denver's Net Zero Energy New Buildings & Homes Implementation Plan (NZE Plan) are to help create clean energy jobs, drive economic recovery, and improve energy equity."***

In Denver's 2018 80x50 Climate Action Plan, the city pledged that in 2035 it would achieve NZE in new buildings and homes. In 2020, the Climate Action Task Force reviewed current climate science and recommended that all of Denver's buildings and homes achieve net zero by 2030. The Task Force also set milestones for net zero in building code to reach NZE by 2030 through highly efficient, all-electric, renewable energy, and grid-flexible goals. With this NZE Plan, Denver's Office of Climate Action,

Sustainability, and Resiliency is updating the 80x50 NZE goals to align with the recommendations of the Climate Action Task Force.

What is Net Zero Energy?

Denver defines "Net Zero Energy (NZE)" as a new building or home that is highly energy-efficient and fully powered from on-site and/or off-site renewable energy. This means that new buildings and homes will be: (1) Highly Energy Efficient, (2) All-Electric, (3) Powered by Renewable Energy, and (4) Providers of Demand Flexibility for the Grid. Each of these is a foundation of net zero energy in Denver and addressed in detail in this NZE Plan.

What are the Costs and Benefits of Net Zero?

This NZE Plan details two cost studies of all-electric buildings, specific to Denver. One study found that building all-electric reduced upfront costs by 27% for single-family new construction and 8% for all-electric new construction commercial buildings, including rebates from Xcel Energy. New construction electric homes cost around $5,300 less to build compared with new construction mixed-fuel homes. New construction commercial buildings cost $18,100 less to build than mixed-fuel new buildings.

> ***"One study found that building all-electric reduced upfront costs by 27% for single-family new construction and 8% for all-electric new construction commercial buildings."***

The second study reported that building an all-electric home saved $2,900 in net present costs over 15 years and $2,700 in upfront costs, and that all-electric homes save 2% in annual utility costs compared to mixed fuel homes. The majority of the upfront savings that electric homes realize are from an avoided gas interconnection.

Building all-electric also offers co-benefits including efficiency, health, and cost savings, such as:

- Electric heat pumps are significantly (200-300%+) more efficient than gas equipment. As a result, there are operational cost benefits from this energy savings.
- Electric induction stovetops also improve safety through reduced risk of burns and fire, and another study explored in this plan found that children in homes with gas stoves have a:
    - 42% increased risk of experiencing asthma symptoms (current asthma)
    - 24% increased risk of ever being diagnosed with asthma by a doctor (lifetime asthma)
    - 32% increased risk of both current and lifetime asthma overall
- There are significant cost savings from avoiding installation of gas distribution supply lines and equipment.

Why Now?

By 2050, about 40% of Denver's building stock will be "new", having been built between 2020 and 2050, therefore, the city's GHG emissions will be significantly reduced if these buildings are net zero and all-

electric. Denver is currently developing a Beneficial Electrification Implementation Plan for Existing Buildings, which will address how to strategically electrify the existing buildings within Denver; this plan is expected to be complete by the end of 2021.

Xcel Energy, the electricity provider in Denver, has committed to reducing emissions from electricity generation 80% by 2030 and 100% by 2050. Electricity comprises 66% of emissions and natural gas comprises 33% of the emissions in Denver's current building stock. By decarbonizing the grid, in 2030 electricity will comprise only 40% of building emissions and natural gas will comprise 60% of the building emissions. Moving toward net zero buildings swiftly will keep pace with the transformation of Xcel's grid, and maximize the opportunity to reduce Denver's GHG burden.

How Does this Plan Promote Equity?

The COVID-19 crisis has crystallized the connection between environmental quality and public health. Denver's low-income neighborhoods and communities of color are disproportionately impacted by climate change and energy insecurity. Affordability, equity and health have always been integral to Denver's climate work, and the stakeholders in this plan placed a heavy emphasis on addressing the impact of net zero implementation on Denver's most climate-burdened communities.

At scale, net zero buildings in Denver will have a noticeable positive impact on neighborhood-level air quality. A grid that is majority powered by renewable sources will generate fewer toxins and particulate matter than today's energy sources. Homes that have all-electric end uses will not have indoor sources of carbon monoxide, eliminating that danger for residents, especially those living with chronic respiratory conditions.

As Denver advances in this transition, the incentives discussed in this NZE Plan will need to focus on low- and moderate-income households, and the owners of buildings in which they live, to drive adoption of these recommendations while also protecting affordability. The forthcoming Beneficial Electrification Plan will present solutions to address the risk of low-income customers being the last on the system bearing the full weight of maintenance costs.

What is the Timeline?

The path to net zero requires technical changes to Denver's Denver Building and Fire Code and implementation of key supports, all of which are detailed in this plan. The NZE Stakeholder Advisory Groups established the following guiding principles for the path ahead:

- We will need incentives to equitably support new construction and the community.
- Denver will be net zero energy as a whole community of buildings and homes, not in every individual building and home.
- There will be different solutions for different buildings: our goal is to write an implementation plan that requires a fair and consistent level of effort across building types, sectors, and neighborhoods.
- Stakeholders will help us figure out this path.

Staffing and program support is needed internally at the city to ensure these goals will be met, and will provide the support needed for the community to succeed. Denver needs both IECC code enforcement

staff as well as staff for incentives, fee reductions, and supports such as marketing and outreach, training and education, financing and incentives, and advocacy. Specific to education, the stakeholders identified the importance of the city providing education and training for design teams, developers, building owners, and the general public.

The NZE Plan presents a thorough timeline for each of the next four code cycles in 2021, 2024, 2027, and 2030. The table below is an abbreviated excerpt of the proposed code requirements for commercial buildings, illustrating that the 2021 code update presents a modest introduction to net zero, then gradually ramps up to full adoption in 2030.

Table 1. Summary of Proposed Requirements for Commercial Buildings

Commercial	2021	2024	2027	2030
HIGHLY EFFICIENT				
Energy Modeling Accuracy	Report on discrepancy in disclosure data	Within 15% of target	Within 10% of target	Achieve target
ALL-ELECTRIC				
Equipment requirement	All-Electric: *except heating & water heating* All-Electric Ready: *conduit for central*	All-Electric: *except water heating*	All-electric equipment	All-electric equipment
RENEWABLE ENERGY				
Minimum renewable offset	50%	75%	100%	100%
GRID FLEXIBLITY				
Grid flexibility requirement	Grid Flexible Equipment	Implementation of Grid Flexible Metric	Improving Grid Flexibility + Increased Storage	Improving Grid Flexibility + Increased Storage

Who is Involved?

Denver's Office of Climate Action, Sustainability, and Resiliency (CASR) produced this plan, in close collaboration with colleagues in the department of Community Planning and Development (CPD), and the two agencies will continue to implement this plan together. The code update process is managed by CPD, and CASR is providing significant staff support to the effort. The code update process also provides formal engagement opportunities for stakeholders and the public, and is likely to launch in the second quarter of 2021 and conclude by the end of the year.

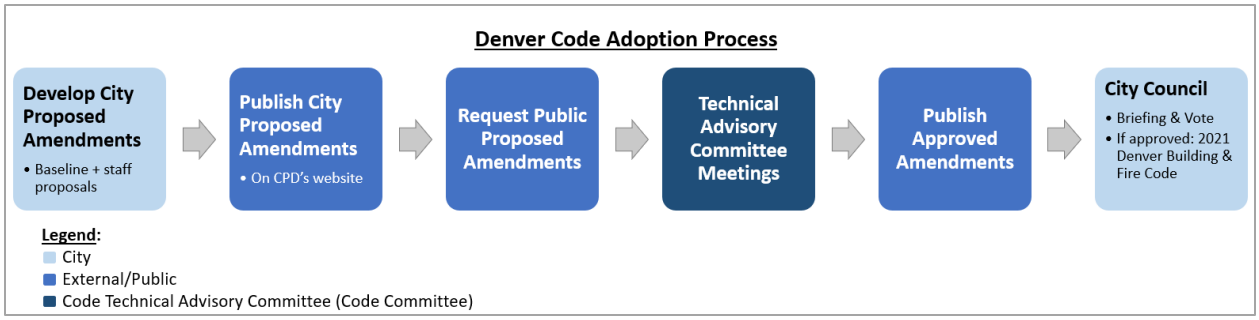


Figure 1. Denver Code Adoption Process

CASR has other stakeholder engagement forums related to this plan:

- The Beneficial Electrification Plan stakeholder groups are deliberating solutions related to the all-electric sections of this plan.
- The Energize Denver Task Force is deliberating similar and complimentary solutions to achieve net zero in existing buildings.
- The Buildings & Homes committee of the Sustainability Advisory Council provides an ongoing forum for discussing policy recommendations and implementation plans.

Under the leadership of Mayor Michael B. Hancock, the City and County of Denver is on track to achieve its net zero goal by 2030 through a process that has been centered on equity and developed in partnership with the stakeholders most impacted by this policy. With continued support and collaboration between agencies, external partners, and the public, implementing this NZE Plan will result in Denver being healthier, more resilient, and producing unto each generation the highest quality of life.

INTRODUCTION

Background

Denver's Net Zero Energy New Buildings & Homes Implementation Plan (NZE Plan) is designed to help create clean energy jobs, drive economic recovery and improve energy equity by passing new building code every three years to enable Denver to get to NZE by 2030 in support of net zero emissions. Net Zero Energy in Denver means that a building is highly energy efficient, all-electric, powered by 100% renewable energy and electricity, and provides demand flexibility to the grid. This NZE Plan details Denver's climate goals, the path to reach these goals, and the supports needed for success.

CENTERING CLIMATE ACTION IN EQUITY

While affordability, equity, and health have always been part of Denver's climate work, it is now more important than ever. In 2020, a number of acute and interrelated crises unfolded: a health crisis due to the COVID-19 pandemic, the associated economic crisis, and the social justice crisis further brought to light by the killing of George Floyd at the hands of a police officer. With each of these, we all became even more acutely aware that the climate crisis deeply intersects with social justice, economic health, and Denver's health and wellbeing. We know that Denver's low-income neighborhoods and communities of color are disproportionately impacted by climate change.

Because of this, it is our goal to view this NZE Plan and all of our work in buildings and homes through an equity lens. There are co-benefits of addressing climate within buildings and homes. We worked to ensure that equity and affordability were considered through our technical NZE Stakeholder Advisory Groups. Finally, we worked closely with Denver's Office of Social Equity and Innovation to ensure we received feedback on this NZE Plan regarding equity and held a public review input and briefing webinar for Denver's community.

Table 2. Co-benefits from Addressing Climate in Buildings and Homes

Co-Benefits	Detail
Social Equity	• **Energy costs have a disproportionate impact on lower income residents** • Energy efficiency measures lower energy bills, **saving money for households and businesses**
Local economy	• Reduction in building energy use reduces costs • When a business or household lowers their energy costs, the **savings can be spent elsewhere in the local economy** • Policies and related programs will create **a market for jobs** to support retrofitting existing homes and buildings
Energy Independence	• Reducing the use of imported fossil fuels **lowers the community's vulnerability to energy price and supply shocks**
Deferred Infrastructure	• Reducing energy consumption can help defer the need for new sources of energy generation
Public Health	• Reducing fossil fuel use in buildings and energy generation **reduces the emissions of air pollutants**, improving air quality and lowering risks of asthma, respiratory disorders, heart attacks, and cancer.

Source: CASR

NET ZERO ENERGY INPUT FROM STAKEHOLDERS

This NZE Plan is a collaboration between Denver's Office of Climate Action, Sustainability, and Resiliency (CASR) and Community Planning and Development (CPD). This collaboration ensures that it is based on Denver's climate goals from Denver's internal experts on new buildings, new homes and energy codes.

It was critical that this plan obtain thorough input from Denver's technical buildings and homes experts. To this end, the City committed to an extensive process of gathering input from technical stakeholders with a wide range of expertise from business-as-usual to high-performance building experts. The NZE Stakeholder Advisory Groups included technical experts for commercial, multifamily, and residential buildings. Additionally, we sought a mix of developers, general contractors, builders, architects, engineers, researchers, sustainability consultants, renewables, and utility experts.

Denver hosted seven (7) stakeholder meetings with the NZE Stakeholder Advisory Groups to provide specific and achievable pathways to NZE new buildings and homes. The meetings included:

- October 2019 – Phase 1 Meetings
    - Commercial Stakeholder Meeting
    - Residential Stakeholder Meeting
- December 2019 – Interim Meetings
    - Commercial Stakeholder Meeting
    - Residential Stakeholder Meeting
- October 2020 – Phase 2 Meetings
    - Commercial Stakeholder Meeting
    - Multifamily Stakeholder Meeting
    - Residential Stakeholder Meeting
- Public Input Meeting: October 2020

The Phase 1 Meetings focused on understanding from the stakeholders the challenges, opportunities, and solutions in achieving net zero as well as discussions on equity for each of the four foundations of net zero energy: highly energy efficient, all-electric, renewable electricity, and grid flexibility. The Interim Meetings focused on building policies and strategies for the Climate Action Task Force, including prioritizing supports and reviewing cost estimates to help Denver address climate change in the most impactful and equitable way. The Phase 2 Meetings focused on feedback on Denver's Draft NZE Plan as well as a review of targets for each building type. Stakeholders also finalized overarching goals and targets.

Denver then held the Public Input Meeting to reach out to the community on the Draft NZE Plan. Denver also conducted a survey to help learn what the community thought of the overarching net zero energy goal. The next section of this report details the goals and recommendations based on stakeholder and public input. Specifics from these meetings are available on Denver's Net Zero New Buildings web page. Denver also reached out to a number of local professional associations to update and ensure ongoing feedback throughout the development of this NZE Plan.

Denver's Climate Goals and Recommendations

UPDATED NZE GOALS SET IN THIS IMPLEMENTATION PLAN

The goal from the 80x50 Climate Action Plan and the recommendations from the Climate Action Task Force were the basis for discussions on timelines for each of the four net zero energy foundations: highly energy efficient, all-electric, 100% renewable electricity, and grid flexibility.

The NZE Stakeholder Advisory Groups reviewed the climate goals and recommendations. Denver also held a public input and briefing meeting to reach out to the community about the timeline. Ultimately, the NZE Stakeholder Advisory Groups recommended that this NZE Plan be developed to reach net zero energy by 2030 and align with the Climate Action Task Force Recommendations and feedback from the public.

Denver's updated NZE goals are:

- Net zero energy, all-electric new homes in the 2024 Building Code
- Net zero energy, all-electric new buildings in the 2027 Building Code
- Performance verification (outcome-based codes) for new buildings in 2030

80X50 CLIMATE ACTION PLAN

The City and County of Denver (CCD) has ambitious climate goals – an 80% reduction in greenhouse gas (GHG) emissions by 2050, according to the 2018 80x50 Climate Action Plan. There are additional goals for buildings and homes that apply as new buildings become existing buildings. Goals of the 80x50 Climate Action Plan are listed in the table below.

Table 3. Denver 80x50 Climate Action Plan Goals

Year	Buildings Goal	Homes Goal
2025		• Homes use 10% less energy
2030	• Buildings use 30% less energy	
2035	• Net zero energy new buildings	• Homes use 20% less energy
2040	• Buildings reduce heating emissions 50%	• Homes reduce heating emissions 25%

Source: CASR

CLIMATE ACTION TASK FORCE RECOMMENDATION

In 2020, Denver further addressed climate by facilitating a Climate Action Task Force charged with developing recommendations to strengthen Denver's work to address climate change equitably in buildings, transportation, 100% renewable electricity, industrial energy use, consumption emissions, and resiliency/adaptation. The Climate Action Task Force developed recommendations for buildings and homes beyond the 80x50 Climate Action Plan including:

- Net zero new homes in the 2024 Building Code
- Net zero new building in the 2027 Building Code
- Performance verification (outcome-based codes) for new buildings in 2030

The Climate Action Task Force defined net zero as highly efficient, all-electric, renewable energy, and grid-flexible.

Table 4. Denver Climate Action Task Force Recommendations for Buildings and Homes

Code Cycle	Buildings	Homes

2021 Building & Fire Code	• 2019 DGC becomes 2021 Base Code
	• Develop 2021 DGC
	  ○ All-electric new buildings
		• 2019 DGC becomes 2021 Base Code
		• Develop 2021 DGC
		  ○ Net zero new homes

2024 Building & Fire Code	• 2021 DGC becomes 2024 Base Code
	  ○ All-electric new buildings
	• Develop 2024 DGC
	  ○ Net zero new buildings
		• 2021 DGC becomes 2024 Base Code
		  ○ Net zero new homes
		• Develop 2024 DGC

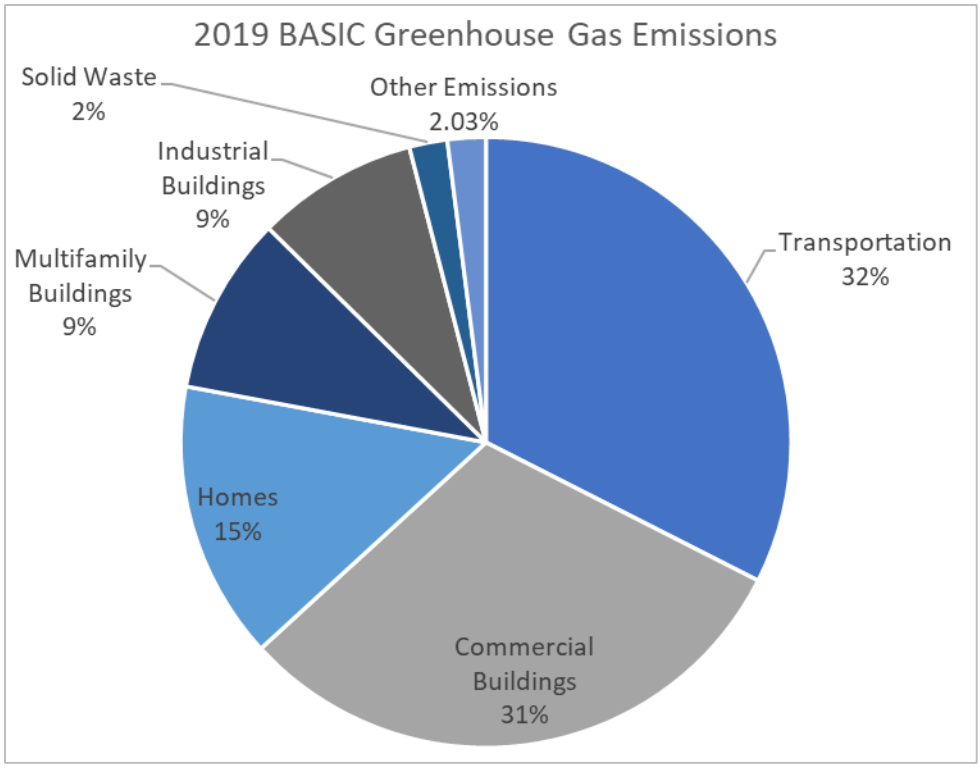
2027 Building & Fire Code	• 2024 DGC becomes 2027 Base Code
	  ○ Net zero new buildings
	• Develop 2027 DGC
	  ○ Performance verification (outcome-based code)
		• 2024 DGC becomes 2027 Base Code
		  ○ Net zero new homes
		• Develop 2027 DGC

2030 Building & Fire Code	• 2027 DGC becomes 2024 Base Code ○ Performance verification • Develop 2030 DGC	• 2027 DGC becomes 2024 Base Code • Develop 2030 DGC

Source: CASR

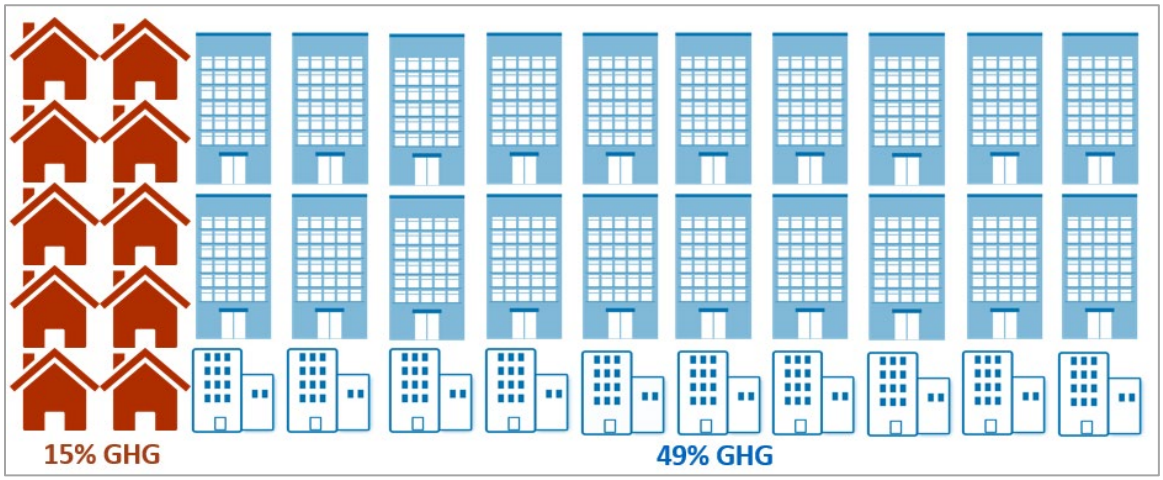
Denver's Emissions

Buildings and homes together represent 64% of Denver's 2019 emissions and are a key component to addressing climate change in Denver.



Source: CASR

Figure 2. 2019 BASIC GHG Emissions in Denver



Source: CASR

Figure 3. Buildings and Homes are 64% of Denver's 2019 BASIC GHG Emissions

Growth from New Buildings and Homes

Additionally, by 2050, about 40% of Denver's building stock will be "newly" built (buildings and homes built between 2020 and 2050). According to Dodge Data and Analytics – Denver City and County New Construction Projections, the five-year increase by building type is as follows.

Table 5. Denver's Projected New Buildings

Commercial & Multifamily Buildings	5-Year Increase (sqft)
Apartments & Condos	19,300,199
Office and Bank	6,716,497
Warehouses	1,725,054
Hotels	1,638,085
Schools	1,289,142
Misc. Non-Res	1,200,500
Hospitals	1,158,273
Stores/Restaurants	1,106,037
Source: Dodge Data and Analytics – Denver City and County New Construction Projections	

Table 6. Denver's Projected New Homes

Homes	5-Year Increase (sqft)
One Family Houses	18,876,629
Two Family Houses	859,211
Source: Dodge Data and Analytics – Denver City and County New Construction Projections	

Implications for Existing Buildings

This NZE Plan only applies to major renovations of existing buildings going through Denver's permitting process.

2019 Denver Codes and Code Adoption Process

The way that the targets detailed in this NZE Plan will become required in the Denver Building and Fire Code is through the ongoing Code Adoption Process. Denver's most recent Building and Fire Code was developed and adopted in 2019. The 2019 Denver Building and Fire Code is based on the 2018 edition of the International Code Council (ICC) codes including: the International Energy Conversation Code (IECC) as well as the IBC, IEBC, IPC, IMC, IRC, IFGC, and IFC. The 2019 Denver Code was approved by City Council on December 23, 2019, and the Mayor signed the bill on December 26, 2019. The code went into effect on July 31, 2020.

The 2019 Denver Green Code is a voluntary stretch code based on the 2018 edition of the International Green Conservation Code (IgCC). The intent is that the current Denver Green Code will be the basis for the next base code in the upcoming Building and Fire Code Adoption Process.

Denver's code adoption process follows the Code Development Cycle of the International Code Council (ICC) codes. Denver staff votes as part of the code adoption process and recently participated in voting on the 2021 ICC Codes. The final versions of each code will be available in 2020 and as a result Denver will begin our next code adoption process in 2021.

DENVER'S NET ZERO DEFINITION

Denver's goal is to be net zero energy, in support of reaching net zero emissions as a whole community of buildings and homes. While this is a community goal based on emissions, the metric within this NZE Plan for each individual building or home is energy because of renewable attributes in Denver. There will be different solutions for different buildings and homes to ensure a fair and consistent level of effort across building types, sectors, and neighborhoods. Additionally, it will frame reaching the NZE goal through Denver's Code Adoption Process by detailing individual building or home requirements as well as the supports needed for the community to reach these goals equitably.

Denver developed a definition of Net Zero Energy and guiding principles as the basis for this NZE Plan and based on the climate goals detailed in the 80x50 Climate Action Plan. In conjunction with stakeholders, Denver determined that each net zero new building will address energy efficiency, reduce greenhouse gas (GHG) emissions through all-electric equipment, use renewable energy and electricity, and provide demand flexibility to the grid. These are detailed further below.

Guiding Principles

Denver developed four guiding principles for net zero energy new buildings and homes including:

- We will need incentives to equitably support new construction and the community.
- As a whole community of buildings, we want to achieve this goal. We will not achieve it in every individual building.
- There will be different solutions for different buildings: our goal is to write a NZE Plan that requires a fair and consistent level of effort across building types, sectors, and neighborhoods.
- Stakeholders will help us figure out this path.

Accounting in Denver

The community goal is to reach net zero emissions with energy as the metric for each individual building or home. The reason for this is because Xcel Energy typically retains the renewable energy credits (RECs). Denver's priority, therefore, is to add renewable capacity and also work with Xcel so that they retire the RECs to reach net zero emissions.

Denver's Net Zero Energy New Building Definition

Denver defines net zero energy as a new building or home that is highly energy-efficient and fully powered from on-site and/or off-site renewable energy. This means that new buildings and homes will be: **1. Highly Energy Efficient, 2. All-Electric, 3. Powered by Renewable Energy and Electricity, and 4. Providers of Demand Flexibility for the Grid**.

In 2030, new buildings and homes in Denver will be:

1. ***Highly Energy Efficient***
    - Highly energy-efficient buildings on site
    - Target Energy Use Intensity (EUI) for commercial buildings;
      Target Energy Rating Index (ERI) for homes
    - Buildings will have to perform as designed where practical for that building type.
    - Energy efficiency is the step that decreases costs through energy savings .
2. ***All-Electric***
    - Reduce greenhouse gas emissions through all-electric equipment in buildings.
    - New buildings and homes free from natural gas
3. ***Powered by Renewable Energy and Electricity***
    - On-site or off-site renewables focused on additional production.
    - REC's (renewable attributes) need to be retired by the customer or the utility and not sold.
    - By 2050 the grid will be 100% renewable. Buildings are part of that equation.
4. ***Providers of Demand Flexibility for the Grid***
    - Energy storage, grid integration, and flexibility to respond to grid signals.

The next four sections of this NZE Plan address each of these four foundations of Denver's Net Zero Energy Goal.

TECHNICAL GUIDANCE: QUICK START

This NZE Plan will help Denver get to net zero in the upcoming Code Adoption Cycles in order to meet Denver's climate goals. As a result, details the goals, targets, and milestones for each upcoming code cycle. It is intended for:

- The City & County of Denver
- Denver's buildings and homes community of developers, architects, engineers, etc.
- Those on the Code Committees in future code cycles

This is a technical document to consider equity costs, support, technologies, gaps, and barriers for new buildings and home. This NZE Plan is extensive to address all of this for each foundation of net zero (highly energy efficient, all-electric, renewable electricity, and grid flexible). Subsequently, this section is a summary of the technical guidance as a "quick start" summary of the detailed content within future sections.

Highly Energy Efficient

The first foundation of Denver's net zero energy (NZE) definition is that new buildings and homes will be highly energy efficient. Energy efficiency is the step that makes all of the foundations more cost effective. Energy efficiency is the first foundation of NZE to ensure that buildings and homes are increasingly energy efficient when getting to net zero energy and saving energy on-site prior to considering renewables.

Energy efficiency for new buildings will be incorporated into future codes through Denver's Code Adoption Process and will be detailed primarily in the IECC. In addition, there are a number of considerations needed in getting to buildings that perform as designed. The first consideration is the prescriptive and performance paths as well as the calibration needed to keep the paths aligned.

Ultimately, the methodology for getting to buildings that perform as designed is through Denver moving to outcome-based (performance verification) codes. Denver will need to address a number of items to be successful including:

- Develop Performance Targets
    - Develop and set performance targets by building type
    - Highly efficient – pEUI targets
    - Address other building types
    - Using EUI targets
- Detail Performance Verification
    - Develop and implement policies for buildings to perform as designed
- Refine Energy Modeling
    - Streamline modeling paths – streamline energy modeling paths within code
    - Address modeling accuracy – increasing focus on predictive accuracy through guidelines
    - Predictive modeling – scaling from comparative to predictive energy modeling
    - Modeling unregulated loads – incentivize improvements without a loophole

- Modeling normalization – what factors are you willing to adjust for in design and operation

- Specify Backstops
  - Eliminate trading out envelope improvements for renewables

DENVER'S HIGHLY EFFICIENT PERFORMANCE TARGETS

To determine the performance targets, an analysis was completed by building type and considered Denver's current building performance from Energize Denver data and the energy use intensity targets for each building type based on the maximum site efficiency using current technologies (without renewables). Denver also asked the NZE Stakeholder Advisory Groups to review the resulting predictive energy use intensity (pEUI) targets for buildings and energy rating index (ERI) targets for homes. Below are these targets based on the analysis for Denver by building type and code cycle.

Table 7. NZE 2027: Commercial pEUI Targets for Denver Code

Building Type	2021	2024	2027	2030 Performance Verification
Small Hotel	47	41	35	35
Large Hotel	68	61	54	54
Medium Office	26	24	21	21
Large Office	54	45	37	37
Standalone Retail	39	34	28	28
Warehouse	13	11	9	9

Table 8. NZE 2027: Multifamily pEUI Targets for Denver Code

Building Type	2021	2024	2027	2030 Performance Verification
Mid-Rise Apartment	35	29	23	23
High-Rise Apartment	38	33	29	29

Table 9. NZE 2024: Residential ERI Targets for Denver Code

Building Type	2021	2024
Single-family Homes	Max ERI = 50 & ERI w/PV = 40	Max ERI = 45 & ERI w/PV = 0

Other Building Types

Some buildings will have a design target predictive energy use intensity (pEUI) that ratchets down over time as detailed in the tables above. However, building types that do not lend themselves to a target EUI will model a baseline and a percent improvement over that baseline.

Table 10. Energy Savings Targets for Other Building Types

ASHRAE 90.1-2016	2021	2024	2027
% Savings Over Baseline	15%	30%	45%

This results in two modeling options:

1) pEUI targets for typically predictable building types. Developers can model to prove they meet the pEUI for those building types.
2) Alternately, projects can be modeled to a baseline and a percent better than baseline.

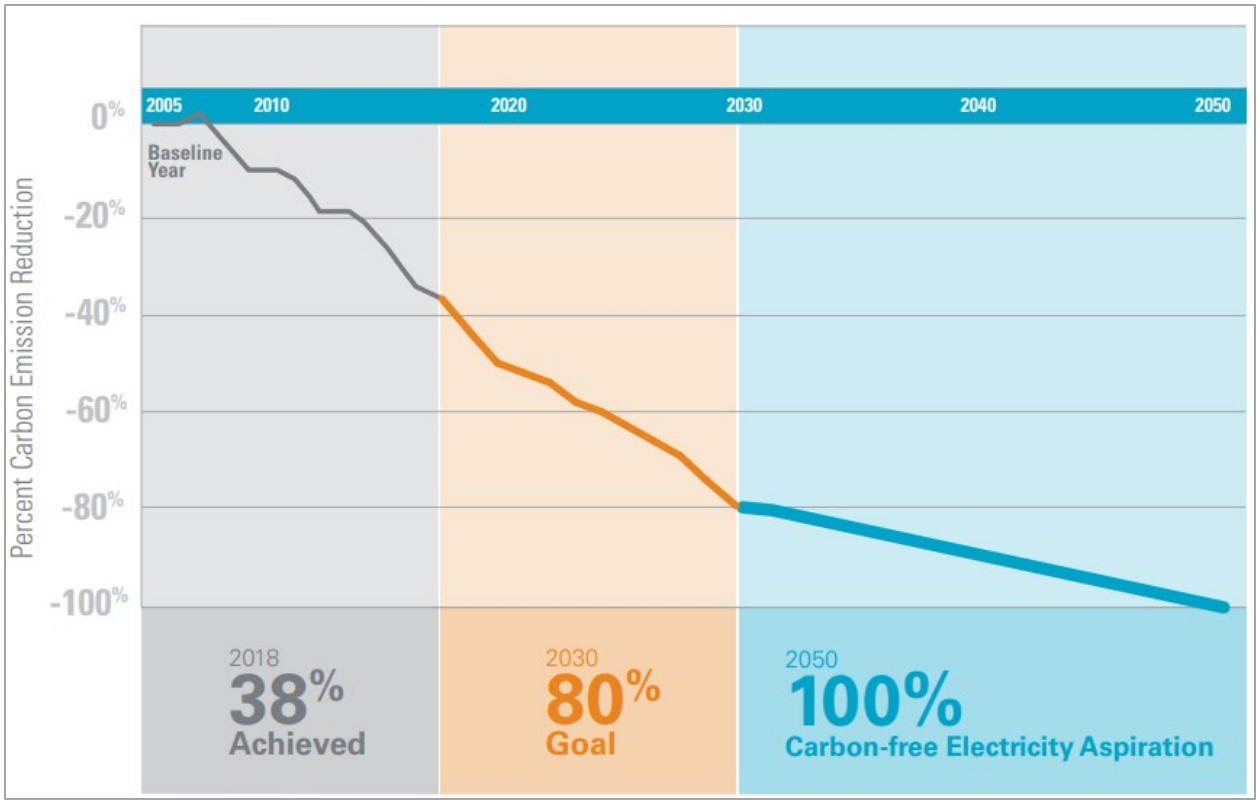
Setting performance targets by building type ensures that considerations are made for that building type and allow developers, owners, and design teams the flexibility to determine the most cost-effective way to meet the energy efficiency targets for a specific project. Additionally, because the performance and prescriptive paths in code will be aligned through modeling, this also allows multiple code paths for a building or home to comply with code.

All-Electric

All-electric is part of Denver's net zero definition and is important in getting to net zero energy in support of reducing emissions. The majority of the emissions from buildings and homes are due to space heating and water heating. Because 40% of buildings will be "new" in 2050, Denver's GHG emissions will be significantly reduced if these are net zero and all-electric. Denver is also working on a Beneficial Electrification Implementation Plan for Existing Buildings. This plan will address how to strategically electrify the existing buildings within Denver and is expected to be complete by the end of 2021.

"Mixed-fuel buildings" have utility connections for both electricity and natural gas, the two major energy fuel sources for buildings in the U.S. An all-electric building is a building whose only utility infrastructure is electricity and major energy systems are served by electricity. Electric loads can be directly offset with renewables, while gas combustion cannot. Therefore, as the supply for the electrical grid decarbonizes, all-electric buildings can leverage increasingly clean fuel sources to achieve long-term carbon reductions beyond what can be accomplished in mixed-fuel buildings.

In addition to addressing the onsite emissions from buildings and homes, another component to reducing emissions within Denver is addressing emissions from electricity generation. Xcel Energy, the electricity provider in Denver, has committed to reducing emissions from electricity generation by 80% in 2030 and 100% by 2050. Currently in Denver's building stock, electricity comprises 66% of building emissions and natural gas comprises 33% of the building emissions. As the grid is decarbonized so swiftly, in 2030 electricity will comprise only 40% of building emissions and natural gas will comprise 60% of the building emissions.



Source: Xcel Energy Carbon Report

Figure 4. Xcel Energy Carbon Reduction Trajectory: Clean Energy Transition 2030 and 2050

There are a number of considerations in getting to all-electric buildings. The first is if all-electric is technically feasible in Denver. This looks at the equipment needed for all-electric buildings and homes including equity considerations. Second, is if the market in Denver is ready for all-electric through interviews with stakeholders. The goal was to understand if all-electric equipment and expertise (installation) is available, the code and regulatory gaps and barriers, and supports needed (incentives, education, outreach, etc.). From this, the proposed all-electric targets are detailed. All-electric also connects buildings and transportation through electric vehicles. While Denver has a Denver Electric Vehicle (EV) Action Plan, the connection of these two is another consideration. Each of these all-electric considerations are detailed within the NZE Plan to determine the targets for all-electric as part of net zero energy in support of net zero emissions.

DENVER'S ALL-ELECTRIC TARGETS

The all-electric targets for each code cycle are in the tables below. These were reviewed by the NZE Stakeholder Advisory Groups. The discussion about all-electric targets determined that system type should be the basis of consideration for commercial buildings. In addition, Denver is considering how best to define "all-electric ready" to ensure that requirements are helpful for buildings and homes that convert from gas to electricity in the future and that these consider cost implications.

Table 11. Commercial Building All-Electric Targets for Denver Code

Building Type	2021	2024	2027
Small Hotel	All-Electric: *except heating & water heating* All-Electric Ready: *conduit for central systems & panel space*	All-Electric: *except water heating*	All-Electric
Large Hotel			
Medium Office			
Large Office			
Standalone Retail			
Warehouse			

Table 12. Multifamily Building All-Electric Requirements for Denver Code

Building Type	2021	2024	2027
3-story townhome & Low-Rise Apartment	Required	Required	Required
Mid-Rise Apartment (R-2: 4-7 stories)	All-Electric Ready: *conduit & panel space*	Required	Required
High-Rise Apartment (R-2: 8 or more stories)	All-Electric Ready: *conduit & panel space*	All-Electric Ready: *conduit & panel space*	Required

Table 13. Residential Home All-Electric Targets for Denver Code

Building Type	2021	2024
Single-family Homes	All-Electric Ready: conduit & panel space	Required

In addition to emissions reductions, there are a number of co-benefits from building all-electric including efficiency, health, and cost savings. While energy efficiency is a separate foundation within this report, it is important to note that when transitioning from gas to electric heating (both space and water), heat pumps are significantly (200-300%+) more efficient than gas equipment. As a result, there are operational cost benefits from this energy savings.

Cooking is another common end use for natural gas. When cooking with electric stoves, especially induction stoves, there not only are emissions benefits but significant improvements to indoor air quality. As detailed in the study Health Effects from Gas Stove Pollution, a meta study looking at the association between gas stoves and childhood asthma found children in homes with gas stoves have a:

- 42% increased risk of experiencing asthma symptoms (current asthma),
- 24% increased risk of ever being diagnosed with asthma by a doctor (lifetime asthma), and
- 32% increased risk of both current and lifetime asthma overall.

There are additional benefits from induction including energy efficiency and safety through reduced burns and lower risk of fire.

Finally, there is a cost benefit (savings) from constructing an all-electric building. When gas is removed entirely from a building there is a significant cost savings from eliminating the need for gas distribution as well as gas supply to the building. The cost benefits are further detailed below in the "Cost Considerations and Study: All Electric" section.

Powered by Renewable Energy and Electricity

The third NZE foundation within Denver's net zero energy definition is that new buildings and homes will be powered by renewable energy and electricity. Once buildings and homes are highly energy efficient and all-electric, they will be fully powered from on-site and/or off-site renewable energy.

Denver's 100% Renewable Electricity Action Plan details that by 2030 renewable electricity will offset 100% of new building energy use for buildings permitted under the code. Code will require increasing minimum levels of renewable electricity in the code cycles leading up to 2030. Additionally, by 2050, the electric grid will be 100% renewable and buildings are part of this equation.

It is important to make sure that renewables are not used to offset basic building performance to a significant degree because a wide range of energy efficiency strategies remain less expensive to deploy at the building level than renewable energy. Indeed, energy efficiency and demand management will make the 100% renewable electricity goal more feasible and cost-effective for buildings. Powering 100% of building operations with renewable power is made more achievable if the building lowers its electricity demand through energy efficiency. For this reason, see the 'backstop code' for which renewable deployment cannot offset basic building performance.

Net zero energy building guidelines in other jurisdictions or states, such as California, say that renewable electricity may only count towards compliance if the building owner retains the Renewable Energy Credits, or RECs, for that renewable electricity. Denver's guidelines differ by prioritizing the addition of new renewable electricity capacity onto the electrical grid beyond what would have been developed otherwise (i.e., "additive RECs"). This is inclusive of renewable energy options, such as Solar*Rewards, in which additive RECs are generated, transferred to and retired by Xcel Energy towards system-wide decarbonization. Whether additive RECs are retired by the utility on behalf of all customers or by individual customers within the system, there is the same net effect on the total renewable content of the overall system. This methodology ensures that local investments in rooftop solar and community solar gardens (CSG) are not inadvertently discounted and discouraged simply because Xcel Energy retains and retires the REC's associated with them.

Denver's renewable vision is to enable a rapid and equitable transition to a 100% renewable electric system in Colorado. By 2030, 100% of Denver's community-wide electricity use will contribute to this vision. The 2030 goal for Denver's electricity use to "contribute to" a 100% renewable electric system is unique compared to goals to be "powered by" 100% renewable electricity. This is in part due to the recognition that Denver is a part of a larger electric system operated by Xcel Energy in Colorado. Denver cannot be powered by 100% renewable electricity until the entire system is powered by 100% renewable electricity.

DENVER'S RENEWABLE ENERGY TARGETS

As part of this NZE Plan, Denver asked the NZE Stakeholder Advisory Groups to review the renewable energy goals and targets for buildings and homes to determine the recommendation for upcoming code cycles shown in the table below.

Table 14. Commercial and Multifamily Building Renewable Energy Targets for Denver Code

	2021	2024	2027	2030
Minimum renewable offset	50%	75%	100%	100%
Minimum % Roof Area	25%	50%	70%	70%

This recommendation includes both a minimum renewable offset that can be met by on-site or off-site solar in order to equitably require solar for varying building types and shapes. Additionally, there is a minimum percentage roof area for on-site solar to encourage on site production.

For residential, the table in the highly efficient section combines efficiency and on-site solar. For this reason, there is not a minimum percent roof area envisioned. However, there is still a minimum renewable offset as detailed in the table below.

Table 15. Residential Home Renewable Energy Targets for Denver Code

	2021	2024	2027	2030
Minimum renewable offset	50%	75%	100%	100%

In addition, based on the NZE Stakeholder Advisory Groups meetings, the renewables for all building types (commercial, multifamily, and residential):

a. Offset total building energy use including natural gas
b. Can be met by creating new solar capacity in Denver by either:
    i. Installing on-site solar
    ii. Paying into a Renewable Denver Community Solar Fund (where the city will build community solar gardens)

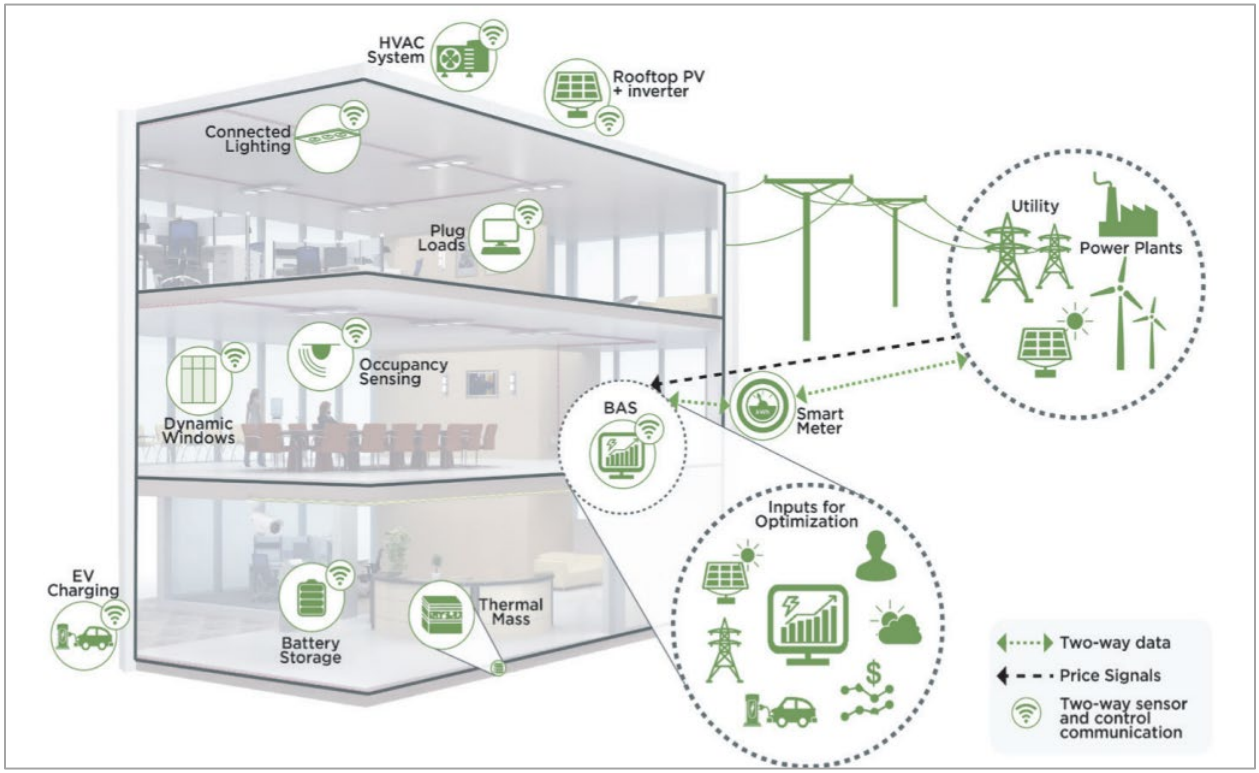
RENEWABLE DENVER COMMUNITY SOLAR FUND

To ensure that all buildings and homes are able to meet the renewables requirement, Denver is currently working to develop a fund – the Renewable Denver Community Solar Fund – that will build community solar gardens. As with any fund, Denver will perform a rate study. The in-lieu rate must be rationally related to the overall cost for the City to provide an equivalent benefit.

Providers of Demand Flexibility for the Grid

The fourth NZE foundation within Denver's net zero energy definition is that new buildings and homes will be providers of demand flexibility for the grid. This includes energy storage, grid integration, and the flexibly to respond to grid signals. There is not a specific climate goal within the 80x50 Climate Action Plan for grid flexibility, however this will be needed as buildings and homes are increasingly all-electric.

In order to electrify everything – our buildings, homes, and vehicles – and then power all those end uses with 100% renewable electricity, we must have systems both to add flexibility to electricity consumption as well as store electricity. New buildings become existing buildings and so need to have grid flexible capabilities installed up front. The following graphic shows ways a building might provide grid flexibility and storage for the grid.



Source: Navigant Consulting

Figure 5. Grid Flexibility and Storage Methods for Buildings

Successful grid flexibility and storage capabilities require both the building and homes as well as third party demand response (DR) aggregators, the grid, and the utility to work together. Buildings and homes must have infrastructure such as water heaters, air conditioning, and HVAC and lighting controls, capable of receiving DR requests or responding to price signals from the utility and implementing load adjustments. The utility must offer demand response programs or structure their pricing to compensate customers when they provide services to the grid.

Denver has current building code requirements for storage, EVs and grid-flexible equipment (demand response – DR capable). Denver's 2019 IECC required that all buildings be battery storage ready. Denver's 2019 IECC also requires the installation of electric vehicle (EV) charging stations – and electric vehicles may play a role in providing grid flexibility in the future. See the EV section of this NZE Plan for details. Finally, Denver's voluntary 2019 Denver Green Code requires that building controls are designed with demand response infrastructure capable of receiving request from the utility for adjustments to:

- HVAC system setpoints
- Variable-speed equipment speed adjustments

- Lighting power demand adjustments

Denver will build upon this foundation to increase the grid flexibility of buildings in Denver over the upcoming code cycles in 2021, 2024, 2027 and 2030.

DENVER'S GRID FLEXIBLE TARGETS

As part of this NZE Plan, Denver asked the NZE Stakeholder Advisory Groups to review grid flexible goals and targets for buildings and homes to determine the recommendation for upcoming code cycles as shown in the table below.

Table 16. Building and Home Grid Flexible Requirements for Denver Code

	2021	2024	2027
All Buildings & Homes	Grid Flexible Equipment	Implementation of Grid Flexible Metric	Improving Grid Flexibility + Increased Storage

Ultimately Denver will work to require grid flexibility in all new buildings when the utility offers programs and rate structures that compensate building owners effectively for the services buildings provide to the grid with these measures.

Technology Adoption

Both the NZE Stakeholder Advisory Groups meetings discussions and the stakeholder interviews indicated that technology is not a particular issue for net zero energy, all-electric buildings and homes. Many of the distributors provide products nationally and have, or could have, efficient equipment available in Denver. However, there is a cost consideration as newer products typically cost more, and the cost decreases as these products are used and installed more frequently.

Building Code/Policy Updates

Ultimately, the targets in this NZE Plan will have to go through each Denver Code Adoption process to be incorporated into the Denver Building and Fire Code. Denver plans to align our code updates with national code updates which are updated every three years and would include 2021, 2024, 2027, and 2030. Denver is committed to ensuring that each of our code adoption processes are open and inclusive.

Denver's code adoption process follows the I-code development process. Key components of Denver's Code Adoption Process are requesting amendment proposals from the public and balanced-interest Code Committees that review and decide upon each proposal. A summary of each Code Committees' decision on each amendment proposal and Committee modification of an approved amendment proposal, if any, will be posted on Denvergov.org.

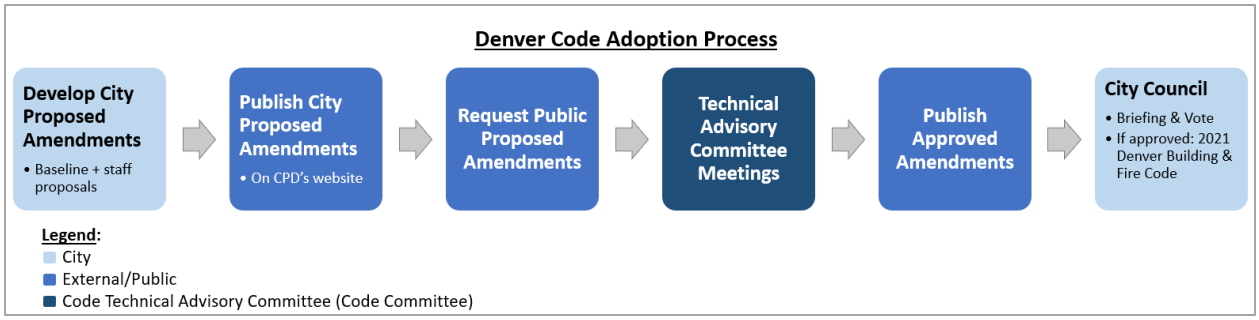


Figure 6. Denver Code Adoption Process

How It All Comes Together

It is critical that all components come together, so planning has been thorough to ensure the application of zoning and supports to reach net zero energy by 2030 with highly efficient, all-electric, renewable energy and electricity, and grid flexibility in mind. Components of the code will need to evolve over the next code cycles to meet Denver's Climate Goals and Recommendations and ensure that buildings perform as designed. This comes together in a timeline for commercial code and residential code that was reviewed and discussed through the NZE Stakeholder Advisory Groups process.

The table below indicates the timeline of each code element through the individual code cycles, and the potential relationship of these transitions to each other through the various code cycles for commercial buildings and residential homes.

Table 17. Denver's Commercial Buildings Code Timeline

Commercial	2021	2024	2027	2030
HIGHLY EFFICIENT				
Prescriptive Path	Add renewables	Add renewables	Small /Remodel Projects only	Small /Remodel Projects only
Performance Target	Meet EUI targets by type & year	Meet EUI targets by type & year	Meet EUI targets by type & year	Meet EUI targets by type & year
Energy Modeling Accuracy	Report on discrepancy in disclosure data	Within 15% of target	Within 10% of target	Achieve Target
Energy Modeling Normalization	Report on discrepancy	Document use changes in model	Document use changes in model	Document use changes in model
Energy Modeling Unregulated Loads	Some flexibility w/ pre- approval	Flexible w/ pre-approval	Flexible	Flexible
Efficiency Backstop	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs
Performance Verification Enforcement	Certificate of Occupancy, Disclosure	Disclosure; Bond or Solar Credit	Disclosure; Bond or Solar Credit	Bond or Solar Credit
ALL-ELECTRIC				
Equipment requirement	All-Electric: *except heating & water heating* All-Electric Ready: *conduit for central*	All-Electric: *except water heating*	All-electric equipment	All-electric equipment
RENEWABLE ENERGY				
Minimum renewable offset	50%	75%	100%	100%
Minimum % Roof Area	25%	50%	70%	70%
GRID FLEXIBLITY				
Grid flexibility requirement	Grid Flexible Equipment	Implementation of Grid Flexible Metric	Improving Grid Flexibility + Increased Storage	Improving Grid Flexibility + Increased Storage

Table 18. Denver's Multifamily Buildings Code Timeline

Multifamily	2021	2024	2027	2030
HIGHLY EFFICIENT				
Prescriptive Path	Add renewables	Add renewables	Small /Remodel Projects only	Small /Remodel Projects only
Performance Target	Meet EUI targets by type & year	Meet EUI targets by type & year	Meet EUI targets by type & year	Meet EUI targets by type & year
Energy Modeling Accuracy	Report on discrepancy in disclosure data	Within 15% of target	Within 10% of target	Achieve Target
Energy Modeling Normalization	Report on discrepancy	Document use changes in model	Document use changes in model	Document use changes in model
Energy Modeling Unregulated Loads	Some flexibility w/ pre- approval	Flexible w/ pre-approval	Flexible	Flexible
Efficiency Backstop	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs
Performance Verification Enforcement	Certificate of Occupancy, Disclosure	Disclosure; Bond or Solar Credit	Disclosure; Bond or Solar Credit	Bond or Solar Credit
ALL-ELECTRIC				
3-story townhome & Low-Rise Apartment	All-electric equipment	All-electric equipment	All-electric equipment	All-electric equipment
Mid-Rise Apartment (R-2: 4-7 stories)	All-Electric Ready: *conduit & panel space*	All-electric equipment	All-electric equipment	All-electric equipment
High-Rise Apartment (R-2: 8 or more stories)	All-Electric Ready: *conduit & panel space*	All-Electric Ready: *conduit & panel space*	All-electric equipment	All-electric equipment
RENEWABLE ENERGY				
Minimum renewable offset	50%	75%	100%	100%
Minimum % Roof Area	25%	50%	70%	70%
GRID FLEXIBLITY				
Grid flexibility requirement	Grid Flexible Equipment	Implementation of Grid Flexible Metric	Improving Grid Flexibility + Increased Storage	Improving Grid Flexibility + Increased Storage

Table 19. Denver's Residential Homes Code Timeline

Residential	2021	2024	2027	2030
HIGHLY EFFICIENT				
Prescriptive Path	Add renewables	Add renewables	Add renewables	Add renewables
Performance Target	Meet ERI targets by size & year	Meet ERI targets by size & year	Meet ERI targets by size & year	Meet ERI targets by size & year
ALL-ELECTRIC				
Equipment requirement	All-Electric Ready: *conduit & panel space*	All-electric equipment	All-electric equipment	All-electric equipment
RENEWABLE ENERGY				
Minimum renewable offset	50%	75%	100%	100%
Energy Rating Index (ERI)	Max ERI = 50, & ERI w/PV = 40	Max ERI = 45, & ERI w/PV = 0	Max ERI = 45, & ERI w/PV = 0	Max ERI = 45, & ERI w/PV = 0
GRID FLEXIBLITY				
Grid flexibility requirement	Grid Flexible Equipment	Implementation of Grid Flexible Metric	Improving Grid Flexibility + Increased Storage	Improving Grid Flexibility + Increased Storage

Preparing for the 2021 Code Cycle

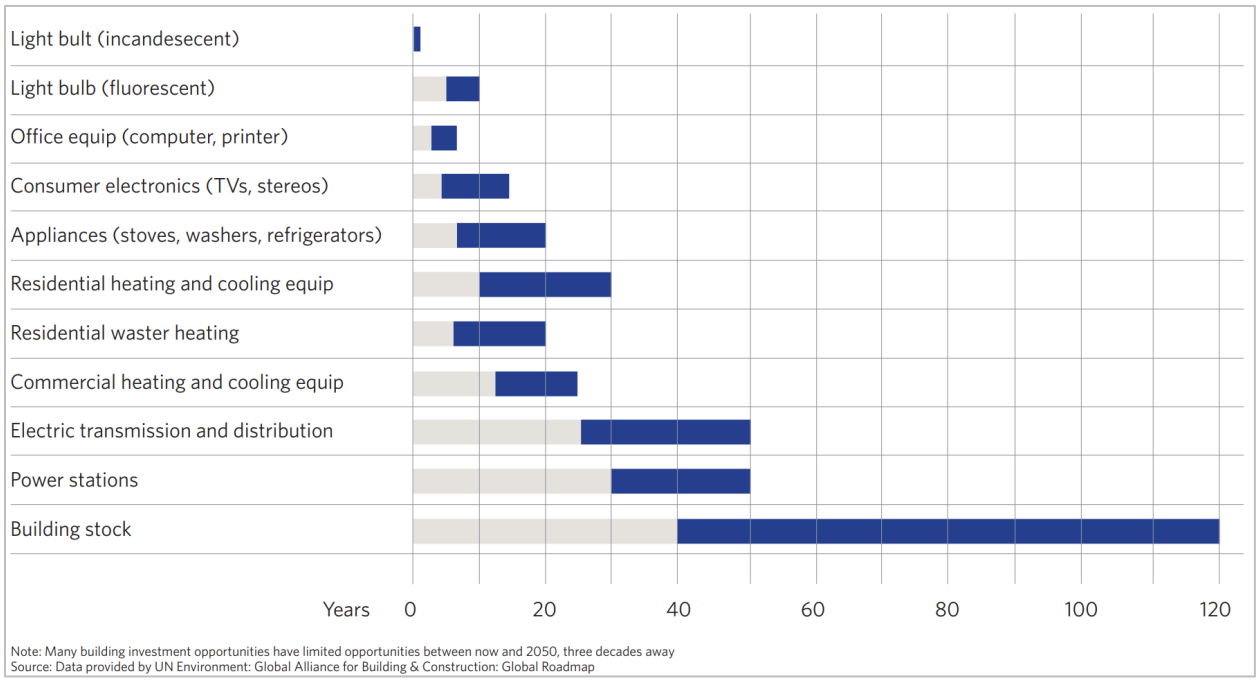
As a next step, Denver is working with New Buildings Institute (NBI) to develop draft code proposals based on the 2021 IECC that meet the goals, targets, and milestones within this NZE Plan. Denver plans to have preliminary meetings to begin gathering feedback in early 2021.

Reducing Emissions: Carbon Considerations

Although this NZE Plan is focused on energy, all four foundations have implications for the carbon emissions of Denver's building stock. Denver is working with New Buildings Institute (NBI) to understand how the goals of each NZE foundation impact Denver's carbon emissions. While energy will remain the metric for this NZE Plan, the carbon impact of the four NZE foundations will continue to be used to inform the implementation of NZE in Denver over the upcoming code cycles. This is an ambitious yet achievable plan to reach net zero energy in support of reducing carbon emissions in Denver.

NZE: HIGHLY ENERGY EFFICIENT

The first foundation of Denver's net zero energy (NZE) definition is that new buildings and homes will be highly efficient. Energy efficiency is the step that makes all of the foundations more cost effective. Energy efficiency is the first foundation of NZE to ensure that buildings and homes are increasingly energy efficient and saving energy on-site prior to considering renewables. This is also important when looking at the lifespan of the building or home as shown in the figure below.



Source: Climate Bonds Initiative

Figure 7. Typical Lifetimes for Buildings and Equipment

Denver is on a path to net zero energy for all new buildings and homes. In addition, for new buildings, Denver wants the buildings to perform as designed.

Goal

Highly energy efficient buildings and homes will be achieved through the code adoption process to reach the goal of net zero energy buildings and homes by 2030. In addition, this NZE Plan includes the milestones for new homes to be net zero and all-electric by 2024 and new buildings to be net zero and all-electric by 2027 as recommended by the Climate Action Task Force.

Table 20. NZE by 2030 Goals and Milestones

Code Cycle	NZE by 2030 Milestones
2021	2019 Denver Green Code becomes base code
2024	New Buildings: All-electric
	New Homes: Net zero
2027	New Buildings: Net zero
2030	New Buildings: Performance verification (*outcome-based*) codes for new buildings to perform as designed
Denver's Goal of Net Zero New Buildings & Homes by 2030	

The 2019 Denver Energy Code is based on the 2018 edition of the International Energy Conservation Code (IECC). The IECC is a national model energy code developed by the International Code Council. During the 2019 code adoption process, Denver made multiple modifications to the 2018 IECC in order to more closely align it with the progress needed to meet Denver's climate goals. As a result, the commercial section of the 2019 Denver Energy Code is estimated to be about 15% more stringent than the 2018 IECC, and the residential section is about 10% more efficient. The 2021 IECC is estimated to be approximately 7% to 12% better than the 2018 IECC for commercial buildings depending on building type and 10% better for residential buildings. However, much of these savings are due to proposals that have already been adopted in the 2019 Denver Energy Code. As a result, future advancements in the Denver Energy Code will need to go beyond the 2021 IECC in order to stay on pace to zero.

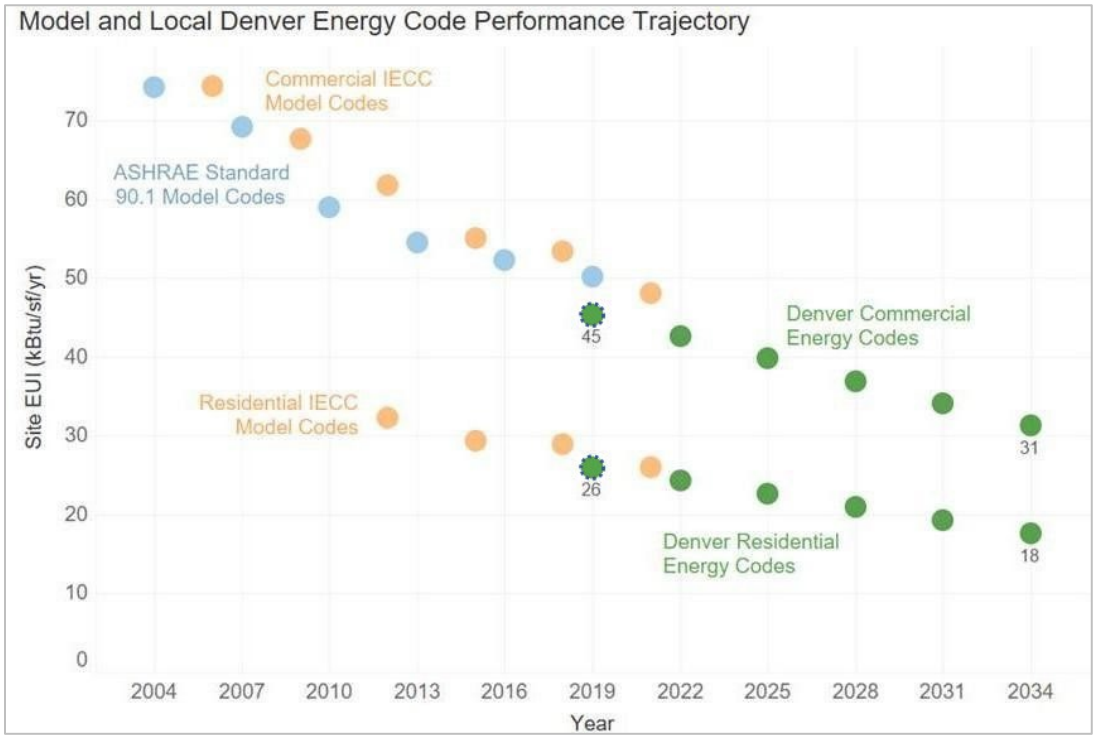


Figure 8. IECC, ASHRAE 90.1 and Denver Code Progression Over Time

NZE Foundation: Highly Energy Efficient

Energy efficiency for new buildings will be incorporated into future codes through Denver's Code Adoption Process and will be detailed in the IECC. In addition, there are a number of considerations needed in order to achieve buildings that perform as designed. The first consideration is the prescriptive and performance paths as well as the calibration needed to keep the paths aligned. Ultimately, the methodology for getting to buildings that perform as designed is to develop performance targets, detail performance verification, refine energy modeling and specify backstops. Additional considerations for achieving buildings that are highly energy efficient include energy code enforcement, cost considerations, technology adoption and building code/policy updates. The following sections detail each of these considerations.

Like most energy codes, the Denver Energy Code (based on the IECC) includes options to comply with the code with either prescriptive or performance approaches. Prescriptive compliance paths are composed of a series of specific requirements for building components that a project must meet to comply with the code. Performance compliance paths allow computer energy modeling to demonstrate that the project complies with the code. In order to meet Denver's goal of highly efficient buildings, the Denver Energy Code will need to increasingly focus on performance. This entails both a greater utilization of performance-based compliance paths and a sharper focus on the actual performance of buildings through performance verification. Additionally, Denver needs to include calibration as part of the Code Adoption Process to ensure that paths are relatively equivalent for each energy code. Ultimately for Denver, code compliance will need to become an outcome-based approach where buildings will have to perform as designed when practical for that building type.

Denver's IECC Prescriptive Path

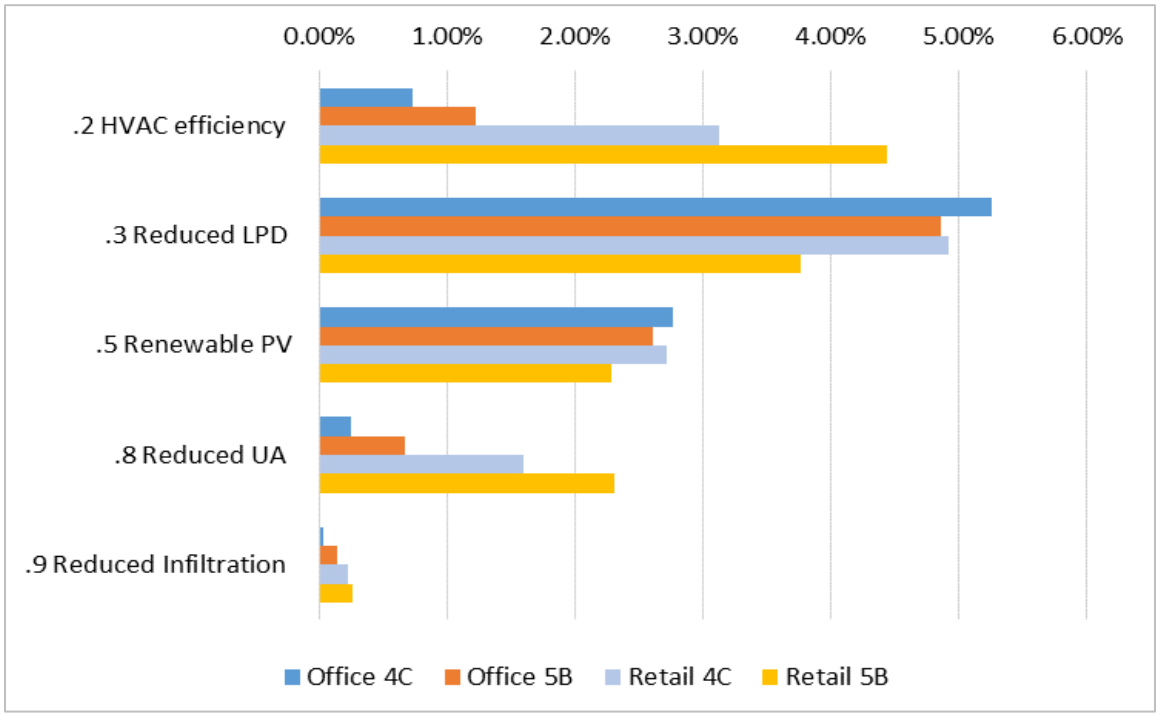
The long-term viability of the prescriptive path is something that Denver will need to assess in each code adoption cycle. The prescriptive path is inherently more limited in the levels of performance that it can deliver compared to modeling-based approaches. However, it can be helpful for small projects and/or alterations. Advances in stringency in future versions of Denver's prescriptive path will come from two sources: advancements in the IECC model code itself and Denver-specific modifications made to that model code to meet Denver's climate goals.

In both the residential and commercial sections of the energy code, the advancement of the prescriptive compliance paths will require the greater leverage of points-based approaches. Points-based approaches allow prescriptive paths to achieve higher levels of stringency while maximizing flexibility. Many energy efficiency strategies and technologies can save significant energy but may not save that energy in all climates or for all building types and so would not be appropriate as a universal prescriptive requirement. In a points-based approach, various energy efficiency strategies are assigned points based on their potential energy savings. The code then requires a minimum number of points, and project teams choose the points options that best fit their projects.

NEW BUILDINGS – COMMERCIAL IECC PRESCRIPTIVE PATH

In the 2021 edition of the IECC, a new points-based additional efficiency requirement was introduced to replace the older additional efficiency package requirement in Section C406. This section was introduced

into the 2012 IECC commercial code in an effort to make the prescriptive path more flexible and able to deliver greater savings without energy modeling. The reason for updating from a package to a points approach in Section C406 is that different packages can deliver different levels of savings in any particular building type or climate zone. In 2018, the Pacific Northwest National Lab (PNNL) analyzed the eight options in C406[21] and found that the savings could range from very little actual savings to over 5% savings on an energy cost basis as shown in Figure 9.



Source: PNNL

Figure 9. Variation in Building Cost Savings for C406 Options

The 2021 edition of the IECC remedies this issue of unequal savings for the various options across building types and climate zones. The new section C406 transitions away from a "pick one" options approach. Instead, it assigns points to each option for a particular building type and climate zone. Based on the PNNL technical analysis, each point is worth 0.25% savings, and the 2021 IECC requires teams to choose one or more options that amount to ten points total (or a 2.5% savings).

[1] www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370rev.1.pdf

Table 21. Points Values of the C406 Options from IECC-2021 for Denver

Building Type	Group B	Groups R & I	Group E	Group M	All Other
C406.2.1: 5% Heating Equipment Efficiency Improvement	1	1	1	2	1
C406.2.2: 5% Cooling Equipment Efficiency Improvement	2	1	1	1	1
C406.2.3: 10% Heating Equipment Efficiency Improvement	2	2	3	3	3
C406.2.4: 10% Cooling Equipment Efficiency Improvement	4	1	2	2	2
C406.3.1: 10% Lighting Power Allowance	7	2	8	12	7
C406.4: Digital Lighting Control	2	NA	2	NA	2
C406.5: Renewable	9	7	6	7	7
C406.6: Dedicated Outside Air System	5	8	NA	2	5
C406.7.1: Solar Water Heating Heat Recovery	NA	14	1	NA	14
C406.7.2: Solar Water Heating Natural Gas Efficiency	NA	9	2	NA	9
C406.7.3: Solar Water Heating Heat Pump	NA	5	1	NA	5
C406.8: 85% Weighted-Average U-factor	10	4	2	4	5
C406.9: Low Leakage Building	11	9	1	3	6
Total available points (without renewable energy)	44	56	47	36	60

The 2021 IECC commercial section C406 points option has several advantages for Denver. The first is simplicity of the mechanism for jurisdictions seeking greater energy savings, such as Denver, to easily require more savings. After adopting 2021 IECC, Denver simply can improve the stringency of the prescriptive path by changing the points target in Section C406. Knowing that each point is worth 0.25% savings, it becomes easy to calibrate the points to a particular savings target for the code cycle.

Another major advantage of this approach is that it will not require significant changes to the base model code, only a change in the number of required C406 points. This effectively limits the need to duplicate the intense stakeholder effort conducted to modify the 2018 IECC model code for local use in Denver. Instead of an extensive and time-consuming process of proposal development; stakeholder engagement; code committee meetings; and proposal vetting, debate and revision; the City can focus stakeholder engagement on the question of the most appropriate level of performance for the code cycle and adjust the points required accordingly.

A third advantage to leveraging the points approach is that it maximizes consistency between Denver's code requirements and the codes in neighboring communities and other markets. Changing the C406 points target leaves the rest of the code aligned with the model code. The base lighting power densities, base insulation requirements, and window requirements all remain the same. This creates a greater level of consistency for designers and builders who work in multiple jurisdictions. The consistency not only will help with market acceptance, it should also improve code enforcement.

Finally, using section C406 means that only minimal changes will be necessary to modify the COMCheck code compliance tool. Denver's 2019 Energy Code required fairly extensive modifications to COMCheck, delaying its availability for use in Denver. And while the U.S. Department of Energy is committed to helping jurisdictions modify the tools to respond to local conditions, future funding availability is uncertain with more jurisdictions going beyond code to meet their own energy and climate goals. Therefore, restricting changes to just the number of points in section C406 means that fewer changes

would be needed for COMCheck, and it may even be possible to use it unaltered with just a simple addendum form.

Implementing the points approach in Denver is a relatively simple matter since it is already built into Section C406 in the 2021 IECC.

NEW HOMES – RESIDENTIAL IECC PRESCRIPTIVE PATH

For residential, the IECC-2021 has a package approach and the 2019 Denver Energy Code included a very similar package options approach in Section R407. Through requiring additional packages, this approach may be able to provide the savings required for the next code cycle. Additionally, the packages will help pave the way for a points approach in future code cycles just as it did in the commercial code.

Multiple points options were proposed for the 2021 IECC. These ICC proposed code amendments did not move forward nationally due to political and market issues (rather than technical issues). However, as mentioned above in the discussion of the commercial points option, **the residential code ultimately will need to transition from the package options to a points option which will achieve the net zero goal, streamline additions to the prescriptive path, and address consistency.**

THE FUTURE OF THE PRESCRIPTIVE PATH IN DENVER

Although meeting Denver's goals for highly efficient buildings will require an increasing shift to the performance approach, the prescriptive approach will play an important role in Denver in both the short and long term. The prescriptive path will be valuable for small projects and alterations, even if Denver reaches a point where it is no longer viable for new construction projects, at which time the prescriptive path may need to be tailored for alteration projects on existing buildings.

The main body of the code will continue to advance, and it is likely that additional points options will continue to be added, extending the viability of the prescriptive path. Denver will need to invest in the development of additional points options to achieve this extended viability.

Some possible additional options could leverage even higher performance HVAC or water-heating equipment, natural ventilation, passive approaches (e.g. passive solar heating), or the selection of inherently more efficient HVAC distribution systems such as ductless heat pumps. Since the options deliver different levels of savings for different building types, the prescriptive path may remain a viable compliance option for some building types longer than for others. As the Denver Energy Code becomes increasingly stringent in future code cycles, the prescriptive path may become too restrictive for many projects, effectively requiring projects to choose the modeled performance-based path.

Path Calibration

Path calibration will ensure that the prescriptive path is delivering the same performance as the modeled performance path. Denver will need to calibrate the prescriptive path to performance targets (and vice versa) each code cycle as it did with the 2019 Denver Energy Code, which is estimated to be about 15% more stringent than the 2018 IECC.

The stringency of the 2021 IECC has been estimated to be at least 10% better than the 2018 edition and the points currently available would allow it to achieve another 7-13% efficiency above that (without counting renewable energy production toward compliance). **Moving forward, part of the calibration**

process for each code cycle will need to include an assessment of whether the prescriptive path can deliver the level of savings required to meet the code performance goal for that code cycle. The performance targets to which the prescriptive requirement will need to be calibrated are discussed in the section "Energy Performance Targets for Denver."

From Prescriptive to Performance

As the Denver Energy Code becomes increasingly stringent in future code cycles, the prescriptive path may become too restrictive for many projects, effectively requiring projects to choose the modeled performance-based path. The future of the prescriptive path also will need to accommodate additional considerations such as electrification and grid integration – not just energy efficiency – as Denver works toward its 2030 goals. Denver's goals will make the performance path increasingly the most cost-effective compliance path.

- The cost of modeling will decrease as modelers and designers gain more experience with modeling, and more modelers enter the market to meet demand.
- The performance path allows buildings to gain savings from strategies that cannot be codified in the prescriptive path.
- The performance path provides flexibility for projects to pursue the most cost-effective strategies for their particular design.

Denver's IECC Performance Path

One of the biggest advantages of performance-based code compliance paths – such as the modeling path in the energy code – is the flexibility they provide. Prescriptive compliance paths are clear and straightforward, but they also have a limited flexibility that in turn limits their ability to deliver higher levels of efficiency. In a performance-based path, modeling tradeoffs can be made between different building elements in order to achieve the whole-building goal.

The future of Denver's performance path lies on the path to net zero as shown in the charts below. The Energy Use (vertical axis) uses the Zero Energy Performance Index (zEPI) as an indication of how buildings are performing in relation to net zero energy goals.

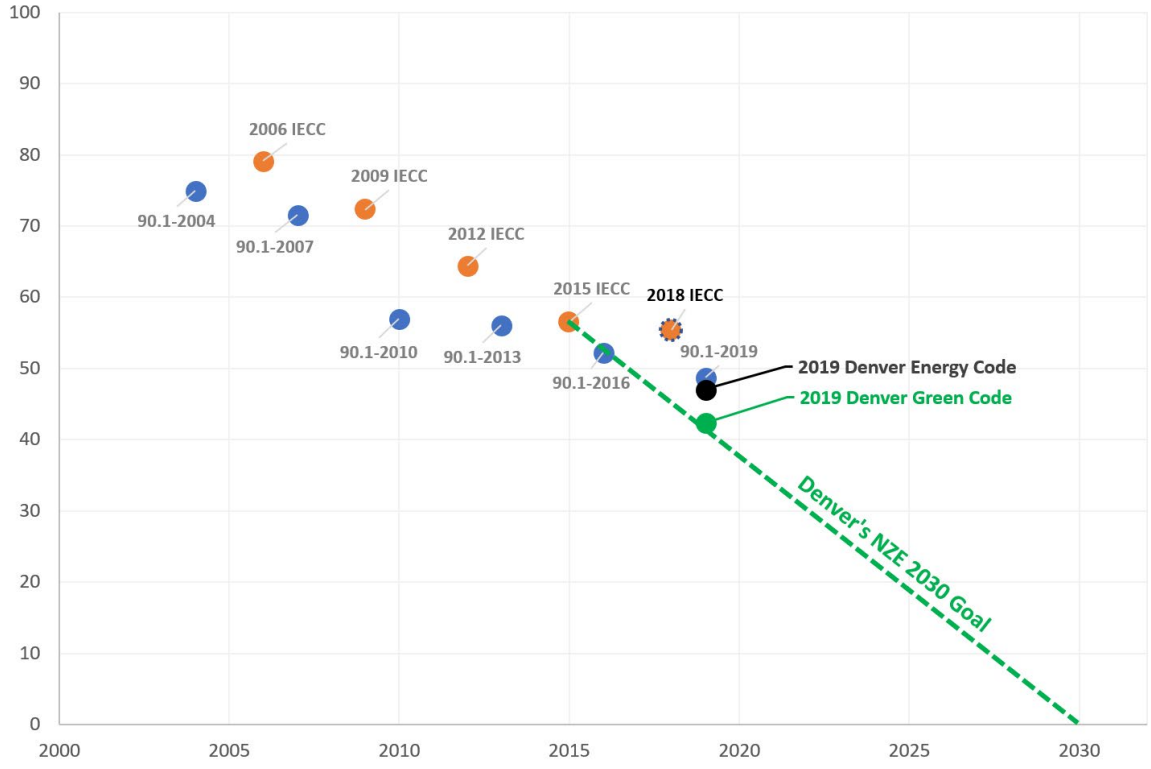


Figure 10. Denver's Path to Net Zero Energy – Commercial

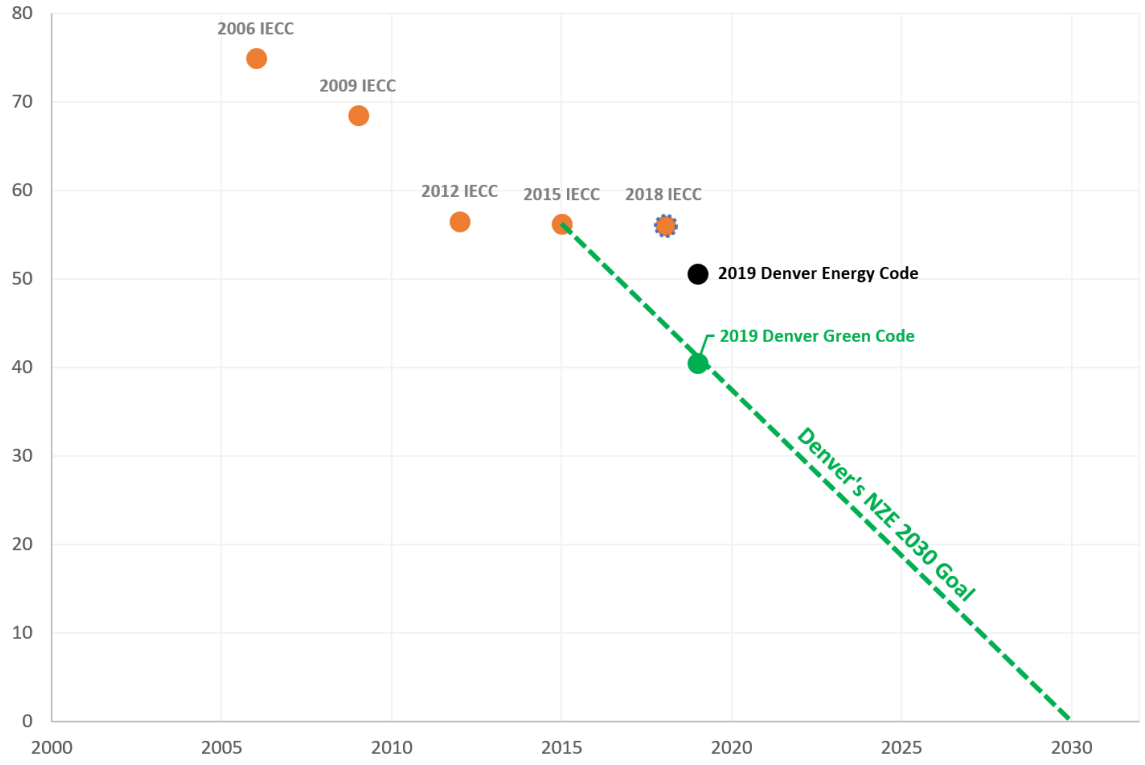


Figure 11. Denver's Path to Net Zero Energy – Residential

ENERGY PERFORMANCE TARGETS IN CODE

The inclusion of energy targets into energy codes and building policies represents a significant departure from the approaches applied by current model energy codes and standards as developed and published by the International Code Council (ICC) and ASHRAE. Leveraging the building performance energy modeling approach shifts the focus from prescribing component-level efficiency to whole building performance.

Incorporating energy targets into the modeling process is an essential step in bridging the gap between code compliance and actual measured energy performance in buildings. Modeling targets provides information about how a code-compliant building could be expected to perform in actual operation. The comparison of code targets to actual performance will inform building owners about potential problems, practitioners about the effectiveness and accuracy of their designs, and regulators about how well buildings are meeting code and policy goals.

Recently, performance targets have started to appear in energy codes, including the 2020 City of Boulder Energy Conservation Code, the 2015 Seattle Energy Code, and the 2018 British Columbia Energy Step Code. The jurisdictions that have taken steps to incorporate energy performance targets into their local adopted energy codes have typically done so by developing a project submittal and verification methodology that is applied as an alternative compliance pathway. In addition, some have established code roadmaps or plans that outline transitions over multiple code cycles from modeled predictions of energy targets to eventual verification of building energy consumption with actual performance data.

Denver's ultimate goal for the performance path is to reach performance verification codes so buildings will have to perform as designed where practical for that building type. Additionally, the Climate Action Task Force recommended that Denver move to outcome-based (performance verification) codes. As a framework, Denver needs to develop and address the following:

- Develop Performance Targets
    - Develop and set performance targets by building type
    - Highly efficient – pEUI targets
    - Address other building types
    - Use EUI targets
- Detail Performance Verification
    - Develop and implement policies for buildings to perform as designed
- Refine Energy Modeling
    - Streamline modeling paths – streamline energy modeling paths within code
    - Address modeling accuracy – increase focus on predictive accuracy through guidelines
    - Predictive modeling – go from comparative to predictive energy modeling
    - Modeling unregulated loads – incentivize improvements without a loophole
    - Modeling normalization – factors to adjust for in design and operation
- Specify Backstops
    - Eliminate trading out envelope improvements for renewables

Each of these items is detailed in the following section. Additionally, energy modeling enforcement plays a critical role in ensuring that buildings perform as designed.

Energy Performance Targets for Denver (by building type)

The development of energy performance targets focuses on the identification of potential targets for certain commercial building types in Denver and the incremental improvement that would be necessary in each code cycle to get to those targets by 2030. The first step is to determine EUI targets (Max Tech EUI) for Denver to place "book ends" on the code by defining where we are starting and where we are going with regard to energy performance targets by building type.

Energy Target Methodology

The research methodology used to generate energy targets utilizes multiple sources of data about building performance. These include specific data about the performance of Denver's existing building stock, determination studies about existing codes, multiple studies that assess the performance levels required to achieve zero net energy, and research into the maximum performance potential of existing technologies. This information is used to inform energy performance target setting in Denver by establishing "book ends" of how buildings are performing now, and how they will need to perform in order to meet the net zero goal in 2035 detailed in Denver's 80x50 Climate Action Plan as a first step. Then this data was used to align with the Climate Action Task Force recommendations to be net zero in Denver by 2030.

Existing building performance provides context on where the building stock is today. Code performance estimates suggest where the starting "book end" is in this new construction code approach today. Zero energy data sets are used to set far "book end" targets that would be required to meet Denver's goals. Extrapolating between those two points reveals discrete energy targets for the code cycles between now and 2030. These targets represent building energy use and do not include the renewable energy that would be required to achieve zero net energy in an individual building. Therefore, the targets never actually achieve "zero."

In the analysis, building types are separated because different building types have different performance characteristics and expected energy use. High-energy use in one building type may be low for another. Therefore, targets have been developed by building type. In addition, data in this analysis accounts for the Denver climate zone.

It is important to note that these EUI targets are "site EUI" and only consider energy consumed at the building rather than the complete supply chain and fuel types that contribute to source energy. Also, this analysis looks at energy that is related to, but is not the same as, carbon or greenhouse gas emissions.

Building Type Selection

The project team drafted and reviewed a list of priority building types to include in this research based on Denver's benchmarking data, the extent of code jurisdiction, and new construction forecasts. These building types represent the majority of buildings permitted and built in Denver, specifically: mid-rise and high-rise apartments, small and large hotels, medium and large offices, standalone retail, and warehouses.

Information on hospitals and restaurants are included in this report for context only. These two building types are not necessarily good candidates for energy targets in codes at this time because there is

insufficient data to determine reasonable targets and limited data on performance of similar buildings to inform the effort. Additionally, the energy use of these building types can vary greatly based on factors outside the scope of energy codes, such as operating hours and plug and process loads.

Existing Building Performance

Denver shared commercial building energy benchmarking data as collected from the Denver commercial building disclosure ordinance. While data was collected in 2016, 2017, and 2018, the 2018 dataset is solely referenced in this analysis because a separate analysis suggested that the 2018 dataset appears to have more buildings included, which may be due to increased reporting in our disclosure ordinance. This data represents existing building energy performance for certain building types listed above. To represent typical energy performance in Denver, the analysis reports the median weather-normalized site EUI, as calculated by Energy Star Portfolio Manager in the disclosure data from the City.

Table 22 details the building characteristics from the disclosure data, including building sizes, property types, sample sizes and site EUI. Figure 12 offers a different view of that data; it shows the performance of each building type by vintage. Using initial data processing completed by the city, the analysis only included buildings tagged as appropriate for use in energy analytics. The analysis also used the “Property Type” for Percentile field included in the disclosure data file generated by the city to match buildings in the disclosure data to the list of ten building types studied. The “Property type for percentile” field is a consolidation of similar space use types reported in Portfolio Manager to simplify the analysis to fewer, more common building types. Note that restaurants did not have any samples in the 2018 dataset studied.

Table 22. Denver Benchmarking Data Included in the EUI Analysis by Building Type

Building Type	Property Type for Percentile	Size Range (ft²)	Samples (n)	Weather-normalized Median Site EUI (kBtu/sf/yr)
Mid-Rise Apartment	Apartment	0-80,000	202	61
High-Rise Apartment	Apartment	80,000+	281	92
Small Hotel	Hotel	0-100,000	43	66
Large Hotel	Hotel	100,000+	41	72
Medium Office	Office	40,000-100,000	166	64
Large Office	Office	100,000+	146	56
Standalone Retail	Retail Store	All sizes	26	79
Warehouse	Non-Refrigerated Warehouse	All sizes	124	45
Hospital*	Hospital (General Medical & Surgical)	All sizes	5	236
Restaurant*	-	-	0	-

**Hospitals and restaurants may not be good candidates for EUI targets for a number of reasons, including significant unregulated loads and little data to inform the analysis.*

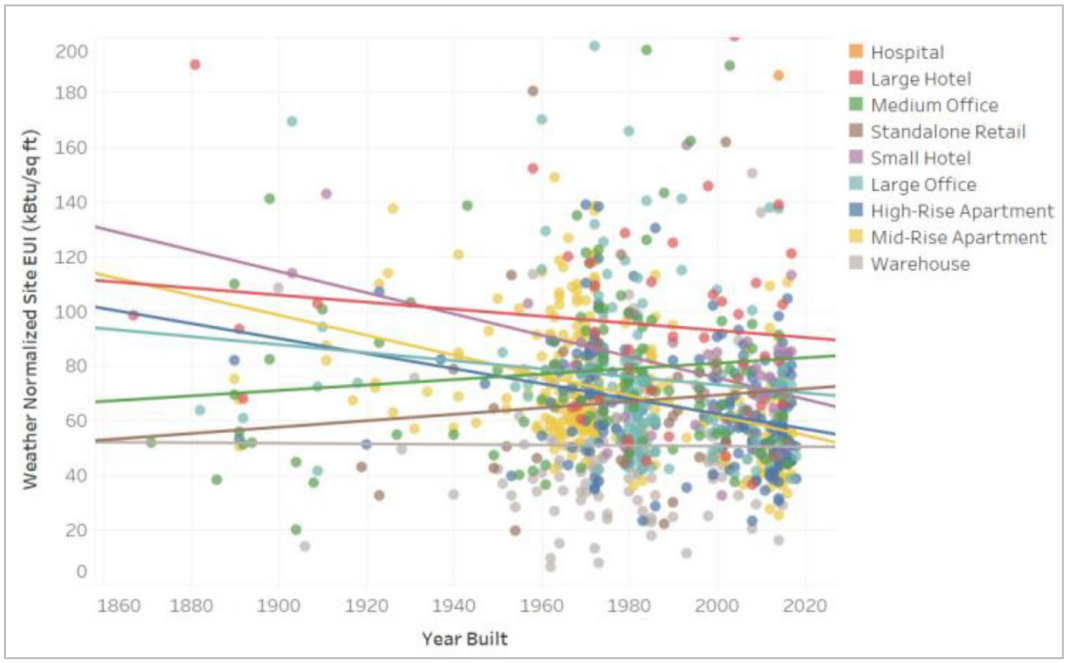


Figure 12. Building Performance by Age for Select Building Types

Energy Code Performance

For energy code performance predictions, NBI typically leverages energy modeling determinations by the U.S. Department of Energy[2]. Code determinations establish the expected energy performance for the national model base codes, including the IECC and ASHRAE 90.1. Code determinations are specific to climate zones, and Denver falls into climate zone (5B).

Denver has just adopted the 2019 edition of its energy code, which is a locally customized version of the 2018 IECC. Since U.S. DOE has not issued a code determination for IECC-2018, NBI has based code savings estimates on proprietary internal data, which suggests that IECC- 2018 is 3-5% better than the IECC-2015 and that Denver's 2019 energy code is about 15% more stringent than IECC-2018.

Zero Energy Performance Targets

Zero energy performance targets are the energy use intensity targets for each building type based on the maximum site efficiency using current technologies (without renewables). These targets represent the 2030 "book end" for the potential savings analysis. Zero energy performance levels are based on research compiled and conducted by NBI, which compiles a mix of modeled analyses and measured performance data for existing zero energy buildings in North America. Each data source represents a particular building type and is specific to Denver's climate zone (5B). Table 23 summarizes the measured performance data, technical potential studies and energy modeling analyses that support the zero energy EUI target development.

[2] https://www.energycodes.gov/development/commercial/prototype_models

Table 23. Published Sources Informing the Performance Target Development

Title	Author	Description	Publication Year	Measured/ Modeled
NBI Getting to Zero Database [3]	NBI	Continuously updated collection of zero energy buildings in North America	2019	Measured and Modeled
Advanced Energy Design Guides [4]	Multiple	Detailed design guide for K-12 school and office buildings to achieve zero energy operation	2019	Modeled
The City of Toronto Zero Emissions Buildings Framework [5]	Multiple	Study to identify feasible maximum performance targets for zero energy buildings in the city of Toronto to meet its climate goals	2017	Modeled
Development of Maximum Technically Achievable Energy Targets for Commercial Buildings [6]	GARD Analytics	National study of best anticipated building performance using best-practice design and operations strategies	2015	Modeled
The Technical Feasibility of Zero Net Energy Buildings in California [7]	ARUP	Study of the best achievable building performance as a basis for zero energy code targets	2012	Modeled
Built to Perform: An industry led pathway to a zero carbon ready building code [8]	Multiple	Australian modeling analysis to establish zero carbon ready building targets	2018	Modeled

Zero energy performance targets based on these data sets are shown in Figure 13. This figure plots how zero energy sources compare by building type. Generally, the net zero performance target combines an average of maximum technical potential studies (i.e. studies that quantify the lowest energy building possible via modeling) and median EUI values for existing zero energy projects. In combining the data from those sources to establish the net zero energy performance target, NBI gave greater weight to measured data from existing buildings than modeling studies. NBI also normalized measured data from various climate zones to Denver's climate using conversion factors to equitably compare energy use between different climate zones.[9]

[3] https://newbuildings.org/resource/getting-to-zero-database/

[4] https://www.ashrae.org/technical-resources/aedgs

[5] https://www.toronto.ca/wp-content/uploads/2017/11/9875-Zero-Emissions-Buildings-Framework-Report.pdf

[6] http://www.gard.com/

[7] https://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=10721

[8] https://www.asbec.asn.au/wordpress/wp-content/uploads/2018/10/180703-ASBEC-CWA-Built-to-Perform-Zero-Carbon-Ready-Building-Code-web.pdf

[9] For more details, please see the Zero Energy Target Setting summary report available here: https://newbuildings.org/resource/zero-energy-commercial-building-targets/.

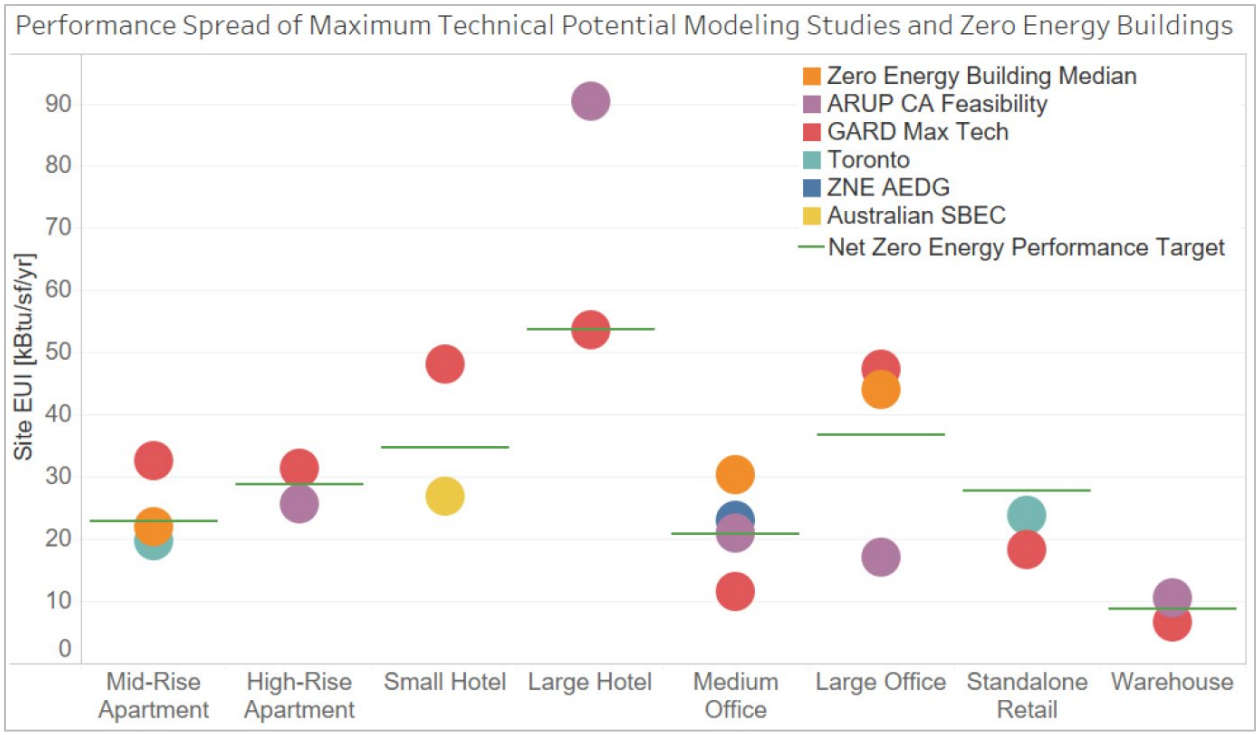


Figure 13. Net Zero Energy Data and Performance Targets by Building Type for Denver Climate Zone

EUI Analysis

Figure 14 plots EUI data from the multiple sources listed above, combining important information for stakeholders and policymakers to consider in setting energy performance targets for each code cycle going forward. It gives context to the performance targets such as current performance levels and net zero energy performance levels established in existing research. This also can help support the transition to a performance code compliance path that relies on absolute energy targets rather than "percent better" reductions. Of course, actual energy performance also will have to consider weather conditions and specific characteristics of individual building designs that may merit an increase or decrease in the energy target.

In Figure 14, the modeling analyses representing zero energy performance levels are shown as dark blue circles, measured Denver benchmarking medians are shown as teal circles, and the estimated 2019 Denver Energy Code (based on the 2018 IECC) performance levels are grey circles. The measured energy data for existing zero energy buildings in the Denver climate zone are included as orange circles, where available.[10]

[10] For large office, the plot points for Denver's benchmarking data and code-level performance are closer to net zero than expected. This is because the code determination studies include data centers within large office, a substantial energy load that may not be common in Denver's office buildings.

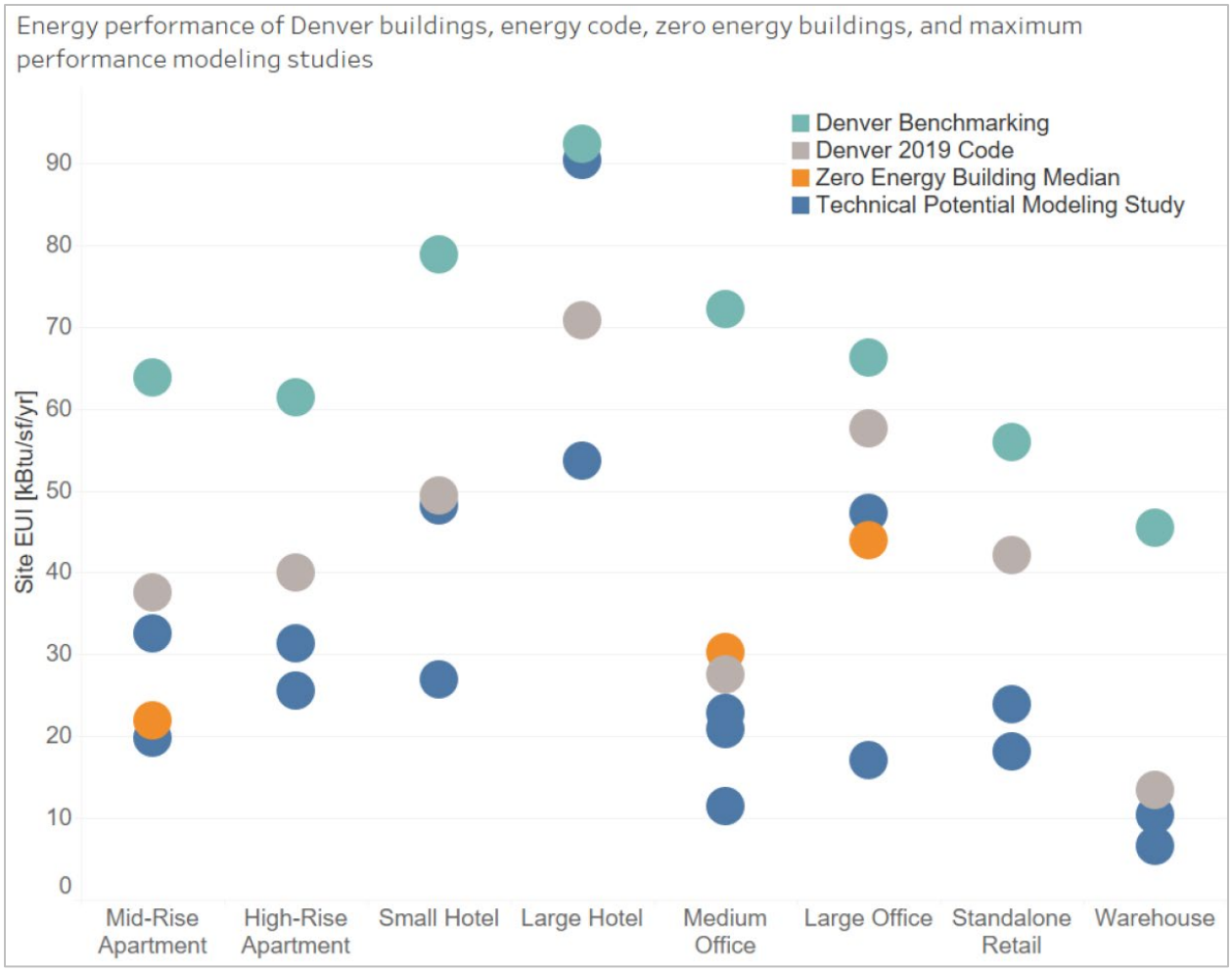


Figure 14. Site EUI from Multiple Data Sources by Building Type for Denver

Research by NBI and others suggest that whole-building energy performance levels, measured in Energy Use Intensity (EUI) of kBtu/square foot per year, are achievable with currently available technology and advanced design practices. Design guidance for reaching low energy consumption levels in various building types are available in NBI's zero energy resources hub,[11] including measured performance data, technical potential studies, and energy EUI.

Table 24 summarizes the site EUIs for the three data sets: existing building energy performance as defined by the Denver Benchmarking Median, the estimated 2019 Denver Energy Code Performance, and the NBI suggested net zero performance targets by building type.

[11] https://gettingtozeroforum.org/technical-resources/

Table 24. Published Sources Informing the Performance Target Development

Building Type	Denver Benchmarking Site EUI Median Performance	Building Type	Denver Benchmarking Site EUI Median Performance
Mid-Rise Apartment (R-2 - 4-7 stories)	64	38	23
High-Rise Apartment (R-2 – 8 or more stories)	61	40	29
Small Hotel (R-1 – 0-100,000 sf)	79	49	35
Large Hotel (R-1 – 100,000 sf and larger)	92	71	54
Medium Office (Group B office –40,000-100,000 sf)	72	28	21
Large Office (Group B office –100,000 sf and larger)	66	58	37
Standalone Retail (Group M)	56	42	28
Warehouse (Group S)	45	13	9
Hospital (I-2, Condition 2)	236	107	n/a
Restaurant (Group A-2 w/commercial kitchen)	-	321	n/a

The zero energy ready targets we propose are significantly lower than the existing building median in Denver, typically by half or more. This variation is expected given that the vast majority of existing buildings may predate modern energy codes.

Figure 15 illustrates the extent that buildings and code have reached net zero energy targets at this point in time. This gap between energy consumption in existing buildings and net zero targets is expected to be shored up by a combination of advancing energy codes and policies, as well as operational practices in buildings to reach and maintain high-performance. Due to technological advancements, the performance level of buildings that achieve net zero energy may improve over time, so the performance target end point also may change for the better.

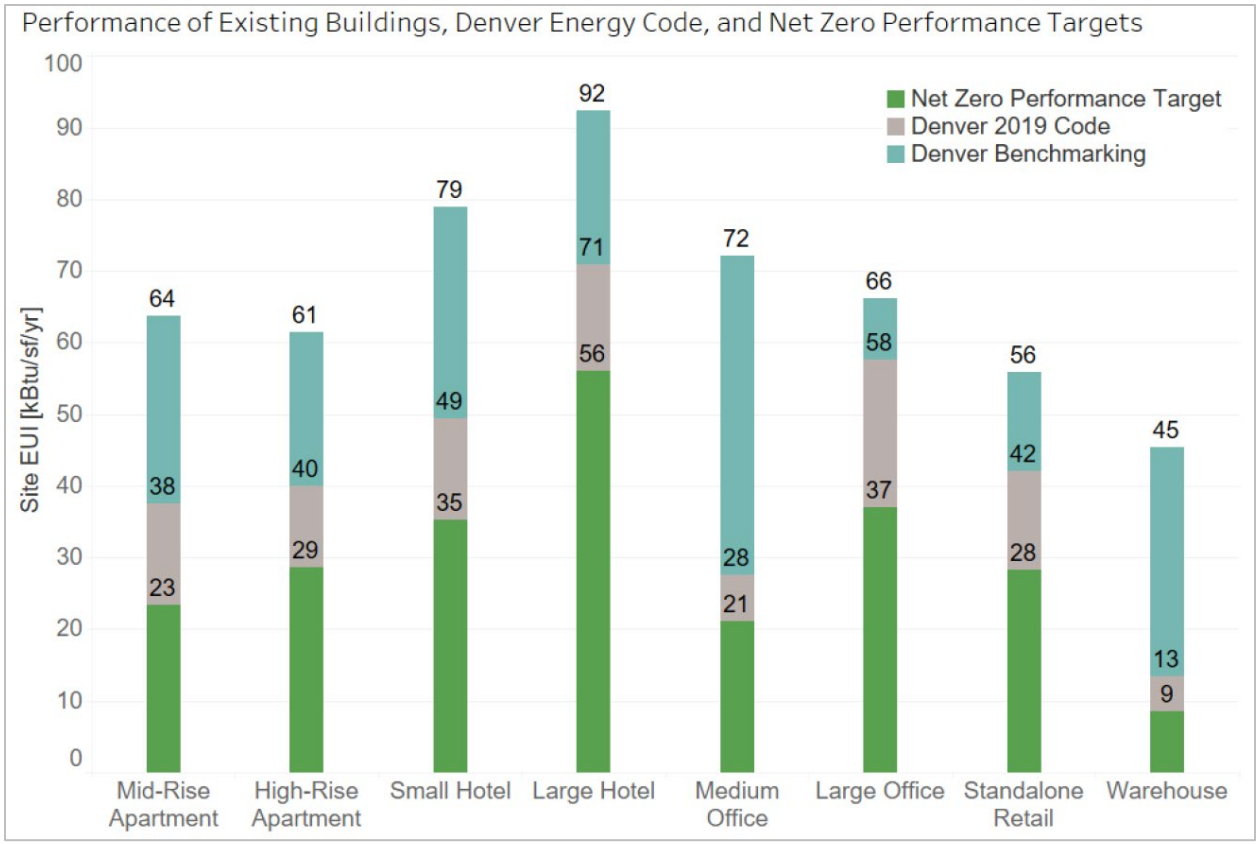


Figure 15. Energy Performance of Existing Buildings, Energy Code, and Net Zero Targets by Building Type

Implications for the Denver Energy Code

The next step is to focus on the getting from Denver's code today and net zero performance. Figure 16 plots a course for predicted building performance improvements to zero by 2035. The 2016 points represent the old Denver code (based on 2015 IECC). The 2019 points show the recently adopted 2019 version of the code (which is better than 2018 IECC). For each building type, Figure 16 extrapolates from current code estimates to net zero performance (assuming a three-year code improvement cycle). Then, assuming equal Energy Use Intensity (EUI) progress in each cycle to get from where we are to where we are going, we plot a straight line for each building type. **This does not consider the probability that net zero buildings in the future may perform even better from an energy perspective. If this is the case, the net zero end points need to be recalibrated at each code cycle increment.**

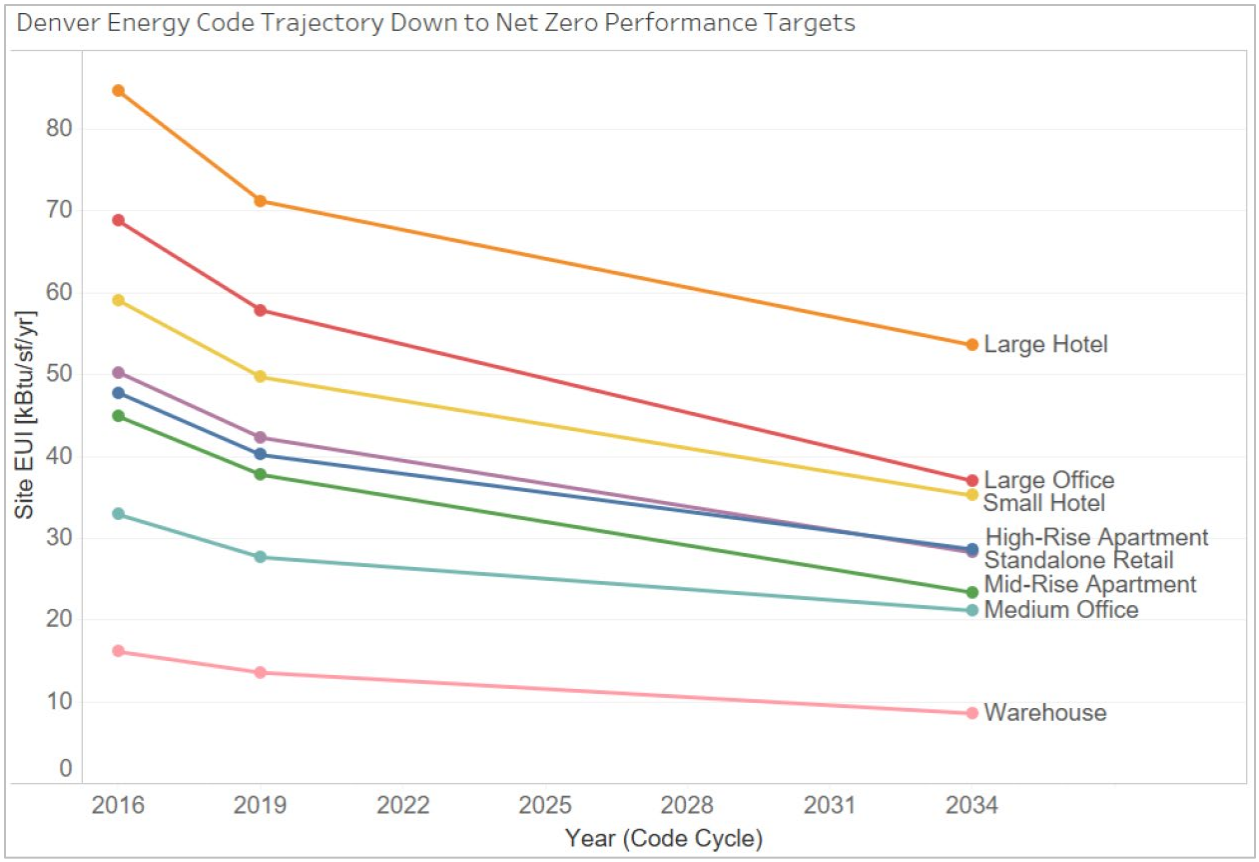


Figure 16. Energy Code Performance Trajectory to Zero Energy by Building Type

Table 25 details the site EUI for each building and code cycle from the plotted scenario. The savings for the upcoming code cycles will need to average 8% (Range: 5-10%) across building types. Looking historically at energy code improvements of both ASHRAE Standard 90.1 and IECC suggests that consistent savings of 8% may be out of the range of expectations for national model codes. **It will therefore be imperative for Denver to continue to push beyond model codes.** The current approach of leveraging the voluntary stretch code along with other policies will help Denver reach net zero energy performance by 2035 and aligns with the current Denver 80x50 Climate Action Plan.

Table 25. Code Performance Trajectory to Zero Net Energy Performance by 2035 (by building type)

Building Type	Site EUI (kBtu/square foot/year)							Average Savings/ Cycle
	2016	2019	2021	2024	2027	2030	2033	
Mid-Rise Apartment (R-2 - 4-7 stories)	45	38	35	32	29	26	23	10%
High-Rise Apartment (R-2 – 8 or more stories)	48	40	38	36	33	31	29	7%
Small Hotel (R-1 – 0-100,000 sf)	59	50	47	44	41	38	35	7%
Large Hotel (R-1 – 100,000 sf and larger)	85	71	68	64	61	57	54	6%
Medium Office (Group B office – 40,000-100,000 sf)	33	28	26	25	24	22	21	5%
Large Office (Group B office –100,000 sf and larger)	69	58	54	50	45	41	37	9%
Standalone Retail (Group M)	50	42	39	37	34	31	28	8%
Warehouse (Group S)	16	14	13	12	11	10	9	9%

Table 25 outlines a building-type specific path to zero energy in commercial buildings. These are focused primarily on the energy performance of the building as measured in site EUI. They do not consider renewables or that fuel sources for electricity in Denver will become less carbon intensive over time.

The adoption of predicted energy performance targets puts a significant burden of proof on the energy modeling process. Certain aspects of this process easily can be misrepresented, resulting in a building that performs very differently from what the energy model estimates predicted.

Despite this, energy modeling will continue to be an essential tool not only in reducing energy loads in buildings but also to help determine energy code compliance. As these tools continue to advance and be utilized by designers and building departments, it is essential that there is feedback and accountability in this process. The simple act of going back to update and understand energy modeling accuracy closes an important feedback loop for the design community and pushes the industry toward more accountability on predictive modeling. Over time with this enhanced feedback loop, the discrepancy between predicted performance and outcome performance will be reduced, and accuracy of models will improve.

As the NZE Stakeholder Advisory Groups reviewed the climate goals and recommendations, they ultimately recommended that this plan be developed to reach net zero energy by 2030 and align with the Climate Action Task Force recommendations. Because of this, the analysis above was used to determine what the site EUI requirements need to be to meet net zero energy by 2030 as shown in the Table 26.

Table 26. Code Performance Trajectory to Zero Net Energy Performance by 2030 (by building type)

Building Type	Site EUI (kBtu/square foot/year)					
	2016	2019	2021	2024	2027	2030
Mid-Rise Apartment (R-2 – 4-7 stories)	45	38	35	29	23	23
High-Rise Apartment (R-2 – 8 or more stories)	48	40	38	33	29	29
Small Hotel (R-1 – 0-100,000 sf)	59	50	47	41	35	35
Large Hotel (R-1 – 100,000 sf and larger)	85	71	68	61	54	54
Medium Office (Group B office – 40,000-100,000 sf)	33	28	26	24	21	21
Large Office (Group B office –100,000 sf and larger)	69	58	54	45	37	37
Standalone Retail (Group M)	50	42	39	34	28	28
Warehouse (Group S)	16	14	13	11	9	9

Denver's Energy Targets

This section finalizes the energy targets based on the analysis above for Denver by building type and code cycle. These targets will enable Denver to reach net zero energy new buildings and homes by 2030. This also includes the milestones for new homes to reach net zero energy and all-electric by 2024, and for new buildings to reach net zero energy and all-electric by 2027. As part of this NZE Plan, Denver asked the NZE Stakeholder Advisory Groups to review the predictive energy use intensity (pEUI) and energy rating index (ERI) targets for buildings and homes respectively to determine recommendation for upcoming code cycles.

Table 27. NZE 2027: Commercial pEUI Targets for Denver Code

Building Type	2021	2024	2027	2030 Performance Verification
Small Hotel	47	41	35	35
Large Hotel	68	61	54	54
Medium Office	26	24	21	21
Large Office	54	45	37	37
Standalone Retail	39	34	28	28
Warehouse	13	11	9	9

Table 28. NZE 2027: Multifamily pEUI Targets for Denver Code

Building Type	2021	2024	2027	2030 Performance Verification
Mid-Rise Apartment	35	29	23	23
High-Rise Apartment	38	33	29	29

Table 29. NZE 2024: Residential ERI Targets for Denver Code

Building Type	2021	2024
Single-family Homes	Max ERI = 50 & ERI w/PV = 40	Max ERI = 45 & ERI w/PV = 0

Other Building Types

Some buildings will have a design target predictive energy use intensity (pEUI) that ratchets down over time as detailed in the tables above. However, building types that do not lend themselves to a target EUI will model a baseline and a percent improvement over that baseline.

Table 30. Energy Savings Targets for Other Building Types

ASHRAE 90.1-2016	2021	2024	2027
% Savings Over Baseline	15%	30%	45%

This results in two modeling options:

1) pEUI targets for typically predictable building types. Developers can model to prove they meet the pEUI for those building types.
2) Alternately, projects can be modeled to a baseline and a percent better than baseline.

Use of Predictive Energy Use Intensity (EUI) Targets

The pEUI targets outlined above are an important cornerstone of the code strategy to zero energy in Denver. **They serve as a clear indicator to building owners and designers on how buildings of a specific type in the Denver market will be expected to perform going forward.** Below is a brief outline of how pEUI targets might be used by the city and local building market actors. The prescriptive and the performance code approaches are topics for future work by NBI under the American Climate Cities Challenge project.

- In the **prescriptive approach**, pEUI targets can be used to calibrate the performance goals for future iterations of the prescriptive code in order to ensure that it is sufficient to achieve the energy performance targets for various building types. This will be done through energy modeling and calibration. If pEUI targets are not achieved, Denver can leverage new provisions in the 2021 International Energy Conservation Code (specifically section C406 options in commercial and the flex points packages in residential) to increase savings

required locally. These code provisions, which are new in the 2021 IECC, offer flexibility and provide an easy mechanism for the city to require increased efficiency while minimizing modifications to the model code.

- In the **performance approach**, pEUI targets can be used to eliminate the need for a "percent better than code" modeling approach. For certain building types where pEUI targets are appropriate, energy modelers can simply create a building model where the predicted pEUI meets the target, as opposed to needing to create a code baseline model for comparison. Eliminating the need for a code comparison model will save time and money for the energy modeler, and therefore the building owner, using the performance approach as the path to code compliance. However, it is imperative that energy modeling assumptions are standardized, even beyond what is already required in the ASHRAE Appendix G Performance Rating Method.
- In the **benchmarking and disclosure** program, energy targets will align with predicted pEUI disclosed in the code compliance documents. With this data, the city will be able to inform owners (and their energy modelers) about how the building actually performs compared to these predictions, closing an important feedback loop in the buildings market. Most energy modelers have no way of knowing how the buildings that they model actually perform, so this information will help inform and improve their modeling process. This is key to transitioning energy modeling from an estimation tool to a predictive one. Conversely, most building owners do not know how their buildings were intended to perform. This information will provide information to owners and facilities staff about how well buildings are meeting their design expectations.
- In **building energy performance standards**, pEUI targets in new construction codes create a connection between code compliance in today's new construction as they transition to compliance with tomorrow's existing building performance standards. Energy targets for each code vintage can have their own standards, which are more efficient than those set for existing buildings today. This helps to ensure that newly constructed and recently renovated buildings are set to a higher standard than today's existing building stock and contribute to meeting Denver's ambitious climate goal.

Performance Verification

Traditional code compliance paths – both prescriptive and modeled performance – are effective at regulating the features that go into a building, but not at how those buildings are operated. If Denver is going to meet its climate goals, it will need to ensure that the energy code delivers the energy savings that policy-makers expect. By comparing the performance expected from the energy code with actual performance, performance verification can support both of these goals. Performance verification is a type of outcome-based code that was recommended by the Denver Climate Action Task Force. Additionally, performance verification will connect the design process with the benchmarking requirement in buildings over 25,000 square feet.

IMPROVING THE ENERGY CODE AND OTHER POLICIES

Performance verification can validate and refine energy code requirements and modeling methodologies. It verifies that recently constructed buildings are performing as expected by comparing the actual performance against the performance expected from the code. It creates a feedback loop

between the energy code, building designs and actual performance. A performance verification policy will give design teams information about the actual performance of their designs, which will allow them to see how well various design decisions are translating to actual performance and to assess the quality of their energy analysis efforts. The feedback loop also provides information to policy-makers, allowing them to see whether code requirements and modeling methodologies are leading to the expected performance as well as whether code enforcement efforts are effective. The result is that both design practice and the energy code itself can be improved by the information that performance verification provides. **The enforcement mechanism provides far more impetus to designers and owners to pay attention to the relationship between designs and actual outcomes than a disclosure law.**

Performance verification also can reinforce and enhance other policies and supports to the community that have a performance component. For example, some cities use above-code performance as a requirement for development bonuses or tax credit programs. Performance verification can be integrated into these policies to provide greater certainty that participants are delivering the performance levels expected, and refine the program offering. Performance verification also will give the public more confidence that these projects are actually providing a real, verifiable benefit to the community. **Implementing performance verification for these kinds of policies can serve to build capacity in staff and acceptance in the market for other, more comprehensive outcome-based policies in the future.**

IMPLEMENTATION CONSIDERATIONS

There are some specific considerations to address in the crafting and implementing of a performance verification policy. Enforcement of a performance verification policy needs to bridge the time between construction and actual performance. There are a handful of ways this can be done including:

- **Temporary Certificate of Occupancy (TCO):** Before occupancy, buildings receive a TCO, and a full Certificate of Occupancy (CO) is not issued until they have demonstrated that they meet the performance target. This approach has the potential to be highly effective since buildings with TCOs can be difficult to refinance and sell. However, building officials often are reluctant to utilize TCOs, which can be difficult to enforce and do not fit well into the existing inspection processes of many building departments.
- **Code Violation:** If the building fails to demonstrate compliance, then the building is issued a code violation that can be cleared only by demonstrating compliance. This can be effective when code violations are an obstacle to leasing, selling or financing a building.
- **Fines:** Buildings that fail to meet the performance target of the code are fined. The success of this approach depends on the magnitude of the fine, which needs to be high enough not to be relegated to the cost of doing business.
- **Surety Bond:** The building owner provides a surety bond before the building receives a CO and receives the bond back when the building meets the performance target. An advantage of a surety bond over a fine is that many commercial buildings are built as speculative developments and the bond is effectively transferred with the building when the building is sold. It also simplifies collection. Jurisdictions might struggle to collect fines after the fact, but easily can get a surety bond that is a pre-requisite for the CO. As with fines, the bond needs to be substantial enough to incentivize compliance. A jurisdiction also needs a way to hold the bond.

An important consideration is the compliance period – how long a building is required to demonstrate actual performance that meets the target. If a building needs 12 months of continuous performance

data to demonstrate compliance, the compliance period will need to be longer. Most buildings have about a six-month period when tenancy ramps up and systems are fine-tuned. Say the compliance period were limited to 18 months, then that still would not be enough time to remedy any problems with the building that arose during full operation. A **24- to 36-month compliance period is recommended** to provide a buffer for the building to reach full operation and remedy issues. A longer compliance period also benefits building owners, helping to reduce market resistance to the policy.

ENERGY CODE REQUIREMENTS THAT SUPPORT PERFORMANCE VERIFICATION

A performance verification policy is more likely to be successful if new buildings include features that enable more efficient and effective operations. When crafting a policy, it is beneficial to pair it with a set of enhancements to the energy code to make it more likely a building will be able to perform as expected. Some examples include:

- **Metering and Monitoring:** While a utility bill can provide the information needed to enforce a performance verification policy, it does not provide enough information to effectively monitor a building's performance. Whole-building interval metering of all fuels with a clear energy display will give building operators information that can be used to track how the building is performing and identify issues as they occur.
- **Sub-metering and Load Segregation:** While a lot can be learned from whole-building metering, even more can be learned from sub-metering the various buildings systems. By segregating different load types – HVAC, lighting, water heating, plug loads, etc. – from each other and metering them separately, building operators are able to pinpoint which systems may be the source of performance issues when whole building metering only allows them to see that there was an issue somewhere in the building.
- **Granular Control Zones:** Large control zones for space conditioning, and especially lighting and ventilation, result in large portions of the building being active even when those zones are only partially occupied. Smaller control zones limit the energy impact of irregular or uneven occupancy schedules.
- **Automatic Controls:** Manual controls require occupants to consistently manage them. Automatic controls allow loads to be reduced by limiting reliance on occupants.

Modern model codes have many of these features, so Denver does not need to create them from scratch but simply ensure they are adopted as part of the energy code.

Refining Energy Modeling for Performance Targets and Verification

There are a number of items to address regarding energy modeling to ensure that performance verification is possible in Denver. As mentioned previously, Denver will need to calibrate the performance path and prescriptive path each code cycle to ensure each path is delivering the same performance. Along with calibration, Denver will need to streamline energy modeling paths, address modeling accuracy, go from comparative to predictive modeling, address unregulated loads, and detail modeling normalization.

STREAMLINING ENERGY MODELING PATHS

Within the IECC, current energy modeling paths offer varying results and have different levels of guidance and specifications for whole building/unit energy modeling. An additional complication is that

the mandatory requirements for each path vary. The whole building modeling pathways in the 2018 IECC include:

- Commercial 2018 IECC modeling paths
  - 2018 IECC: C407 Total Building Performance
    - C407.2 Mandatory requirements
    - Energy cost analysis
    - Limited guidance on modeling/analysis
  - ANSI/ASHRAE/IESNA 90.1-2016: Chapter 11 Energy Cost Budget Method
    - 11.2 Mandatory requirements
    - Energy Cost Budget analysis
    - Limited guidance on modeling/analysis
  - ANSI/ASHRAE/IESNA 90.1-2016: Appendix G Performance Rating Method
    - G1.2.1 Mandatory requirements
    - Performance Cost Index (PCI) analysis
    - Extensive guidance on modeling/analysis
    - Appendix G used for LEED energy modeling methodology, though the PCI method is new
- Residential 2018 IECC modeling paths
  - 2018 IECC: R405 Simulated Performance Alternative
    - R405.2 Mandatory requirements
    - Energy cost (with exception allowing source energy use analysis)
    - Limited guidance on modeling/analysis
  - 2018 IECC: R406 Energy Rating Index (ERI) analysis
    - R406.2 Mandatory requirements
    - Energy cost
    - Detailed guidance on modeling/analysis
    - ANSI/RESNET/ICC 301 is the basis for a HERS Index and used by raters

As codes progress, the first task is to streamline these paths for Denver to minimize the options and assist with code enforcement while providing appropriate flexibility to the community. As a first step in the 2019 code, Denver eliminated the ANSI/ASHRAE/IESNA 90.1-2016 Chapter 11 Energy Cost Budget Method to reduce the commercial whole building modeling pathways to two. **Depending on feedback from Denver's community, there is potential in the next code cycles to further reduce the number of pathways.**

ENERGY MODELING ACCURACY

Approaches to increase proficiency and accuracy of energy modeling for commercial/multifamily and single-family are needed in Denver. There are a number of resources and studies on the accuracy of energy modeling. The only effective way to increase accuracy is through predictive energy modeling that is then normalized (calibrated) to account for actual weather, building occupancy, schedules and more.

The following steps are intended to prepare the market for a future outcome-based code.

Near-term Steps:

- Introduce predicted energy use intensity (pEUI) as an option for the modeled performance approach using the pEUIs that have the highest levels of confidence.
- Establish a local network of energy modeler expertise and incentives and trainings to improve that expertise.
- Encourage the network to compare modeled assumptions to actual performance. Research how the city can ensure this through reporting procedures to communicate predicted EUIs compared to actual measured results back to modelers, designers and owners.

Mid-term Steps:

- Expand pEUIs available based on additional data from more data sources including code submittals and make the pEUI approach mandatory for certain building types.

Long-term Steps:

- Make pEUI mandatory for all modeled performance compliance.

Enhancing energy modeling accuracy is the basis of getting to predictive modeling, which is key in performance verification.

Energy Modeling Guidelines

To increase accuracy of energy modeling, Denver will need to establish modeling guidelines for commercial/multi-family and single-family. Denver is currently creating a checklist for energy modeling requirements, and the city is collaborating with Boulder to align performance path documentation requirements and learn from each other as modeling is increasingly used for code compliance.

Currently, Denver staff provide guidance on the expectations for energy modeling in response to Site Development Plan (SDP) submittals, prior to CDs being submitted for permit

Energy Mode Expectations for Accuracy:

Denver CPD staff provides expectations for energy modeling at superstructure permit submittal that helps streamline GBO review including:

- Per GBO R+Rs Article IV Section 4.04(c)(ii), please provide energy model data indicating estimated annual average electricity usage including both site and source pEUI values. If the building includes parking please provide four pEUI values: site and source for the building excluding parking, and site and source for the building including parking.

- With this data, please provide a statement pertaining to identifiable limitations to reasonably anticipated accuracy of data. Please do your best to speak to limitations you think will create the biggest challenges specific to this project, related to anticipated occupants, building design features, team structure, or other characteristics.

- This statement should focus most on limitations imposed by modelling approach taken (code compliance as opposed to predictive performance, eg), but may also speak to expected impact that might be associated with factors such as project team coordination of occupant use assumptions and ownership building operations; building envelope and building system detailing and controls; expected construction quality / constructability of details; inability of energy modeling approach to account accurately for air infiltration and/or thermal bridging; expectations for facilities maintenance; or other factors the team deems relevant.

- Please include a ROM best professional estimate for percentage swing in accuracy of values / anticipated difference between anticipated (pEUI) and actual energy use (EUI), understanding that EUI data will become available each year following construction via Denver's mandatory

(shown in the sidebar). This also empowers design teams to streamline the project's Green Buildings Ordinance (GBO) review.

The energy modeling industry takes time to understand accuracy. One example is Boulder, where they do not yet require performance but do report back to developers/modelers via benchmarking so they get feedback and start to learn how to model more accurately. Within the next code cycle in Boulder, energy modeling will have to be within ~15% of the target. The following code cycle, ~10% is the required tolerance, then ~5%, and in 2031 actual performance is required in Boulder. **For Denver, this also will be the basis for moving toward performance verification.**

PREDICTIVE ENERGY MODELING

One challenge to advancing the stringency of the performance path – and to the greater alignment of modeled performance with actual performance – is that the current modeling approach within code is a comparative model. Both the IECC section 407 and ASHRAE modeling are a proposed building model compared to a baseline. Fundamentally, a comparative model is not a predictive model. In some cases, the proposed model is assumed to use baseline systems and components due to modeling protocols.

In order to address this limitation, the modeled performance path will need to transition away from a comparative model to the use of performance targets. The inclusion of energy targets into energy codes and building policies represents a significant departure from the approaches applied by current model energy codes and standards as developed and published by the International Code Council (ICC) and ASHRAE. **Leveraging the building performance energy modeling approach shifts the focus from prescribing component-level efficiency to whole building performance.**

MODELING UNREGULATED LOADS

One of the most significant things that performance verification can do is provide a way to regulate the loads that traditional energy codes leave unregulated and under-regulated. Performance verification will allow Denver to ensure that the maximum limit for unregulated loads in the performance target are actually met. Buildings will be unlikely to meet a performance target if their plug and operational loads exceed those anticipated in the target. By lowering that limit over time, building occupants will be incentivized to choose efficient equipment and operate it efficiently.

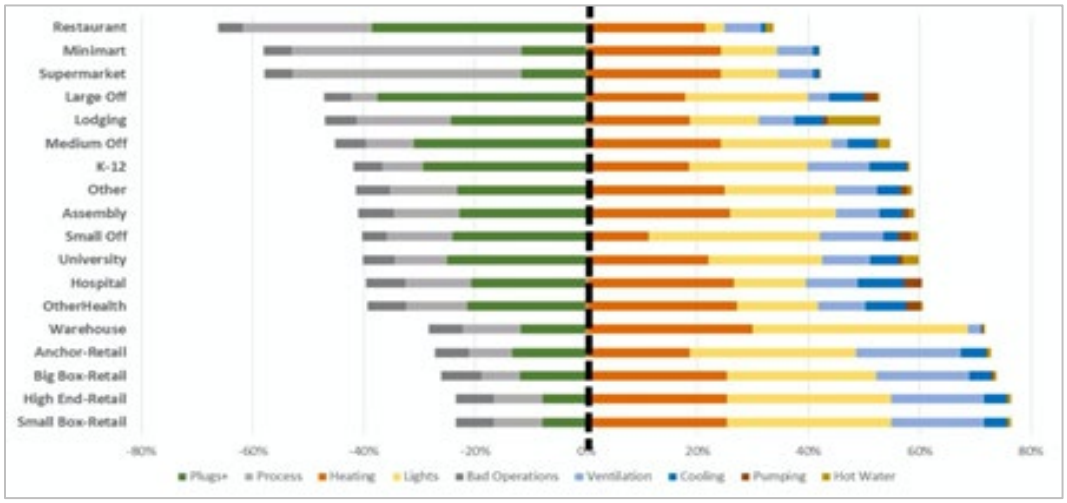
Even the regulated loads in new buildings are not completely regulated by the energy code. Many operational factors can impact the actual performance of the systems that are regulated by the energy code. Factors like thermostat set-points and automatic control configuring (or disabling) can have a significant impact on building performance. While existing energy codes cannot impact these post-occupancy issues, a performance verification policy can.

An additional advantage of addressing unregulated loads is that it reduces reliance on regulated loads as the only option for meeting Denver's climate goals for new construction. A performance verification policy allows a jurisdiction also to generate energy savings from unregulated and operational loads. This in turn can result in simpler energy codes that are easier to follow and enforce, and less controversial to adopt.

To encourage projects to address the impact of unregulated loads on building energy use, specific credits may be allowed in the modeling process to account for commitments by the project to reduce

unregulated load energy use. In the early stages of this, credit for unregulated load reduction will be limited to 10 percent of anticipated loads. As the building department and projects become acquainted with strategies to pursue and document reduction in unregulated loads, the amount of savings allowed in this category may increase. By the 2030 cycle, managing unregulated loads will be an integral part of achieving NZE building performance.

Denver can develop policies to better address unregulated loads. Figure 17 includes an example of this issue from Washington state. It shows the regulated vs. unregulated end uses by building type. In order to meet Denver's performance goals, it will be necessary to address these unregulated loads that are beyond the scope of the energy code as part of performance verification policies.



Source: NBI

Figure 17. Regulated and Unregulated End Uses by Building Type Based on the Washington State Energy Code [12]

NORMALIZATION FOR ENERGY MODELING

Despite the best intentions of designers, energy modelers, and building operators, building energy use can vary from year to year based on factors outside the control of these groups. Changing weather will introduce variability, as will changes in tenants, occupant density, building use, etc.

These are perfectly normal reasons for building energy use to fluctuate and must be accounted for in considering whether a building is achieving its performance goals/requirements. Adjusting building energy targets based on these factors is called 'normalization' of performance expectations. Once enforcement mechanisms focus on measured building performance data, performance targets will need to be able to account for normalization strategies so that buildings can carry on with their typical market function of adding and reducing occupants, changing use types (like adding a deli on the main floor), and maintaining comfort in a particularly cold winter.

Normalization accounts for routine weather and market variability that is an expected part of building operation. Normalization factors will account for performance variability that is not the result of poor operations and inefficient system operation, so that buildings can adjust performance targets over time

[12] *Washington State Energy Code Roadmap.* Prepared by New Buildings Institute. 2015.

based on actual weather and use characteristics. It is to be anticipated that individual projects may request specific adjustments to performance criteria based on unanticipated tenant and operating characteristics. This ability to adjust performance targets will become more critical over multiple code cycles, as buildings are expected to perform more closely to the performance targets set in the design process.

There may be potential normalization factors that are needed to address reasonable variables that must be considered (change of use, abnormal weather conditions, etc.) Eventually Denver could develop and publish normalization protocols to clarify for energy modelers the allowable normalization factors.

The normalization recommended for 2021 is including discrepancy reporting between modeling and design. In future code cycles, the recommendation is to include normalization for occupancy, schedules, and weather.

PERFORMANCE PATH BACKSTOPS

In a performance-based path, modeling tradeoffs can be made between different building elements in order to achieve the whole-building goal. However, one danger of tradeoffs is that buildings might lower the performance of a building component too far. Code backstops ensure that certain minimum standards are met even while there is flexibility above those absolute minimums.

Backstops are already present in the energy code, such as mandatory minimums which ensure that certain building features do not get traded off for efficiency elsewhere. In the IECC, these include minimum requirements for items such as building air leakage, lighting controls and HVAC equipment efficiency. Modeling protocols in the performance path are a less obvious example of a backstop. These protocols set rules for how building features are modeled. This kind of backstop limits the impact that modeling variables can have on whether a building complies with the code or not.

Backstops could play another important role specifically in Denver. Denver's NZE Plan is structured with multiple "foundations" where energy efficiency and renewable energy are addressed separately. However, as Denver moves closer to its 2030 goals, it may become necessary to have some interaction between those foundations, and backstops would play an important role in managing the impact of that interaction, ensuring that efficiency is not simply traded off for more renewables.

Backstops play an especially important role in any code or policy requirements that are based on actual building performance. As Denver progresses towards its 2030 goals, its energy policies will need to directly address operations in buildings. Backstops ensure that new buildings have the features necessary to allow them to be operated to meet the performance goals.

- Backstops play multiple roles in the energy code and take multiple forms including mandatory minimums and modeling protocols.
- Mandatory minimums provide guidance to the design community, ensure that critical building features meet minimum performance standards, and set minimum requirements for building features that modeling does not fully address.
- Modeling protocols are a form of backstop that applies to how a building must be modeled instead of the features that must go into a building.
- Backstops that are necessary to address limitations in modeling, including those for hot water distribution systems, how models address thermal bridging, and daylighting.

- Addressing building operations through outcome-based codes requires that actual performance requirements be linked with building feature backstops.
- Alternate metrics can be used as a part of a backstop to achieve specific goals like renewable energy and electrification. Examples of alternative metrics might be a greenhouse gas use intensity, thermal energy demand, and peak energy/carbon load per square foot.

Backstops can be used to extend the viability of the prescriptive path while minimizing the integration of the energy efficiency and renewable energy within Denver's NZE Plan.

Energy Code Enforcement

One challenge with the IECC is ensuring that code is enforced. This becomes even more important when implementing performance verification policies to ensure that a design meets code prior to construction. In 2019, Denver conducted an assessment to determine how compliant the city was at applying the IECC code. The study was conducted by the Institute for Market Transformation (IMT) and Natural Resources Defense Council (NRDC). Researchers and Denver's Community Planning and Development (CPD) selected several projects for the evaluation.

The scope of the research was to "assist the city in meeting its climate goals by reviewing the previous report and determining which recommendations have been implemented, repeating the full CEP Assessment Methodology, providing recommendations for IECC compliance under the current and updated code, and identifying potential barriers to compliance with the IgCC and any subsequent reach code."

The results of the project showed that many issues arose during the construction, permitting and inspection processes of these buildings, which resulted in the city receiving a 65% compliance rate. Many of the issues had to do with lack of communication, poor knowledge of building codes, vague communication and difficulty communicating with people involved in the construction of the building. The two biggest issues involving communication were centered around internal and external communication.

Internally there were many administrative issues involved in these processes. Researchers found that there were an overwhelming number of permits and inspections for the staff and that incentives encouraged approving permits at high volume. Hiring more staff and building better review policies for permitting and inspections were suggested remedies. Creating better outlined and more efficient building inspection sheets for inspectors and builders also was put forth.

External problems included unclear instructions, poor builder training and knowledge, and shortcuts. Suggestions for improvement included writing notes to the builder in clear, informative and concise language to foster a better understanding of instructions. It was recommended that Denver host events to educate city staff and builders to help inform both sides about building codes. Also suggested was a secondary internal review of externally submitted check sheets or compliance forms to check for accuracy. Finally, ensuring the calibration of energy modeling systems used in these processes was a concern.

The most significant suggestions from this study were focused on increasing communication internally and externally, educating builders and city staff about code, creating better administrative form review and submission processes, creating more efficient communication routes between city staff/builders/designers and creating more effective inspection check sheets to ensure nothing is skipped or missed during inspection.

It has become clear that Denver's CPD team will need additional staff to support compliance for the IECC based on the "City and County of Denver Energy Code Assessment Report" from IMT and also requires additional staff to reach the climate goals detailed in this NZE Plan. Currently, Denver has only 2.5 full-time equivalent (FTE) staff supporting the IECC – a far cry from what will be needed to accomplish the work. To that end, Denver reached out to both Seattle and Washington, D.C. to understand how many staff in similar cities support IECC implementation. After comparing, it became apparent that Denver needs to grow its CPD team to an additional 11-16 FTEs supporting energy code enforcement in order to increase the compliance rate and support Denver's Climate Goals and Recommendations.

Cost Considerations: Highly Energy Efficient

There are a number of costs to consider with net zero new buildings and homes. A key consideration is that supports are integral to ensure that the goals and recommendations to reach net zero are equitable and affordable. Costs for net zero new buildings and homes include costs to the city of managing equitable codes, policies, and programs as well as construction costs and operational costs.

CONSTRUCTION COSTS

The first NZE Stakeholder Advisory Groups meetings asked attendees about costs to reach net zero. The primary takeaway from the stakeholders was that if net zero is designed from the outset, there will be little impact on construction costs. If NZE is intentionally incorporated early into the design process, net zero can be achieved within the budget for a building. However, the later it is incorporated, the more redesign will be necessary, and construction costs will increase.

Concern about additional costs or even perceived costs is a barrier to overcome. Stakeholders said that the solution is to assure the community with example projects demonstrating that additional cost is not an issue. Pilot programs, education, and outreach as detailed in the supports section will serve to address these perceptions. Incentives as well are part of the solution to address costs. An example of this with green buildings from the USGBC is a 2007 public opinion survey conducted by the World Business Council for Sustainable Development. **It found that respondents believed, on average, that green features added 17% to the cost of a building, though a study of 146 green buildings found an actual average marginal cost of less than 2%.** Additionally, for lower levels of LEED certification (such as LEED Certified) the premium is between 0-4%. This is particularly applicable to the highly efficient portion of Denver NZE because the savings realized are typically due to energy cost savings.

NET ZERO COST STUDIES

Denver is currently conducting a feasibility analysis for Affordable Housing Zoning Incentives and studying the 2019 Denver Green Code (DGC) costs as part of this effort. This includes both LEED Certified as an equivalent to DGC and net zero energy. While the full results will be available in 2021, an initial literature search shows the following regarding NZE costs.

Buildings NZE Costs

- One of the first studies to evaluate cost premiums for net zero buildings was conducted in 2012 by New Buildings Institute (NBI) and was based on a small sample of net zero projects, most of which were smaller buildings (20,000 square feet or less). Results were inconclusive but anecdotally suggested the incremental cost for net zero buildings was 0 to 10 percent higher than similar conventional buildings. An update to that study in 2014 indicated that cost premiums for net zero are closer now to conventional costs (though the premiums were not actually quantified).

- A 2013 analysis of net zero commercial buildings in Washington, D.C. found that increasing certification from LEED Platinum to net zero created an additional premium of 5 to 19 percent (over LEED Platinum costs).

Homes NZE Costs

- A study by Rocky Mountain Institute, updated in 2019, found that premiums on net zero construction of single-family homes were about 6 to 8 percent over conventional homes. Zero energy ready homes had an even lower premium of 0.9 to 2.5 percent.

- Evidence from the Pennsylvania Housing Finance Authority, who recently added points in their competitive tax credit allocation process for passive house standards, indicates limited and declining cost premiums for construction with the Passive House certification for affordable multi-family units.[13] Affordable housing developers anticipated passive house compliance would add 15 to 20 percent to construction costs but actual applications indicated a 5.8 percent premium relative to conventional applications the first year points were offered (2015), a 1.6 percent premium in year two (2016), and a discount of 3.3 percent relative to conventional applications in 2018.[14]

As a result, cost studies are showing that NZE is about a 5-19% additional first cost for buildings and 6-8% for homes. Initial interviews as part of this Affordable Housing Zoning Incentives work align with these ranges.

OPERATIONAL COSTS

Building operations are an important consideration in terms of cost. For most highly efficient buildings, additional up-front costs for energy typically results in operational savings. Yet for all-electric buildings, the operational cost can be a significant barrier, according to interviews with stakeholders (detailed in the section “Market Barriers to All-Electric Buildings”). In most cases, operational costs can be optimized for each building but do require active management of building operations. Operational costs can be lowered through training and educational supports.

[13] Denver Green Code includes compliance paths for Residential Energy Efficiency that include a “Passive House Approach” with certification under either Passive House Institute US (PHIUS) or Passive House Institute (PHI).

[14] No data for 2017 as tax credits were not awarded that year.

Technology Adoption: Highly Energy Efficient

Both the NZE Stakeholder Advisory Groups meeting discussions and the stakeholder interviews indicated that technology is not an issue for highly efficient buildings. Many of the distributors provide products nationally and have efficient equipment available or accessible in Denver. However, there is a cost consideration as newer products typically cost more, and the cost decreases as products are used and installed more frequently.

Energy Efficiency Building Code/Policy Updates

Ultimately, the targets within this NZE Plan will have to go through each Denver Code Adoption process to be included in the Denver Building and Fire Code. Denver plans to align its code updates with national code updates that are updated every three years and will include 2021, 2024, 2027, and 2030. **Denver is committed to ensuring its code adoption processes are open and inclusive.**

Denver's code adoption follows the I-code development process. Key components of Denver's Code Adoption Process are requesting amendment proposals from the public and balanced-interest code Committees that review and decide upon each proposal. A summary of each Code Committees' decision on each amendment proposal or modification of an approved amendment proposal will be posted on Denvergov.org.

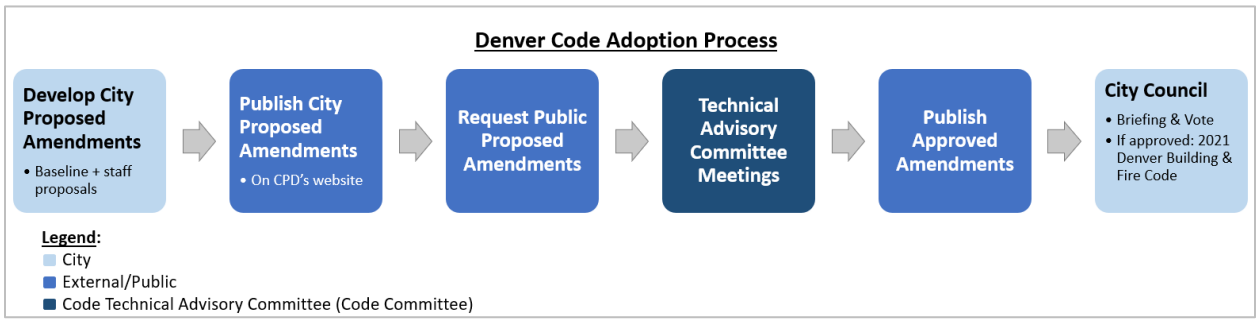


Figure 18. Denver Code Adoption Process

For the 2021 Code Adoption Process, Denver plans to facilitate a separate IECC pre-Committee (different members than the code committee) that will have preliminary meetings to gather stakeholder input from the community as part of developing the initial proposed City-Staff amendments to meet Denver's climate goals and recommendations detailed within this NZE Plan. For the IECC process, the Code Adoption process will include:

- Preliminary energy meetings, detailed below, to develop:
  - A comprehensive set of IECC energy proposals that align with Denver's climate goals and recommendations in this NZE Plan
  - Energy recommendations for the Denver Green Code (DGC) and IgCC Committee
- Developing and publishing proposed City (Staff) amendments
- Requesting public proposed amendments
- IECC Committee reviewing, addressing and voting on each amendment in the formal code committee public meetings

- Providing summaries of the proposed amendments and track changes versions online

NEXT STEPS IN CODES

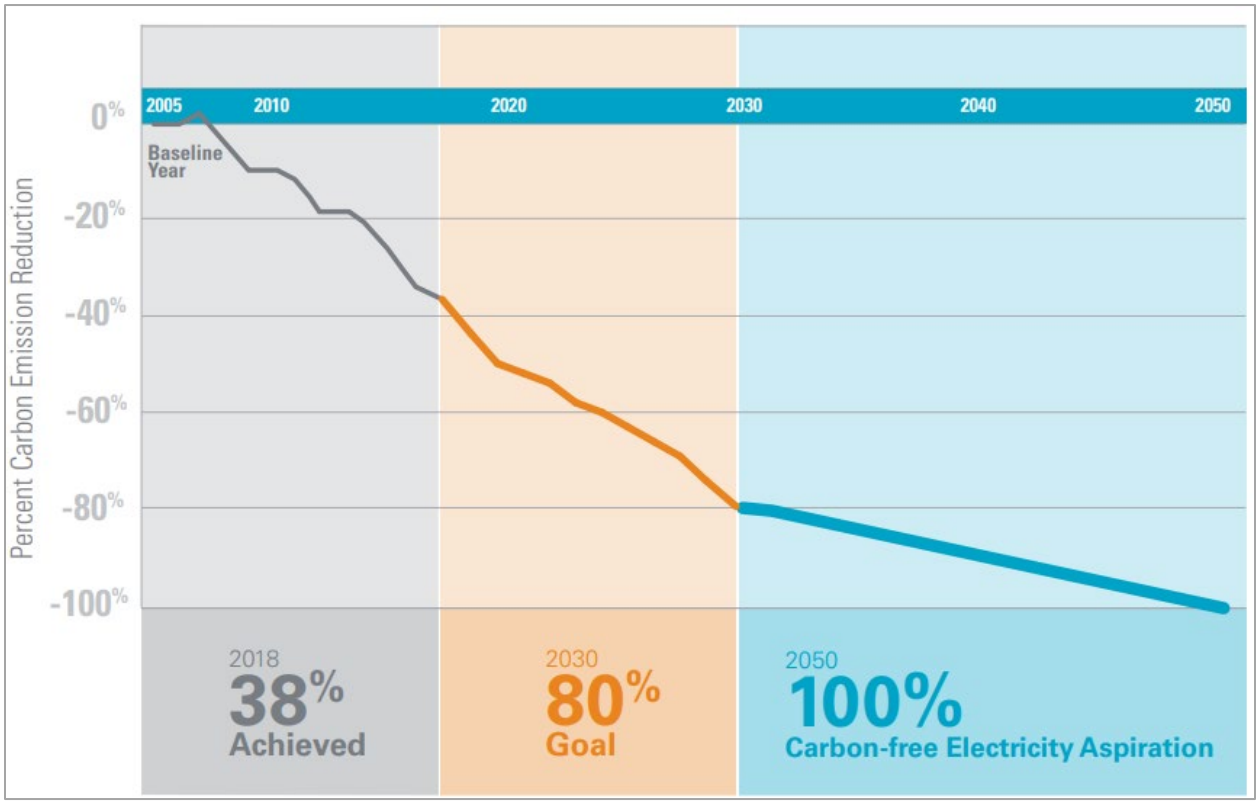
Denver is working with NBI to develop draft code proposals based on the 2021 IECC that meet the goals and recommendations in this NZE Plan. This is further detailed at the end of this report in "How it All Comes Together." More broadly, the transition to a performance-based code that includes predicted energy use targets represents a significant paradigm shift. As Denver embarks on this process there are a number of important considerations that must be considered in future code cycles. These include:

- Selecting **performance metrics** that are compatible with existing modeling software, encourage building efficiency, and are aligned with Denver's objectives, especially in regard to promoting electrification.
- **Periodically calibrating the energy targets to the prescriptive path so that they deliver reasonably consistent energy outcomes.**
- Addressing **building verification** and how outcomes will be enforced. In early code cycles, this is expected to start by simply comparing modeling estimates to the code performance targets for a particular building type. **In future code cycles, the actual performance of buildings would be compared against the modeled energy targets.**
- Developing a **feedback loop** for energy modelers to develop capacity in the use of assumptions and tools so modeling outcomes become more predictive of actual energy outcomes. **Comparing building verification to benchmarking data will enable a feedback loop between actual performance outcomes and the energy code.** It will also inform the code development process so that lessons learned about modeling best practices can be integrated into the modeling requirements.
- Clarifying **backstop requirements** to ensure efficiency is consistently incorporated in buildings and to prevent projects from trading-off building efficiency with renewable sources.
- **Creating normalization approaches and procedures that address variations in performance due to weather, occupancy, and/or other factors for when actual performance is compared to code targets.**
- Ensure that **stakeholders** are informed and capable to deliver new code approaches, including using lessons learned from performance verification to educate other practitioners in the energy modeling community.
- Work to **integrate efficiency with overall decarbonization**, electrification and renewables approaches and goals.
- **Clarify how energy is related to carbon to ensure that this aim for zero energy is achieving carbon reduction goals, recognizing that the relationship between energy and carbon is dynamic and will continue to change over time as the grid is decarbonized.**
- Developing policies that can better address **unregulated loads**. Figure 17 includes an example of this issue from Washington state. It shows the regulated versus unregulated end uses by building type. In order to meet Denver's performance goals, it will be necessary to address these unregulated loads that are not within the scope of the energy code through a policy such as an outcome-based code or building performance standard.

NZE: ALL-ELECTRIC

The second foundation of NZE within Denver's net zero energy definition is all-electric buildings and homes. Buildings and homes together represent 64% of the 2019 GHG emissions. Because Denver is a heating climate, the majority of the emissions from buildings and homes are from heating and water heating. As previously mentioned, 40% of buildings will be "new" in 2050. As a result, if these 40% of "new" buildings are net zero and all-electric, that will significantly reduce Denver GHG emissions. Denver is also working on a Beneficial Electrification Implementation Plan for Existing Buildings. This will address how to strategically electrify the existing buildings within Denver.

In addition to addressing on-site emissions from buildings and homes, another aspect of reducing emissions within Denver is addressing emissions from electricity generation. Xcel Energy, the electricity provider in Denver, has committed to reducing emissions from electricity generation by 80% in 2030 and 100% by 2050. Currently in Denver's building stock, electricity comprises 66% of building emissions and natural gas comprises 33% of the building emissions. As the grid is decarbonized so swiftly, in 2030 electricity will comprise only 40% of building emissions and natural gas will comprise 60% of the building emissions.



Source: Xcel Energy Carbon Report

Figure 19. Xcel Energy Carbon Reduction Trajectory: Clean Energy Transition 2030 and 2050

Benefits of Electrification

In addition to emissions reductions, there are a number of co-benefits from building all-electric including efficiency, health, and cost savings. While energy efficiency is a separate foundation within this report, it is important to note that when transitioning from gas to electric heating (both space and water heating), heat pumps are significantly (200-300%+) more efficient than gas equipment. As a result, there are operational cost benefits from this energy savings.

Cooking is another common end use for natural gas. **When cooking with electric stoves there are not only emissions benefits but significant improvements to indoor air quality.** As detailed in the study Health Effects from Gas Stove Pollution, a meta study looking at the association between gas stoves and childhood asthma found children in homes with gas stoves have a:

- 42% increased risk of experiencing asthma symptoms (current asthma),
- 24% increased risk of ever being diagnosed with asthma by a doctor (lifetime asthma), and
- 32% increased risk of both current and lifetime asthma, overall.

There are additional benefits from induction including energy efficiency and safety with reduced burns and lower risk of fire.

Finally, there is a cost benefit (savings) from constructing an all-electric building. **When gas is eliminated entirely from the building, there is a significant cost savings by removing gas distribution and gas supply to the building.** The cost benefits are detailed below in the "Cost Considerations and Study: All Electric" section.

Goal

The current goal is that heating emissions are reduced 50% by 2040. Additionally, the Climate Action Task Force recommends that all new homes are net zero emissions by 2024 and all new buildings are net zero emissions by 2027. This goal is the result of all-electric equipment for heating, hot water heating and cooking in buildings and homes.

While the focus of this NZE Plan is new buildings and homes, Denver also has all-electric goals for electric vehicles (EVs). Because charging stations are increasingly tied to buildings and homes, EVs in the code are also included in this section. Denver's current 80x50 Climate Action Plan goal is for 100% of light-duty vehicles to be electric by 2050. Additionally, the Climate Action Task Force recommends an emissions-free transportation system by 2040. This is further detailed in the Denver Electric Vehicle (EV) Action Plan.

The two major energy fuel sources for buildings in the U.S. are electricity and natural gas. "Mixed-fuel buildings" have utility connections for both electricity and natural gas. An all-electric building is a building where the only utility infrastructure is electricity and major energy systems are served by electricity. Electric loads can be directly offset with renewables, while gas combustion cannot. Therefore, as the supply for the electrical grid decarbonizes, all-electric buildings can leverage increasingly clean fuel sources to achieve long-term carbon reductions beyond what can be accomplished in mixed-fuel buildings.

NZE Foundation: All-Electric

Getting to all-electric as part of Denver's net zero energy definition will reduce greenhouse gas emissions through all-electric equipment in buildings and homes. There are a number of considerations in getting to all-electric buildings detailed in the sections below. The first is whether all-electric buildings and homes are technically feasible in Denver. This looks at the equipment needed for heating, water heating, and cooking. Secondly is if the market in Denver is ready for all-electric through interviews with stakeholders to understand available equipment, code and regulatory gaps and barriers, and support (incentives, education, outreach, etc.) needed. Next, the proposed all-electric targets are detailed including considerations for electric vehicles. Finally, all-electric cost considerations are detailed to understand the impact for buildings and homes in Denver.

All-Electric Feasibility in Denver: Heating, Water Heating and Cooking

Many jurisdictions have or are considering electrification policies to meet carbon reduction goals. Cities in California have led this effort thorough the adoption of electrification reach codes. It is important to note that while carbon impact is one of the driving motivations for electrification, most of them are prohibiting new gas hookups based on life safety issues such as indoor air quality, fire safety and earthquake safety. Cities like Berkeley and San Jose have prohibited natural gas hook-ups in some or all new buildings. Other cities have adopted reach codes that incentivize all-electric buildings by requiring greater efficiency from mixed-fuel buildings and electrification-readiness for gas loads.

Work done to support these policies in California can inform Denver on the issues of electrifying buildings. Work done to date includes cost effectiveness studies done for all-electric buildings and an "experts roundtable" meeting in San Jose. The roundtable brought together stakeholders and technical and market experts and provided significant insight into the barriers and opportunities for building electrification.

The loads commonly served by gas include water heating, cooking, space conditioning and miscellaneous loads. Different loads may pose greater or lesser degrees of difficulty to electrify. The feasibility of all-electric buildings has multiple facets including: the availability of electric equipment, the availability of the expertise necessary to design and install that equipment and the market acceptance of that equipment. While market acceptance is not a technical feasibility issue, it is an important consideration because consumer perception and preferences can create a non-technical barrier to electrification.

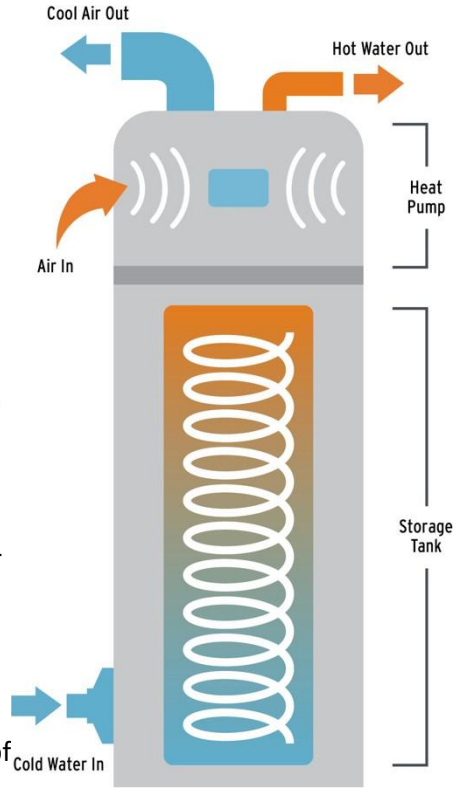
WATER HEATING

Not all electric water heating is the same. The electric water heating equipment category includes both lower-efficiency electric resistance and higher-efficiency heat pump technology. Electric resistance equipment generates excess heat resulting in poor efficiency. In fact, buildings with resistance water heating may have a difficult time complying with Denver's energy code. Therefore, this section focuses on the feasibility of the more efficient heat pump water heater (HPWH) systems and the technical issues related to that technology.

Heat pump-based systems move heat from the surrounding air or another source into the water. Since they work by moving heat rather than creating it, HPWHs are capable of achieving levels of efficiency 3-4 times their electric resistance counterparts and 4-5 times as efficient as their gas counterparts.

There are a handful of high-level technical considerations in the use of heat pump equipment for water heating:

- ***Storage Tank Size.*** Heat pump water heaters are generally slower at heating water than electric resistance or gas water heaters, therefore they tend to require larger storage tanks to act as a buffer against demand. For example, a load that could be served by an electric resistance or gas water heater with a 30-gallon tank would generally require a 50-gallon tank with a heat pump water heater, or a 65-gallon tank for a heat pump water heater replacing a 40-gallon gas or electric resistance water heater. These larger tanks need to be incorporated into the building design, and the space requirements could have impacts on building layouts if not considered early in the design process.
- ***Access to air source.*** Since HPWHs move and concentrate heat instead of creating it, they need a source of heat. Most HPWHs simply use ambient air, so generally the source of heat is the air around the heat pump. The heat pump therefore needs access to a large enough volume of air to provide the heat to "pump" into the water. If heat pumps are located in a traditional water heater closet or "boiler room"-sized space, this poses a challenge for heat pumps, because they will quickly extract all of the heat from the air in the room.



Source: The Environmental Center

Figure 20. How a HPWH Operates

- ***Impact on space conditioning.*** Even in a heating-dominated climate like Denver's, a HPWH's impact on space heating when located within the conditioned space is much less than the efficiency gains. Taller buildings tend to be more dominated by internal heat gains than shorter residential buildings, so those buildings may even see a space conditioning benefit from the HPWH's cooling and dehumidifying impact.
- ***Other sources besides air.*** Some HPWHs utilize water source heat pumps that use another source of water (such as a ground source loop that pulls heat from underground, or warm wastewater) and therefore do not need access to a minimum volume of air.
- ***Dehumidification***. Since air-source HPWHs take heat from the surrounding air, they will cool and dehumidify the area where they are located. This can actually be advantageous in some circumstances, especially in buildings dominated by cooling loads.
- ***Acoustics***. Heat pump water heaters generate noise, similar to chillers, air-handlers and other types of equipment. The level of noise varies considerably but is lower than earlier generations of HPWH equipment. Noise can be an issue in some applications – such as apartments – but water heaters are often located in locations where noise is not a significant issue.

- ***Efficiency***. Some heat pumps are far less efficient when heating warm versus cold water. This has an impact on the design and equipment selection in central water heating systems (discussed in greater detail below).
- ***Capacity and electric service size***. The larger storage tanks used for heat pump water heater systems mean that heat pump water heating systems generally use equipment with a much lower equipment capacity than their gas counterparts. This reduces the impact on electric service size.

Individual vs. Central Systems

Hot water is delivered by two basic configurations of equipment: individual systems and central water heating systems with recirculation loop.

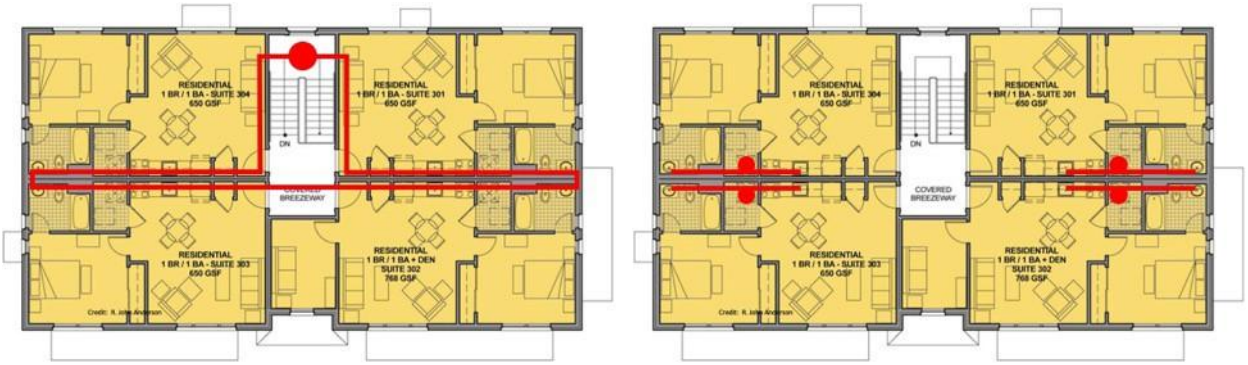


Figure 21. Central Water Heating with Recirculation Loop (left) vs. Individual Water Heaters (right) Connected Directly to the Hot Water Points of Use

In individual water heating systems, the water heating equipment and the points of use for hot water are located close together; hot water flows directly from the equipment to the point of use. They cannot be located too far apart or else it will take too long for a user to get hot water from the equipment. Long wait times are an inconvenience to users, and hot water cooling in the pipes is a major source of energy losses. Individual systems are generally smaller (in a single-family residence) but can be quite large in applications such as restaurants or laundries.

The decision to use a central system generally is driven by the space constraints of taller buildings. In a central system, there is greater distance between the water heating equipment and the points of use, and the points of use are not connected directly to the equipment. Instead, both the equipment and the points of use are connected to a recirculation loop that distributes hot water around the building. The recirculation loop ensures that there is always hot water near the points of use even though they may not be near the water heating equipment. The recirculation loop has to be kept hot when hot water draws are needed, which can be most of the day in buildings like apartments. **The heat losses from a central system's distribution system mean that, on a whole-system basis, they are generally less efficient than individual systems.**

Individual Systems

Individual systems are used in both residential and commercial occupancies in both low-rise and high-rise buildings. Smaller individual systems are generally integrated heat pump water heaters where the

heat pump and the water storage tank are integrated in a single piece of equipment. Although they exist, split systems where the tank is separate from the heat pump are not common in individual systems.

Smaller individual systems are used in single-family homes. The type of HPWH used in this building type is already widely available and most of the barriers can be solved with thoughtful but simple design solutions. Basements and garages are good locations for HPWHs since they provide noise isolation and air temperatures that are more temperate than Denver's outdoor temperatures, especially in the winter. Locating equipment in a garage does create thermal envelope penetrations, so these will need to be carefully addressed in the air barrier sealing.

Individual dwelling units in multifamily buildings also may have individual HPWH units. Individual water heaters generally become less common as multifamily buildings get taller and space becomes more valuable, and this holds true for HPWHs. The larger space required for heat pump water heaters only exacerbates that issue. The need for access to a volume of air can be an issue in multifamily applications. Split-systems are generally not possible because of the building size and the distance that would be required between the heat pump and the tank. Putting the heat pump water heater in a closet with a louvered door is not likely to provide sufficient air flow for efficient or even effective operation, and the noise generated by the heat pump can be a problem in the compact dwelling units typical of mid-rise multifamily.

Some heat pump water heaters can be vented to the outside, but that creates envelope penetrations and adds the expense of ductwork. Some projects have acoustically isolated the heat pump water heater from the dwelling unit and connected it to the air of the corridor instead. This confines the noise to the corridor where acoustics are less critical. This approach may make individual systems more practical in some multifamily projects. Another potential solution is to design the dwelling units so that their hot water points of use are all clustered together which allows multiple units to be served by an individual water heater. The efficient pipe layout keeps hot water wait times acceptable without the use of a recirculation loop. One of the advantages of individual water heaters in each dwelling unit is that it vastly simplifies metering each dwelling unit. This approach creates complexities for energy metering similar to those for central systems with a recirculation loop.

Individual systems are frequently used in commercial buildings for individual lavatories or kitchenettes. These are often smaller integrated units. Larger equipment is also used for commercial kitchens and laundries. Larger systems are more likely to utilize split systems where the tank is separate from the heat pump. Multiple integrated heat pump water heaters can be combined to provide sufficient capacity for a larger hot water load. Likewise, multiple split-system heat pumps can be connected to a single larger storage tank to provide sufficient capacity for a larger load. Currently, the latter appears to be the more common approach for larger loads.

Central Systems

In central systems, the water heating equipment is located in a central location or distributed central locations. Central systems are far more common than individual systems in buildings with larger, but distributed, water heating loads, especially mid- and high-rise multifamily buildings and hotels. If the loads are smaller and distributed – like bathrooms and kitchenettes in a large office building – multiple individual water heating systems are typically used. Central systems also will sometimes utilize multiple

larger integrated heat pump water heaters piped together to increase capacity, but this is less common than split systems in central systems.

In larger buildings, it can make sense to break the building into multiple water heating zones, but this is not unique to heat pump water heater systems. In fact, most of the more challenging technical issues in central water heating systems in taller buildings are not due to electric versus gas equipment at all. In tall buildings, managing the pressure that results from piping water vertically is often the most complex issue.

Figure 22. Central Gas Water Heating System (left) and Central Heat Pump Water Heating System (right)

The defining feature of the central system is the recirculation loop. Hot water is pumped through the recirculation loop to bring hot water closer to the points of use. The water in the recirculation loop needs to be kept hot when hot water draws are expected. In effect, there are two hot water loads: heating cold water for use in the building and maintaining the temperature in the recirculation loop. In a gas boiler system, these two loads are typically served simultaneously by the boiler. The return water from the recirculation loop is simply routed back through the boiler to get it hot again. However, this strategy can create an issue for some heat pump water heaters because some heat pump water heaters are not as effective at reheating warm water as they are at heating cold water (also an issue for high efficiency condensing natural gas boilers). Therefore, if warm water is recirculated to the heat pump, the efficiency of the system can drop dramatically to levels delivered by electric resistance equipment.

The recommended approach for addressing this issue is to separate the water heating and recirculation loop temperature maintenance loads and serve them with separate equipment. With this strategy, a heat pump water heater that is more effective at heating cold water can be selected to heat incoming cold water while a heat pump water heater that is more effective at heating warm water can be used to keep the recirculation loop hot. Some practitioners have developed highly effective and very sophisticated strategies to maximize the efficiency of this approach. However, it also can be done with more straightforward and effective designs.

The large storage tank of hot water used in central heat pump water heating systems acts as a buffer for demand but also can pose a design issue. Gas systems typically use large-capacity gas boilers with smaller tanks instead of buffer tanks to meet hot water demand. With electric HPWH systems, designers will need to accommodate larger tanks – which could contain thousands of gallons of water in some

buildings – in their designs. Ideally, this is done very early on in order to minimize the cost to change the layout of the mechanical rooms.

Just as with individual systems, access to sufficient air for central HPWH systems can be an issue. Heat pumps cannot be located in the same kind of small rooms typically used for boilers. The ambient air simply will not have sufficient heat for the larger water heating loads. Therefore, mechanical rooms might be vented to bring in air through louvers or ductwork. The heat pumps themselves can be vented to another space, and most split system units are designed to accommodate this venting. Heat pumps even can be ducted to the exhaust air of the building and recover the waste heat and improve efficiency, or a garage exhaust system can be used as a source of outside air. Parking garages provide more temperate air than the outdoors and can be an ideal location for central HPWH equipment in Denver's climate.

Transforming the Market for Central Heat Pump Water Heating

Industry and incentive programs (including Xcel Energy) are already actively engaging in widespread market transformation efforts for smaller individual HPWHs. The biggest barrier to the electrification of central water heating systems in new construction is that the gas equipment cannot just be replaced with a heat pump water heater. A central heat pump water heater system has different design requirements that, while not especially complicated, are different from the standard designs for gas systems that have prevailed for years. According to interviews with some practitioners, the learning curve for central heat pump systems is much less than other high-performance systems such as chilled beams or ground source heat pumps.

While the technology for these systems is widely available, finding the equipment through distributers can still be an issue. Without more practitioners with experience and expertise with these systems, distributors tend not to stock the equipment, which creates a bit of a catch-22. Right now, a small number of firms are successfully designing central HPWH systems. Leveraging and highlighting their success provides an opportunity to transfer the knowledge and lessons learned by these pioneers to the broader market. Xcel Energy is working with distributers on midstream incentives to distributors regarding HPWHs as part of their Xcel Store. Xcel Energy also has rebate programs promoting HPWHs that could be expanded. This is valuable for both new construction and existing building retrofits, which can be more complicated, especially when transitioning from gas to electric equipment.

Denver might employ a number of strategies to address the barriers of lack of product availability and lack of awareness, including:

- ***Design workshops***. Denver could host professional development workshops where more experienced practitioners can train their peers how to effectively design central heat pump water heater systems. These workshops would preferably come with professional education credits since practitioners already have a need for continuing education.
- ***Technical support from the City*.** Denver could contract with some of the more experienced practitioners to assist and mentor project teams with less experience. In this way, the experience of the small number of experienced practitioners is spread out more broadly. Practitioners who are new to the design approaches would learn from more experienced practitioners and would have greater success in their early projects.

- ***Guidance Documents.*** **A technical guide on how to design central heat pump water heating systems could be used by practitioners unfamiliar with the systems.** Since there is a broader need for this kind of guidance, Denver may be able to partner with other cities (e.g., San Jose) and organizations (e.g., NBI) to create this guidance document.
- ***Equipment Manufacturers*****.** Many manufacturers of equipment hold regular education and training sessions at their distributors or in the offices of design engineers. Denver could host similar training sessions open to the profession.
- ***Utility Incentive and Continuing Education Programs***. Denver can continue to work with Xcel Energy and its incentive programs to promote HPWHs, as well as leverage Xcel's existing trade allies' programs to disseminate resources**.**

SPACE HEATING

Heating is the primary HVAC load that uses natural gas combustion, since air conditioning and ventilation are already almost universally provided by electric equipment. In the transition from gas to electric, it is critically important to note that electrifying heating loads does not mean utilizing electric resistance heat. **Just as heat pump water heaters can produce hot water far more efficiently than resistance water heaters, heat pump space conditioners can produce warm air far more efficiently than resistance heat systems.** It can be difficult, if not impossible, to meet Denver's new energy code with electric resistance equipment unless they are serving small loads.

Historically, performance of heat pumps in cold climates like Denver's has been a challenge. However, many manufacturers have released cold climate models that can efficiently deliver heat down to -17 degrees Fahrenheit. These models tend to be more efficient in all temperature ranges. The Northeast Energy Efficiency Partnership has a cold climate heat pump initiative and has both guidance and product lists that are relevant to Denver.

Electrification of Mid-Rise and High-Rise Heating Systems

Electric heating technologies already are widely used in mid- and high-rise buildings and generally understood. Some mid-rise buildings can use the same technologies and equipment as low-rise buildings. For example, some multifamily buildings use split-system heat pumps where each unit has its own outdoor heat pump located on the roof. Many buildings can also use variable refrigerant flow (VRF) systems where multiple indoor units are connected to a single outdoor heat pump. There are limits on the length of the refrigerant line that connects the indoor and outdoor units (these vary by equipment), so they are more common in mid-rise buildings. The through-the-wall packaged heat pumps that are common in hotels can be used in taller buildings, and only become less common when buildings start to use curtain wall systems for the building envelope.

As buildings get taller, they have fewer system options in general, not just when considering all-electric buildings. Mixed-fuel high-rise buildings generally use a chiller and boiler to provide cooling and heating loops that serve equipment inside the building. Heat pumps and "reverse chillers" can be used to provide heating in these systems instead of boilers. It is important to note that as buildings get taller, they become more and more dominated by cooling loads and less by heating loads. This means that a tall building can be providing air conditioning to the spaces even during the winter when people's homes would be providing heat. **As a result, as buildings get taller, cooling equipment becomes more**

dominant and heating equipment becomes smaller. This makes it more feasible to electrify the heating equipment for larger buildings.

COOKING

While cooking ranges and cooktops are the primary issue for gas use in residential cooking, commercial kitchens have a much wider array of gas equipment that includes equipment such as fryers. Electric equipment already exists for both residential and commercial kitchens. In fact, portions of the U.S. do not use gas (for example, in parts of Florida where ground conditions preclude gas infrastructure) but rely primarily on electricity for their energy needs. Equipment availability is not the primary issue for electrifying cooking loads because in both residential and commercial kitchens, electric alternatives to all major appliances are readily available.

Technically, there is a difference between cooking on gas ranges and traditional electric ranges. With gas ranges, the temperature can be changed more quickly and more minutely than traditional electric stoves. Electric resistance coil and ceramic cooktops tend to have a significant lag when changing temperatures and this has an impact on cooking. However, electric induction ranges offer a solution to this issue. These use an electromagnet field to "induce" heat in ferrous cooking vessels like pots and pans. They allow the temperature to be changed as quickly and minutely as gas. **Therefore, for cooking ranges, induction stoves offer an adequate alternative to gas.**

The issues for the electrification of cooking loads are very different for residential and commercial kitchens as discussed further below.

Residential Cooking

In residential cooking, the primary barrier is a market preference for gas cooking by some consumers, and developer perception of market preferences. Gas cooking is seen as an amenity, and sometimes an essential amenity in higher-end projects. There are recent studies indicating that customer perception may change with increased exposure to induction cooking. A recent customer research study conducted by the Sacramento Municipal Utility District (SMUD) found that 79% of customers had a negative impression of induction cooking prior to trying it, but a 91% positive impression afterwards.[8] Additionally, many people believe that "gourmet" stoves are gas models, but in 2018 Consumer Reports rated induction cooktops far ahead of gas in terms of performance.

Induction models are often more expensive than electric resistance or gas models. Induction cooking provides a cooking experience more like gas cooking, but induction cooking is not the only electric cooking option and many consumers are satisfied with electric resistance cooking.

Source: Consumer Reports

Figure 23. Consumer Reports 2018 – 10 Top Rated Cooktops

The decision to use gas cooking in residential actually comes at a considerable cost. The infrastructure required for gas cooking is substantial, especially in multifamily buildings. Gas cooking also creates the need for more indoor ventilation, which increases the size and cost of the ventilation system. Gas cooking is also very inefficient, with only about 30% of the energy consumed making it into the food, while electric cooking equipment can approach 90% efficiency.[15] **Perhaps most significantly, gas cooking has a tremendous impact on indoor air quality. Gas cooking can release levels of pollutants that, if they were measured outside, would violate the Clean Air Act.**[16] As a result, households with gas cooking have nearly three times the rate of treatment for asthma.[17]

Outreach and education programs can be used to address these issues. Denver could create an induction check-out program where residents could check out an induction countertop unit to give it a try and could host induction cooking workshops. As first step for outreach, through the American Cities Climate Challenge, the city worked with Sierra Club who developed a one-minute video that explains the concept of building electrification and the indoor air quality issues of gas cooking.

Commercial Cooking

As for residential cooking, the electric equipment for commercial kitchens is readily available. National food restaurants, for example, have both gas and electric options for their restaurants depending on what utilities are available. However, in many commercial kitchens, the use of gas is more than just a market preference. Commercial cooking is a production process and comprises part of the business model of restaurants. Professional chefs are often trained on gas equipment and the cooking processes

[15] Frontier Energy. "Residential Cooktop Performance and Energy Comparison Study." Prepared for Sacramento Municipal Utility District, July 2019.

[16] Gillis, J. and Nilles, B. (2019). "Your Gas Stove Is Bad for You and the Planet" The New York Times. http://www.nytimes.com/2019/05/01/opinion/climate-change-gas-electricity.html

[17] Jarvis et al. (1996) "Evaluation of asthma prescription measures and health system performance based on emergency department utilization." https://www.ncbi.nlm.nih.gov/pubmed/8618483

in kitchens have often been built around the specifics of gas equipment. **Therefore, electrification requires a change to production and business practices, not just market perception.**

However, induction cooking is making inroads, even in commercial kitchens. Since it only heats the pots and pans, induction cooking is safer than gas or electric resistance cooking. There is less chance of a fire, and less risk of burns for cooking staff. Induction ranges also put less heat into the kitchen, making them more comfortable and more likely to meet the new OSHA indoor occupational heat standards while reducing cooling loads. Many of the commercial kitchens in Silicon Valley tech office buildings are all-electric, and some global tech firms are now working to transition all of their kitchens from gas to electric. **Denver could work with a handful of local restaurants and top chefs to pilot all-electric kitchens to provide an example for other commercial kitchens.**

OTHER GAS LOADS

There are a number of other smaller gas loads that need to be considered in any electrification strategy.

- **Clothes Dryers:** Electric clothes dryers are widely available at the residential scale. Larger "commercial" electric dryers are also widely available. However, electric models are less common among very large commercial dryers such as those used in commercial laundries and hotels. **All-electric buildings with very large laundry loads may need to alter their designs to accommodate different equipment layouts that utilize different dryer models.** Heat pump dryers also can be an effective alternative to gas dryers.
- **Gas Fireplaces:** There are electric alternatives to indoor gas fireplaces. One technology utilizes LED lighting to create a fairly convincing approximation of flames. **It is worth noting that gas fireplaces were introduced as an alternative to wood fireplaces, and they too were only an approximation of the wood fires they replaced.**
- **Gas Barbecues:** There are electric alternatives to free-standing gas barbecues. Additionally, most free-standing barbeques are fueled by portable propane tanks instead of being connected to natural gas infrastructure. These would not be impacted by a policy that addresses natural gas utility hook-ups.
- **Swimming Pools:** Swimming pools often use gas boilers or water heaters to maintain pool temperature. Heat pump boilers are capable of filling this purpose. Additionally, many pools make use of solar thermal systems that use solar energy to heat water, so it is possible to eliminate this gas load without adding any electric load or equipment. **The lower water temperatures needed for pools makes solar thermal heating particularly well-suited to pool water heating.**

IMPACT ON ELECTRICAL INFRASTRUCTURE

The increased electrical load that can result from electrification may have an impact on costs and the electrical infrastructure that serves all-electric buildings. These considerations include the impact on electrical service and transformer size. There are several important considerations that can mitigate the impact of electrification on the electrical capacity of a building:

- Denver's new energy code is more stringent than most other energy codes in the U.S. **New buildings in Denver will be considerably more efficient than buildings in other jurisdictions.**

The impact of electrifying gas loads is therefore less than other jurisdictions with similar climates and less efficient buildings.

- **Where a building also has cooling, electrifying the heating load has less, or even no impact on the building's electrical capacity.** When heating can be provided by the same equipment that provides cooling – as is the case with heat pumps – electrifying the heating load frequently does not require any additional electrical capacity.
- The heating capacity (output of equipment) required for heat pump water heater systems is considerably less than gas counterparts. The capacity of heat pump systems can be one-quarter to one-third the capacity required by gas water heating systems.
- Electrical service and transformer sizes are not very granular. There can be large steps between one transformer and the next size larger transformer and one electrical service size and the next size larger. As a result, some buildings have capacity to spare and some do not. It is very possible that some buildings will not need any additional capacity to accommodate the additional load, while others may trigger an increase in transformer service size. As a result, the impact of electrification on electrical service infrastructure costs (both in the building and from the utility) are difficult to predict.
- **Any costs from increases in electrical capacity would be mitigated by the savings from not installing gas infrastructure to the site. In a set of cost-effectiveness studies for California's Electrification Reach Code, all-electric buildings cost less to construct in most cases examined.** [18][15]
- Electrical codes allow the required capacity of the electrical service to be reduced when load management equipment is installed in the building. Load management equipment turns off or reduces the power to parts of the building in response to the amount of electrical capacity that is otherwise available. This equipment can be leveraged by the utility to reduce or even avoid the need for increased electrical infrastructure in buildings due to the electrification of loads or even the addition of electric vehicle charging infrastructure. While load management equipment has historically been targeted toward larger buildings and larger loads, "smart" electrical panels and other smaller equipment is bringing this functionality to smaller buildings, even single-family homes.

IMPACT ON EQUITY

While any market transformation effort comes with its own set of equity considerations, electrification brings to the table the unique challenge of natural gas infrastructure acting as a stranded asset. The cost of safely maintaining the natural gas system is set to grow while infrastructure costs and safety upgrades combine with a decline in demand as buildings transition away from fossil fuels. **It is vital that the most vulnerable populations, whether they be low-income, communities of color, renters or others, are not the last customers to electrify.**

Within the new construction context, it is imperative to place an exaggerated focus on building new low-income housing as all-electric, such that property owners are not delaying the electrification of their building at the expense of their tenants increasing heating bills. Heat pumps also provide the

[18] "2019 Nonresidential New Construction Reach Code Cost Effectiveness Study." Prepared by TRC Advanced Energy and EnergySoft for California Energy Codes and Standards Statewide Utility Program. Draft – 2019.

opportunity to provide air conditioning for low income residents who previously may have foregone cooling as an unaffordable luxury. This is especially crucial due to heat island effects. Due to lack of green space, and a high density of heat trapping concrete and asphalt, marginalized neighborhoods in Denver can be upwards of 12 degrees Fahrenheit hotter than other neighborhoods throughout the city. In addition, marginalized communities experience higher level of respiratory diseases due to poor indoor and outdoor air quality, providing yet another reason for electrification of any and all low-income housing.

ALL-ELECTRIC FEASIBILITY IN DENVER: KEY CONSIDERATIONS

The key considerations regarding all-electric feasibility in Denver include:

- **Equity must be a key consideration in electrification strategies.**
- Equipment most often served by gas in buildings includes space heating, hot water heating, kitchen loads, and miscellaneous loads such as gas dryers, fireplaces, barbeques and swimming pools.
- Electric replacements for gas equipment are generally available, although there may be some challenges with local distributers stocking practices for some electric equipment. This is expected to decrease with more local examples. Incentives and education programs can help accelerate this transition.
- The load that poses the greatest difficulty for electrification is central water heating systems in multifamily buildings and hotels. **The equipment is available, and the design approaches are well established. The issue with central water heating systems is that there is a need for more practitioners who have experience and expertise to effectively design them.** Possible ways to address this barrier include training workshops, technical resources, and technical assistance.
- Kitchen equipment faces a strong perceived market preference for gas, especially in higher end residential and in restaurant settings. Developers of multifamily buildings may see gas as a sales point, and restaurant staff have frequently been trained on gas equipment so cooking processes revolve around gas equipment. Addressing these issues may require public outreach and pilot programs that demonstrate the advantages of all-electric cooking over gas cooking and help overcome the market perception and business practice hurdles.
- Electrification of buildings could have an impact on the electrical infrastructure needed both on- site (service size and on-site transformers) and the grid. This impact can be unpredictable from building to building and can be mitigated through the use of load management equipment.
- **The elimination of gas infrastructure comes with significant first-cost savings that can offset increased life cycle costs that might result from electrification.**
- There are both long-term and short-term equity issues, and as markets continue to electrify on their own, those members of society least able to electrify their buildings will have to bear an increasing share of the cost to maintain natural gas infrastructure.

Denver Market Readiness Assessment for All-Electric

The current state of all-electric buildings is a critical consideration for Denver to reach net zero emissions. This section outlines the state of Denver's market, and its readiness to adopt all-electric building designs more broadly. It addresses the lack of market adoption of all-electric buildings and the low level of awareness or market readiness which will need to be overcome to achieve carbon neutral buildings. It also discusses the market barriers to all-electric design that have led to its low to non-existent adoption and strategies that Denver could adopt to address those barriers.

While the market readiness assessment for all-electric examines the market barriers for building electrification in detail, there are a few high-level, fundamental issues including:

- There is no functional all-electric building market in Denver yet. There are all-electric buildings, but they are rare and the result of happenstance or niche building such as accessory dwelling units (ADUs). There is a very low starting point for an effort at market transformation in Denver and the market will need to be educated about building electrification.
- Operating costs pose the most substantial market barrier. The very low cost of natural gas and Denver's heating-dominated climate mean that building electrification, when not paired with (perhaps substantial) efficiency, can have a significant impact on utility bills. This issue is particularly pronounced in residential buildings, which are generally dominated by space and water heating loads. **As a result, housing affordability is one of the dominant concerns and creates critical equity issues in any electrification policy that the City crafts.**
- Widespread building electrification of both new and existing buildings and homes will create substantial new loads that will need to be accommodated on the grid.

The basis for this assessment is a combination of sources including:

- Market issues that have been discussed on the national level and in other markets including:
    - A targeted "Electrification Experts Roundtable" held in San Jose in 2019
    - Multiple electrification sessions and the zLab electrification workshop at the 2019 Getting to Zero Forum
- A set of targeted interviews with 14 interviewees in Denver, conducted between June 15 and 30, 2020, with stakeholders active in both the Denver Commercial and Residential New Construction Markets including practitioners (architects, engineers, consultants, etc.), owners/developers, and code officials. An interviewee list and the interview instrument are included in Appendix A.
- Several reports on electrification issues including:
    - Equitable Building Electrification: A Framework for Powering Resilient Communities (Greenlining Institute)
    - The Economics of Electrification (RMI)
    - Building Electrification: Research Perspectives on Technologies, Policies, And Mitigation Strategies (Energy Innovation)
    - Building Electrification Report (Emerald Cities Collaborative)

NEW CONSTRUCTION VS. RETROFIT

The technical challenges of electrification can be very different for new construction and existing building retrofits, and these differences lead to some different market barriers. However, most of the market barriers identified– particularly issues around market perception and operating costs – are applicable to both new construction and existing building retrofits. The discussion of market barriers identifies those cases where an issue is specific to new construction or retrofits or between new construction and retrofits. Further detail on electrification of existing buildings in Denver will be part of a separate Implementation Plan specifically focused on Strategic Electrification for Existing Buildings and Homes.

THE STATUS OF ALL-ELECTRIC CONSTRUCTION IN DENVER

The stakeholders interviewed for this section uniformly stated that all-electric buildings are very uncommon and not often considered in Denver where heating demand is high and gas prices are inexpensive. Accessory Dwelling Units (ADUs) are the exception to this larger trend. For both code compliance and cost reasons, nearly all of the ADUs in Denver are all-electric.

Market Drivers

As all-electric buildings are still very rare in Denver, interviewees were asked about the drivers that are leading projects to *consider* all-electric design. They identified a handful of market drivers including ideologically motivated or mission-driven owners, zero net energy design, and limited regulatory drivers.

IDEOLOGICALLY/MISSION MOTIVATED OWNERS

The interviewees noted that owners motivated by ideology or mission are the primary driver for considering above-code building designs in general and all-electric designs in particular. These owners consider all-electric designs for various reasons including:

- **Carbon reduction:** Interviewees appear to have some doubts about whether all-electric buildings actually deliver lower carbon consumption with Denver's climate and electric generation mix (see "Market Perception" below). However, electrification is seen as a way to reduce carbon consumption now, or at least in the future, particularly when paired with renewable energy.
- **Air quality:** Electrification is seen as a way to improve both indoor air quality (particularly from cooking) and outdoor air quality, and by extension, a way to improve the health of occupants.
- **Zero Energy:** According to the interviewees, many net zero energy buildings in Denver do include natural gas. However, factors such as the International Living Future Institute's Zero Energy Certification gas prohibition are making all-electric design a larger consideration for net zero energy building projects.
- **Market Differentiation:** Some owners and developers are looking at low-carbon design as an option for creating market differentiation. This is in response to a couple of factors. The first is the increasing focus on carbon in the sustainable market. The second is that traditional market differentiators such as LEED have become more common and are less able to provide market differentiation.
- **Affordable Housing:** **Affordable housing owners tend to have a more holistic view of cost and are therefore more likely to consider the first cost savings that can be possible from an all-electric design.** Additionally, many of the Colorado Housing and Finance Authority programs

require the Enterprise Green Communities Criteria, which incentivizes all-electric design. (However, they are also more likely to consider the impact on operating costs for tenants, which could hinder the adoption of an all-electric design.) Affordable housing is not subject to the market pressures for gas cooking discussed in the "Market Perception" section.

REGULATORY FACTORS

The interviewees only identified one regulatory driver for all-electric design. Eliminating combustion and combustion penetrations makes it easier to meet the air leakage requirements for ADUs.

COST FACTORS

As discussed in the "Cost Barriers" section below, cost is a complex issue. Only one interviewee was able to think of a project that had considered an all-electric design based on the cost savings of eliminating gas infrastructure, and that was in a nearby market, not Denver.

However, cost is a factor in the decision for ADUs. Many of the costs for gas infrastructure are relatively fixed on a per-building basis. As a result, the infrastructure cost for gas is very high on a square-foot basis for ADUs with their small size. Additionally, ADUs are less likely to be impacted by the market drivers for gas cooking discussed in the "Market Perception" section.

Considerations for Market Buildout

One interviewee raised an issue that is important for consideration. This interviewee anticipated that the City of Denver itself effectively would be built out before Denver's 2030 goal. Once this occurs, most of the construction in Denver will be retrofits, site scrapes and multifamily projects. If this prediction is accurate, it will have a significant impact on how Denver structures its policies. It would make near-term new construction policies more important in order to have a more significant impact. It also would make existing building electrification strategies even more important beyond the near term.

MARKET BARRIERS TO ALL-ELECTRIC BUILDINGS

The interviews with the stakeholders revealed several market barriers to greater acceptance of all-electric construction. These barriers are all generally variations on cost and familiarity. Before addressing these issues in greater detail, it is important to address one overarching issue that emerged from the interviews. The interviewees frequently had a hard time distinguishing between all-electric buildings and zero energy buildings. Many responses focused on issues for zero energy buildings that have little or no bearing on all-electric buildings. The issue of familiarity is not just an issue with understanding how to create all-electric buildings – design, finance, build, market, etc. – but an issue understanding what all-electric buildings even are. The tendency to revert to thinking about zero energy buildings reveals how fully those buildings have taken over the mind-space for above-code, sustainable buildings. Electrification policies will therefore need to begin with establishing a basic level of understanding of what an all-electric building is and the role that they play in meeting Denver's goals.

Cost Barriers

Cost by far was identified as the major barrier to adopting all-electric designs. However, the issue of cost is more fundamental than whether projects can find cost-effective strategies in design and development. Natural gas is less expensive than electricity in Denver – "stupid cheap" as one interviewee characterized it – so all-electric buildings are not considered an option in the Denver

market. Beyond the lack of market awareness, all-electric buildings pose several cost barriers discussed below.

OPERATING COSTS

The very low cost of natural gas combined with Denver's cold climate means that operating costs of all-electric buildings can be substantially higher than mixed-fuel buildings, especially for residential buildings with higher space and water heating loads. While interviewees did not provide specific details, the overall perception was that it would take a substantially above-code performance for an all-electric building to have similar operating expenses to a code-compliant, mixed-fuel building. Denver's cold climate reduces the efficiency advantages of heat pump technology which means that the efficiency premium that an all-electric building needs to reduce the cost gap with a mixed-fuel building is at its lowest exactly when space heating loads are highest.

This operating cost gap was identified by the interviewees as serious particularly in residential buildings and especially problematic in affordable housing. Operating expenses for homes have a very direct impact on consumers and are often the second largest home expense (after mortgage/rent). Interviewees repeatedly raised the issue of housing affordability, both in terms of upfront and utility costs.

Affordability and Equity

The issue of operating costs is particularly important for housing affordability. Even small impacts on operating costs can have a substantial impact on households with constrained incomes, especially those already making monthly decisions about whether to pay for utilities, food or medicine. With Denver's cold climate and relatively inexpensive natural gas prices, there is the potential for significant impacts on housing affordability from electrification. **These potential cost impacts will be very important for Denver to address in its electrification policies to ensure equity.**

EQUIPMENT COST

Studies that have found that all-electric buildings are cheaper to build in other markets also have used a holistic approach to assessing cost-effectiveness. The lower cost of all-electric buildings typically relies mostly or entirely on the cost savings of eliminating the gas infrastructure on the site. In the discussions with the interviewees, it was clear that most projects are not considering cost in this holistic, project-wide manner, but at an individual equipment level. Electric equipment is often more expensive than its gas equivalent, therefore partial electrification generally comes with higher costs.

The interviews often assumed induction technologies when electric cooking was discussed. Induction cooktops are considerably more expensive than typical natural gas cooktops, creating the impression that electric cooking equipment is more expensive overall. This may represent an example where early market outreach around the effectiveness of induction cooking to replace gas cooking may have had unintended negative consequences.

RISK PREMIUM

When designers and installers are unfamiliar with a strategy or technology, they are more likely to add a "risk premium" to the cost of the project to insure against unexpected costs that stem from that unfamiliarity. The interviewees gave mixed messages about whether this would be an issue in Denver. About half of the interviewees took it as a given that risk premiums would impact cost, while the other

half did not expect a risk premium to be an issue. This difference in perspective did not align with any readily apparent factor, such as a focus on commercial or residential buildings.

Follow-up questions did reveal more detail. **Risk premiums were seen to be more likely when systems are more complex, and the market would be less familiar, which generally aligns with commercial systems.** Risk premiums also were seen to be more likely when subcontractors have more influence on design decisions. Many installers, especially those working on residential and small commercial projects, also provide the system engineering. A couple of the interviewees noted that installers were more likely to inflate their prices when faced with an unfamiliar technology due to the increased risk in proper installation. Additionally, these installers anticipate service calls if something does not work right, so they carry the highest risk. They also tend to have narrow profit margins that depend on replicability to maintain profitability. Installers even at times will overinflate the estimate on unfamiliar options specifically to drive projects toward familiar technologies and approaches. One interviewee brought up that these risk premiums had been applied to technologies like Variable Refrigerant Flow (VRF) when they entered the market but had since largely disappeared when the market became more familiar with them.

Design teams do not typically have the budget to put together a cost estimate to counter inflated costs from installers, giving the mechanical subcontractors significant influence on equipment selection. Additionally, estimates given earlier in a project are more likely to include padding to account for any unknowns, which only exacerbates this issue.

MARKET TRANSFORMATION COST

Interviewees noted that one of the strategies for keeping design and installation costs down is to use or adapt the same designs for building components over and over for projects, even reusing the same drawing elements and specification sheets from project to project. A bidder who can reduce the cost of their bid by leveraging existing design work is more likely to get the job. This introduces an additional "market transformation cost" to the adoption of new technologies and strategies. **Practitioners will need to invest time and effort into the creation of new standard designs and construction document templates.**

Grid and Service Capacity

Multiple interviewees expressed concerns about the impact of the increased electrical capacity that would be required by widespread electrification of buildings. This concern was two-fold: the ability of the grid to sustain significant increases in electricity demand and the impact on the electrical service size for buildings.

The interviewees repeated a concern that has often been expressed in other jurisdictions about whether the grid could handle such increased demand. This concern is exacerbated by the fact that PV and electric vehicle charging are also being simultaneously introduced to the grid. Even though PV is not a load, it still requires capacity on the grid.

The impact on service size was seen as real but not significant. For most commercial buildings, the increased cost was considered likely to be minimal and not a leading issue. In residential, the impact depends on the market segment. Many builders are already moving to 200A service in single-family homes, which was seen as sufficient capacity for an all-electric home. However, some low-end builders

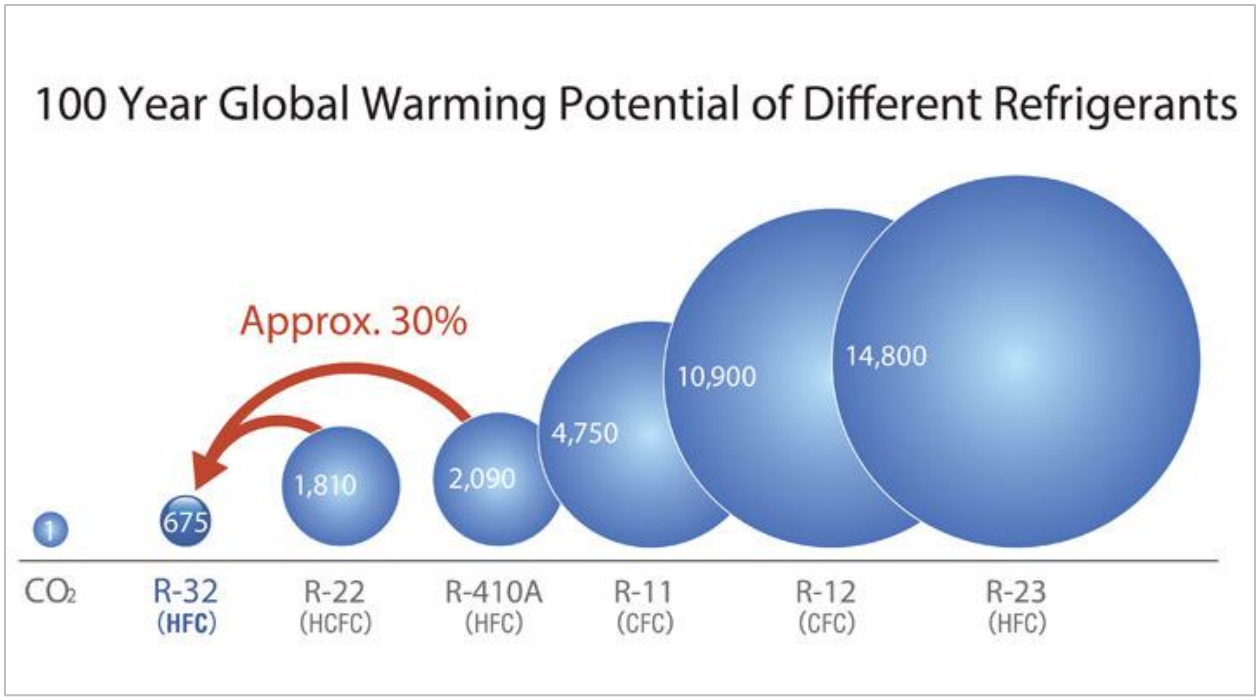
are still using 150A services, which could be problematic depending on the specific development and house.

A related issue with PV was noted by one interviewee. He reported that Xcel Energy uses a general rule to limit allowable capacity of an on-site PV system that is based on the home size. This approach lacks flexibility with no consideration for realistic production from the PV system (only system size). This also generally results in a system size that would be insufficient to achieve zero net energy in an all-electric home. Considering the overlapping motivations for zero net energy and all-electric buildings, this could force motivated home builders/owners to choose one or the other .

Market Perception

One of the biggest issues with market perception identified by the interviewees was that perception about heat pumps was often based on outdated information. The interviewees noted that perceptions of heat pumps – among both consumers and practitioners – was based on heat pump technology from 20-30 years ago or incorrect entirely. **Even some of the interviewees were not aware of recent developments in heat pump technology, particularly low-temperature heat pumps that have been designed to be effective in climates like Denver's.** One interviewee identified an unexpected common professional perception. He said that home inspectors often denigrate heat pumps during home sales based on issues from previous technologies. This gives a good sense of the scale of the fundamental issue of familiarity in the market perception of heat pumps.

Some of the interviewees also raised concerns among practitioners who are familiar with heat pumps about the impact of refrigerants. The global warming potential (GWP) of refrigerants can be thousands of time greater than that of CO2. The market is making progress in producing and adopting less harmful refrigerants and better safety precautions, but even these "cleaner" refrigerants can have a GWP hundreds of times higher than CO2. One interviewee noted that she had worked on a project that had a refrigerant leak that completely wiped out all the climate gains of the heat pump system in one event.



Source: Daiken Corporation

Figure 24. Global Warming Potential of Common Heat Pump Refrigerants

The interviewees identified a series of common perceptions from consumers, as well. The first is the same issue of familiarity. Consumers frequently know nothing about heat pumps or hold misconceptions. Many consumers are not aware of heat pump water heaters. Heat pumps are also seen as an expensive premium, or as one interviewee put it, "the Cadillac option."

The result is that market perception is a multi-faceted issue that needs to be addressed at the consumer and practitioner level. Market perception of all-electric buildings is hindered by a combination of unfamiliarity and outdated information, creating at least two distinct market education needs.

PERFORMANCE CONCERNS

The interviewees also identified legitimate construction concerns about the performance of heat pumps. These largely come down to heating capacity. For space conditioning, there was a concern if heat pumps would be able to output enough heat for larger homes due to the inherent inefficiency of larger homes and the more limited performance of HPs in cold weather. A couple of interviewees said that heat pumps often are installed in hybrid configurations with gas backup. The heat pump provides high-efficiency performance at less extreme temperatures and the gas equipment allows the heating load to be met at any temperature.

For heat pump water heaters (HPWH), there is a concern about running out of hot water because of the longer recovery times. One interviewee noted that plumbers sometimes amplify these concerns with the reality that Denver's inlet water temperature is colder than average. There was also a concern about the impact of locating a HPWH in a conditioned space and increasing the heating load or "stealing" heat from the space conditioning system. One interviewee noted that installers often set HPWHs to run

primarily in resistance mode out of a concern for heat pump mode performance issues leading to service calls.

Another concern raised by a couple of interviewees was whether all-electric buildings would really be less carbon-intensive than natural gas buildings. This concern brings together the issue of heat pump performance in Denver's climate and the perceived "dirtiness" of the electrical supply (grid). Denver's electricity generation continues to have a high percentage of coal generation. Natural gas messaging about it being a clean alternative to coal has been successful in reinforcing the idea that electric heating is therefore dirty. This can be addressed through the supports needed to reach NZE such as marketing and education.

COOKING

The interviewees identified cooking as a particularly challenging issue. Gas cooking is seen as an amenity, and a requisite amenity in higher end but even market-rate housing. Electric resistance cooking is seen as something that only goes into non-premium housing. One interviewee noted that the gas infrastructure for including gas cooking in multifamily is significant yet is still the norm. Where induction cooking is known, it is often seen as a fringe technology that will require an investment in all new pots and pans on top of the higher equipment cost. As one interviewee put the market perception: "Electric resistance is seen as cheap and induction is crazy."

Availability of Equipment

The consensus of the interviewees was that the availability of electric equipment is generally not an issue. They noted that most local distributers are representatives for larger regional or national companies. Heat pump equipment for smaller projects might not be as available in supply houses as smaller gas equipment, but it can be ordered readily. For larger projects, equipment is generally ordered anyway.

The major issue identified was that heat pumps for space heating do not offer the same level of equipment diversity as there is for gas equipment. Mechanical engineers don't solely select equipment based on matching equipment size to conditioning loads. Equipment size has to be large enough to meet the peak load of the building, yet the building doesn't always operate at its peak load but at partial load. Mechanical engineers also select equipment based on performance curves, matching the peak performance of the equipment to the most common space conditioning load conditions in the building. While there is generally enough diversity of sizes in the heat pump market, the more limited diversity in performance curves for heat pump equipment relative to gas equipment may cause issues for some designs.

Fireplaces are the one equipment type with few alternatives to gas equipment. The interviewees noted that gas fireplaces are very popular in the Denver market. They are not an essential piece of equipment, and are not regulated by the energy code, but are still a consideration. Electric fireplaces are available, but while the flame effects for these fireplaces has improved tremendously in recent years, they are still markedly different from the flames in a gas fireplace. It is worth noting that the market adjusted to gas fireplaces, which originally faced the same market resistance.

Availability of Expertise

Interviewees agreed that the availability of expertise to design all-electric buildings is a concern but the issue varies based on building type and equipment type.

RESIDENTIAL

Interviewees working in the residential market stated that residential practitioners – for both single-family and low-rise multifamily – generally have experience with heat pump space conditioning equipment, even if they push back somewhat against it. However, there were concerns raised about the design tools used in residential designs. Denver building officials noted that the sizing calculations that come with residential designs frequently have issues, both from the tools themselves and the use of the tools by contractors. They noted that these issues are present for both gas and electric equipment, but more problematic with heat pump designs. Therefore, while there may not be an issue with the availability of practitioners who can design and install heat pump systems, there may be quality issues that require planning and care.

Xcel Energy's heat pump water heater (HPWH) program has help spread the market exposure of HPWHs. HPWHs don't really require new skills – the electrical hookups are the same, and the condensate drain that is required is similar but simpler than the one required for high efficiency gas water heaters. The only significant issue is the requirement for access to air for the heat pump.

COMMERCIAL

On the commercial and high-rise multifamily side, interviewees said that local practitioners generally do not have the expertise needed for some of the larger electric systems. They pointed out that practitioners are familiar with systems such as VRF that have been in the market for a while, but less so with gas boiler alternatives for central water heating and space heating systems. They did, however, consistently express the belief that local practitioners are fully capable of learning these technologies. All-electric design strategies and equipment were not seen as something any harder to learn than any other new technologies that have come on the market in the past.

The interviewees noted that the issue of the availability of expertise cannot be considered only locally. Many of the firms operating in Denver are actually national or regional firms that may have more experience in other offices where they can draw. Many of them have other offices in markets – such as California or Seattle – where electrification is more common. One interviewee noted that this has a potential downside. Firms that have team members in other markets with more experience in all-electric buildings may submit bids for projects, but there is no guarantee that the team members with relevant experience will work in Denver. This issue has been raised in other areas. When San Jose held a stakeholder meeting on the issue of building electrification, one participant said that even though his firm was a leader in all-electric design in California, parts of his firm were not familiar and would struggle to successfully design some electric systems. **As a result, the issue of practitioner expertise cannot just be addressed at the firm or company level; it needs to be addressed at the level of individual practitioners, as well.**

Regulatory Barriers

Interviewees identified a handful of regulatory barriers to all-electric buildings.

UTILITY REGULATION

One of the primary regulatory barriers identified by interviewees was utility rates. Utility costs are not driven purely by market factors, and several interviewees identified the regulation of utility rates in a way that keeps gas cheap as a barrier to wider electrification. **However, any discussion of rates will need to engage issues of affordability.** A rate-based approach to narrowing the gap between electricity and natural gas costs that increases the cost of natural gas will have a negative impact on the affordability of existing gas-fired systems. This will be a critical consideration for affordable housing.

Another utility-related issue that was identified by one interviewee was the nature of peak charging in building campuses. Xcel Energy does not allow aggregation of multiple buildings on a campus for the purpose of calculating peak charging. Therefore, one building with very good peak performance or available on-site renewable energy production cannot be used to offset the peak load of another building on the campus. Since all-electric buildings can have poor heating season peak periods, this would put all-electric designs on a campus at a disadvantage.

ENERGY CODE

In the code, two essential barriers for all-electric buildings were the code baseline/metric and code enforcement.

Code Baseline/Metric

Some interviewees noted one broader barrier to all-electric buildings in the code: code envelope requirements. Better envelopes reduce heating loads, which decreases heat pump system sizing and reduces heat pump operating costs. Without advancing envelope requirements in the code, heating loads in buildings will remain higher in new buildings, exacerbating both first- and utility-cost barriers.

In the commercial code, one of the primary modeling compliance paths – ASHRAE 90.1 Appendix G – is based on energy cost and has gas equipment in the reference building. These structural issues place all-electric buildings at a disadvantage as they have to be much more efficient in the rest of the building to make up for that disadvantage. Stakeholders in the 2019 Denver Energy Code development process identified these modeling issues as one of the primary barriers to all-electric buildings. The Denver code allows the use of source energy in the Appendix G approach and that reduces the advantage of gas systems. Source energy still disadvantages all-electric buildings, but not as much energy cost, so while it reduces the disadvantage, it does not eliminate it entirely. Denver currently allows the use of IECC Section 407 for modeled compliance and utilizes site energy for the metric, which places electricity at much less of a disadvantage. However, Section 407 is not as well defined as other modeling paths. Unfortunately, converting Appendix G to site energy would require substantial modification.

There is a similar issue on the residential side. The ENERGY STAR for Homes program (used for both single-family and low-rise multifamily homes) penalizes all-electric designs since it is source energy-based, and the source energy conversion for electricity is much higher than for natural gas.

Code Enforcement

All-electric buildings and homes can simplify code enforcement through reducing enforcement time and costs because they lack natural gas service connections, piping, and hookups. This could be a significant advantage for Denver. However, the current model of code enforcement in Denver may not be equipped for a large number of all-electric buildings. Building officials interviewed noted that since there are not many all-electric projects currently, staff do not have much familiarity with some electric

equipment or design strategies (e.g. central HPWH systems, reverse chillers, etc.). Therefore, they will require education to effectively check all-electric designs. This issue is different for commercial and residential, however. According to building official interviewees, larger residential projects and PV systems already go to commercial staff for review. Commercial staff are required to maintain professional certifications (architecture, engineer, ICC) that require ongoing education courses. **This creates a natural opportunity to implement additional training for all-electric technologies and strategies if trainings include continuing education units that can be used to fulfill ongoing professional education requirements.**

The interviews also identified some issues specific to residential code enforcement. Currently, plan reviewers do not check plumbing, mechanical or electrical systems. Enforcement for these items is through inspections. This may necessitate some procedure changes to ensure that certain issues (such as electric service capacity) are included in plan review. Additionally, Denver does not require professional licensure for residential projects, and building officials noted that there is a very high level of variability in the quality of submittals with some of them being very sub-par. As noted in the "Availability of Expertise" section, this issue is exacerbated for heat pump designs. Shifting the market to greater use of all-electric designs will require more enforcement oversight.

More Challenging Building Types

Interviews revealed some building and equipment types where they believed electrification would be more difficult:

- **Large central water heating systems:** Due to unfamiliarity with the systems and very different space requirements, this was seen as the major barrier in particularly large multifamily residences and hotels. This was also identified as a barrier for healthcare buildings, which can have high hot water loads.
- **Restaurants:** Buildings with commercial cooking were seen as particularly challenging since electrification would require business practice changes and workforce education.
- **General Multifamily:** Multifamily was seen as challenging due to very thin margins. This makes it more susceptible to cost impacts due to factors such as disrupting standard designs or impacting market positioning due to the lack of gas cooking.
- **Industrial/Manufacturing:** Any industrial building with gas-driven industrial or manufacturing process (including food production) would be very difficult to electrify since it would require the development of a new process. One interviewee noted that it might be necessary to draw a clear line between building loads and process loads to avoid this problem.

ELECTRIFICATION STRATEGIES

Most of these market barriers can be addressed with various market transformation and regulatory strategies. This section contains electrification strategies that have been suggested more broadly at the national level and in other markets as well as some strategies suggested by the interviewees.

Regulatory Drivers

Several interviewees stated that electrification was unlikely to see meaningful adoption without a regulatory driver that explicitly or effectively requires it. They identified Denver's Green Ordinance as

one of the primary drivers of above-code performance and one of the bigger opportunities to foster electrification in Denver.

Education

As discussed in the "Availability of Expertise" section, the interviewees were generally confident in the ability of local practitioners to learn about electrification strategies and technologies. However, it was noted that part of the low market awareness and accurate familiarity was due to the fact that most practitioners, developers, owners and code officials are simply too busy to research these technologies on their own. They identified education as a critical need and suggestions generally aligned with education opportunities identified in national and other market discussion, including:

- **Design Workshops**. Denver could host professional development workshops where practitioners can learn how to effectively design all-electric buildings.
- **Technical Support from the City.** Denver could contract with some of the more experienced practitioners in the market to assist and mentor project teams with less experience.
- **Equipment Manufacturers**. Many manufacturers of equipment hold regular education and training sessions at their distributors or in the offices of design engineers. Denver could host similar training sessions open to the profession. However, interviewees noted that many practitioners and owners can react negatively if they feel like they are being given a sales pitch, so this strategy should be approached with care.
- **Utility Incentive and Continuing Education Programs**. Denver can work with Xcel Energy and its incentive programs to promote electric systems, as well as leverage Xcel's existing trade ally programs to disseminate resources**.**

Due to the business of practitioners, continuing education credits for training sessions are critical. Many practitioners – especially those who are licensed – are required to take a minimum number of continuing education credits each year, creating an opportunity to drive increased participation of electrification education sessions to earn those credits.

The building official interviewees identified the need for education of building officials. **They noted that code enforcement staff would require both fundamental education in all-electric designs and equipment and training in any enforcement issues.**

Market Outreach

Market outreach could be framed as education for the consumer. The interviewees identified several areas where consumer ignorance would be an obstacle to the adoption of all-electric buildings but that it could be addressed in market outreach. **Low public awareness about all-electric design requires a market outreach plan that covers the basics on all-electric buildings – not just the benefits and reasons consumers should want them.** It also would need to address commonly held but dated perceptions of heat pumps in the Denver market.

INTERIOR AIR QUALITY (IAQ)

Interviewees identified health and interior air quality (IAQ) as a major opportunity for market outreach messaging. The market is already emphasizing filtration as a value-add for buildings to improve IAQ. An outreach plan could capitalize on IAQ and health advantages of all-electric buildings. Interviewees said

the focus needs to be on cooking since most other gas combustion equipment including furnaces and boilers have sealed combustion chambers in the Denver market.

COOKING

IAQ might provide one of the more potent messages for addressing the strong market preference for gas cooking identified in the "Market Perception" section. The viability of induction cooking could be another market message that could help mitigate the strong market preference for gas cooking. Recent studies indicate that customer perception may change with increased exposure to induction cooking. For example, the Sacramento Municipal Utility District (SMUD) found that 79% of customers had a negative impression of induction cooking prior to trying it, but a 91% positive impression afterwards.[19] Additionally, many people believe that "gourmet" stoves are gas models, but in 2018 Consumer Reports rated induction cooktops far ahead of gas in terms of performance. In addition, San Jose has an induction "hot plate" check-out program where residents can check out an induction hot plate and experience how they work for themselves. A program like this could be run at relatively low cost and help introduce people to the technology.

The commercial market will require different messaging. Several strategies have been considered in other markets. **One strategy would focus on recruiting prominent local and national chefs to endorse induction cooking in commercial cooking in order to both introduce the market to the technology as a viable alternative and ideally foster a trend.** Another focuses on safety and emphasizes induction cooking as a safer alternative to gas cooking since there are no flames, no hot surfaces and only the pans and the food in them get hot.

Market Differentiation

Interviewees identified cooking as one of the larger market obstacles for both residential and commercial buildings. In residential cooking, the primary barrier is a market preference for gas cooking by many consumers, and developer perception of market preferences. Gas cooking is seen as an amenity, and sometimes an essential amenity in higher-end projects.

Interviewees noted that developers, especially production residential builders, are always looking for market differentiation. The market outreach plan could position all-electric to offer them that differentiation. However, the existing prevalence of zero net energy goals in Denver – and the frequent confusion between zero net energy and all-electric buildings – means that Denver will very likely need to select one of the two to be Denver's "gold standard" for net zero emissions.

Incentives

Like national and other market stakeholders, interviewees identified incentives as a potentially powerful tool for increasing market penetration of all-electric buildings. They identified a few considerations that could be important for incentive programs in Denver:

- **Design Incentives.** Equipment incentives are important, but design incentives can help practitioners cover the additional time required to design all-electric buildings as they gain proficiency.

[19] http://2019.utilityforum.org/Data/Sites/5/media/posters/smud-induction-infographic-poster2.pdf

- **Market Segment.** Incentives need to be targeted at the mass market and not just go to the top end of the market. Since high-efficiency heat pumps are sometimes seen as the "Cadillac" option, incentives could be seen as give-away to the top end of the market. One interviewee said that ideological leanings of many Colorado residents could lead to backlash if the public feels they are paying for incentives that are "just paying for some rich guy's efficiency."
- **Expedited Permitting.** The adage that "time is money" is especially true in real estate development where higher-interest "hard money" and bridge loans are used to get from land acquisition through construction. One interviewee noted that the real opportunity is the land-use approval – as opposed to building permit approval – since that is the approval that can take months, incurring significant financing costs.

Incentive programs need to be structured to specifically benefit affordable housing, as that is the segment of the market where utility costs are most critical. This is particularly the case for financial incentives. It may make sense to reserve all or most financial assistance for buildings that will be used for affordable housing or businesses owned by disadvantaged communities.

Pilot Projects

Interviewees frequently identified the value of pilot projects. Pilot projects can be helpful with the issues of market awareness and market perception. They give a concrete, local proof-of-concept for all-electric buildings and can be used in market pushes and promotion. Pilot projects also can build market capacity for practitioners who gain proficiency in all-electric design.

One interviewee offered a word of warning about using municipal projects as pilot projects. Municipal projects can be seen as having generous budgets that do not reflect real-world projects. These are often building types not found in the commercial market – fire stations, schools, etc. – and so may not have as much of an impact as an office or similar building type.

LOAD CURVE ANALYSIS

Multiple interviewees expressed concerns about the impact of the increased electrical capacity with widespread electrification of buildings. This NZE Plan does not go into detail regarding load curves, however, a load curve analysis would assist in determining technologically how things must roll out for the grid. This effort is shaped with Denver's Strategic Existing Building Electrification Plan and further detail will be available when that is finalized.

MARKET READINESS ASSESSMENT FOR ALL-ELECTRIC: KEY CONSIDERATIONS

The key considerations regarding market readiness include:

- Cost is overwhelmingly the most significant factor in the current status of all-electric buildings in Denver and is the largest market barrier to the wider adoption of all-electric buildings in Denver.
    - Operating cost is a far larger issue than construction cost due to the very low relative cost of natural gas compared to electricity and the high heating loads in Denver.
    - Operating cost creates a significant issue for equity and affordability that will need to be addressed as an integral part of any policy strategy.
    - Construction cost barriers are due largely to projects considering the cost of the electrification of different systems in isolation rather than whole-building electrification strategies that allow for the significant cost savings of eliminating natural gas infrastructure.

    - Considering the substantial cost market barriers, regulatory drivers likely will be critically necessary to meaningfully drive all-electric building market penetration.
    - High heating loads in Denver, combined with low natural gas prices, create a situation where substantial gains in efficiency may be required to close the utility cost gap between mixed-fuel and all-electric buildings.
- The familiarity with current heat pump technologies is relatively low in Denver, leading many practitioners and consumers to have a negative perception of heat pumps based on older generations of equipment.
    - Practitioner familiarity with many important electric design strategies – particularly central heat pump water heater systems – is rather low. This creates barriers to all-electric design in the form of pushback and higher costs.
    - Low familiarity with all-electric building technologies creates a need for fundamental market education.
- Gas cooking is a significant market barrier in both residential and commercial buildings. In residential buildings, cooking is a market differentiator. Gas cooking is the norm in commercial kitchens and would require significant market transformation efforts.
- There appears to be a conceptual connection in the Denver market between zero energy buildings and all-electric buildings. This could pose challenges for outreach and market education. **It also can provide an opportunity if building electrification slots into the market space already occupied by zero net energy.**

Denver's All-Electric Targets

This section details all-electric requirements to reach the goal of net zero energy all-electric buildings and homes by 2030. In addition, this includes the milestones for new homes to be net zero and all-electric by 2024 and new buildings to be net zero and all-electric by 2027. As part of this NZE Plan, Denver asked the NZE Stakeholder Advisory Groups to review the targets for buildings and homes respectively to determine the recommendation for upcoming code cycles.

Table 31. Commercial Building All-Electric Targets for Denver Code

Building Type	2021	2024	2027
Small Hotel	All-Electric: *except heating & water heating* All-Electric Ready: *conduit for central systems & panel space*	All-Electric: *except water heating*	All-Electric
Large Hotel			
Medium Office			
Large Office			
Standalone Retail			
Warehouse			

Table 32. Multifamily Building All-Electric Requirements for Denver Code

Building Type	2021	2024	2027
3-story townhome & Low-Rise Apartment	Required	Required	Required
Mid-Rise Apartment (R-2: 4-7 stories)	All-Electric Ready: *conduit & panel space*	Required	Required
High-Rise Apartment (R-2: 8 or more stories)	All-Electric Ready: *conduit & panel space*	All-Electric Ready: *conduit & panel space*	Required

Table 33. Residential Home All-Electric Targets for Denver Code

Building Type	2021	2024
Single-family homes	All-Electric Ready: conduit & panel space	Required

Buildings and Electric Vehicle Charging Infrastructure

Denver's Electric Vehicle (EV) Action Plan (EV Action Plan) details the city goals for electric vehicles and how this fits into Denver's larger picture. One element within Denver's 80x50 Climate Action Plan is promoting the adoption of light-duty electric vehicles (EV), which have been shown to significantly reduce GHG emissions compared to gasoline vehicles.

The EV goals include:

- 2025: 15% of Denver vehicle registrations are electric
- 2030: 30% of Denver vehicle registrations are electric
- 2050: 100% of light-duty vehicles are electric

There are three key themes including: EV adoption is one piece of Denver's larger mobility picture, EV equity is a critical consideration, and the EV Action Plan focuses on light-duty plug-in EVs.

EVS IN CODE

In addition to the EV Action Plan, Denver also has code requirements for new buildings to support EV charging infrastructure. Because charging stations are increasingly tied to buildings and homes, considerations for electric vehicles within the code and the relationship to buildings is also included in this section. Denver's current 80x50 Climate Action Plan goal for EVs is 100% of light-duty vehicles to be electric by 2050. Additionally, the Climate Action Task Force recommends an emissions-free transportation system by 2040.

In 2019, Denver adopted one of the most aggressive EV-ready building code amendments in the country. Implementation of this code is planned to begin in August of 2020.

A consideration for future code cycles will be if the EV-ready code amendment should be more or less targeted for commercial buildings. Currently, the amendment focuses on six types of building occupancy (as defined in the IBC): assembly, business, educational, institutional, mercantile and low hazard storage. These building occupancies were chosen to focus on places where people are likely to park cars and have opportunities to charge during the day. It may be that additional occupancy types should be included to maximize the coverage of EV charging at different locations. It is also possible that within each occupancy type, the scope could be narrowed as several of these types have subclassifications.

An additional possibility in future code would be to allow DC fast charging stations to replace a certain number of Level 2 stations. The code currently requires Level 2 stations, but some of the commercial buildings with shorter dwelling times may be better suited for DC fast charging.

BUILDINGS AND TRANSPORTATION

Currently most electric vehicle charging takes place at the residence of the EV owner. This is the easiest and often least expensive place to recharge an electric vehicle. Many EV owners rely on basic Level 1 charging (a regular 110V outlet) in their garage or driveway, which can add around 40 miles of electric range during twelve hours of overnight charging, meeting the daily driving demands of many people.

Having access to charging at home is important for EV ownership. While some early adopters are able to take advantage of workplace or publicly available charging, most people desire convenient access to affordable charging. The current estimate of charging location is: 80% at home, 10% at work and 10% at public stations.

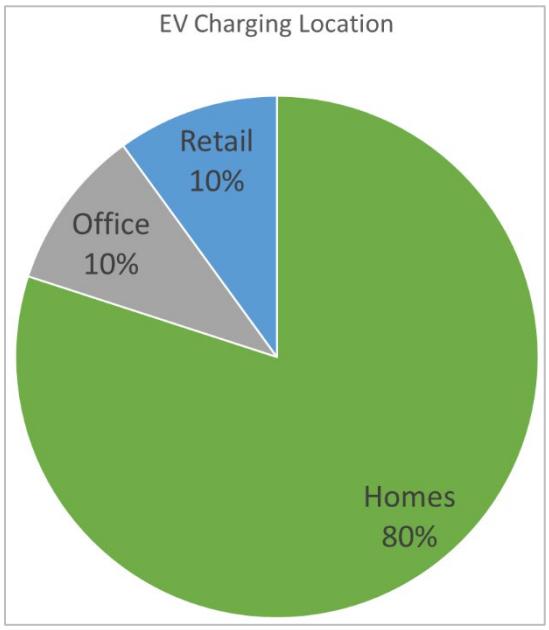


Figure 25. EV Charging Location: Homes, Office, Retail

Two trends are likely to encourage more charging outside the home. First, there will be more publicly available charging stations added in Denver in the future, in part due to the EV Ready building code amendments discussed above.

Second, if EV sales are to expand to meet the City's vehicle electrification goals, EV ownership will need to expand beyond those Denver households with access to home charging.

ESTIMATES OF ADDITIONAL ENERGY FROM EVS

There are considerations of the additional electrical use by electric vehicles. To do this analysis, Denver needs to understand or estimate the number of EVs registered, the miles/year and kWh/year that the EVs use, and the location of EV charging. As a first step, the number of EVs registered in Denver as well as projected numbers are shown in the table below.

Table 34. Baseline Total Number of EVs Registered in Denver

# EVs Registered	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Battery Electric Vehicle (BEV)	2,600	4,000	6,000	8,800	12,700	17,700	24,000	31,400	39,800	49,100	59,000	69,900
Plug-in Hybrid Electric Vehicle (PHEV)	1,700	2,400	3,300	4,200	5,200	6,200	7,400	8,600	9,800	11,100	12,300	13,700
Total Plug-in Electric Vehicles (PEVs)	4,300	6,400	9,300	13,000	17,900	23,900	31,400	40,000	49,600	60,200	71,300	83,600

Next, estimates are needed for annual mileage for Battery Electric Vehicle (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs). These include:

- Battery Electric Vehicle (BEVs)
  - Travel about 10,000 miles/year
  - Each BEV will use 3,300 kWh/year
- Plug-in Hybrid Electric Vehicles (PHEVs)
  - Travel about 7,500 miles/year
  - Each PHEV will use 2,500 kWh/year

Finally, Denver can estimate EV charging locations to be 80% residential, 10% office/workplace and 10% public (mainly retail).[20] From these parameters, future energy use was estimated for Denver.

[20] https://www.sciencedirect.com/science/article/pii/S136192091930896X#b0225; https://www.energy.gov/eere/electricvehicles/charging-home

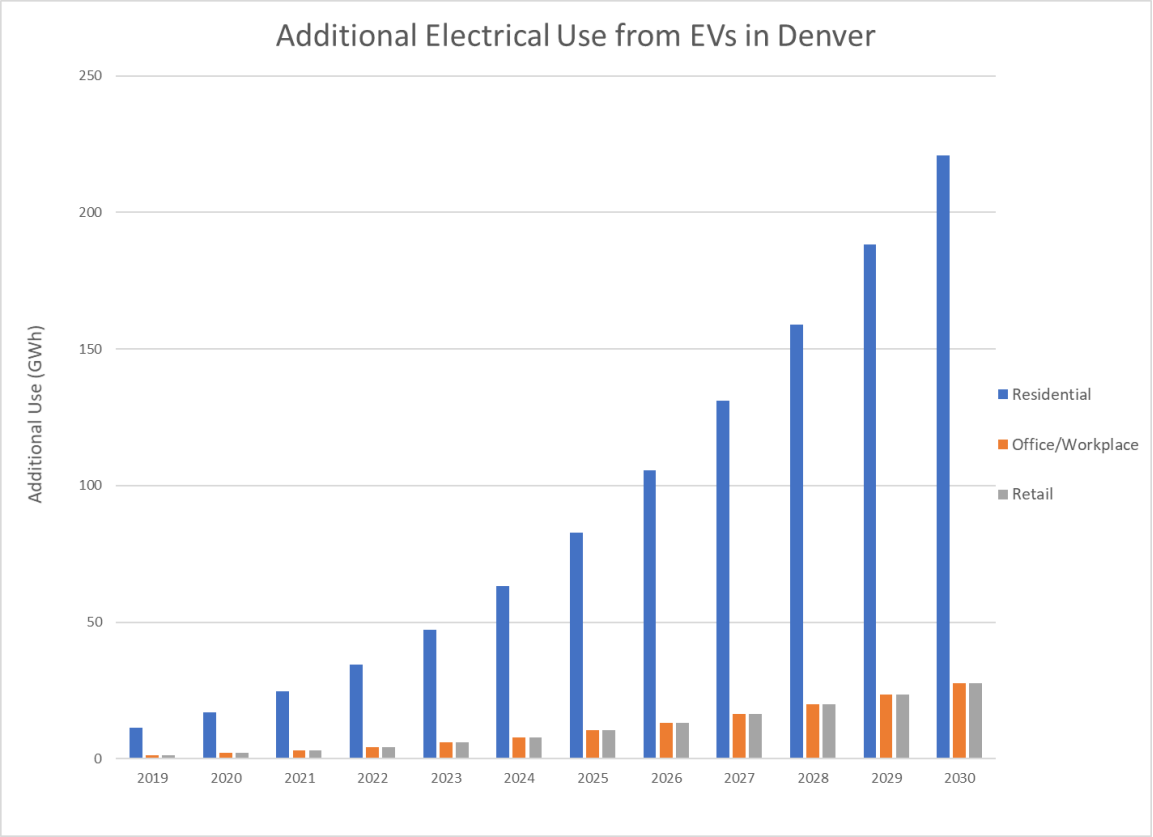


Figure 26. Additional Electrical Use from EVs in Denver

Charging Stations

A building's size can help determine the number of charging stations required. For most commercial buildings, adding one or two Level 2 charging stations should not have a significant impact on the building's electrical load. However, EV charging stations can negatively affect a building's demand charge if they are on a commercial rate. For most residential buildings, they currently do not have a demand charge. Xcel Energy does have a pilot program for residential time-of-use rates with demand charges that could result in savings if residential charging happens at off-peak times.

GRID FLEXIBILITY

The additional load from EVs can impact grid capacity, but the main issue is timing.

- Residential load is likely to occur between 6 p.m. and 6 a.m. and is primarily single-family residential.
- Workplace/office charging occurs between 9 a.m. and 2 p.m.
- Retail/public charging occurs between 9 a.m. and 6 p.m., with peaks likely during commute times.

VEHICLE TO GRID

The potential for electric vehicles as mobile power generators providing power back to the grid is limited to small pilot projects currently. For electric vehicle batteries to become grid resources in the future, a number of issues will need to be overcome.

First, the number of EVs on the road will need to increase by significant amounts to make the potential volume of distributed power large enough to have an appreciable impact on the grid.

Also, vehicle and battery manufacturers will need to become more comfortable with vehicle-to-grid power flow. Only one major manufacturer (Nissan) allows vehicle to grid without voiding the warranty on the vehicle's battery.

Finally, communication between vehicles, charging stations and utilities will need to be developed and refined. Utilities will need clear information on vehicles locations in order to rely on them for power.

Cost Considerations and Study: All-Electric

All-electric buildings have a range of costs compared with mixed-fuel equivalents. Two cost impact studies were done for the Denver market to quantify the cost differences between all-electric and mixed fuel buildings. A handful of studies also have been done for other markets, and these contain important lessons on cost impact of building electrification. Combined with feedback from Denver stakeholders, these studies can help frame considerations for electrification in Denver.

ALL-ELECTRIC COST STUDIES

Only a limited number of formal studies have examined the cost impact of electrification for buildings and homes. Specifically for Denver, Group 14 completed a building electrification study including an office building and single-family home – Electrification of Commercial and Residential Buildings. The Rocky Mountain Institute (RMI) studied a number of climates for single-family homes including Denver in The Economics of Electrifying Buildings. The most comprehensive all-electric cost studies have been done for California with a smaller study done for Salt Lake City, and these offer lessons and insights for Denver.

Calculating the Cost of All-Electric Buildings

The cost of all-electric buildings can be considered in two primary ways: first cost and lifecycle cost (LCC). First cost includes only the cost of design and construction and does not include operating costs. The LCC includes both first cost and the operating costs over a set period of time.

To evaluate the first cost of an all-electric building, the cost of design and construction is compared to a mixed-fuel building. A first cost assessment needs to go beyond just the equipment in the building; it also needs to account for the costs savings of the building's energy infrastructure and utility connections. For example, an all-electric building could have higher costs from a larger electric service size, on-site transformers or additional electrical wiring, but lower costs from the elimination of a natural gas service connection and piping in the building.

Lifecycle cost (LCC) goes beyond first cost by including operating costs. The definition of the length of the lifecycle can vary from one LCC approach to another. Some common time periods include the service life of the building (typically 30 or 50 years), the service life of the equipment being considered, or the length of a typical mortgage (often 30 years for residential and 15 years for commercial buildings). The way that future costs are calculated also varies from one LCC approach to another. For example, future utility costs could be held constant or change based on projections from an analysis of future utility costs.

Additionally, some LCC calculations include a net present value (NPV) calculation that discounts the value of costs and benefits by how far in the future they are. NPV calculations are common in making real estate development and investing decisions and may be important to certain stakeholders. The bottom line is that LCC calculations can be complex and vary considerably by approach.

ELECTRIFICATION OF COMMERCIAL AND RESIDENTIAL BUILDINGS

The office building and single-family home study Electrification of Commercial and Residential Buildings included an evaluation of system options, economics and strategies to achieve electrification. It focused on upfront and long-term cost estimates of electrification from data retrieved from a single-family home in Arvada , CO and a commercial office building in Lakewood, CO.

The study found that constructing an all-electric home had 27% lower upfront costs for single-family new construction. The study included Xcel Energy rebates currently available for heat pumps. As a result, new construction electric homes cost around $5,300 less to build when compared to new construction mixed fuel homes. This includes the cost savings on natural gas connections.

	End-of-Life Replacement		New Construction[1]	
Description	**Heat Pump**	**Natural Gas**	**Heat Pump**	**Natural Gas**
Central heating/cooling system (including install)	$15,000	$15,000	$13,000	$13,000
Tank type domestic hot water heater	$3,300	$2,600	$3,100	$2,400
Electrical modification	$2,100	----	$500	----
Natural gas connection and piping (new construction only)	----	----	----	$6,500
Total Cost	**$20,400**	**$17,600**	**$16,600**	**$ 21,900**
Delta in Cost for Heat Pump		***$2,800***		***$ (5,300)***

[1]The costs shown in the table are estimated for custom installations at a single-family home. Larger projects by developers are expected to have lower first costs. Developer first costs are estimated to be around $12,250 total for the heat pump option compared to $18,200 total for the natural gas option, including the electrical and natural gas connections, which is a cost savings of **$5,950** or **33%**.

Source: Electrification of Commercial and Residential Buildings

Figure 27. Single-Family Homes All-Electric First Costs

The study also found that constructing an all-electric office building had 8% lower upfront costs, showing that constructing commercial buildings costs about $18,100 less.

	End-of-Life Replacement		New Construction	
Description	Heat Pump	Natural Gas	Heat Pump	Natural Gas
Central heating/cooling system (including install)	$234,000	$234,000	$216,000	$216,000
Tank type domestic hot water heater	$4,200	$2,600	$3,800	$2,400
Electrical modification	$3,000	----	$1,500	----
Natural gas connection and piping (new construction only)	----	----	----	$21,000
Total Cost	**$ 241,200**	**$ 236,600**	**$ 221,300**	**$ 239,400**
Delta in Cost for Heat Pump		***$ 4,600***		***$ (18,100)***

Source: Electrification of Commercial and Residential Buildings

Figure 28. Office Building First Costs

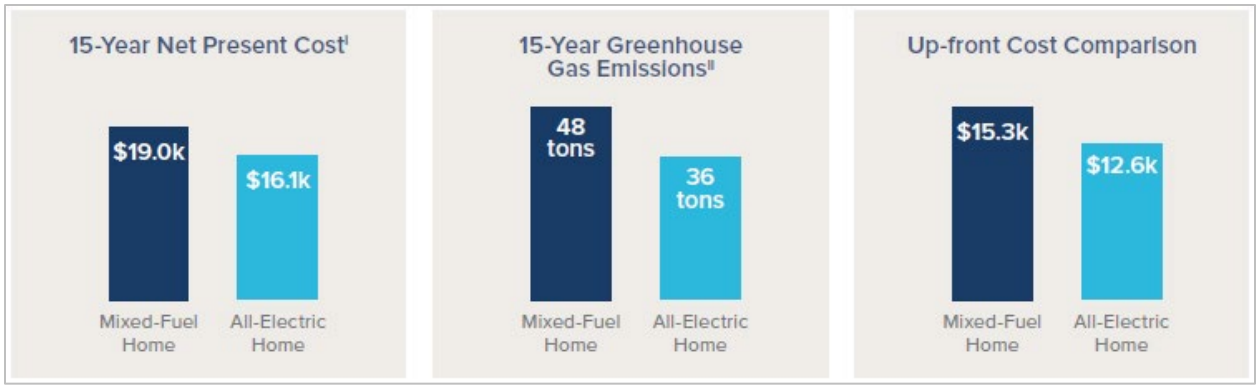
Denver also reached out to local builders who reviewed the costs in this study. They responded to the costs and identified supports needed including:

- All Electric First Cost Considerations
  - First costs from a builder with a real example in Denver are higher than shown in the studies
  - Incentives offsetting the actual first cost for heat pump heating and water heating would be beneficial
  - Incentives for developer of all-electric communities would be beneficial
  - Utility rate changes are needed to incentivize all electric through reduced operating costs
- Supports Needed for All Electric
  - Significant marketing and education
  - Consumer awareness of all electric products and their operation
  - Benefits of all-electric need to be understood by consumers
  - City needs to understand consequences that may affect the acceptance, marketability and sale of new residential construction

The technical details and costs in this NZE Plan should be considered in conjunction with the supports needed to reach the goals, targets and milestones to successfully reach net zero energy. Supports are further detailed in the "Cost and Supports Needed for NZE" section.

RESIDENTIAL NEW CONSTRUCTION: DENVER, SINGLE-FAMILY HOMES

The Rocky Mountain Institute (RMI) studied a number of climates for single-family homes including Denver for The Economics of Electrifying Buildings – Residential New Construction: Denver, Single-Family Homes. This study outlined upfront and lifetime cost estimates for new construction of an all-electric single-family home and a new construction mixed fuel single-family home, both in the Denver region. The all-electric home cost $2,700 less in up-front costs. The majority of the upfront savings that electric homes realize are by avoiding gas interconnection.



Source: The Economics of Electrifying Buildings

Figure 29. Economics of Electrifying Buildings in New Single-Family Homes in Denver

The study also found that building an all-electric home saved $2,900 in net present costs over 15 years and that all-electric homes have 2% lower annual utility costs than mixed fuel homes.

THE CALIFORNIA ELECTRIFICATION REACH CODE EXPERIENCE

In 2019 and 2020, several California jurisdictions began to implement electrification reach codes. These reach codes were configured specifically to foster electrification in new buildings. In general, they did this by requiring mixed fuel buildings to achieve higher levels of efficiency than all-electric buildings and to include electrification-readiness requirements. The intent was for the additional cost of mixed-fuel buildings to incentivize all-electric design.

To support this effort, the California Codes and Standards Statewide Utility Program[21] developed a collection of cost studies. To date, these studies offer the most comprehensive examination of the cost impact of all-electric buildings by far. These studies included a comprehensive analysis of the cost of multiple above-code scenarios that included different combinations of efficiency measures, photovoltaics (PV) and on-site storage. This is an important element of this exercise: under California's energy code, both PV and on-site storage can be used to contribute to code compliance. In 2019, two studies were released. The low-rise residential study[22] included single-family homes and low-rise multifamily scenarios. The non-residential study[23] included office, retail and mid-rise hotel scenarios. In California, a mid-rise hotel prototype is typically used to represent high-rise multifamily, as well.

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[21] The California Codes and Standards Statewide Utility Program is an initiative funded and administered by the California utilities that supports code advancement. Through their involvement in the code development process, the California utilities are able to claim a portion of the savings from the energy code toward their state-mandated energy efficiency goals. See https://localenergycodes.com for more about the reach code.

[22] "Cost-effectiveness Study: Low-Rise Residential." Prepared by Frontier Energy, Inc. & Misti Bruceri & Associates, LLC for The California Codes and Standards Statewide Utility Program. 2019. (https://localenergycodes.com/download/73/file_path/fieldList/2019%20Res%20NC%20Cost-eff%20Report)

[23] "2019 Nonresidential New Construction Reach Code Cost Effectiveness Study." Prepared by TRC Advanced Energy & EnergySoft for The California Codes and Standards Statewide Utility Program. 2019. (https://localenergycodes.com/download/74/file_path/fieldList/2019%20NR%20NC%20Cost%20Effectiveness%20Report)

However, the issue of central heat pump water heating[24] created the need to address mid-rise[25] and high-rise multifamily scenarios directly.

The studies identified the maximum above-code performance that could be achieved cost effectively[26] for both all-electric and mixed-fuel buildings. The studies then used this information to compare the cost of all-electric and mixed fuel buildings. They calculated the cost differential of an all-electric building by using a code-compliant mixed fuel building as the baseline and characterized the difference in terms of first costs, annual on-bill costs and lifecycle costs.

Relevance of Results to Denver

Differences in utility costs, construction costs, code baseline and climate mean that the results from these California studies are not directly applicable Denver. However, the incremental cost information from California is still relevant to Denver in that it demonstrates broad trends.

- **Climate:** The climates in Denver and most of California are very different, however, parts of Northeast California are in Climate Zone 5B (see Figure 30, left: US Climate Zones. California uses a custom set of climate zones for code (see Figure 30, right: California energy code climate zones), and California's Climate Zone 16 is the most relevant for Denver.
- **Energy Costs:** California has generally higher energy rates compared to those in Denver. For example, the rate for residential electricity in Denver is $0.05461 to $0.11876 per kWh[27] but is $0.14189 to $0.53525 per kWh for the Climate Zone 16 case in the California Cost Effectiveness studies.[28] Likewise, the residential natural gas rate for Denver is $0.13268/therm[29] but $1.4552 to $2.05353/therm for the Climate Zone 16 case in the California Cost Effectiveness studies.[30] The much higher energy rates in California mean that energy efficiency is going to tend to be more cost effective.

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[24] See ACCC Report: "Technical Feasibility of All-Electric Design." Prepared for the City of Denver by New Buildings Institute

[25] "2019 Mid-Rise New Construction Reach Code Cost-Effectiveness Study." Prepared by Frontier Energy, Inc. & Misti Bruceri & Associates, LLC for The California Codes and Standards Statewide Utility Program. 2019. (https://localenergycodes.com/download/492/file_path/fieldList/2019%20Mid-rise%20NC%20Cost-Eff%20Report.pdf)

[26] The California Energy Commission (CEC) has set a set of standards to test cost effectiveness for changes made to Title 24, California's energy code. This is the cost effectiveness standard followed by the reach code cost effectiveness studies. The CEC allows either on-bill cost or Time Dependent cost Valuation (TDV cost takes into account the varying cost of energy production based on time of day and time of year) to be used as part of the cost effectiveness calculation.

[27] "Public Service Company of Colorado Electric Tariff Index." (https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Regulatory%20Filings/CO%20Recent%20Filings/PSCo_Electric_Entire_Tariff.pdf)

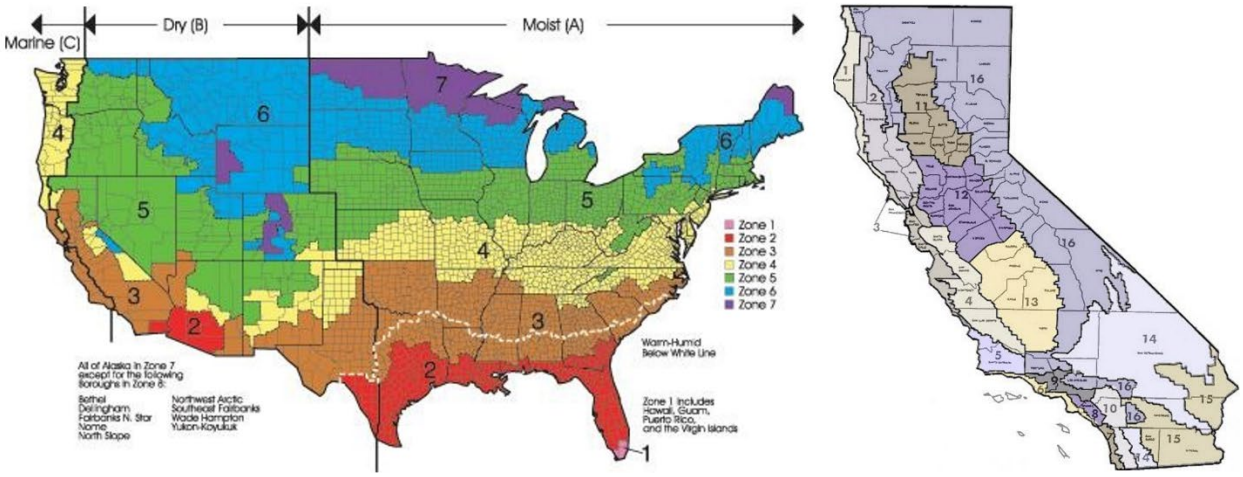
[28] Residential Time of Use. (https://www.pge.com/tariffs/Res_Inclu_TOU_Current.xlsx)

[29] Public Service Company of Colorado Gas Tariff Index. (https://www.xcelenergy.com/staticfiles/xe/PDF/Regulatory/psco_gas_entire_tariff.pdf)

[30] Residential Non-CARE and CARE Gas Tariff Rates. (https://www.pge.com/tariffs/Res_Current.xlsx)

- **Gas Costs:** The cost disparity between the gas rates is much higher than the disparity between the electric rates, which means that the operating costs' impact of electrification will be far greater in Denver than the California experience. The variables used in the California cost studies likely underrepresent future gas costs. At the same time, California gas utilities are facing major capital expenditures in the near future to comply with seismic safety requirements for their infrastructure and electrification is already a major trend in California. As a result, increased infrastructure costs will need to be supported by a smaller customer base. These issues may not represent the situation in Colorado, but they highlight the impact that future cost can have on life-cycle cost-effectiveness.
- **Time-of-Use Rates:** California also has a more robust set of time-of-use rates than Denver. As a result, technologies that save peak energy have a larger impact on energy costs.

- **Construction Costs:** The California cost effectiveness studies assume California labor rates, which will be generally higher than those in Denver. However, there is another element of construction cost that is more difficult to quantify. Due to California's longer-standing carbon reduction efforts, milder climate and relatively more expensive natural gas costs, all-electric design is more common in California than Denver. Therefore, costs for all-electric buildings in Denver may be increased by designers and contractors applying "risk premiums" to projects to account for the additional costs that they could incur as a result of their lower level of familiarity with all-electric designs. Anecdotally, a risk premium as high as 60% has been seen in a central heat pump water heater (HPWH) design in the Northwest.



Source: PNNL (left), California Energy Commission (right)

Figure 30. US Climate Zones (left), California Energy Code Climate Zones (right)

COST EFFECTIVENESS RESULTS

At the time of writing, results are available for single-family, low-rise multifamily, office, retail, mid-rise hotel and supplemental results for mid-rise multifamily. The non-residential and residential follow slightly different methodologies and report the results differently. However, in all cases there are key

pieces of information: first cost and lifecycle utility cost impact.[31] The first cost impact of an all-electric building type is lower if the number is positive and higher if the number negative. The lifetime on-bill impact is better for an all-electric building type if the number is green and worse for a number that is red. The relevant results are summarized in the table below.

Table 35. Summary of CA CZ 16 Results by Building Type

Building Type [a]	First Cost Impact (+ savings/- expense)	Lifetime On-Bill Impact [b]
Single-Family: Code Compliant	+$5,349	($12,042)
Single-Family: Above Code	($11,279)	+$19,813
Low-Rise Multifamily: Code Compliant	+$2,337	($3,725)
Low-Rise Multifamily: Above Code	($2,061)	+$6,600
Mid-Rise Multifamily: Code Compliant [c]	+$531	($1,268)
Mid-Rise Multifamily: Above Code [c]	($2,635)	NA
Office: Code Compliant	+$64,096	($247,469)
Office: Above Code	($309,046)	+$399,822
Retail: Code Compliant	+$25,771	($58,338)
Retail: Above Code	($189,562)	+$511,477
Mid-Rise Hotel: Code Compliant	+$1,275,575	($1,426,771)
Mid-Rise Hotel: Above Code	+$1,263,534	-$905,844

a. Results for single-family are per home, results for multifamily are per dwelling unit, results for all others are per building.
b. Green numbers indicate that the scenario is cost-effective, red numbers indicate that the scenario is not cost-effective. Negative numbers can still be cost effective and positive numbers can still be not cost effective.
c. As of the writing of this report, the results for the mid-rise cost-effectiveness study are still preliminary and the results for the high-rise cost-effectiveness study are not available at all. Information in this table for mid-rise multifamily are from "2019 New Construction Cost-effectiveness Studies: Mid-Rise Multifamily Residential Cost-effectiveness Study Preliminary Results" presented by Misti Bruceri at the CA Reach Codes Team monthly coordination call on March 5, 2019.

Single-Family

The first cost of a code compliant all-electric single-family home in the study was lower by $5,349 than the first cost for mixed-fuel homes (resulting in a first cost savings). These savings were due mostly to the elimination of the natural gas utility connection, internal piping and the elimination of combustion exhaust. However, the lifetime utility cost increase was more than double the first cost savings. An all-electric home therefore costs less to build/buy, but more to operate on an annual and lifecycle basis. However, the study also evaluated cost effective above-code all-electric scenarios. With the addition of cost-effective efficiency measures, the benefit cost ratio was increased above 1 and the lifetime on-bill impact was $19,813 (single-family: above code).

Low-Rise Multifamily

A code-compliant all-electric building is not cost effective on an on-bill basis for low-rise multifamily. Like the single-family analysis, the all-electric low-rise multifamily building costs less to construct ($2,337), but more to operate. It is important to note that increased cost is just over $10 per month; this highlights that a pure cost-effectiveness analysis does not give a sense of real-world dollar impact.

[31] For the low-rise residential study, the lifecycle period is 30 years. For the non-residential study, the lifecycle period is 15 years. Due to the use of a Net Present Valuation calculation and utility rate annual increase factor, the lifetime utility cost impact cannot simply be divided by the lifecycle period to generate the annual utility impact.

However, while this impact may be minimal for some households, even a small increase in utility cost can be a substantial burden to resource-constrained households.

The low-rise multifamily code-compliant scenario is closer to being cost effective than the single-family code-compliant scenario. This is due in large part to the fact that multifamily generally has a higher load density than single-family homes and is therefore less heating-load dominated, which mitigates the impact of costlier electric heating. Like with single-family, adding a cost-effective amount of energy efficiency results in the all-electric building being cost effective on an on-bill basis.

Office

The office prototype uses a VAV system and includes a heat pump and electric resistance re-heat in the all-electric version. This is not a particularly efficient all-electric approach, especially when time of use charges are considered, and so the cost effectiveness is particularly poor. Moving to a cost-effective above-code design is cost effective on an on-bill basis. The selection of a heat pump system with better performance during peak periods with demand rates could also improve the cost effectiveness.

Retail

The all-electric retail prototype is also less costly to construct but costlier to operate and does not meet the cost-effectiveness test. The lifecycle utility costs are nearly twice the first cost savings. Also, like the other building types, a cost-effective level of performance makes the all-electric design cost effective on an on-bill basis.

Mid-Rise Hotel

The midrise hotel results show substantial first cost savings for the all-electric approach. They also almost show cost-effectiveness on an on-bill basis. However, the prototype model used for the mid-rise hotel utilizes individual water heaters for each room, a very unlikely approach in a mid-rise hotel. Hotels typically use central water heating systems even though they are far more expensive because of the space savings they afford. The cost effectiveness would look very different if a central heat pump water heating system were compared to a central gas boiler system. The preliminary results for the mid-rise multifamily prototype below make this comparison and probably give a more realistic assessment of the costs for a hotel.

Some mid-rise multifamily units do use individual water heaters. These water heaters are generally electric because of the cost and complications of running gas piping and exhaust vents for gas water heaters through a mid-rise building.

Mid-Rise Multifamily

Mid-rise multifamily was assessed separately (as of the writing of this report, the high-rise cost-effectiveness study is not yet complete). The mid-rise study looked at two “central” HPWH systems: a clustered approach and a true central system. The clustered approach does not use a recirculation loop and includes multiple water heaters distributed throughout the building.

The central system uses a central HPWH plant connected to a recirculation loop. The clustered approach has a lower first cost than a central gas boiler system but the central HPWH system has a higher first cost. California requires the installation of a minimally sized solar thermal system for gas boilers. Denver has a similar requirement, but Denver’s requirement allows a project to install a higher efficiency boiler instead, which can be achieved at minimal or even zero incremental cost. When the cost of the solar

thermal system is removed from consideration, the clustered HPWH approach also has a higher incremental cost.

	Central Gas Boiler (CZs 1-9)	Central Gas Boiler (CZs 10-16)	Clustered HPWH	Central HPWH
System Quantity/Description	1 boiler recirc		32 units 80 gal. each no recirc	15 units .1,200-gal total recirc
Total Equipment Cost	$98,733		$126,778	$213,364
Solar Thermal	(20% SF) 110,096	(35% SF) $131,817	-	-
Solar PV	-	-	-	$23,580 (8.8 kW_{DC})
Total First Cost	$202,920	$224,641	$126,778	$236,944
Maintenance/Replacement Cost (NPV)	$69,283	$69,283	$81,374	$120,683
Total Cost (NPV)	$272,203	$293,924	$208,152	$357,627
Incremental Cost CZ 1-9 (NPV)			($64,051)	$85,424
Incremental Cost CZ 10-16 (NPV)			($85,772)	$63,703

Source: 2019 Mid-Rise Residential New Construction Cost-Effectiveness Study

Figure 31. First Cost of a Central and Clustered Water Heating System in a Mid-rise All-Electric Building [32]

With the study's first cost, the clustered approach is not cost effective on an on-bill basis. The central system is not analyzed since its higher first costs make cost-effectiveness impossible. These results are very relevant for Denver since central HPWH systems have also been identified as the gas load that poses the greatest technical and market barriers to electrification.

SUMMARY

This series of cost effectiveness studies for California present a clear pattern when it comes to costs in all-electric construction. In most cases, all-electric buildings have lower first-costs than mixed-fuel buildings. This is due largely to the savings from the elimination of the gas service and on-site gas infrastructure.[33] **As a result, all-electric buildings are less expensive for developers and builders to construct and many California developers and builders are doing just that in order to reduce construction costs.** However, the higher lifecycle costs of using electricity for space heating, water heating and cooking often exceed those savings. Denver's substantially cheaper gas prices exacerbate that issue.

[32] From "2019 New Construction Cost-effectiveness Studies: Mid-Rise Multifamily Residential Cost-effectiveness Study Preliminary Results." Presented by Misti Bruceri at the CA Reach Codes Team monthly coordination call on March 5, 2019.

[33] There is an additional cost savings from the elimination of the gas service that the studies do not include. Scheduling utility connections poses a major risk for delays, which come with potentially significant costs. Eliminating one of the two utility hook-ups eliminates that delay risk.

Pairing energy efficiency and electrification can address the operating cost issue. **Electric equipment is capable of achieving much higher levels of efficiency than their gas counterparts, and that efficiency can be leveraged to cost-effectively reduce operating costs**. Electric water heating with HPWHs creates another opportunity for operating cost savings. The larger tanks typically used in HPWH systems can be used as a buffer to shift equipment operation to off peak hours. With the greater use of time-of-use rates, this load-shifting capacity could result in substantial savings.

THE SALT LAKE CITY EXPERIENCE

In 2019, the Building Electrification Initiative and Cadmus conducted an incremental cost study of all-electric new multifamily construction. Salt Lake City is in IECC Climate Zone 5B like Denver, and likely has a weather profile that is more similar to Denver than California Climate Zone 16.

Due to limited City resources to support electrification, the study focused on scenarios where an economic analysis based on the customer could support electrification aiming to:

- Identify buildings and retrofits with positive customer economics under today's conditions,
- Prioritize strategies the City or local utility can employ to improve customer economics, and
- Educate and engage the building community on increasing heat pump installations.[34]

This analysis is comprised of multiple variations that included additional variables such as increased efficiency and PV. Results are presented in first-year savings, simple payback and lifecycle (NPV). The utility rates for Salt Lake City are also much more comparable to Denver – electric rates of $0.088 to $0.145 per kWh and gas rates of $0.587 to $0.713 per therm – though still substantially higher.

EE Measures	PV (Solar Subscriber)	Incremental upfront cost (w/ incentive)	First year net operating savings	Payback period (simple)	NPV *(10% discount rate)*	NPV *(5% discount rate)*
Without Air Sealing/ Insulation	Without PV	$2,250	$108	0 years	$3,290	$3,720
	With PV	$2,250	($37)	0 years	$2,780	$3,160
With Air Sealing/ Insulation	Without PV	$1,270	$119	0 years	$2,420	$2,890
	With PV	$1,270	($25)	0 years	$1,900	$2,310

Source: Building Electrification Initiative Salt Lake City: Customer Economic Analysis

Figure 32. Incremental Cost for New All-Electric Mid-rise Multifamily

Figure 32 shows the results for a new all-electric mid-rise multifamily building. This scenario utilizes individual HPWHs and includes the impact of locally available incentives. In most cases, the first-year

[34] "Building Electrification Initiative Salt Lake City: Customer Economic Analysis." Prepared for Salt Lake City by The Building Electrification Initiative and Cadmus. November 5, 2019

results (first cost plus first year of operating costs) showed cost savings. In all cases, the simple payback was less than a year and the lifecycle impact resulted in total savings.

The bulk of the up-front cost savings resulted from the elimination of the gas utility connection and on-site gas infrastructure and from utilizing ductless heat pumps and eliminating ductwork and soffit costs (Figure 33). The study also identified savings from eliminating envelope penetrations and identified space savings from eliminating gas exhaust infrastructure.

Input Description	Input	Unit	*Notes/ Sources*
Avoided gas connection costs	$425	$/unit	*Local Interviews*
Avoided construction costs related to gas	$2,000 – ductwork $300 – combustion air shafts $200 – envelope penetrations	$/unit	*Local Interviews*
Added electrical cost	$857	$/unit	*Local Interviews*
Avoided monthly fixed cost	$6.75	$/ month	*Dominion*
Subscriber Solar	$0.117 (fixed over 20 years)	$/kWh	*Rocky Mountain Power*

Source: Building Electrification Initiative Salt Lake City: Customer Economic Analysis

Figure 33. Line Item Cost Impacts of All-Electric Design

One important thing to note about this study is that the all-electric building includes an inherent performance advantage. The gas equipment in the baseline only meets the code minimums while the electric equipment in the all-electric case is significantly more efficient than code minimums and the rest of the building features are held constant. The all-electric building therefore has an advantage reducing operating costs compared to a code-compliant all-electric building. In this way, this study resembles the above-code scenarios in the California Reach Code studies more than the code-compliant scenarios.

	Counterfactual Equipment			Electrification Equipment		
Input Description	**Natural Gas Furnace**	**Central A/C**	**Air Exchange**	**Ductless mini-split**	**Air Exchange**	**Notes/Sources**
System info	10 kbtu	0.6 ton	Air exchange - Air King BFQ80	0.75 ton *0.5 ton – w envelope measures*	Panasonic FV-08VKS3 Exhaust Fan	*BEopt outputs*
System efficiency	80% AFUE	14 SEER		12 HSPF, 22 SEER (cold climate)		*BEopt defaults*

Source: Building Electrification Initiative Salt Lake City: Customer Economic Analysis

Figure 34. Efficiency Levels of Gas and Electric Equipment

ALL-ELECTRIC COST IN DENVER

Incremental cost can be very nuanced, and this section summarizes a series of key issues for considering the cost of all-electric buildings. These considerations ensure that any discussion or research of the costs of all-electric buildings are complete, targeted and accurate.

- **Take a holistic approach to cost that accounts for both the increased costs and the cost savings of all-electric buildings.** The most important issue for considering the incremental cost of all-electric buildings is to compare the costs of mixed-fuel and all-electric buildings holistically. In interviews with Denver stakeholders, it was clear that when electrification is being considered in the Denver market, it is rarely being considered on a whole-building basis. More typically the cost considerations are solely a switch from one piece of equipment to another.
- **Use anecdotal cost information with caution; do not use speculative or estimated cost information.** Actual buildings are sometimes used as a source of cost information. Anecdotal information from real projects can be very useful but should be considered with caution. It can be misleading since it is based on the circumstances of a specific project that may not apply to other projects.
    - Anecdotal cost information based on estimated expectations of cost are particularly problematic. It is not based on either prototypes that represent average building characteristics or the proven costs of actual buildings. Prototypes and actual projects provide the specific details of the building systems that are necessary for accurate cost estimation. It is very difficult to meaningfully estimate costs without that specific information.
- **Utilize a lifecycle analysis that incorporates both the upfront and ongoing costs of building electrification.** A lifecycle cost analysis will consider both up-front and long-term costs. Long-term costs can include utility costs, maintenance costs, financing costs and even equipment replacement costs if the lifecycle term is long enough. A lifecycle analysis also can incorporate a net present value calculation (such as the case in the California reports), which can put future costs (and savings) in terms of present dollars. When assessing these long-term costs, there can be substantial differences between mixed-fuel and all-electric buildings:
    - The annual costs of maintenance for electric and gas equipment can be very different.
    - **Upfront cost savings can also result in ongoing financing cost savings.**
    - The escalation rates (the rate at which costs like utility costs increase from year to year) can be very different for natural gas and electricity.[35]
- **Consider who pays which costs.** Related to the issue of lifecycle cost, it is important to consider who pays which costs of electrification. **In buildings that are rented rather than owned, upfront costs and operating costs can be paid by different parties.** Any program that is meant to address potential cost increases from electrification needs to pay special attention to these issues. Incentives that reduce up-front costs are unlikely to pass to occupants and effectively address utility cost affordability.

[35] Escalation rates can be a challenging topic. Natural gas is currently relatively cheap in Denver due to factors such as hydraulic fracking, but those costs could change dramatically with changes in regulations on natural gas. Costs could also change notably if electrification becomes far more common and the cost of maintaining gas infrastructure falls on a significantly smaller customer base.

- **Use prototype buildings as the basis for any costing exercise. Prototypes generally do not resemble any specific building, and that is their strength.** It allows them to be used to produce information that is widely applicable and is less impacted by the design features that are specific to a design that has been built. The Pacific Northwest National Lab has developed prototype buildings that are used for modeling the energy impact of the national model energy codes. These buildings also can be used as the basis for assessing incremental cost. This can save the effort of creating prototypes, but it means the energy impact of electrification can be directly related to the costs of electrification in order to calculate cost-effectiveness.

- **Base cost information on up-to-date electrification technologies/strategies and up-to-date costs for those technologies/strategies.** Cost databases sometimes contain older data for building equipment and materials. **Additionally, the cost of many pieces of electric equipment have come down considerably in the last few years.** The market for electric equipment, particularly heat pumps, has advanced recently, creating new options for electrification strategies that may not have been available before.

    - This relates to issues using cost data for actual projects. For strategies or technologies that are rapidly evolving, such as heat pumps, costs can change quickly and projects that already have been constructed are more likely to have dated cost data either because prices have changed or the strategies/technologies they used have been supplanted in the market.

- **Include only the costs that are directly related to electrification.** It is important to only include the costs from electrification in the all-electric building case. As noted by some of the Denver stakeholder interviewees, heat pumps can sometimes occupy the premium end of the market. The models that are more familiar or readily available in the Denver market might also be the models with premium features like advanced controls, remote access, grid interactivity or other features that are not necessary for electrification. The cost of electrification should not include the cost of these additional features.

  This issue can get complicated due to the high efficiency of most heat pump equipment available on the market. **Most heat pump equipment is considerably more efficient than code minimums.** If gas equipment in a design is replaced with heat pumps – and other changes are made to the design – the resulting incremental cost represents both electrification and additional efficiency. In order to eliminate the portion of the cost premium due to efficiency, the design would need to be altered to reduce the efficiency in other parts of the building. (The chart below depicts this conceptually. While not depicting actual costs, it shows the impact of accounting for efficiency in the total cost of an all-electric building.)

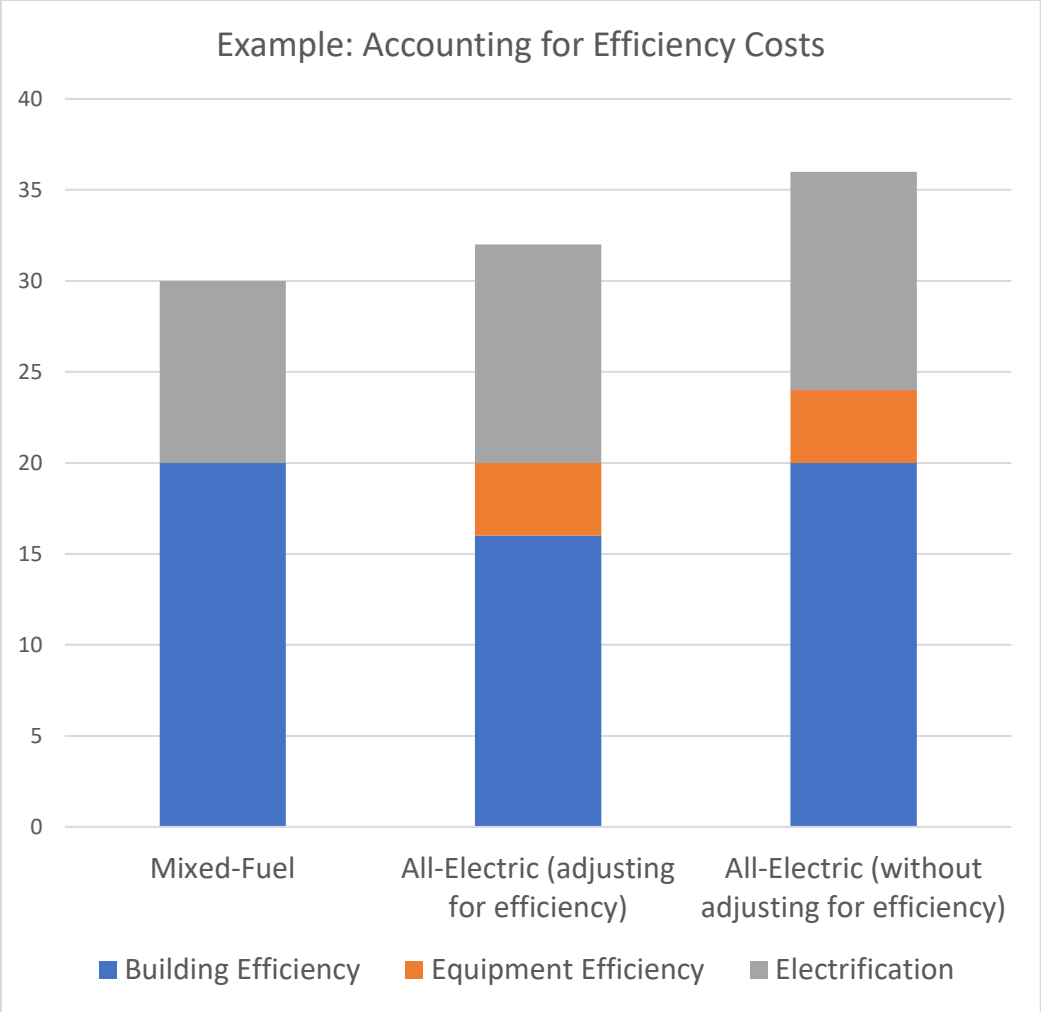


Figure 35. Example: Account for Efficiency Costs

- **The cost of electrification should be based on the most cost-effective option.** When evaluating the cost of electrification for policy decisions, it is important to identify the most cost-effective strategy available as the basis for the cost of the policy. **Sometimes the most cost-effective solution is not the most common solution or the solution that is preferred by the market.** However, the cost impact of electrification policies still should be based on the most cost-effective solution. Individual projects may choose to go with a costlier option due to factors specific to their project – such as familiarity, design constraints, etc. – but that increased cost would be due to the design decisions of the project team, not due to electrification itself. If individual project teams decide to adopt an approach that is not cost-effective, that does not mean that electrification itself is not cost effective.

  For example, central heat pump water heating systems for multifamily often have higher upfront costs than central gas boiler water heating systems. However as discussed in the "The California Electrification Reach Code Experience" section, a distributed HPWH system can have lower first costs. **By distributing smaller HPWHs and storage tanks around the building that each serve a small zone of hot water uses, the complexity and costs of equipment and the**

distribution system can be reduced. This approach requires changing the internal layouts of buildings and adopting system designs that may be unfamiliar to design teams. Some design teams may be unwilling to adopt the most cost-effective solution. When a design team makes that decision, that additional cost should not be attributed to electrification.

It is therefore important to base the cost differential of all-electric buildings relative to mixed-fuel buildings on the most cost-effective option available.

These considerations can help guide both the discussion of all-electric building costs and the development of any studies that might be done in the future.

In summary, it is true that electric equipment can be more expensive than its natural gas counterpart in a one-for-one replacement. However, the cost impact of all-electric buildings is about more than just individual systems. Avoidance of natural gas infrastructure is the source of considerable cost savings in new construction. This includes avoiding both gas piping in a building and gas service to a site. In most cases, infrastructure costs are substantial and far exceed any additional costs from electric equipment.

Technology Adoption: All-Electric

Both the NZE Stakeholder Advisory Groups meetings discussion and the stakeholder interviews indicated that technology is not a particular issue for all-electric buildings. Many of the distributors are national and have access to efficient, all-electric equipment. More pressing is to ensure that an all-electric design is considered as explained further in the all-electric section. The primary gap here continues to be low gas prices as well as training and education on the benefits of electrification.

NEXT STEPS IN ALL-ELECTRIC

Denver is working with NBI and stakeholders to develop code proposals based on the 2021 IECC that meet the goals and recommendations of this section. The transition to all-electric buildings represents a significant change in the way that Denver buildings are powered, and comes with some important considerations:

- Denver's all-electric foundation is focused on building loads. Manufacturing and industrial natural gas loads are a separate issue that are not addressed in this NZE Plan.
- Equity must be a key consideration in Denver's electrification strategy. Electrification needs to be thoughtfully combined with efficiency and incentives in order to ensure that operating expenses do not increase as buildings move away from cheap natural gas.
- Electric replacements for gas equipment are generally available. In the near term, there may be some challenges with availability at local distributers. As adoption rates of all-electric buildings increase – due to education, incentives and pilot projects – stocking practices should respond naturally to the increased demand.
- The building load that poses the greatest difficulty for electrification in Denver is central water heating systems in multifamily buildings and hotels. The equipment is available, and the design approaches are well established. The issue with these systems is that there is a need for more practitioners who have experience and expertise to effectively design these systems. Possible ways to address this barrier include training workshops, technical resources and technical assistance.

- Kitchen equipment faces a strong perceived market preference for gas, especially in higher end residential and in restaurant settings. Developers of multifamily buildings may see gas as a selling point. Restaurant staff have been trained on gas equipment for cooking. Addressing these issues may require public outreach and pilot programs that demonstrate the advantages of all-electric cooking over gas cooking and help overcome the market perception and business practice hurdles.
- All-electric buildings generally cost less to construct than mixed-fuel buildings due to the substantial savings from eliminating natural gas infrastructure. However, with Denver's cold climate and especially low cost of natural gas, all-electric buildings are generally more expensive to operate. **Investing construction savings in increased efficiency can narrow or eliminate the operating cost advantages of natural gas.** Denver's current grid mix is not as clean as other jurisdictions aggressively pursuing carbon reductions. As a result, electrification in Denver would not have as significant of a carbon-reducing impact on its own as it does in regions with less carbon-intensive electricity supply. This makes electrification more reliant on policies to decarbonize the electricity supply for the grid or the individual building, particularly the installation of on-site renewable energy systems.
- Familiarity with the latest heat pump technologies (particularly cold-climate heat pumps) is relatively low in Denver, leading many practitioners and consumers to have a negative perception of heat pumps based on older generations of equipment. This creates a significant need for education of both practitioners and consumers.

All-Electric Building Code/Policy Updates

As the electricity supply for Denver continues to decarbonize, one of the most effective strategies for reducing the carbon intensity of building operations is to electrify buildings. Other jurisdictions, especially those in California who are leading on this issue, have leveraged strategies such as electrification-readiness requirements, higher performance requirements for mixed fuel buildings and even gas infrastructure prohibitions to foster electrification. Additionally, efforts to electrify the transportation sector through electric vehicle charging infrastructure requirements will have an impact on the prescriptive path. Incorporating these kinds of requirements into the code also will have an impact.

Electrification raises an additional consideration for the prescriptive path. All-electric buildings are not inherently efficient. Heat pump technologies for space and water heating allow for very high levels of efficiency, but other electric technologies such as resistance space and water heating are much less efficient. Therefore, as electrification plays a bigger role in Denver, it will need to be balanced with efficiency. **Special care will need to be given to ensure that the use of low-efficiency electric technologies, such as resistance heat, is restricted to only very limited and minor uses.**

Electrification-Readiness

Electrification-readiness requirements are forward-thinking requirements that ensure that the electric infrastructure exists to convert new gas loads to electricity at some point in the future. This serves a dual purpose. The first is that it is much more cost effective to build this infrastructure during initial building construction than in a retrofit, which reduces the future obstacles to electrification retrofits.

The second is that these requirements also increase costs for gas applications, which provides an incentive to electrify the load from the beginning.

Some examples of electrification-readiness requirements include:

- A 240V, 50A circuit to gas stove locations
- A 240V, 30A circuit to gas water heater locations, as well as a requirement for a condensate drain and access to a minimum volume of air for the heat pump

Electrification-readiness requirements could be located in the electrical code or in the energy code. If they are placed in the energy code, then the prescriptive path will need to accommodate these as mandatory requirements.

Higher Performance Requirements for Mixed-Fuel Buildings

Another strategy for fostering electrification in new buildings is to require a higher level of efficiency for mixed fuel buildings than all-electric buildings. This creates an incentive to build all-electric buildings without prohibiting buildings from installing natural gas. Cities in California have adopted performance premiums between 5% and 15%. These cities were constrained by options that met the California Energy Commission's cost effectiveness requirements.

Naturally, a higher performance premium will provide a stronger incentive to build all-electric buildings, and a mixed fuel option that is still cost effective is less likely to provide a strong incentive.

Requiring higher performance is a simple matter in the performance path; the EUI target can be reduced or the compliance margin relative to the reference building can be increased. In the prescriptive code, Denver would leverage the points approach and require additional points from mixed-fuel buildings. However, the prescriptive path's limitations for delivering increasing levels of performance may mean that there are no additional points available to require for mixed fuel buildings. If this electrification strategy is chosen, it may add an additional reason to augment the points approach with additional points options for Denver.

Gas Infrastructure Prohibitions

A more aggressive electrification policy approach is to prohibit gas infrastructure in some or all new buildings. A prohibition like this is not within the scope of the energy code, so most jurisdictions that are pursuing this approach are adopting it within the building or zoning codes. The justification is that gas combustion in a building creates significant indoor air quality issues and a fire hazard, so the infrastructure is being prohibited as a life-safety issue rather than an energy or carbon issue. While these prohibitions may not be located in the energy code, they would impact the energy code and prescriptive path. A prohibition would make many of the requirements in the prescriptive path non-functional.

NEXT STEPS IN CODES

Denver is working with NBI to develop draft code proposals based on the 2021 IECC that meet the goals and recommendations in this NZE Plan. This is further detailed at the end of this report in "How it All Comes Together."

NZE: POWERED BY RENEWABLE ENERGY AND ELECTRICITY

The third NZE foundation within Denver's net zero energy definition is that new buildings and homes will be powered by renewable energy and electricity. Once buildings and homes are highly energy efficient and all-electric, they will be fully powered from on-site and/or off-site renewable energy.

Goal

Denver's 100% Renewable Electricity Action Plan details that by 2030, renewable electricity will offset 100% of new building energy use for buildings permitted under the code. Code will require increasing minimum levels of renewable electricity in the code cycles leading up to 2030. Additionally, by 2050, the electric grid will be 100% renewable and buildings are part of this equation.

It is important to make sure that renewables are not used to offset basic building performance to a significant degree because a wide range of energy efficiency strategies remain less expensive to deploy at the building level than renewable energy.

NZE Foundation: Powered by Renewable Energy and Electricity

By 2030 renewable electricity capacity will offset 100% of new building energy use for buildings permitted under the code. Code will require increasing minimum levels of renewable electricity capacity in the code cycles leading up to 2030. It is important to make sure that renewables are not used to offset basic building performance to a significant degree because a wide range of energy efficiency strategies remain less expensive to deploy at the building level than renewable energy. Indeed, energy efficiency and demand management will make the 100% renewable electricity goal more feasible and cost-effective for buildings. Powering 100% of building operations with renewable power is made more achievable if the building lowers its electricity demand through energy efficiency. For this reason, the highly efficient foundation section includes details on providing a 'backstop' within code for which renewable deployment cannot offset basic building performance.

Many net zero energy building guidelines say that renewable electricity may only count toward compliance if the building owner retains the Renewable Energy Credits, or RECs, for that renewable electricity. Denver's guidelines differ by prioritizing the addition of new renewable electricity capacity onto the electrical grid beyond what would have been developed otherwise (i.e., "additive RECs"). This is inclusive of renewable energy options, such as Solar*Rewards, in which additive RECs are generated, transferred to, and retired by Xcel Energy towards system-wide decarbonization. Whether additive RECs are retired by the utility on behalf of all customers or by individual customers within the system, there is the same net effect on the total renewable content of the overall system. **This methodology ensures that local investments in rooftop solar and community solar gardens (CSG) are not inadvertently discounted and discouraged simply because Xcel Energy retains and retires the RECs associated with them.**

Denver's renewable vision is to enable a rapid and equitable transition to a 100% renewable electric system in Colorado. By 2030, 100% of Denver's community-wide electricity use will contribute to this vision. The 2030 goal for Denver's electricity use to "contribute to" a 100% renewable electric system is unique compared to goals to be "powered by" 100% renewable electricity. This is in part due to the

recognition that Denver is a part of a larger electric system operated by Xcel Energy in Colorado. **Denver cannot be powered by 100% renewable electricity until the entire system is powered by 100% renewable electricity.**

REACHING 100% RENEWABLE ELECTRICITY BY 2030

The City's 100% renewable electricity goal is articulated such that to achieve it, we must obtain new sources of clean electricity rather than taking credit for existing renewable energy sources.
Denver's renewable electricity contribution metrics adopt a holistic view of the electric system and Denver's place in it and measure progress towards system wide decarbonization. They include:

- **System Renewables**: The RECs inherent in the electricity Xcel Energy delivers to all retail customers that are not created by, subscribed to, or sold to other customers.
- **Distributed Solar**: The RECs created by Denver customers with on-site solar arrays or subscriptions to community solar gardens that are transferred to Xcel Energy and retired for system-wide decarbonization.
- **Utility-Scale RE Subscriptions**: The RECs retired due to participation in Xcel Energy's Renewable*Connect and Windsource programs by Denver customers.

Xcel Energy delivered 99% of Denver's community-wide electricity use in 2019. Fortunately, Xcel Energy is a national leader in the clean energy transition among investor-owned utilities (IOUs). Xcel Energy was the first IOU in the country to announce a voluntary target to deliver 100% carbon-free electricity by 2050 and to reduce carbon on their system 80% by 2030 from a 2005 baseline.[36]

By 2030, 100% of Denver's community-wide electricity use will contribute to a clean grid.

The following metrics track Denver's progress:

System Renewables

20.7% (2019) → 60-80% by 2030
System renewables account for nearly all of Denver's renewable electricity and are expected to continue to account for the majority of Denver's 100RE attainment in 2030. Xcel Energy projects it will retire RECs for approximately 60% renewable energy by 2030. Exceeding this target requires collaboration with Xcel Energy and regulatory engagement.

Denver is pursuing a 60-80% contribution from system renewables by 2030.

Distributed Solar

1.2% (2019) → 30-40% by 2030
Denver has significant untapped distributed energy potential that can be increased by strengthening building codes, supporting CSG and rooftop solar programs, and regulatory engagement.

Denver is pursuing a 30-40% contribution from distributed solar by 2030.

Utility-Scale RE Subscriptions

0.8% (2019) → 10-15% by 2030
Utility-scale renewable electricity subscriptions by Denverites to options such as Windsource and Renewable*Connect are necessary to fill any gap that system renewables and distributed solar leave below Denver's target of 100% renewable electricity by 2030. Community engagement and education is expected to be the primary driver to increase subscriptions.

Denver is pursuing a 10-15% contribution from utility-scale RE subscriptions by 2030.

Denver has some confidence in the rate at which renewable electricity will be added to grid thanks to 2019 legislation and Xcel Energy's commitment to its Certified Renewable Percentage approach. Xcel Energy will incrementally increase the amount of RECs retired on behalf of Colorado customers each

[36] "Building a Carbon-Free Future." Xcel Energy. www.xcelenergy.com/environment/carbon_reduction_plan

year, allowing customers to count that increasing renewable percentage of their electricity mix towards their energy goals. [37, 38] The utility currently projects it will retire RECs for approximately 60% renewable energy by 2030. However, there is still a gap that Denver must close between Xcel Energy's renewable electricity trajectory and the City's goal.

Approximately 1,150 MW of distributed solar (on-site solar and community solar gardens) will need to be deployed over the next decade to reach a 30% contribution to Denver's goal. This can be accomplished if approximately 9% of total roof space in Denver is used for solar, and it can be supplemented by deploying solar over parking lots and at local vacant land parcels within and adjacent to Denver.

CLOSING THE GAP WITH NEW CONSTRUCTION

New buildings can help contribute to closing this gap by supporting the addition of distributed renewable energy capacity beyond what would have been developed otherwise. There are two ways new buildings can contribute additive distributed renewable energy resources:

1. On-Site Solar Deployment: Install on-site solar through Xcel Energy's Solar*Rewards program, including the option to act as a community solar garden site host.
2. Distributed Solar Support Fund: Pay into a City-directed fund to support the development of local solar deployment (i.e., community solar and behind-the-meter solar). A cost study will be needed to set the amount a developer must pay into the City directed solar fund per kW of capacity to be built.

By 2030, new buildings should install sufficient on-site solar panels and/or pay the City to develop sufficient distributed solar on their behalf such that 100% of the projected electricity needs of the building are covered. Requirements for new buildings to install or pay renewable energy capacity will step up over time toward the goal to cover 100% of their electricity needs.

Subscriptions to community solar gardens and Colorado renewable energy program options, while supportive of Denver's goal for community-wide electricity use to "contribute to" a 100% renewable electric system, are not possible due to administrative, regulatory, and legal reasons: 1) A developer's subscription contract may or may not be transferable to a future owner; and 2) It is impractical and inefficient for the City to monitor that renewable electricity contracts have been maintained, renewed, and/or transferred from one owner to the next over time. Additionally, some renewable energy subscription options do not bring new renewable energy onto the Colorado grid and/or only circulate what's already available.

[37] Senate Bill 19-236 added Colorado Revised Statute §40-2-125.5 requiring Xcel Energy to file a "Clean Energy Plan" with the PUC by March 31, 2021. The plan will reduce carbon dioxide emissions associated with retail electricity sales by 80% from 2005 levels by 2030, and provide customers with energy generated from 100% clean energy resources by 2050.

[38] Xcel Energy Certified Renewable Percentage is described in filing number G_764613, proceeding 19AL-0268E. Colorado Public Utilities Commission.

The following types of renewable energy purchases, and any other programs outside of the two approved compliance pathways, will **NOT** be options for new buildings in Denver to achieve Net Zero Energy under the code:

Table 36. Renewable Options Not Available to Achieve NZE

Xcel Energy Renewable Subscriptions	Other REC Purchase Options
• Renewable*Connect • Community Solar Gardens • Windsource	• Purchases of unbundled RECs • Virtual Power Purchase Agreements • Expedited review

This is not to say that some of the above options do not create additive RECs or are not considered valuable to Denver's clean electricity objectives. Building tenants and electricity customers are indeed encouraged to subscribe to Colorado's renewable electricity program options and to pursue opportunities to create additive RECs that help to offset their local, national, or global carbon footprints.

This Code focuses on Denver's built environment and the opportunities which the City can control or exert meaningful influence over, and where the City can overcome challenges to implementation. As was mentioned previously, the City is prioritizing renewable electricity strategies that result in the addition of new renewable electricity capacity to the grid. The City's two compliance pathways create simplicity in administration and most effectively create new renewable electricity capacity and additive, local RECs.

Denver's Renewable Energy Targets

As part of this NZE Plan, Denver asked the NZE Stakeholder Advisory Groups to review the renewable energy goals and targets for buildings and homes to determine the recommendation for upcoming code cycles shown in the table below.

Table 37. Commercial and Multifamily Building Renewable Energy Targets for Denver Code

	2021	2024	2027	2030
Minimum renewable offset	50%	75%	100%	100%
Minimum % Roof Area	25%	50%	70%	70%

This recommendation includes both a minimum renewable offset that can be met by on-site or off-site solar in order to equitably require solar for varying building types and shapes. Additionally, there is a minimum percentage roof area for on-site solar to encourage on site production.

For residential, the table in the highly efficient section combines efficiency and on-site solar. For this reason, there is not a minimum percent roof area envisioned. However, there is still a minimum renewable offset as detailed in the table below.

Table 38. Residential Home Renewable Energy Targets for Denver Code

	2021	2024	2027	2030
Minimum renewable offset	50%	75%	100%	100%

In addition, based on the NZE Stakeholder Advisory Groups meetings, the renewables for all building types (commercial, multifamily and residential):

a. Offset total building energy use including natural gas
b. Can be met by either:
    i. Installing on-site solar
    ii. Paying into a Renewable Denver Community Solar Fund (where the city will build off-site community solar gardens)

Renewable Denver Community Solar Fund

To ensure that all buildings and homes are able to meet the renewables requirement, Denver will develop a fund, the Renewable Denver Community Solar Fund, that will build community solar gardens. As with any fund, Denver will perform a rate study. The in-lieu rate must be rationally related to the overall cost for the City to provide an equivalent benefit.

The scope of work defined for the in-lieu rate study is as follows:

- The study will show the cost the City would incur to install equivalent required renewables within community solar gardens as what would have been required to be installed on the building site. It will include items such as land value, construction, and operations and maintenance. Land costs are included because the rate has to be reasonably connected to the cost for the City to supply the service, and land purchases are sometimes potentially needed. This rate will be the fee-in-lieu rate for those buildings not doing any solar on-site.
- The rate also will include a reduced rate if a developer/builder maximizes solar roof coverage. This reduced rate will help ensure a similar return on investment as installing on-site solar. As a result, the study will:
    - Detail on-site solar return on investment
    - Recommend a lower rate for a developer/builder who maximizes solar roof coverage
    - Ensure that priority subscriptions are included with an appropriate duration such as 20 years (in the contract with the solar developer, adhere to requirements)
- The cost should be based on City pricing, not private pricing. The cost of an equivalent project contract with the City is often higher than the cost to a private developer because of City labor law and other requirements.
- Because the City will be administering the funds, the rate study will determine the necessary administrative costs of the City.
- The rate should include a recommendation regarding how the fee should best be increased in the future with a formula tying it to an index/value that is measured regularly.

The rate recommended is based on a compilation of costs including the following:

- Land Values (Costs): parking lots, rooftops, and land
- Capital Costs (Construction)
- Operations and Maintenance
- City Administrative Costs

NZE: PROVIDERS OF DEMAND FLEXIBILITY FOR THE GRID

The fourth NZE foundation within Denver's net zero energy definition is that new buildings and homes will be providers of demand flexibility for the grid. This includes energy storage, grid integration, and the flexibly to respond to grid signals.

Goal

There is not a specific climate goal within the 80x50 Climate Action Plan for grid flexibility, however it will be needed as buildings and homes are increasingly all-electric.

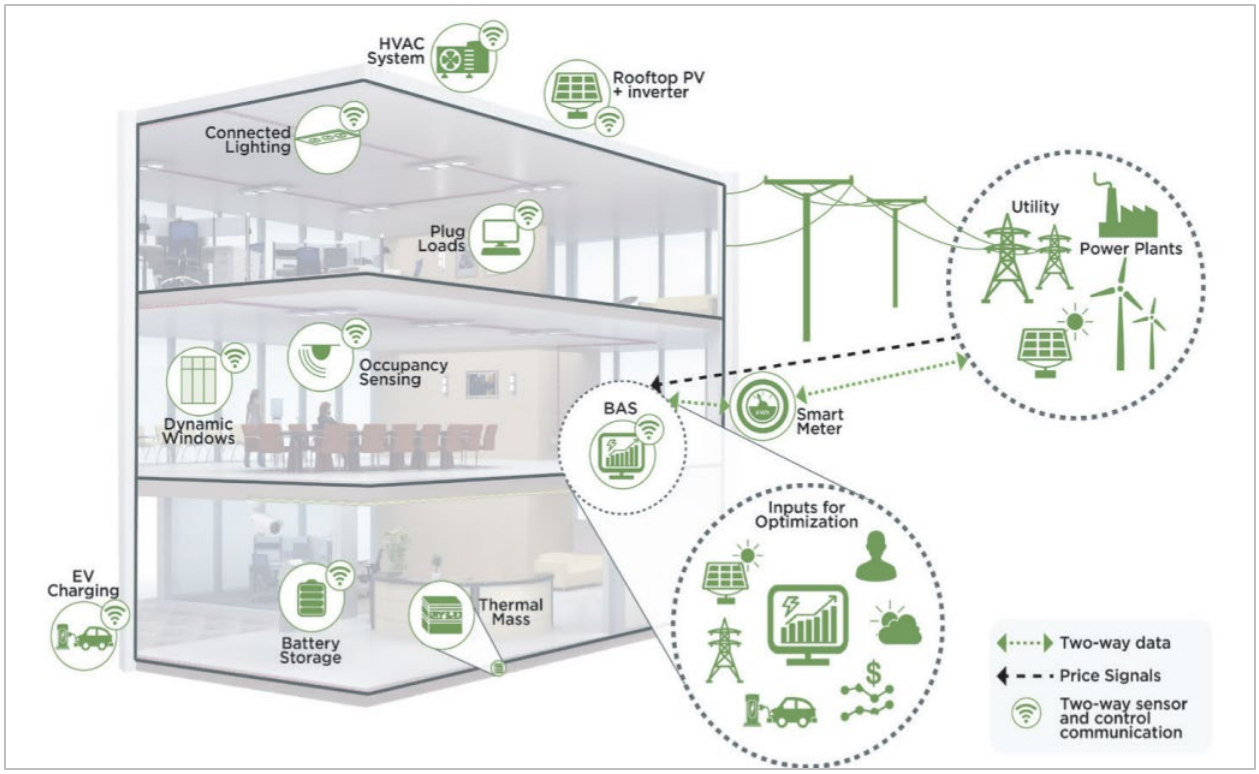
NZE Foundation: Providers of Demand Flexibility for the Grid

WHAT IS GRID FLEXIBILITY AND STORAGE?

Today, a significant amount of the electricity that is generated is simply wasted. The traditional utility business model is to match electricity production to consumption in real time. This leads to vast inefficiencies because consumption is far from constant over time. The intermittency of renewable electricity can create additional complications if not coupled with dispatchable resources, energy storage, and load management. Peaks in consumption that may occur for only a few hours every year result in expensive fossil fuel power plants being built to operate just a few days each year to meet those peaks.

Denver will need to increasingly pay attention to efficiency as a function of time of day. **An energy code requirement that saves more energy in total may actually be less desirable than an energy code requirement that can balance energy use throughout the day.** As a consequence, the prescriptive path and mandatory minimums in the modeled path will very likely need to incorporate grid-responsive requirements that recognize the importance of the quality as much as the quantity of energy savings.

In order to electrify everything – our buildings, homes and vehicles – and then power all those end uses with 100% renewable electricity, we must have systems to add both flexibility to electricity consumption and store electricity. New buildings become existing buildings and need to have grid flexible capabilities installed up front. The following graphic shows ways a building might provide grid flexibility and storage for the grid.



Source: Navigant Consulting

Figure 36. Grid Flexibility and Storage Methods for Buildings

There are two ways these grid flexible and storage resources in a building might be controlled:

1. ***Beyond the Building***. The utility may be able to directly control systems in the building to adjust consumption and production of electricity to meet the grid's needs through automated demand response programs. Third parties such as demand response (DR) aggregators or other service providers also may be contracted by either the utility or the building owner.
2. ***At the Building***. The building automation system, or even some individual systems, could take price or demand signals from the utility and enable the user to adjust both the building's consumption and production of electricity to match grid signals.

In both cases systems would be set up to primarily be adjusted in ways that would not negatively impact occupant comfort or occupant energy needs. For example, the walls and floors and other thermal mass of a building could be pre-cooled at night to reduce the cooling load needed during the day. Water heaters could heat and store very hot water when the grid has excess electricity, and a mixing valve could lower it to the user's set point when it is delivered. Occupancy sensors could ensure lights are off and ventilation is lower in rooms without occupants.

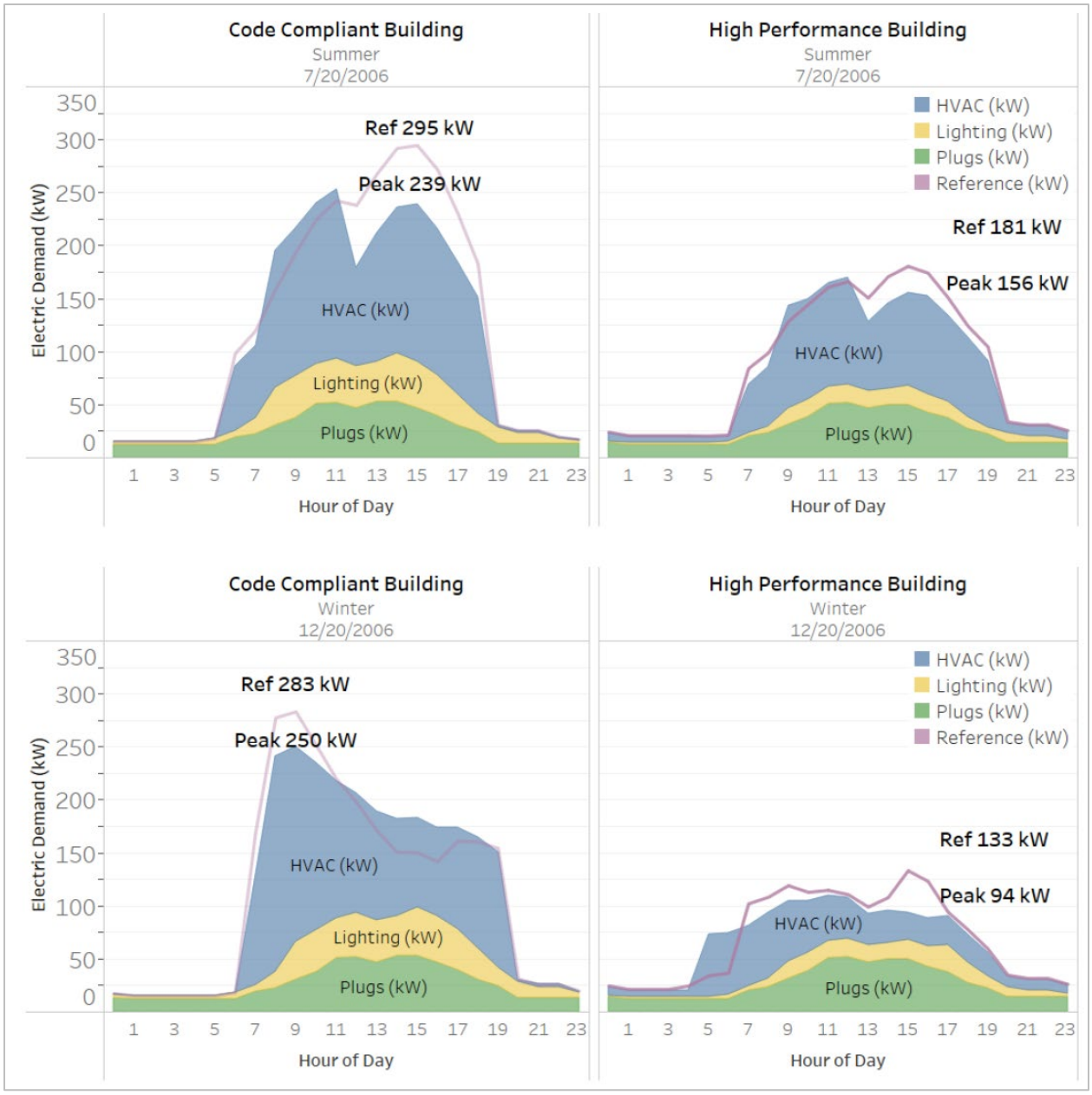
BENEFITS OF GRID FLEXIBILITY AND STORAGE

Grid-flexible and storage capable buildings have many benefits for the building owner and occupants as well as the grid:

- Significant potential GHG emissions benefits due to the ability to tune energy consumption patterns to better utilize energy when it is low-carbon and reduce loads when energy is high-carbon. This benefit accrues to society at large. This benefit grows as the grid decarbonizes (due to having more variable generation resources on the grid).
- **Small additional up-front costs have the potential to significantly lower energy bills over the life of the equipment because of the valuable services they provide to the grid.** Value may come to the building owner through:
    - Payment for participation in demand response programs with large equipment that can take a signal from the grid (automated demand response); often a third-party aggregator may aggregate controls on a large number of small pieces of equipment to offer larger "blocks" of load reduction capacity to the utility.
    - Reduced demand charges based on a facility having reduced peaks in demand.
    - The ability to use electricity only when it is cheapest with time of use rates or other time differentiated charges; or
    - "Critical peak pricing" programs offered by some utilities that can provide additional load management incentives.
    - Potential for reduced interconnection/hookup fees in cases where the utility can be confident that the facility's maximum demand will be less than what is theoretically possible.
    - These are best practice recommendations, and some are not in place in Denver yet.
- In some cases, there will be less frequent equipment replacement needs because equipment will be run more purposefully and less frequently.
- New services for tenants like greater power reliability, smart EV charging, and support for corporate sustainability through better building data and demonstrably lower greenhouse gasses attributable to their energy use.
- Increased resiliency and reliability through the ability to operate as a microgrid, insulating the building from grid outages. Critical facilities – such as hospitals, public safety and security facilities, military installations, and water and wastewater facilities – can be good buildings in which to do demonstration projects for microgrid, grid flexibility and storage functions to help them ride out outages without disruption.

GRID FLEXIBILITY AND STORAGE POTENTIAL

Buildings have the opportunity to reduce peaks through a variety of measures. The Commercial Building Load Modification and Flexibility Potential report from New Buildings Institute (NBI) shows a similar heating climate to Denver using Burlington, VT. The graphs below show the impact of grid flexibility measures showing similar trends to other climates. The largest observation in Burlington is the peak demand reduction from the Code Compliant Building to the High Performance Building. In winter, the peak demand is reduced by 54% before applying any measures. This is primarily due to the heat recovery ventilator and a higher thermally insulated envelope.



Source: Commercial Building Load Modification and Flexibility Potential Report

Figure 37. Seasonal Daily Power Demand by End Use (HVAC, lighting, plugs) in Vermont

This analysis produced a broad set of information about how building energy efficiency and controls strategies can be used to impact peak demand and demand shape. The key findings indicate that significant adjustments to building load shape are possible to support grid integration, and that load modification and energy flexibility measures may be best applied in packages.

TODAY IN DENVER

Successful grid flexibility and storage capabilities require both the building and homes as well as third party demand response (DR) aggregators, the grid, and the utility to work together. Buildings and homes

must have infrastructure, such as water heaters, air conditioning, and HVAC and lighting controls, capable of receiving DR requests or responding to price signals from the utility and implementing load adjustments. The utility must offer demand response programs or structure their pricing to compensate customers when they provide services to the grid.

The City can require buildings and homes to have capable infrastructure through the building code, but it only can advocate to the utility and state regulators for the utility to offer programs and pricing that utilize that infrastructure. Today in Denver, most buildings do not have infrastructure capable of receiving DR requests or responding to price signals from the utility.

In Colorado, for non-residential customers, Xcel Energy offers several demand response options: Peak Day Partners, Peak Partner Rewards, Interruptible Service Option Credit and Critical Peak Pricing/EV Critical Peak Pricing. Also, the default rate for industrial customers has time of use (TOU) built into it. In addition, Xcel Energy offers an AC Rewards and Saver's Switch for Business.

Xcel Energy offers Tiered Pricing, which is a form of TOU, for residential, as well as the Saver's Switch/AC Rewards programs (DR). They are in the pilot phase for TOU pricing for other customers. The TOU pricing should phase in for all customers over the next 3-5 years. But it's not very dynamic (time-based on-peak/off-peak regardless of when renewables are on the system).

Denver's 2019 IECC required that all buildings be battery storage ready. The main electrical service panel shall have a reserved space to allow for installation of a two-pole/three-pole circuit breaker or disconnect switch for future electrical energy storage system installation. This space shall be labeled "For Future Energy Storage." Denver's 2019 IECC also requires the installation of electric vehicle (EV) charging stations – and electric vehicles may play a role in providing grid flexibility in the future. See the EV section of this NZE Plan for details on the EVs.

Denver's voluntary 2019 Denver Green Code requires that building controls are designed with demand response infrastructure capable of receiving request from the utility for adjustments to:

- HVAC system setpoints
- Variable-Speed Equipment speed adjustments
- Lighting power demand adjustments

Denver will build upon this foundation to increase the grid flexibility of buildings in Denver over the upcoming code cycles in 2021, 2024, 2027 and 2030 in this ambitious yet achievable plan.

CURRENT EXAMPLES FROM OTHER JURISDICTIONS

California

Title 24 gives mandatory requirements for demand management that include demand-responsive zonal HVAC controls and lighting controls in certain nonresidential buildings. In residential buildings, mandatory requirements for solar ready buildings make exceptions for residences with demand-responsive thermostats.

Washington (DC), Baltimore (MD), Rockville (MD), Carbondale (CO) and Snowmass (CO)

All of these cities and towns have adopted the 2012 IgCC as a mandatory code, which has similar demand response ready infrastructure requirements as the 2019 Denver Green Code.

FIRST STEP FOR DENVER IN 2021

Adjust the Prescriptive Path for Time-Specific Efficiency

The effectiveness of energy efficiency measures can vary by time of day. As a consequence, the prescriptive path should be adjusted to focus on requirements that save energy specifically during times of anticipated grid congestion and high marginal GHG emissions. This could take the form of additional mandatory minimums that apply to all compliance paths, or modifications to the points values to provide greater value to the options that provide efficiency during those times of grid congestion and high marginal GHG emissions.

Prescriptive Path and Mandatory Minimums Require Grid-flexible Equipment

Require the following capabilities to be installed in all buildings immediately when adopting code in 2021 to future-proof buildings so they are ready to participate in demand response programs and to take advantage of utility or other price signals when they become available. The following actions have a relatively low up-front cost with significant potential savings over the life of the asset. They should therefore be installed in buildings immediately, even before utility programs are in place.

- Incorporate the voluntary 2019 Denver Green Code requirements as base code. Require DR infrastructure capable of receiving requests from the utility for adjustments to HVAC system setpoints, variable-speed equipment, variable-speed equipment speed adjustments and lighting power demand adjustments. Update requirements to ensure they include but are not limited to:
    - Large buildings have BMS that can adjust HVAC setpoints, motors, drives and other variable speed equipment. Only large buildings need grid flexible lighting power demand adjustment capabilities.
    - Small buildings and homes have RTUs or and HVAC systems that are controlled by a thermostat with grid-flexible capabilities.
- Require different sizes of buildings to have storage capable space in the panel that are sized to match the potential load of the building.
- Require electric heat pump load controllable water heaters.
- Require all new electric water heaters installed to have the CTA-2045 modular communication interface. Tank-style water heaters are the only form of energy storage that are already in most customer's homes. They can provide services to the grid and the customer by:
    - Lowering the setpoint: This will reduce energy consumption immediately and/or shift that load to a later time. Without increasing tank size or temperature, only small adjustments may be possible without affecting user comfort.
    - Increasing the setpoint: Importantly, this can only be done if a mixing valve is installed, to ensure users don't get scalded. This strategy allows a utility to store heat in a water heater when there's excess renewable energy on the grid. CTA-2045 can do a lot more

than just temp up/temp down. For example, HPWHs have four modes: electric resistance, heat pump only, energy saver (hybrid of those two), and vacation (off, basically). CEA-2045 could tell the HPWH to change modes as well as setpoints.
    - Providing a larger supply of hot water. Most HPWHs have larger tanks than their electric resistance equivalents. A home well served by a 40-gal electric resistance water heater might get a 50-gal HPWH.
- If a building has the following equipment installed, then it must be grid flexible capable:
    - On-site storage
    - On-site generation
    - EV charging

Advocate for Xcel's Energy Design Assistance program to help make sure technologies are installed.

GRID FLEXIBLITY: SHORT-TERM

Advocate to the utility and state regulators for more DR programs and time of use (TOU) rates or other time differentiated charges to be rolled out in ways that ensure communities and individuals with a greater energy burden don't see energy bills increase. Low-income customers often can't afford the technologies to shift/manage their load. We need complementary DR programs to make this effective. Pay customers to change their behavior (DR incentive) rather than penalize customers for being unable to afford to store/time-shift energy (TOU structure). Also, advocate to include GHG emissions as a consideration factor in ratemaking.

In 2024 Code:

- Require the implementation of the GridFlexible metric.
- Require different sizes of buildings to have storage capable locations in the building as needed that are sized to match the potential load of the building.

GRID FLEXIBLITY: LONG-TERM

Require the following to be done in all new buildings when the utility offers programs and rate structures that compensate building owners effectively for the services buildings provide to the grid with these measures. Generally, in 2027 and 2030 code adoptions Denver should require improved grid flexibility and increased storage. Specifically, this may mean:

- Performance Path – Consider moving to enhanced code compliance models so they are good to the hourly level and can be adjusted based on a building's static, dynamic, or on-call electric loads. Could be a trade-off or a minimum mandatory requirement. This could allow Denver to select most-critical load hours and credit targeted building load modifications during those hours. It could also be tied to carbon in Denver's requirements.
- Require commissioning to have a plan to set up the programming for load shifting in responses to price or demand signals from the grid. Require functional testing of capacity and duration during the commissioning process.
- Require Battery Storage controlled by an energy management system that is programmed to maximize value to the customer and the grid, including customer resiliency, carbon reductions, and system management. It is important to ensure that battery storage not be charging during

times of grid congestion and/or high GHG emissions. This can be done by programming the battery controls (end user control) or by having the battery behavior controlled in whole or in part by a utility or third party. In any case it is important to ensure that charge/discharge patterns align with GHG emissions and grid congestion.

Grid Interactive Capable buildings in 2030 can take and shed as much load as electric heat, solar PVs and EVs add on a net-basis. Metrics for grid interactivity do not exist, but people are working on them, and as they begin to exist Denver will assess how to incorporate them into policies. An initial draft of what these metrics may be are the grid flexible metric components that follow.

Table 39. Grid Flexible Metric Components

Grid Flexible Metric	Detail
Grid Peak Contribution	Degree to which building demand contributes to load on the grid during system peak hours
On-site Renewable Utilization Efficiency	Building's consumption of renewable energy generated on-site (not exporting to grid) over a year
Grid Carbon Alignment	Degree to which the building demand contributes to upstream (grid) carbon emissions over a year
Energy Efficiency vs. Baseline	Percent better than code (annual total energy use)
Short-Term Demand Flexibility	Building's ability to reduce demand (shed) for 1 hour
Long-Term Demand Flexibility	Building's ability to reduce demand (shed) for 4 hours
Dispatchable Flexibility	Building's ability to reduce demand (shed) for 15 minutes, controlled by utility/third party
Resiliency	Building's ability to island from grid and/or provide energy for critical loads for 4-24 hours; motor soft start capability to help grid restart after outage

GridOptimal is working on a single metric to assess whole building flexibility. Denver will eventually want to identify the level of GridOptimal scoring needed to achieve that goal on a scale of 0-100%. These metrics combine two basic approaches to evaluate the quality of building-grid interactions: (1) building energy consumption patterns (load shape or demand profile), and (2) building assets (capabilities).

Denver's Grid Flexible Targets

As part of this NZE Plan, Denver asked the NZE Stakeholder Advisory Groups to review grid flexible goals and targets for buildings and homes to determine the recommendation for upcoming code cycles as shown in the table below.

Table 40. Building and Home Grid Flexible Requirements for Denver Code

	2021	2024	2027
All Buildings & Homes	Grid Flexible Equipment	Implementation of Grid Flexible Metric	Improving Grid Flexibility + Increased Storage

COST AND SUPPORTS FOR NZE

In conjunction with technical solutions and recommendations to get to net zero emissions in Denver, there are additional strategies needed to support the community and enable the passage of equitable policies and incentives. Reaching the goals and recommendations for net zero will require supports. This includes Denver community support such as marketing, outreach, training, education, financing, advocacy, etc. as well as internal support such as staffing and resources. This section outlines the costs and supports needed. Consideration of costs and supports together is critical in ensuring that the goals and targets in this NZE Plan are met.

The potential cost considerations for highly energy efficient and all-electric are detailed within those sections. For NZE first costs related to energy efficiency, cost studies detail that NZE is about 5-19% additional first cost for buildings and 6-8% for homes. Operational costs, however, make up for any additional costs from efficiency to make this particularly attractive to owners and developers who are planning to hold the building longer-term. For all-electric, cost studies show that heat pumps do cost more compared to gas equipment. However, incentives from Xcel Energy for heat pumps and avoiding the natural gas connection and piping costs ensure that it is less expensive for both an all-electric building and home. Further detail on the all-electric costs by building type are detailed in the "Cost Considerations and Study: All-Electric" section of this report.

While these cost considerations are important to understand, market transformation still will require supports for equity and affordability. **The supports needed to get to net zero for building and homes include: marketing and outreach, training and education, financing and incentives, and advocacy.**

Supports needed include both supports for the community for net zero design and performance as well as supports for the city to help facilitate this through the Code Adoption Process as well as through code review and inspections. Denver has also worked with the Climate Action Task Force and the NZE Stakeholder Advisory Groups to understand needed supports.

NZE Supports

In the first NZE Stakeholder Advisory Groups meetings, the stakeholders identified that one key role of the city is to educate. This was also detailed and identified in later stakeholder meetings as well. Education includes bringing in expertise from other areas, educating design teams, and sharing technologies and training. Additional education for owners and the general public also was discussed as a need. Similarly, Denver's Climate Action Task Force recommendations included recommendations for supports for buildings and homes.

CLIMATE ACTION TASK FORCE SUPPORT RECOMMENDATIONS FOR NZE

The Climate Action Task Force process identified a number of supports needed to reach net zero by 2030. They identified priority incentives as part of identifying solutions for net zero new buildings as seen below.

Table 41. Climate Action Task Force Priority Incentives

Climate Action Task Force **Priority New Buildings and Homes Incentives** 2020-2022
Incentivize affordable housing through zoning in coordination with Denver's Department of Housing Stability (HOST).
Provide net zero energy new buildings and homes training for developers, design teams, contractors.
New construction net zero energy buildings and homes incentives. In particular, building height incentives and expedited permitting incentives should be considered.

Additionally, supports needed for all buildings and homes were recommended. These include the following support categories:

- **Marketing and Outreach**: Outreach to the public on the value of energy efficiency, healthy buildings, and beneficial electrification. Communicate Denver's climate goals and work.
- **Training and Education**: Provide training and education on energy efficiency and building electrification.
- **Financing**: Finance solutions for buildings and homes for energy efficiency and beneficial electrification.
- **Advocacy**: Advocacy at the state or federal level for policy change that parallels the recommendations of the Task Force.
- **Education**: Educate local officials in surrounding jurisdictions about Denver's codes, policies, and incentives so they can consider adopting similar ones.
- **Programs**: Programs to engage the community and connect incentives.

Each of the supports identified by the Climate Action Task Force were identified and then prioritized by phase of near-term (2020-2022), mid-term (2023-2025), and long-term (2025-2030). The tables below detail the support recommendations from the Climate Action Task Force prioritized by phase.

Table 42. Near-term Climate Action Task Force Supports for Buildings and Homes

Buildings and Homes Supports: Near-term: 2020-2022
Marketing: Educate general public on value of energy efficiency and healthy buildings and potential clean energy jobs in buildings. Work with schools to promote these career tracks.
Marketing: Education on energy efficiency, building electrification focused on health benefits and better indoor air quality.
Outreach: Summarize annual energy savings from buildings and homes to community.
Training: Develop training for building owners, operators, managers, developers, homeowners, and realtors (work with the Department of Regulatory Affairs to require training) focused on energy efficiency, net zero energy, and strategic building electrification.
Training: Workforce training for technicians and contractors to enhance energy efficiency and strategic building electrification. Encourage workforce training of contractors tied to contractor licensing and unions to encourage use of efficient equipment by contractors. Provide incentives or scholarships for existing trainings/certificates by industry associations, trade schools, and community colleges. Work with Denver Public Schools to promote careers in climate solutions, specifically sustainable buildings. Promote or subsidize extracurricular modes of education in sustainable building. Create green business incubators.
Training: Create training and jobs in the clean energy transition focused on our most impacted/vulnerable communities. Create market incentives for hiring green workforce.

Buildings and Homes Supports: Near-term: 2020-2022
Education: Develop an Energy Resource Center that provides support, guidance, and assistance to help owners, managers, contractors, etc. complete design and projects focused on energy efficiency and strategic building electrification.
Education: Promote models where tenants and building owners are educated on sustainable benefits to building improvements.
Advocacy: Xcel Energy Time of Use electricity rates to encourage use when the grid is less carbon intensive. Ensure that equity is part of the rate design to enable low-income households to take advantage of better rates and not unintentionally burden them with higher bills.
Advocacy: Regulatory changes at state level and Xcel Energy. Advocate for new construction incentives for affordable housing, in particular to enable electrification.
Programs: Connect/enhance low-income programs, include incentives that improve indoor air quality and health. Ensure ventilation is sufficient and that upgrades improve overall health and safety.

Source: CASR

Table 43. Mid-term Climate Action Task Force Supports for Buildings and Homes

Buildings and Homes Supports: Mid-term: 2023-2025
Marketing: Communicate Denver's goals, work, and health benefits to the community.
Outreach: Host/participate in events, meetings, and conferences.
Outreach: Build awareness and celebrate success.
Programs: Small commercial and multifamily, connect/enhance low-income programs, improve affordability through integration of existing programs (childcare and others).
Program: Connect Sustainable Neighborhoods program to energy and electrification. Target early adopters of renewables and efficiency with electrification messaging.
Financing: Solutions for commercial and multifamily buildings.
Financing: Solutions for homes.
Advocacy: Support residential PACE financing for zero energy ready homes by evaluating and advocating for it to be considered by Colorado's General Assembly, building on the work of the Colorado Energy Office. Any proposal should prevent predatory lending.

Source: CASR

Table 44. Long-term Climate Action Task Force Supports for Buildings and Homes

Buildings and Homes Supports: Long-term: 2025-2030
Policy/Code: Convert building types to reduce GHG.
Policy/Code: Historic home and building considerations; accessibility within historic buildings as a consideration; determine energy efficiency solutions for temporary housing through rental policies and affordable housing programs.
Program: Create a green certification or green credit program.
Advocacy: Reduce GHG through renewable natural gas and carbon-free hydrogen.
Connection-Waste: Address waste in buildings. [see consumption and waste recommendations]
Connection-Transportation: Reduce construction transportation emissions. [see transportation policies]

Source: CASR

NZE STAKEHOLDER ADVISORY GROUPS SUPPORT REVIEW

Once initial solutions and supports were developed by the Climate Action Task Force, Denver convened the NZE Stakeholder Advisory Groups to review the solutions and prioritize these for net zero. Similar groups reviewed the solutions, supports, and costs that were ultimately reviewed by a focused Climate Action Task Force buildings and homes group that provided recommendations to the entire Task Force.

Table 45. NZE Stakeholder Advisory Groups - Top Commercial Supports

Strategy	Detail
Development incentives for following Denver Green Code (non-monetary)	• Height incentive/density bonus • Reduced parking requirements • Expedited review • Others to be defined
Design and construction team incentives	• Incentive for the increased time requirement for designing a NZE building • NZE charrettes • pEUI modeling • Cx, MBCx, enclosure Cx • M&V
Permit fee reductions	• Permit fee reductions for following Denver Green Code
Cash rewards from City	• For efficiency technology (HVAC, controls, lighting, etc.) • Renewables • Storage • Electric HVAC and water heat • Performance (meeting NZE) • Land purchases for NZE buildings

For commercial buildings, the top strategies include zoning incentives, expedited review, design/ construction team incentives, and permit fee reductions.

As a result of these discussions, Denver's Community Planning and Development (CPD) took a first step in the Denver Green Code and Affordable Housing Pilot Program. The all new, voluntary Denver Green Code provides guidance for higher performing buildings and sites through energy efficiency, resource conservation, sustainable materials, indoor environmental quality, water safety, site development, land use, and overall building performance. CPD will identify five major commercial projects for the Denver Green Code pilot program. To qualify, projects must choose one of four paths:

- Comply with the provisions of the Denver Green Code as written;
- Achieve Platinum Certification using version 4.1 or later of the US Green Building Council's (USGBC) Leadership in Energy and Environmental (LEED) program;
- Achieve Zero Net Energy; or
- Achieve Passive House certification plus comply with the provisions of all non-energy chapters of the Denver Green Code as written.

The benefits include a fee reduction, enhanced site development process, and expedited building log plans review.

Table 46. NZE Stakeholder Advisory Groups - Top Residential Supports

Strategy	Detail
Cash rewards from City	• For efficiency technology (HVAC, controls, lighting, etc.) • Renewables • Electric HVAC and water heat • Low carbon construction materials • Performance (meeting NZE) • Land purchases for NZE buildings • Demand flexibility: storage, energy storage, water heater, PV
Development incentives for following Denver Green Code	• Density bonus • Setbacks • Lot layout: building orientation • Expedited review
Design and construction team incentives	• Incentive for the increased time requirement for designing a NZE building • NZE charrettes • pEUI modeling • Blower door testing • M&V
Permit fee reductions	• Permit fee reductions for following Denver Green Code

For residential homes, the top strategies include cash rewards, development incentives, and development design/construction team incentives.

As a result of these discussions, Denver's Community Planning and Development (CPD) took a first step in the Denver Green Code and Affordable Housing Pilot Program. All new detached single-unit homes and duplex construction projects (excluding master and type approved projects) that follow the Denver Green Code between November 1, 2020 and January 31, 2021 will receive expedited reviews.

Zoning Supports for NZE: Incentives and Considerations

One of the top supports identified above includes incentives as part of zoning such as additional height, density, setback, parking and others. Beyond building codes and policies, zoning is an opportunity to incorporate NZE specifications and incentives. Zoning is also critical to affordable housing within Denver and the pairing of affordability and sustainability can enhance both equity and affordability. In addition, Denver is currently working on an Affordable Housing Zoning Incentive Study that includes a feasibility analysis and considerations of cost in meeting the Denver Green Code through understanding costs of LEED Certified and net zero energy.

NZE AND ZONING INCENTIVES

Zoning incentives allow for higher value development on projects that promote public policy objectives. Zoning incentives influence the size and scale of buildings and often apply in a particular area within a city. Types of zoning incentives include up-zoning, Floor Area Ratio (FAR) bonuses, height bonuses and sometimes a contribution to public funds to pay for things such as parks or city infrastructure. An example of up-zoning is allowing for different zoning that supports a more valuable use (for example, from an industrial use to residential). A FAR bonus allows additional gross floor area to be added to the

building lot size if certain objectives are met. Height bonuses allow developers to build a taller building than is allowed by right in zoning.

Eligibility requirements on how to achieve the incentive is generally considered during the long-term public process facilitated by the land use planning group within a city. Some cities have engaged in comprehensive community planning processes for a particular neighborhood which have resulted in suggestions on how development incentives can be used. In those cases, after the planning process, the requirements have to be vetted through normal zoning code processes.

Commonly used to promote affordable housing, an increasing number of jurisdictions are using these regulatory levers as a way to prevent the displacement of low- and moderate-income residents and to achieve climate goals and objectives. Municipalities also can use bonuses for buildings that design and construct to a stretch code and comply with energy outcomes. These incentives can precede code mandates and serve to increase familiarity with advanced measures. Local case studies can facilitate future code enhancements by paving the way through development of a track record of success for newer approaches. This also can serve to improve code compliance once new codes with these requirements are passed by educating early adopters in the market on new code approaches.

This section provides a review of regulatory approaches in the zoning code used by cities to promote energy efficient and green commercial and residential buildings. The analysis draws from other research, including analysis by BetterBuilt Northwest[39], a policy white paper by M-Group and Karen Warner Associates for the City of Santa Rosa[40], as well as a market scan conducted by *Architecture 2030* done in partnership with New Buildings Institute for the Urban Sustainability Directors Network and a dozen cities in the Zero Cities project during 2019. This assessment details how these approaches have been used by other jurisdictions, and share lessons learned on how they can be used to encourage net zero residential and commercial buildings in Denver.

Development and Zoning Approaches

Many cities in the United States have created zoning incentive programs to achieve a number of public policy objectives including affordable housing, green buildings, conservation of open spaces and agricultural lands, inclusion of common spaces and amenities for residents. The approaches researched and listed below include those focused on green building and energy performance.

Arlington, VA New development project teams may request additional bonus density and/or height in exchange for LEED certification and Energy Star Portfolio Manager certification within four years of occupancy. Projects designed and constructed to achieve at least LEED Gold certification plus two Arlington priority credits plus Net Zero Energy Building certification through the International Living Future Institute may apply for bonus density above 0.55 FAR. Affordable housing projects receiving tax credits from the Virginia Housing Development Authority (VHDA) are allowed to earn bonus density using the Earthcraft green building rating system at the Gold or Platinum certification level.

Austin, TX – Under Section 25-2-586 Downtown Density Bonus Program, developers can pay a fee instead of meeting the standard to receive density bonus to pay for neighborhood development or

[39] https://betterbuiltnw.com/

[40] https://srcity.org/DocumentCenter/View/18475/Density-Bonus-Policy-White-Paper?bidId=

affordable housing. Under section (E)(8) Green Building Community Benefit, owners may receive FAR bonus area or height bonuses if the project substantially complies with the Urban Design Guidelines as determined by the Design Commission. The applicant also must provide streetscape improvements along all public street frontages, consistent with the Great Streets Standards. In addition, the building must achieve two stars under the Austin Energy Green Building program. If the owner does not achieve the AEGB or LEED certification within nine months of occupancy, the owner must pay into the Affordable Housing Trust Fund the bonus fee that was initially granted.

Bar Harbor, ME – Within their code for Planned Unit Development, (6)(a)[d] provides a density bonus for an increase in the market-rate dwelling units that meet LEED standard "or an approved equivalent." The bonus applies in a Planned Unit Development and compliance is demonstrated with a certification program application or by affidavit of a team member.

Boston, MA - The City created plans that recommend new density bonus zoning for two major neighborhoods. The plans are allowing developers to increase height or floor area in exchange for low-income restricted units. The areas are distinctly different, and the resulting policies reflect this.

> The Plan: JP/Rox Planning Report recommends design guidelines go beyond LEED standards to ensure new buildings and large development projects reduce carbon emissions and environmental impacts. Passive practices include efficient building envelopes and orientation while active, innovative strategies and technologies include building-integrated renewable energy, energy storage, and community solar.
>
> The Plan: South Boston Dorchester Avenue Planning Report recommends sustainability leadership and carbon free development as demonstrated by a minimum of LEED Gold, with platinum as the goal. The South Boston Dorchester Avenue neighborhoods also will require renewable energy. The work in Boston is not done. The next step is to develop EUI targets and renewable energy requirements that are required to achieve the carbon emission reduction goals outlined in both neighborhood plans.

Bothell, WA – Under Bothell Ordinance number 2028, developers who apply for LEED or the National Green Building Standard can reduce the required number of on-site parking spaces. In addition, the city offers a fee-bate for green buildings with up to a 50 percent rebate for achieving LEED Platinum or National Green Building Standard Gold.

Emeryville, CA - The Emeryville Municipal Code 9-4.204 Development Bonuses has a FAR bonus points schedule for affordable units. Half of the points needed to achieve FAR bonuses must come from affordable housing. Remaining points, up to 50, can be earned by providing a variety of community benefits. Fifty points can be earned for buildings that are zero net energy and produce as much energy as they create over the course of a year. A number of other options are provided to earn points, such as financial contributions to specific funds (citywide park fund, city underground utility fund, etc.) or public improvements.

Pittsburgh, PA - The City of Pittsburgh Zoning Code within 915.04. Sustainable Development Bonuses has both floor area and height that promote green building, LEED certified building, and waste reduction. LEED Certified buildings have a cap of 20% floor area (FAR) increase and 20% of height beyond of specifications in that district. The penalty for not achieving LEED certification is 1% of the construction costs.

Portland, OR – The City of Portland has an Administrative Rule covering Energy Efficiency Building Requirement for Planned Development Bonus in certain use zones. The rule places additional requirements on development in commercial/mixed use zones necessary in order to achieve floor area and height bonuses. The rule requires an energy target and certification program participation. It uses building type specific Energy Use Intensity targets as outlined below for 50,000-square-foot buildings.

Table 47. Energy Efficiency Standards for Planned Development Bonus

Use Type	Baseline EUI (kBtu/sf)	Baseline Reduction (percentage)	EUI Standard (kBtu/sf)
Residential			
Multifamily Dwelling	55.3	50	27.7
Commercial			
Financial Office*	73.1	70	21.9
Fitness Center	42.6	70	12.8
Hotel	69.3	70	20.8
Medical Office*	77.5	70	23.2
Office*	79.3	70	23.8
Retail*	72.0	70	21.6
Institutional			
Adult Education	71.0	70	21.3
College	131.9	70	39.6
K-12 School*	71.1	70	21.3
Library	103.6	70	31.1
Meeting Hall	30.7	70	9.2
Performing Arts	37.4	70	11.2
Preschool	73.2	70	22.0
Residence Hall*	74.2	70	22.2
Senior Care	107.5	70	32.2
Vocational School	63.1	70	18.9

* For these Use Types, the Baseline EUI and EUI Standard varies depending on building size, and the values presented on Table 1 are based on a 50,000 square foot building. The online Architecture 2030 Zero Tool may be used as an alternative to the table to determine the size-specific Baseline EUI. The size-specific EUI Standard is calculated by multiplying the Baseline EUI by a 70 percent reduction factor.

Source: Portland, OR Energy Efficient Building Requirements for Planned Development Bonuses

The rule allows for customized EUI; for example applicants can use of the Architecture 2030 Zero Tool to determine the EUI standard that must be achieved, or building projects in the Energy Trust of Oregon "Path to Net Zero" utility incentive program can use the EUI target as determined as a participant in that program. Owners must follow up with proof of certification and an as-built EUI which can be published publicly by the Bureau of Planning and Sustainability. Penalties for noncompliance can be up to 5% of the Project Valuation as set forth in the permit.

Sacramento, CA – In the Sacramento City Code 17.704.080, height bonuses are available to projects that are designed and built to exceed CALGreen reach code and are energy efficient. Reaching Tier 1 in CALGreen allows a 10% height bonus, while Tier 2 under CALGreen can receive a 20% height bonus. A separate bonus is allowed for green roofs, but together the height bonus cannot exceed 30%.

Santa Rosa, CA – This white paper describes recommendations for a point system where points are provided for the production of affordable housing, with additional points available for: open spaces, historic/landmark preservation, family-sized units, infrastructure/capital improvements, public art, or other innovative community benefit. The recommendation was to provide up to 60/80/100% of base density depending on considerations like capacity of the neighborhood, existing density of the residential neighborhood, access to transit, proximity to schools and single-family neighborhoods, existing site conditions, infrastructure, and impediments.

Seattle, WA – The City of Seattle has a number of incentives related to green and energy efficient buildings. The Living Building Pilot program (23.40.060) provides specific types of bonuses for up to 17 buildings that (1) participate in either the International Living Future Institute's Living Building Challenge or petal certification (water, energy or materials); (2) demonstrate an EUI target 25% below those used elsewhere in the Seattle Energy Code (section C401.3); (3) does not include gas combustion; and (4) uses only non-potable water. The Living Building pilot programs runs through December 2025. It allows developers to request additional departures from the Seattle Land Use Code through Design Review and earn the following benefits:

- Up to 25 percent more floor area
- Up to 30 percent more floor area if saving an unreinforced masonry structure
- 12.5 feet of additional height for residential construction or 15 feet of additional height for non-residential construction in zones with height limits of 85 feet or less
- 25 feet of additional height for residential construction or 30 feet of additional height for non-residential construction in zones with height limits greater than 85
- Additional design departures for the pilot programs as specified in SMC 23.41.012D

The Living Building pilot project must document certification with a report to the city within two years of occupancy. This provides a clear verification procedure, ensuring that targets are achieved. Penalties include $500/day for non-submittal of the report, up to 25% of the construction value according to a table provided in the pilot ordinance.

To qualify for the Architecture 2030 Challenge Pilot program, a project must:

- Qualify for design review or review by a special district or historic review committee
- Be located within an urban center, excluding lots within the shoreline or the international special review districts
- Renovate an existing structure that qualifies as a substantial alteration as determined in the Seattle Energy Code and the Seattle Existing Building Code
- Retain either the opaque portions of all exterior walls or the superstructure of existing structures (the foundation, structural frame, floor framing, and slabs of the structure)

The environmental requirements are to:

- Reduce predicted total energy use by 25 percent, or more based on the Energy Use Intensity (EUI) targets in the Target Performance Path of the Seattle Energy Code Section C401.3, and use no fossil fuel for space and water heating
- Reduce annual stormwater runoff and potable water use by at least 50 percent from program baselines

- Reduce single-occupant vehicle trips for work and non-work-related trips to percentages equal to or better than rates defined in the Seattle Comprehensive Plan

The Architecture 2030 pilot program in Seattle expires on December 31, 2025, or when 20 projects enroll in the 2030 Challenge Height Performance Existing Building Pilot. Architecture 2030 does not verify the performance of the energy or water outcomes. The city is responsible for verifying the predicted values meet the eligibility requirements.

Sunnyvale, CA – Sunnyvale has a Green Building Program that allows density bonuses for LEED certification. It provides a detailed table of incentives for projects to add floor area to an existing site and qualify for the incentive if all buildings at the existing site meet CALGreen and LEED. FAR bonuses are granted for new construction, core and shell, commercial interiors, existing buildings. Single-family, multifamily, commercial new construction and commercial tenant improvements are all eligible for the incentive.

West Hollywood, CA – Ordinance number 17-1005 rescinds the Green Building Policy which required all new commercial development with three or more units must either pursue LEED or comply with the Green Building Point System. The city allowed reduced parking in exchange for achieving at least 90 points from the points matrix to reach the 90-point threshold. Projects had to submit a preliminary and final green building plan if they were not pursuing LEED certification (at the lowest "certified" level). In addition, the old Green Building Policy incentives promoted green roofs in multi-family and mixed-used projects and allowed for tradeoffs between private and common open space. The 2007 Green Building Policy was rescinded because the city recognized the progress that the green building industry made including the establishment of several national sustainable design standards, the adoption of the CALGreen building code and the state trend toward zero net energy. West Hollywood has facilitated a series of working group meetings to update their policy. This involved soliciting feedback from stakeholders and representatives from the development, architecture, construction, housing, and sustainable design industries, as well as residents and local business owners.

ZONING INCETIVES FOR NZE: KEY CONSIDERATIONS

The key considerations regarding commercial zoning incentives include:

- Many cities have zoning and density incentives to promote affordable housing. A handful of cities are also tying bonuses to green building, energy efficiency and renewable energy.
- Incentives come in a variety of forms including up-zoning, Floor Area Ratio or height bonuses. Some incentives allow for bonuses when payments to city funds are made, for example, to the affordable housing fund, utility infrastructure fund, park fund, etc.
- Cities typically implement development incentives through the zoning code, although Portland, Oregon has used an administrative rule to institute an approach based on EUI targets. Sometimes land use planning staff at the city incorporate these requirements into comprehensive neighborhood planning or local improvement district processes and then run an additional public process to finalize language changes in the zoning code.
- Often cities focus the use of these bonuses in particular neighborhoods because one size does not always fit all. Some cities engage in a comprehensive public planning process which recognize the unique character of the neighborhood when developing incentive approaches.

This helps to ensure that the increased density is appropriate to the context of the local neighborhood.

- Bundling approaches (for example, affordable housing and efficiency) allows cities to create packages and achieve a variety of goals. However, cities should be clear regarding how the different bonuses layer on each other and what the maximum bonus is.
- Cities seem to be moving away from bonuses exclusively for green building. At least one city, West Hollywood, CA, has rescinded their green building policy which was established in 2008 and was based on LEED. According to the city's website, this was rescinded because the city recognized the progress that the green building industry made including the establishment of several national sustainable design standards, the adoption of the CALGreen building code, and California's trend toward zero net energy.
- **Increasingly, there is evidence that these policies should dovetail with policies that support equity, environmental justice and anti-gentrification.** For example, in Portland, Oregon, green building policies in the Williams/Vancouver/ Mississippi Avenue area have been seen by communities of color as being synonymous with gentrification.
- Bonuses for renewable energy should address how off-site procurement of renewable energy credits will be addressed to meet the requirement. If a city were to pursue bonuses for renewable energy, RECs should be purchased for a minimum of 15 years to offset energy consumption based on an agreed to calculation methodology. In addition, this should be noted as a covenant in the deed of sale guaranteeing continued participation for the required number of years.
- **Any type of zoning incentive should have a clear plan for penalizing buildings that do not achieve the intended result.** This is especially true for approaches that rely on a certification that will not be final until post occupancy.
- Cities should attempt to identify ways to streamline internal processes for long-term monitoring of properties under a bonus program. Program eligibility requirements and how they are achieved should be as clear and consistent as possible. Furthermore, the city should allot sufficient funding and time to ongoing review, and programs should be recalibrated regularly to ensure they respond to changing market conditions.
- Typically in cities, the regular zoning stakeholder process can be intensive. **Dovetailing efforts with other city land use planning efforts can be an effective way to manage costs.** If this is the path forward, it is imperative that those planning staff responsible for that process are familiar with the green or zero energy benefits that are trying to be achieved.
- Zoning bonuses can be an extremely effective way to align between where code is now, and where code needs to go to achieve Denver's aggressive climate goals. Denver might consider providing bonuses for developers who are willing to pursue the Denver Green Code or perhaps a particular path within the reach code, such as the passive house pathway.
- Finally, with regard to density bonuses, equity is key. **Any efforts that will increase property values to developers must consider how equity is addressed.**

NZE AND RESIDENTIAL ZONING

For NZE in residential single-family homes, one way to ensure that the home is as efficient as possible is through orientation on the lot. As a result, one consideration for residential zoning is to

require or provide incentives for maximizing solar gain. This has the benefit of reducing loads within the home as well as optimizing solar and allows builders to orient homes optimally on lots. This was discussed as part of the NZE Stakeholder Advisory Groups meetings and would engage NZE with residential developers and allow NZE to start with developers, move to builders, and then to homeowners. This allows optimal savings from the beginning of a development.

Specifically, the Geos Neighborhood in Arvada was able to optimize home orientation because the developer and the builder were the same entity. As another example of the importance of working at the development level for incentives, the Northfield community in Denver required all builders in the community to build to a minimum energy savings level. This allows builders the flexibility of determining what to build but all be at similar performance levels.

Denver Staffing and Program Needs

Staffing and program support is also needed internally at the city to provide these supports for the community. **For staffing, Denver needs both IECC code enforcement staff as well as staff for the incentives, fee reductions, and supports detailed in the previous section.**

For code compliance, Denver needs additional staffing to improve IECC compliance, as detailed in the "Energy Code Enforcement" section. From analysis and outreach to similar cities including Washington, D.C., and Seattle, WA, Denver identified that 11-16 FTEs are needed in addition to 2.5 current FTEs for IECC enforcement.

Staffing is also needed at the city to provide the supports for the community identified in the previous section development incentives (zoning and expedited reviews), design/construction team incentives, permit fee reductions and/or cash incentives. Denver has worked with Group 14 to identify and detail building and home supports needed as part of the Climate Action Task Force Process. The analysis looked at solutions, support, and costs in each of the critical areas including buildings and homes, transportation, 100% renewable electricity, industrial energy use, consumptions emissions and resiliency/adaptation. For buildings and homes, internal city resources including staffing were estimated at high, medium, and low costs to the city. The study resulted in 4-16 additional staff needed to support all of the identified commercial building supports. For homes, 3-12 additional staff are needed to support all of the identified residential homes supports.

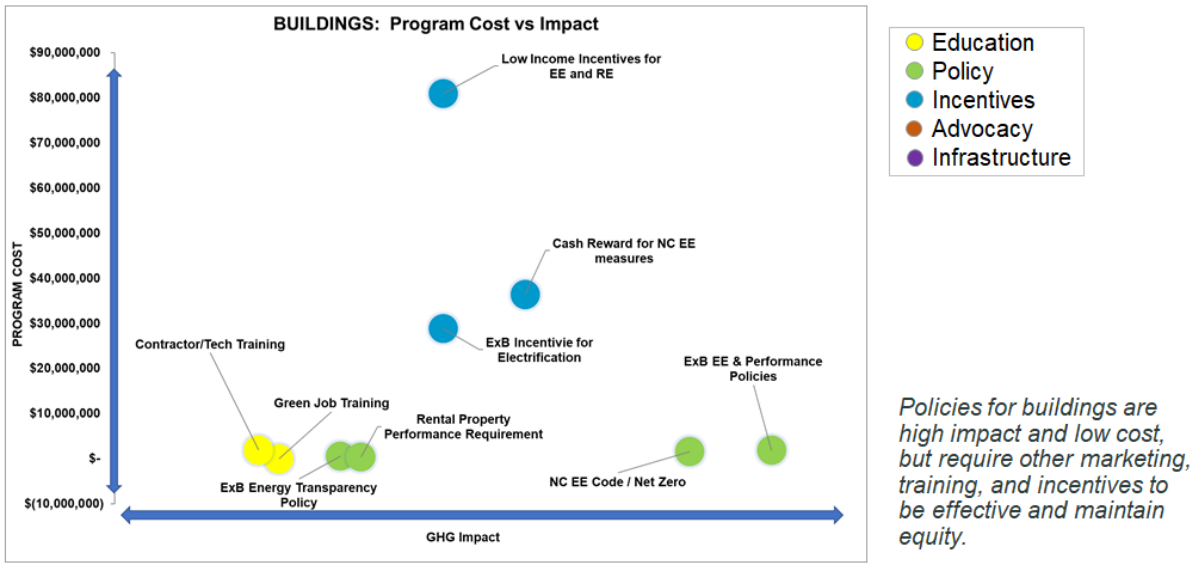
Table 48. Staffing Estimates for Supports

City Staffing Needs	Commercial Buildings	Residential Homes
Low Estimate	4	3
Medium Estimate	7	6
High Estimate	14	12

Source: Group 14's Climate Action Task Force Analysis for Denver

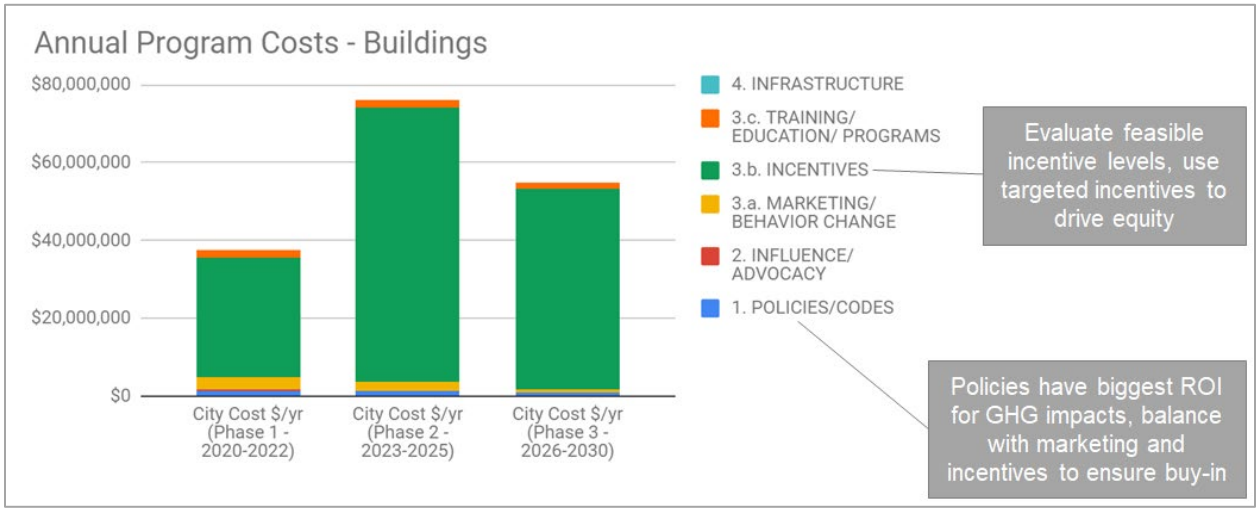
Beyond staffing, the city also needs funding for programs to ensure that Denver can meet the goals and recommendations for net zero. The Climate Action Task Force process identified building strategies and solutions as well as determined the annual program investment needed to support meeting the

buildings and homes recommendations. Combining the solutions and support into strategies with cost considerations is critical. It is also essential that building policies and incentives account for a holistic assessment of environmental impacts to avoid unintended consequences. The following chart shows the estimated program cost and GHG impact of the strategies. **A combination of codes, policies, and support is needed to ensure equity and impact.**



Source: Denver's Climate Strategies Cost and Savings Analysis and Presentation by Group 14

Figure 38. Denver's Building Strategies for the Climate Action Task Force



Source: Denver's Climate Strategies Cost and Savings Analysis and Presentation by Group 14

Figure 39. Denver's Building Investment for the Climate Action Task Force

HOW IT ALL COMES TOGETHER: THE NEXT FOUR CODE CYCLES

One key element of this NZE Plan is how the components – highly efficient, all-electric, renewable energy and electricity, and grid flexibility – come together. While more detail on each of these is in previous sections of this report, this section details the components of the code that should evolve over the next four code cycles to meet Denver's Climate Goals and Recommendations and ensure that buildings perform as designed through performance verification. **This comes together in a timeline for commercial buildings, multifamily buildings, and residential homes that was reviewed and discussed through the NZE Stakeholder Advisory Groups process.**

The tables below indicate the timeline of each code element through individual code cycles (every three years aligning with national I-Code updates), and the potential relationship of these transitions to each other through the various code cycles for commercial buildings and residential homes.

Table 49. Denver's Commercial Buildings Code Timeline

Commercial	2021	2024	2027	2030
HIGHLY EFFICIENT				
Prescriptive Path	Add renewables	Add renewables	Small/remodel projects only	Small/remodel projects only
Performance Target	Meet EUI targets by type & year	Meet EUI targets by type & year	Meet EUI targets by type & year	Meet EUI targets by type & year
Energy Modeling Accuracy	Report on discrepancy in disclosure data	Within 15% of target	Within 10% of target	Achieve target
Energy Modeling Normalization	Report on discrepancy	Document use changes in model	Document use changes in model	Document use changes in model
Energy Modeling Unregulated Loads	Some flexibility w/ pre-approval	Flexible w/ pre-approval	Flexible	Flexible
Efficiency Backstop	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs
Performance Verification Enforcement	Certificate of Occupancy, Disclosure	Disclosure; Bond or Solar Credit	Disclosure; Bond or Solar Credit	Bond or Solar Credit
ALL-ELECTRIC				
Equipment requirement	All-Electric: *except heating & water heating* All-Electric Ready: *conduit for central*	All-Electric: *except water heating*	All-electric equipment	All-electric equipment
RENEWABLE ENERGY				
Minimum renewable offset	50%	75%	100%	100%
Minimum % Roof Area	25%	50%	70%	70%
GRID FLEXIBLITY				
Grid flexibility requirement	Grid Flexible Equipment	Implementation of Grid Flexible Metric	Improving Grid Flexibility + Increased Storage	Improving Grid Flexibility + Increased Storage

Table 50. Denver's Multifamily Buildings Code Timeline

Multifamily	2021	2024	2027	2030
HIGHLY EFFICIENT				
Prescriptive Path	Add renewables	Add renewables	Small/remodel projects only	Small/remodel projects only
Performance Target	Meet EUI targets by type & year	Meet EUI targets by type & year	Meet EUI targets by type & year	Meet EUI targets by type & year
Energy Modeling Accuracy	Report on discrepancy in disclosure data	Within 15% of target	Within 10% of target	Achieve target
Energy Modeling Normalization	Report on discrepancy	Document use changes in model	Document use changes in model	Document use changes in model
Energy Modeling Unregulated Loads	Some flexibility w/ pre- approval	Flexible w/ pre-approval	Flexible	Flexible
Efficiency Backstop	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs
Performance Verification Enforcement	Certificate of Occupancy, Disclosure	Disclosure; Bond or Solar Credit	Disclosure; Bond or Solar Credit	Bond or Solar Credit
ALL-ELECTRIC				
3-story Townhome & Low-Rise Apartment	All-electric equipment	All-electric equipment	All-electric equipment	All-electric equipment
Mid-Rise Apartment (R-2: 4-7 stories)	All-Electric Ready: *conduit & panel space*	All-electric equipment	All-electric equipment	All-electric equipment
High-Rise Apartment (R-2: 8 or more stories)	All-Electric Ready: *conduit & panel space*	All-Electric Ready: *conduit & panel space*	All-electric equipment	All-electric equipment
RENEWABLE ENERGY				
Minimum renewable offset	50%	75%	100%	100%
Minimum % Roof Area	25%	50%	70%	70%
GRID FLEXIBLITY				
Grid flexibility requirement	Grid Flexible Equipment	Implementation of Grid Flexible Metric	Improving Grid Flexibility + Increased Storage	Improving Grid Flexibility + Increased Storage

Table 51. Denver's Residential Homes Code Timeline

Residential	2021	2024	2027	2030
HIGHLY EFFICIENT				
Prescriptive Path	Add renewables	Add renewables	Add renewables	Add renewables
Performance Target	Meet ERI targets by size & year	Meet ERI targets by size & year	Meet ERI targets by size & year	Meet ERI targets by size & year
ALL-ELECTRIC				
Equipment requirement	All-Electric Ready: *conduit & panel space*	All-electric equipment	All-electric equipment	All-electric equipment
RENEWABLE ENERGY				
Minimum renewable offset	50%	75%	100%	100%
Energy Rating Index (ERI)	Max ERI = 50, & ERI w/PV = 40	Max ERI = 45, & ERI w/PV = 0	Max ERI = 45, & ERI w/PV = 0	Max ERI = 45, & ERI w/PV = 0
GRID FLEXIBLITY				
Grid flexibility requirement	Grid Flexible Equipment	Implementation of Grid Flexible Metric	Improving Grid Flexibility + Increased Storage	Improving Grid Flexibility + Increased Storage

Each of the code timeline tables includes each of the four foundations of net zero energy within this report of highly efficient, all electric, renewable energy, and grid flexibility. While the full sections have further detail, a summary of each is below.

Highly Efficient

Improving the performance of new buildings and homes through increased efficiency is the first foundation of Denver's NZE Plan. The Denver Energy Code, based on the International Energy Conservation Code (IECC), will need to be updated over the next four code cycles through Denver's Code Adoption Process. The goal is to achieve zero net energy performance levels by 2030 where buildings perform as designed. It is discussed in greater detail in the "NZE: Highly Energy Efficient" section and outlined below.

HIGHLY EFFICIENT COMMERCIAL AND MULTIFAMILY BUILDINGS

The Highly Efficient foundation maximizes the energy efficiency of new commercial and multifamily buildings through increasing the on-site energy efficiency for new construction, adding performance verification (outcome-based) requirements to ensure that new buildings are performing as designed and improving energy code enforcement. To get to buildings that perform as designed the steps include:

- Developing Performance Targets
- Detailing Performance Verification
- Refining Energy Modeling
- Specifying Backstops for Code

Energy Efficiency Performance Targets

This NZE Plan details the performance verification targets for buildings to meet Denver's NZE in 2030 and the milestone of net zero energy, all-electric buildings in the 2027 base building code. They are predictive energy use intensity (pEUI) targets by building-type to ensure nuances of individual building types are considered. Additionally, the energy paths within code (including performance and prescriptive) will be calibrated to ensure that the energy performance is equivalent between paths within Denver code each cycle. This allows projects the flexibility to select the prescriptive or performance path.

While the code timelines above are as comprehensive as possible, the one missing item are the pEUI targets by building type per code cycle. As a result, the targets by building type and code cycle are shown in the tables below.

Table 52. NZE 2027: Commercial pEUI Targets for Denver Code

Building Type	2021	2024	2027	2030 Performance Verification
Small Hotel	47	41	35	35
Large Hotel	68	61	54	54
Medium Office	26	24	21	21
Large Office	54	45	37	37
Standalone Retail	39	34	28	28
Warehouse	13	11	9	9

Table 53. NZE 2027: Multifamily pEUI Targets for Denver Code

Building Type	2021	2024	2027	2030 Performance Verification
Mid-Rise Apartment	35	29	23	23
High-Rise Apartment	38	33	29	29

DENVER COMMERICAL CODE: PERFORMANCE PATH

Each code cycle, these targets will be reevaluated to make sure that they remain in alignment with available technologies and Denver goals. The targets will be introduced into the Denver Building and Fire Code through proposed code amendments in future code cycles, giving the market time to adapt to this approach. Currently, some building types do not lend themselves to setting these absolute performance goals. The traditional reference model approach will continue to be available for those building types until targets can be reasonably and defensibly set in future code cycles.

DENVER COMMERICAL CODE: PRESCRIPTIVE PATH

Denver will be utilizing the "Additional Efficiency Options" in Section C406 of the upcoming 2021 edition of the IECC to ensure that the performance and prescriptive path are calibrated. This "credits" approach allows design teams to select a combination of efficiency options that are most appropriate for the specific project. Through increasing the number of credits required and adding additional

credit options, Denver can increase the energy efficiency of the prescriptive path while maximizing its flexibility of the prescriptive path.

Performance Verification

Traditional code compliance paths – both prescriptive and modeled performance – are effective at regulating the features that go into a building, but not at how those buildings are operated. If Denver is going to meet its climate goals, it will need to ensure that buildings are performing as designed. Performance verification involves the comparison of a building's actual energy performance once in service to the energy performance expected by the design. This feedback loop allows owners, operators, occupants and regulators to identify performance issues after occupancy and take corrective action. This feedback also will provide the City of Denver information about the effectiveness of efficiency requirements in the energy code, informing future code advancements, refinements and enhancements.

Performance verification represents a new regulatory layer for buildings; therefore, it will be introduced gradually over multiple code cycles. At first, performance verification will be only informative, providing building owners and design teams with information about how the actual performance of the buildings compares to the expectations of the designs. As the code cycles progress, performance verification will be accompanied by increasingly stringent enforcement, including requirements to get closer and closer to the targets required by the energy code. Performance in buildings can reasonably vary due to many different factors; therefore, the enforcement of performance verification will need to be able to accommodate the normalization of the target to respond to these factors. Normalization and other issues related to performance verification is discussed in greater detail in the "Performance Verification" section.

Performance verification is a very similar policy to a Building Performance Standard (BPS), and can be thought of as a BPS with special performance targets for recently constructed existing buildings.

HIGHLY EFFICIENT RESIDENTIAL

Similarly, the Highly Efficient foundation of net zero energy (NZE) maximizes the energy efficiency of new residential buildings through increasing the on-site energy efficiency for new construction. This NZE Plan details the targets for homes to meet Denver's NZE goal in 2030 and the milestone of net zero energy, all-electric homes in the 2024 base building code.

Energy Efficiency Performance Targets

For residential homes, the energy performance targets proposed are energy rating index (ERI) targets. As with buildings, the energy paths within code (including performance and prescriptive) will be calibrated for homes to ensure that the energy performance is equivalent between paths within Denver code each cycle. This allows projects the flexibility to select the prescriptive or performance path.

While the code timelines above are as comprehensive as possible, the one missing item are the energy targets by building type per code cycle. As a result, the targets by code cycle are shown in the table below.

Table 54. NZE 2024: Residential ERI Targets for Denver Code

Building Type	2021	2024
Single-family homes	Max ERI = 50 & ERI w/PV = 40	Max ERI = 45 & ERI w/PV = 0

DENVER RESIDENTIAL CODE: PERFORMANCE PATH

A key element of achieving the residential ERI targets is the integration of an additional efficiency-credits approach into the residential code similar to the one adopted for commercial buildings in the 2021 edition of the IECC. Under this approach, the code requires a targeted number of additional efficiency credits and provides a series of efficiency options with varying credit values. Design teams select from that list to create a custom combination of measures and credits to meet the code goal. As discussed for commercial buildings above, this approach allows the stringency of the prescriptive path to be increased while maximizing design flexibility for design teams.

DENVER RESIDENTIAL CODE: PRESCRIPTIVE PATH

This "credits" approach for the residential portion of the IECC allows design teams to select a combination of efficiency options that are most appropriate for the specific project. Through increasing the number of credits required and adding additional credit options, Denver can increase the energy efficiency of the prescriptive path while maximizing flexibility of the prescriptive path. Both the number of credits required and the target for the ERI approach will be calibrated for the performance target of each code cycle.

All Electric

The second foundation of NZE within Denver's net zero energy definition is all-electric buildings and homes. All-electric is part of Denver's net zero definition and is important in getting to net zero energy in support of reducing emissions. The majority of the emissions from buildings and homes are due to heating and water heating. As Xcel Energy continues to decarbonize the electric grid and Denver effectively decarbonizes local electricity consumption through aggressive renewable energy goals, the emissions due to electricity consumption in Denver will continue to decrease to zero.

As a result, Denver's NZE Plan includes a future goal for all new buildings to be all-electric and is detailed in the "NZE: All Electric" section. The transition of Denver buildings away from natural gas equipment and to electric equipment will enable those buildings to take advantage of the ongoing emissions improvements from Denver's decarbonizing electricity supply.

Electrification of buildings in Denver works synergistically with Denver's goals for increasing efficiency. High performance electric heat pumps can achieve performance levels four to six times higher than their gas-fired counterparts. Heat pump technology has also been making substantial improvements in cold-weather performance in recent years, delivering performance advantages over gas even in Denver's climate. These high levels of performance will be increasingly necessary to meet Denver's efficiency goals.

Electrification also has an important connection to Denver's renewable energy requirements. Under Xcel's current plan for grid decarbonization, it would be several years before building electrification would lead to lifetime carbon reductions. However, Denver's renewable energy requirements effectively

accelerate the decarbonization of the local electrical supply. As a result, electrification, efficiency, and renewable energy generation work together to reduce carbon emissions more than any one strategy could on its own.

The electrification of buildings will be progressing simultaneously with the electrification of the transportation sector. Buildings play a key role in this other electrification goal as well. Denver's Electric Vehicle (EV) Action Plan details the city goals for electric vehicles and how these fit into Denver's larger picture.

Renewable Energy

The third NZE foundation within Denver's net zero energy definition is that new buildings and homes will be powered by renewable energy and electricity. It will be necessary to deploy renewable energy to offset building energy use to achieve NZE performance. In order to achieve this, this NZE Plan includes renewable energy goals that increase over multiple code cycles. The goal is that 100 percent of community-wide new construction energy will be from renewable energy by 2024 for residential buildings and 2027 for commercial buildings. Renewable energy installations are already increasing, and there is no reason to delay accounting for renewable installations in the code process. Projects may choose to deploy more than the minimum amount of renewable energy production to meet overall code targets.

As renewable deployment requirements increase, some buildings may not be able to meet the renewable energy offset requirements. Some buildings are shaded, some have non-optimal solar orientation, some are tall with a high ratio of building square-footage to roof area, and some buildings (such as hospitals) have justifiably high energy usage rates. For this reason, Denver is currently working to develop a fund – the Renewable Denver Community Solar Fund – that will build community solar gardens. This will enable the renewable offset to be met by on-site or off-site through the Fund.

In addition, Xcel Energy has a goal to decarbonize its electricity supply by 2050. Renewable energy requirements in the code will allow Denver to meet its own sustainability goals by 2030. They will allow Denver to effectively decarbonize its own electricity supply ahead of Xcel. The Renewable Energy foundation is discussed in greater detail in the "NZE: Powered by Renewable Energy and Electricity" section.

Grid Flexibility

The fourth NZE foundation within Denver's net zero energy definition is that new buildings and homes will be providers of demand flexibility for the grid. As the quantity of renewable energy supply on the grid is increased, there is also an increasing misalignment between the time of day when energy is produced and when it is consumed. Grid flexibility is one strategy to address this potential misalignment. **As renewable deployment increases, the value of being able to spread building loads to time periods when renewables are not available increases significantly.** Through design strategies that minimize energy usage when renewable energy is less available, control strategies that can shift equipment operation to times when renewable energy is more available and other energy storage strategies, buildings can shape their energy consumption to more closely align with renewable energy

availability. The Grid Flexibility foundation is discussed in greater detail in the "NZE: Powered by Renewable Energy and Electricity" section.

Preparing for the 2021 Code Cycle

Denver is currently working with New Buildings Institute (NBI) and stakeholders to develop drafts of the first round of proposed code amendments for Denver's 2021 Code Adoption Process to modify the 2021 IECC. These proposals are being developed to specifically implement the goals, recommendations, and milestones in this NZE Plan. In early 2021, Denver will continue to engage more stakeholders and other interested parties to review and refine these proposals before taking them through the Code Adoption Process.

HIGHLY EFFICIENT

The general proposed updates for energy efficiency in commercial and multifamily buildings include adding the energy targets, streamlining the modeled performance compliance path, and expanding and enhancing the additional efficiency credits options in the prescriptive path. The general updates for energy efficiency in residential buildings include adding an additional efficiency credits section to the residential section for the prescriptive compliance path.

ALL-ELECTRIC

Natural gas equipment is currently typical in the Denver market, and the widescale adoption of all-electric buildings represents a substantial shift in the market. Therefore, the Denver NZE Plan does not include an immediate move to all-electric buildings. In the next code cycle, the proposed updates under consideration include basic "electrification-capable/ready" infrastructure such as conduit and panel space to enable easier, more effective and less costly electrification retrofits in the future. These specifications look different for commercial and residential buildings, as well as for small and large equipment.

The implications of the electrification retrofit of smaller natural gas loads found in both residential and commercial buildings are different than the implications of electrification retrofits of larger natural gas loads found in commercial and some multifamily buildings. These "electrification-capable/ready" requirements will incentivize early adoption of all-electric buildings and will also enable future, cost-effective electrification of new mixed-fuel buildings. In future code cycles, consideration will be given to all-electric equipment for specific building loads (process loads such as those in manufacturing facilities will always need to be considered separately from building loads like space and water heating and cooking). Some gas end-uses are more challenging to electrify than others, and therefore Denver will evaluate each code cycle whether there are any reasonable or necessary specifications and considerations for proposed code amendments.

RENEWABLE ENERGY

"Net" energy is the balance of energy consumed on site and the renewable energy produced for the site. The next code cycles will include increasing renewable energy from on-site systems. Recognizing that some building types and some building sites make on-site renewable energy challenging; considerations will include options to meet those minimum renewable energy requirements with dedicated off-site renewable energy production.

Building performance requirements in Denver may approach technical limits in future code cycles, so there will be a need to allow a fraction of building performance goals to be provided by renewable energy. Projects may choose to deploy more or less renewable to achieve the targets, with increasing minimums for renewable deployment in subsequent code cycles. Basic building performance will be ensured by backstop code requirements to prevent over-dependence on renewables.

GRID FLEXIBILITY

Near-term code cycles will include requirements for the installation of grid-interactive demand response (DR) controls that are already available on the market, particularly for water heaters and thermostats. Through having these controls available, buildings will have the functionality necessary to participate in demand response programs as they become more prominent. In future code cycles, Denver will consider increased grid flexibility from buildings through the implementation of emerging grid flexibility metrics and standards as they become available and market-ready.

Reducing Emissions: Carbon Considerations

Although this NZE Plan for new buildings and homes is focused on energy, all four foundations have implications for the carbon emissions of Denver's building stock. Denver is working with New Buildings Institute (NBI) to understand how the goals of each NZE foundation impact Denver's carbon emissions. While the metric for this NZE Plan will remain energy, the carbon impact of the four NZE foundations has been and will continue to be used to inform the implementation of NZE in Denver to reach the climate goals, milestones, and targets over the upcoming code cycles.

Each of the four foundations of Denver's NZE Plan have different considerations and can be considered using multiple metrics. As a result, it is challenging to understand the impacts between the foundations and over time as NZE progresses in Denver. One solution to this problem is to establish a way to convert the goals for each foundation to the same metric, and carbon emissions makes the most sense as a common metric.

As a result, New Buildings Institute (NBI) developed a system that considers all four foundations (efficiency, renewables, all-electric, demand flexibility) and can be used by Denver to understand progress towards emissions reductions. The goal is to help Denver answer: 1. how to estimate and represent all four foundations together each code cycle and 2. how to define the end goal in quantified, measurable terms.

The first steps of this work involved background research to determine the current status and end goal of each foundation and then approximate the foundation in terms of carbon emissions. It is important to note that, while this is rooted in sound data and assumptions, these results are approximations that use national level building energy use breakdown estimates, assumptions about fuel type for those end uses, and readily available information about the carbon intensity of the electricity grid in Denver. To explicitly calculate and model the carbon impact of Denver's NZE Plan would require much more substantial background research, data, and analysis. However, this exercise can be used to inform implementation decisions by giving a broad-scale sense of the carbon emission impact of different policies and strategies.

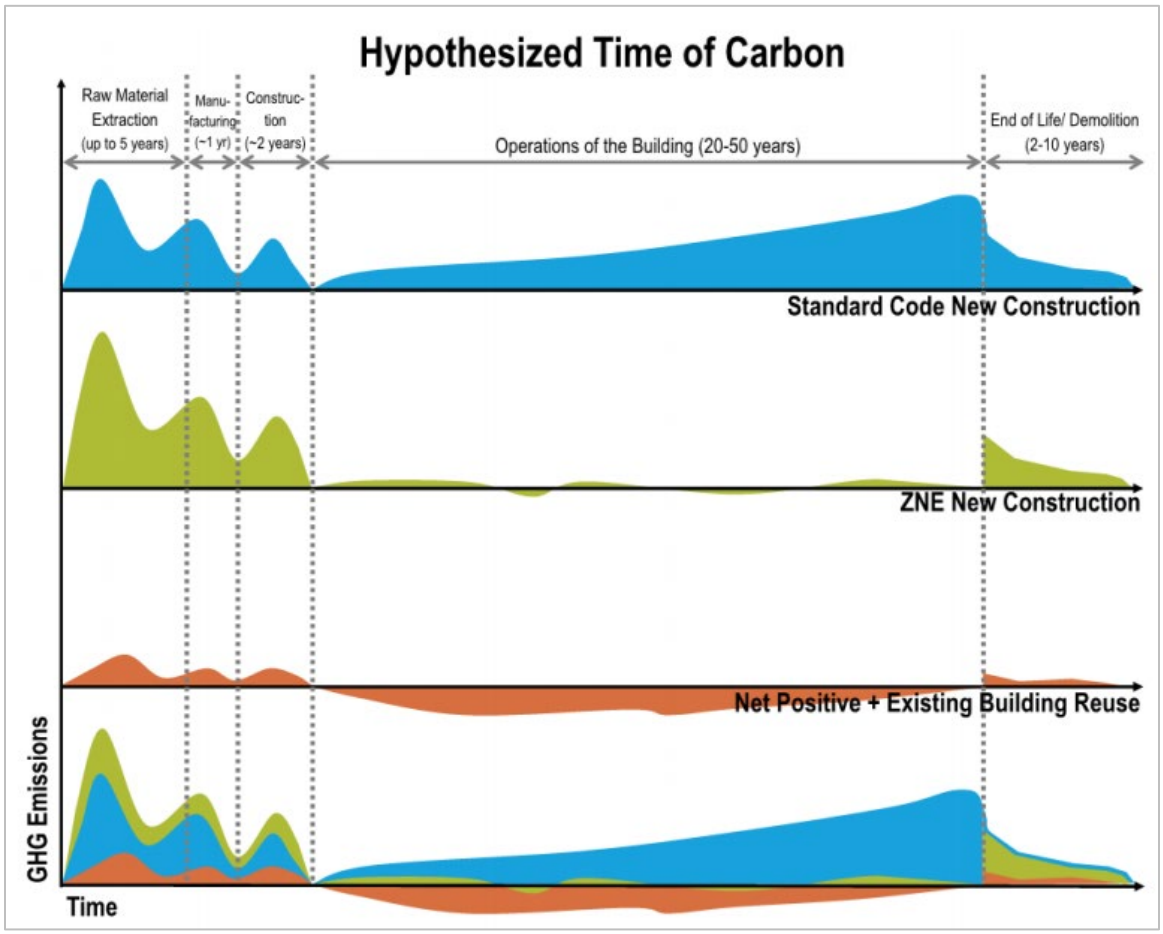
This carbon emissions exercise reveals some important insights about the impact of this NZE Plan including:

- **The most important takeaway of this exercise is the interrelatedness of the four foundations. Changes in policies for one foundation will influence the carbon impact of another foundation. This highlights the importance of considering the interactive effects of the different requirements implemented.**
- The carbon impact of all of the foundations increases until 2027 and then declines afterward. This is because 2027 is the year that the recommended renewable energy requirements reach 100% of commercial building energy usage. After 2027, the continuing decarbonization of the Xcel Energy grid mix means that the foundations have less of an impact on carbon emissions. Effectively, as the grid decarbonizes, reducing electricity from that consumption has less of an impact.
- The recommended requirements for renewable energy have the greatest carbon impact. This is for two reasons. The first is that the recommended renewable energy requirements are relatively aggressive. The second is that the carbon intensity of the Xcel Energy grid is still relatively high and is set to decline on a much longer timeline than Denver's NZE Plan in general and renewable energy goals in particular.
- The carbon impact of grid flexibility is relatively very low. This is because the importance of grid flexibility is less about direct carbon savings and more about support for increasing renewable energy production on the grid. Grid flexibility enables increases in renewable energy production by shifting building energy consumption to better align with the timing of renewable energy production.
- Due to the carbon intensity of Xcel Energy's electricity supply, the carbon impact of electrification is highly impacted by both efficiency requirements and renewable energy production. Without decarbonizing the building electricity supply or increasing building efficiency, electrification would actually result in higher carbon emissions in Denver. The efficiency requirements reduce the total energy required by the building and the renewable energy requirements reduces the effective carbon intensity of the electricity consumed. When combined, the three foundations are a potent carbon reduction strategy.
- Energy efficiency is an important prerequisite for effective renewable energy requirements. Energy efficiency reduces the total amount of renewable energy that will be required to meet the NZE goal, milestones, and targets. Without energy efficiency, the quantity of renewable energy required would be substantially higher, exacerbating the issues that arise from adding more renewable energy production to the grid.

EMBODIED CARBON

Denver is also working to understand embodied carbon in buildings through an inventory titled "Analyzing Denver's Building Sector Embodied Carbon Emissions." Denver currently has an initial draft and the study will be complete in early 2021.

The embodied emissions are significantly less than operational emissions for existing buildings and buildings built to code. For net zero buildings, the operations emissions are significantly lower. The figure below from The Total Carbon Study shows the rough order of magnitude evaluation in the total GHG emissions released over time (Cradle to Gate) related to buildings by comparing Standard code-compliant new construction, Zero Net Energy (ZNE) new construction, and Net Positive existing building reuse.



Source: The Total Carbon Study

Figure 40. Rough Order of Magnitude Evaluation in the Total GHG Emissions Released over Time (Cradle to Gate)

APPENDIX A. ALL-ELECTRIC MARKET READINESS ASSESSMENT INTERVIEWS

Interviewees:

- Alicia Bock – Building Official at City and County of Denver
- Joel Champagne – Building Official at City and County of Denver
- Julie Edwards – Associate, Director of Sustainability at Oz Architecture
- Cheryl Hoffman – Project Manager at Hensel Phelps
- Tom Hootman – Associate Principal, Senior Sustainability Consultant at Integral Group
- Nathan Kahre – Business Development Manager at EnergyLogic
- Don Larsen – SVP of Construction & Development Mgmt. at McWhinney
- Joshua Radoff – Senior Vice President at WSP
- Robby Schwarz – Principal Thinker at BUILDTank
- Tony Thornton – Senior Associate at Stantec
- Michael Walton – Building Official at City and County of Denver

Interview Guide:

1. How common are all-electric buildings in Denver?
2. What are the primary drivers for considering all-electric buildings?
3. What are the primary technical obstacles to all-electric buildings in Denver?
    a. Is the equipment readily available?
    b. Are there electrical panel/capacity sizing issues?
4. What are the primary market obstacles to all-electric buildings in Denver?
    a. Are there risk premiums being applied to the cost for new/unfamiliar electric equipment?
5. Are there any regulatory issues for all-electric buildings? Code compliance? Modeling? HERS?
6. Are there building types that are more challenging to make all-electric than others?
7. How do the heat pumps perform in Denver's climate?
    a. Do the low-temperature heat pumps operate better?
8. Based on your experience with individual heat-pump water heaters (like those used in single-family), please answer the following questions.
    a. What are the primary issues with using them in Denver?
    b. Do the trades have the necessary experience to install them?
    c. Do they create issues on electrical panel sizing?
    d. What have been the primary drivers for their adoption?
9. Based on your experience with central heat pump water heater systems (like those used in multifamily, please answer the following questions.
    a. What are the primary issues with using them in Denver?
    b. Are there mechanical engineers and/or design-build firms in the Denver market that have experience with these systems?
    c. What have been the primary drivers for their adoption?

ORDINANCE NO. ____

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF CUPERTINO AMENDING CITY CODE CHAPTERS 16.54 AND 16.58 ADOPTING THE 2019 CALIFORNIA ENERGY CODE AND GREEN BUILDING STANDARDS CODE WITH CERTAIN EXCEPTIONS, DELETIONS, MODIFICATIONS, ADDITIONS AND AMENDMENTS.

The City Council of the City of Cupertino finds that:

1. Pursuant to Sections 17922, 17958, 17958.5, 17958.7, 17958.11, and 18941.5 of the California Health and Safety Code, the City of Cupertino may amend the provisions of the 2019 California Energy Code (Part 6 of Title 24) and the 2019 California Green Building Standards Code (Part 11 of Title 24) with certain modifications and amendments to those provisions which are reasonably necessary because of local climatic, geological or topographical conditions. The City makes the amendments, additions and deletions described herein to these provisions to address these local conditions, and to reduce energy use and lower greenhouse gas emissions for the residents of Cupertino through building electrification, electric vehicle charging infrastructure, and additional green building measures.

2. The additions, deletions, and amendments hereinafter described are hereby adopted and are deemed reasonably necessary because of local climatic, geological, or topographical conditions pursuant to Government Code Sections 18941.5 and 17958.5. Express findings that these modifications to the Building Codes are reasonably necessary are hereby made and will be filed with the California Building Standards Commission in accordance with California Health and Safety Code Section 17958.7 before this ordinance takes effect.

3. The City Council finds that the additions, deletions, modifications and amendments made to the Energy Code as described herein are cost-effective in accordance with California Public Resources Code Section 25402.1(h)(2). The finding of cost-effectiveness is described in greater detail in the Staff Report and the accompanying analyses, and is primarily derived from the California Codes and Standards Reach Code Program, which has determined specific modifications to the 2019 State Energy Code for climate zone 4 that are cost-effective. The City Council also finds, pursuant to Public Resources Code Section

25402.1(h)(2), that the additions, deletions, modifications and amendments to the Energy Code as described herein will require the diminution of energy consumption levels permitted by the 2019 State Energy Code. The City Council's findings of cost-effectiveness and energy savings will be filed with the California Energy Commission pursuant to Title 24 Chapter 10-106 before this ordinance takes effect.

4. The City Council of the City of Cupertino held a duly noticed public hearing on December 17, 2019, and after considering all testimony and written materials provided in connection with that hearing introduced this ordinance and waived the reading thereof.

NOW THEREFORE, THE COUNCIL OF THE CITY OF CUPERTINO DOES ORDAIN AS FOLLOWS:

SECTION 1. Adoption.

The Cupertino Municipal Code is hereby amended as set forth in Attachment A.

SECTION 2: Severability and Continuity.

The City Council declares that each section, sub-section, paragraph, sub-paragraph, sentence, clause and phrase of this ordinance is severable and independent of every other section, sub-section, paragraph, sub-paragraph, sentence, clause and phrase of this ordinance. If any section, sub-section, paragraph, sub-paragraph, sentence, clause or phrase of this ordinance is held invalid, or its application to any person or circumstance, be determined by a court of competent jurisdiction to be unlawful, unenforceable or otherwise void, the City Council declares that it would have adopted the remaining provisions of this ordinance irrespective of such portion, and further declares its express intent that the remaining portions of this ordinance should remain in effect after the invalid portion has been eliminated. To the extent the provisions of this Ordinance are substantially the same as previous provisions of the Cupertino Municipal Code, these provisions shall be construed as continuations of those provisions and not as an amendment to or readoption of the earlier provisions.

SECTION 3: California Environmental Quality Act.

This Ordinance is not a project under the requirements of the California Environmental Quality Act, together with related State CEQA Guidelines (collectively, "CEQA") because it has no potential for resulting in physical change in the environment. In the event that this Ordinance is

found to be a project under CEQA, it is subject to the CEQA exemption contained in CEQA Guidelines section 15061(b)(3) because it can be seen with certainty to have no possibility that the action approved may have a significant effect on the environment. CEQA applies only to actions which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA. In this circumstance, the proposed action would have no or only a de minimis effect on the environment. The Ordinance is also exempt from CEQA under CEQA Guidelines section 15308, because it is a regulatory action for the protection of the environment. The foregoing determination is made by the City Council in its independent judgment.

SECTION 4: Effective Date.

This Ordinance shall take effect thirty days after adoption as provided by Government Code Section 36937.

SECTION 5: Publication.

The City Clerk shall give notice of adoption of this Ordinance as required by law. Pursuant to Government Code Section 36933, a summary of this Ordinance may be prepared by the City Clerk and published in lieu of publication of the entire text. The City Clerk shall post in the office of the City Clerk a certified copy of the full text of the Ordinance listing the names of the City Council members voting for and against the ordinance.

INTRODUCED at a regular meeting of the Cupertino City Council on December 17, 2019, and **ENACTED** at a regular meeting of the Cupertino City Council on _____, 2020, by the following vote:

Members of the City Council

AYES:

NOES:
ABSENT:

ABSTAIN:

SIGNED: _____ _____ Steven Scharf, Mayor City of Cupertino	_____ Date
ATTEST: _____ Grace Schmidt, City Clerk	_____ Date
APPROVED AS TO FORM: _____ Heather Minner, City Attorney	_____ Date

ATTACHMENT A

SECTION 1. Chapter 16.54 of the Cupertino Municipal Code is hereby repealed in its entirety and replaced with the following Chapter 16.54 to be entitled, numbered, and to read as follows:

Chapter 16.54: Energy Code

Section

16.54.010 Adoption of the 2019 California Energy Code.

16.54.040 Local Amendments.

16.54.100 Scope.

16.54.110 Definition and Rules of Construction.

16.54.010 Adoption of the 2019 California Energy Code.

A. The provisions of the 2019 California Energy Code, Part 6 of Title 24 of the California Code of Regulations, and each and all of the regulations, provisions, conditions and terms of the code are referred to as if fully set forth in this chapter, and, except as to additions, deletions and amendments hereinafter described, such code is hereby adopted and made a part hereof, the same as if fully set forth in this Chapter. Notwithstanding the foregoing, the additions, deletions, and amendments hereinafter described shall not become operative until the California Energy Commission approval process is completed.
    a. In accordance with California Health and Safety Code Sections 17958.7 and 18941.5, express findings that modifications to the Energy Code are reasonably necessary because of local climatic, geological, or topographical conditions are either already on file with the California Building Standards Commission or will be filed prior to the effective date of the ordinance codified in this Chapter.
    b. Pursuant to California Public Resources Code Section 25402.1(h)(2), the City Council's findings that modifications to the Energy Code are cost-effective and will require the diminution of energy consumption levels permitted by the Energy Code are either already on file with the California Energy Commission or will be filed prior to the effective date of the ordinance codified in this Chapter.
B. One (1) copy of the code therefore is on file in the office of the Building Official pursuant to Health and Safety Code Section 18942 and is made available for public inspection.

16.54.040 Local Amendments.

The following provisions of this Chapter shall constitute local amendments to the cross-referenced provisions of the 2019 California Energy Code and shall be deemed to amend the cross-referenced sections of said code with the respective provisions set forth in this Chapter.

16.54.100 Scope.

Amend Section 100.0(e)(2)(A) of the 2019 California Energy Code to read as follows:

2. Newly constructed buildings.

A. All newly constructed buildings. Sections 110.0 through 110.12 apply to all newly constructed buildings within the scope of Section 100.0(a). In addition, newly constructed buildings shall meet the requirements of Subsections B, C, D, or E, as applicable and shall be an All-Electric Building as defined in Section 100.1(b). For the purposes of All-Electric Building requirements, newly constructed buildings as defined in Section 100.1 shall not include newly constructed additions and tenant improvements in existing buildings.

Exception 1: Nonresidential F, H, and L Occupancies, or other similar research & development uses as determined by the building official, are exempt from the all-electric building provisions of this section. If this Exception applies, the applicant shall comply with the pre-wiring provision of Note 1 below.

Exception 2: "Essential Facilities," as defined by the *California Building Code* are exempt from the all-electric building provisions of this section. If this Exception applies, the applicant shall comply with the pre-wiring provision of Note 1 below.

Exception 3: Kitchens located within nonresidential buildings shall be exempt from the all-electric building provisions of this section. If this Exception applies, the applicant shall comply with the pre-wiring provision of Note 1 below.

Exception 4: If the applicant establishes that there is not an all-electric prescriptive compliance pathway for the building under the Energy Code, and that the building is not able to achieve the performance compliance standard applicable to the building under the Energy Code using commercially available technology and an approved calculation method, then the Building Official may grant a modification. If the Building Official grants a modification pursuant to this Exception, the applicant shall comply with the pre-wiring provision of Note 1 below.

Exception 5: Accessory Dwelling Units and Junior Accessory Dwelling Units shall be exempt from the all-electric building provisions of this section. For purposes of this exception, "Accessory Dwelling Unit" and "Junior Accessory Dwelling Unit" have the same definitions as set out in Government Code Sections 65852.2 and 65852.22, respectively.

Note 1: If natural gas appliances are used under Exception 1, 2, 3, and/or 4, each natural gas appliance location in such building must be electrically pre-wired for future electric appliance installation. Each such natural gas appliance location shall include the following:

i. A dedicated circuit, phased appropriately, for each appliance. Each such circuit shall have a minimum amperage requirement for a comparable electric appliance (based on the manufacturer's recommendations), an electrical receptacle or junction box that is connected to the electric panel, conductors of adequate capacity within 3 feet of the appliance. Each such circuit shall be accessible with no obstructions;
ii. Both ends of the unused conductor or conduit shall be labeled with the words "For Future Electric Appliance" and be electrically isolated;
iii. A reserved circuit breaker space shall be installed in the electrical panel adjacent to the circuit breaker for the branch circuit and labeled for each circuit, an example is as follows: "For Future Electric Range"; and

iv. All electrical components, including conductors, receptacles, junction boxes, or blank covers, related to this section shall be installed in accordance with the California Electrical Code.

Note 2: If a building is entitled to apply Exception 1, 2, 3, 4, and/or 5, the Building Official is authorized to approve alternative materials, design, and methods of construction or equipment per California Building Code Section 104.

Amend Section 100.0(e)(3)(A) of the 2019 California Energy Code to read as follows:

3. New Construction in existing buildings (additions, alterations and repairs).

A. Nonresidential, high-rise residential, and hotel/motel buildings. Section 141.0 applies to new construction in existing nonresidential, high-rise residential, and hotel/motel buildings. New construction in existing buildings includes additions, alterations and repairs. Section 141.0 specifies requirements that uniquely apply to additions, alterations or repairs to existing buildings, and specify which requirements in other sections also apply. For alterations that change the occupancy classification of the building, the requirements specific in Section 141.0 apply to the occupancy after alterations.

i. Nonresidential tenant improvements are not subject to the all-electric building requirement for new construction in section 100.0(e)2A.

16.54.110 Definitions and Rules of Construction.

Amend Section 100.1(b) of the 2019 California Energy Code to add the following definition:

ALL-ELECTRIC BUILDING: is a building that has no natural gas or propane plumbing installed within the building, and that uses electricity as the sole source of energy for its space heating, water heating (including pools and spas), cooking appliances, and clothes drying appliances. All-Electric Buildings may include solar thermal pool heating.

SECTION 2. Chapter 16.58 of the Cupertino Municipal Code is hereby repealed in its entirety and replaced with the following Chapter 16.58 to be entitled, numbered, and to read as follows:

Chapter 16.58 Green Building Standards Code

Section

16.58.010 Adoption of the 2019 California Green Building Standards Code.

16.58.015 Adoption of Appendix Chapters.

16.58.020 Local Amendments.

16.58.030 Title.

16.58.040 Scope.

16.58.100 Mandatory Requirements.

16.58.110 Project types.

16.58.120 Residential Projects.
16.58.130 Residential New Construction – Equal to or less than nine (9) homes
16.58.140 Residential New Construction – Greater than nine (9) homes or more
16.58.150 Major multi-family residential renovations/additions.
16.58.160 Non-residential new construction, small
16.58.170 Non-residential new construction, medium
16.58.180 Non-residential new construction, large
16.58.190 Non-residential renovations/additions, minor.
16.58.200 Non-residential renovations/additions, major.
16.58.210 Mixed-Use.
16.58.220 Table 101.10
16.58.230 Alternate green building standards.
16.58.240 Verification.
16.58.260 Exemptions.
16.58.280 Definitions.
16.58.290 Tenant Improvements.
16.58.300 Compliance with local water-efficient landscape ordinance- Residential.
16.58.310 Compliance with local water-efficient landscape ordinance- Non-Residential.
16.58.400 Electric vehicle (EV) charging - Residential.
16.58.420 Electric vehicle (EV) charging – Non-Residential.

16.58.010 Adoption of the 2019 California Green Building Standards Code.

A. The provisions of the 2019 California Green Building Standards Code and each and all of the regulations, provisions, conditions and terms of the code is referred to as if fully set forth in this chapter, and, except as to additions, deletions and amendments hereinafter described, such code is hereby adopted and made a part hereof, the same as if fully set forth in this Chapter.
    a. In accordance with California Health and Safety Code Sections 17958.7 and 18941.5, express findings that modifications to the California Green Building Standards Code are reasonably necessary because of local climatic, geological, or topographical conditions are either already on file with the California Building Standards Commission or will be filed prior to the effective date of the ordinance codified in this Chapter.

B. One (1) copy of the code therefore is on file in the office of the Building Official pursuant to Health and Safety Code Section 18942 and is made available for public inspection.

16.58.015 Adoption of Appendix Chapters.

No Appendix Chapters from the 2019 California Green Building Standards Code have been adopted.

16.58.020 Local Amendments.

The following provisions of this Chapter shall constitute local amendments to the cross-referenced provisions of the 2019 California Green Building Standards Code, and shall be deemed to amend the cross-referenced sections of said Code with the respective provisions set forth in this Chapter.

16.58.030 Title.

Amend Section 101.1 of the 2019 California Green Building Standards Code to read as follows:

101.1 Title. These regulations shall be known as the California Green Building Standards Code as amended by the City of Cupertino and may be cited as such and will be referred to herein as "this code." The California Green Building Standards Code as amended by the City of Cupertino is an amendment to Part 11 of 12 parts of the official compilation and publication of the adoption, amendment and repeal of building regulations to the California Code of Regulations, Title 24, also referred to as the California Building Standards Code.

16.58.040 Scope.

Amend Section 101.3 of the 2019 California Green Building Standards Code to read as follows:

101.3 Scope. The provisions of this code shall apply to the planning, design, operation, construction, use and occupancy of every newly constructed building or structure, unless otherwise indicated in this code for the City of Cupertino.

The California Green Building Standards Code also is hereby amended to apply to additions, renovations and tenant improvements of privately-owned buildings and structures in accordance with the provisions of this Chapter.

It is not the intent that this code substitute or be identified as meeting the certification requirements of any private, third party green building program.

16.58.100 Mandatory Requirements.

Amend Section 101.10 of the 2019 California Green Building Standards Code to read as follows:

101.10 Mandatory requirements. This code contains mandatory green building measures. In addition, this Chapter contains required minimum green building measures as amended by the City of Cupertino. All new buildings and structures, additions, renovations and tenant improvements subject to requirements in Table 101.10 shall comply with the mandatory measures of the 2019 California Green Building Standards Code as adopted by the state in addition to local amendments included in this code, regardless of height or number of stories, unless specifically exempted by this code.

16.58.110 Project Types.

Add Section 101.10.1 of the 2019 California Green Building Standards Code to read as follows:

101.10.1 Project Types - as set forth in Table 101.10.

16.58.120 Residential projects.

Add Section 101.10.1.1 of the 2019 California Green Building Standards Code to read as follows:

101.10.1.1 Residential projects - as set for in Table 101.10.

16.58.130 Residential New Construction – Equal to or less than nine (9) homes.

Add Section 101.10.1.1.1 of the 2019 California Green Building Standards Code to read as follows:

101.10.1.1.1 Residential new construction - Equal to or less than nine (9) homes - as set forth in Table 101.10.

16.58.140 Residential New Construction – Greater than nine (9) homes or more.

Add Section 101.10.1.1.2 of the 2019 California Green Building Standards Code to read as follows:

101.10.1.1.2 Residential new construction - Greater than nine (9) homes or more - as set forth in Table 101.10.

16.58.150 Major multi-family residential renovations/additions.

Add Section 101.10.1.1.3 of the 2019 California Green Building Standards Code to read as follows:

101.10.1.1.3 Major multi-family residential renovations/additions - as set forth in Table 101.10. Requirements shall only apply to the area of renovation/addition.

16.58.160 Non-residential new construction, small.

Add Section 101.10.1.1.4 of the 2019 California Green Building Standards Code to read as follows:

101.10.1.1.4 Non-residential new construction, small - as set forth in Table 101.10.

16.58.170 Non-residential new construction, medium.

Add Section 101.10.1.1.5 of the 2019 California Green Building Standards Code to read as follows:

101.10.1.1.5 Non-residential new construction, medium - as set forth in Table 101.10.

16.58.180 Non-residential new construction, large.

Add Section 101.10.1.1.6 of the 2019 California Green Building Standards Code to read as follows:

101.10.1.1.6 Non-residential new construction, large - as set forth in Table 101.10.

16.58.190 Non-residential renovations/additions, minor.

Add Section 101.10.1.1.7 of the 2019 California Green Building Standards Code to read as follows:

101.10.1.1.7 Non-residential renovations/additions, minor - as set forth in Table 101.10. Requirements shall only apply to the scope of work of renovation/addition.

16.58.200 Non-residential renovations/additions, major.

Add Section 101.10.1.1.8 of the 2019 California Green Building Standards Code to read as follows:

101.10.1.1.8 Non-residential renovations/additions, major - as set forth in Table 101.10. Requirements shall only apply to the area of renovation/addition.

16.58.210 Mixed-Use.

Add Section 101.10.1.1.9 of the 2019 California Green Building Standards Code to read as follows:

101.10.1.1.9 Mixed-Use - as set forth in Table 101.10.

16.58.220 Table 101.10–Added.

Add Table 101.10 of the 2019 California Green Building Standards Code to read as follows:

Project Type	*Minimum Green Building Requirement*	*Required Verification*
A. NEW CONSTRUCTION		
Residential		
Single Family and Multi-Family homes equal to or less than 9 homes:	• CALGreen Building Code in accordance with CALGreen's minimum thresholds.	City Review
Single Family and Multi-Family homes greater than 9 homes:	• GPR certified at minimum 50 points or • LEED Silver or	Third Party GPR or LEED certification as applicable

	• Alternate Reference Standard per Section 101.10.2	Alternate Reference Standard: See Section 101.10.2
Non-Residential		
Small, less than 25,000 SF:	• CALGreen Building Code * per Chapter 5 of the California Green Building Standards Code	City Review
Mid-size, from 25,000 to 50,000 SF:	• LEED Certified or • Alternate Reference Standard per Section 101.10.2	Third Party LEED Certification Alternate Reference Standard: See Section 101.10.2
Large, greater than 50,000 SF:	• LEED Silver or • Alternate Reference Standard per Section 101.10.2	Third Party LEED Certification Alternate Reference Standard: See Section 101.10.2
B. RENOVATIONS AND ADDITIONS		
Residential		
Single-family	• CALGreen Building Code in accordance with CALGreen's minimum thresholds.	City Review
Multi-family (minor):	• CALGreen Building Code in accordance with CALGreen's minimum thresholds.	City Review
Multi-family (major): Renovations and/or additions with a Floor Area Ratio (FAR) increase ≥ 50% and at least 35,000 square feet, and that replace or substantially alter the HVAC system and at least two of the following: building envelope, hot water system and lighting system.	• GPR minimum 50 pts or • LEED Certified or • LEED EBOM Certified or • Alternate Reference Standard per Section 101.10.2	Third Party GPR or LEED Certification as applicable Alternate Reference Standard: See Section 101.10.2
Non-Residential		
Minor: Renovations and/or additions that do not meet the higher thresholds for "major renovations and additions" outlined as defined in (ii) below.	• CALGreen Building Code in accordance with CALGreen's minimum thresholds.	City Review
Major: Renovations and/or additions that comprise at least	• LEED Certified (applicable only to the area of renovation/ addition) or	Third Party LEED Certification

35,000 square feet, and replace or substantially alter the HVAC system and two of the following: building envelope, hot water system, and lighting system.	• LEED EBOM Certified or • Alternate Reference Standard per Section 101.10.2	Alternate Reference Standard: See Section 101.10.2
Mixed-Use For new and renovation/addition projects with residential and non-residential components, the use shall comply by either: 1. Meeting the applicable requirements for each use; or 2. Meeting the applicable requirements for the use that comprises the majority of the project's square footage where uses are attached and/or combined in a building.		
Notes: *"Major" renovations and/or additions apply only to the area of the renovation/addition unless the LEED EBOM Certified option is selected.* *Chapter 5 of the California Green Building Standards Code (Cal Green Mandatory) requirements shall only be applied to elements included in the scope of a project, unless otherwise required by the California Green Building Standards Code.		

16.58.230 Alternate green building standards.

Add Section 101.10.2 of the 2019 California Green Building Standards Code to read as follows:

101.10.2 Alternate green building standards. The applicant may request to apply an alternate green building standard for a project in lieu of the minimum standards per Table 101.10. In making a determination in response to an application under this section, the Building Official may allow an alternate standard if he/she finds that the proposed alternative standard complies with all of the following:

A. Addresses a comprehensive scope of green building issues including energy efficiency, water efficiency, resource efficient materials, and healthy building practices;
B. Applies standards that are, when taken as a whole, as stringent as the GPR and LEED standards;
C. Includes a formalized certification process that incorporates third party verification; and
D. The project will advance the purposes of this Chapter.

16.58.240 Verification.

Amend Section 102.3 of the 2019 California Green Building Standards Code to read as follows:

102.3 Verification. Documentation of conformance for applicable green building measures shall be provided to the City of Cupertino. Verification that the project meets the applicable environmental standards occurs through either the Third Party process or City Review per the requirements in Table 101.10. The following lists the verification requirements for Third Party verification, and alternative methods:

A. Third Party Certification. A project will be required to meet the Third Party certification process if the City determines that the project meets or exceeds the applicable thresholds listed in Table 101.10. The applicant shall submit all of the following to the City, in addition

to other application requirements, to assist the City in determining compliance with the green building requirements:

a. Planning Application. A green building checklist that includes cross-references to appropriate locations in the construction documents for all prerequisites and selected points or credits that demonstrates that the proposed project meets the applicable minimum requirements.
b. Building Permit.
    i. Proof of project registration with administrating body of the applicable reference standard, and
    ii. A green building checklist that includes cross-references to appropriate locations in the construction documents for all prerequisites and selected points or credits; that demonstrate that the proposed project meets the applicable minimum requirements, and
c. Green Building Deposit. The green building deposit in an amount that may be set from time to time by resolution of the City Council. The applicant may provide the deposit in the form of cash or in any other form that the City finds acceptable to meet the purposes of this Section. The full amount of the deposit shall be returned upon the certification document being provided per 102.3 (A)(c). If however, the project does not meet the requirements of this Chapter, as applied to the project, then the City shall retain the full amount of the deposit, and shall use the deposit solely to advance the purposes of this Chapter.
d. Time Limit. Within 18 months of Final Occupancy - Provide certification document for LEED, GPR or alternate rating standard in a form accepted by the City per Table 101.10. The Building Official may grant a one-time 6-month extension.

16.58.260 Exemptions.

Added Section 102.3.1 of the 2019 California Green Building Standards Code to read as follows:

102.3.1 Exemptions. The Building Official shall determine the maximum feasible threshold of compliance reasonably achievable for the project. Projects that are exempted from the requirements of the California Green Building Standards Code as amended by the City of Cupertino shall meet the requirement in section A and at least one of the requirements in sections B-D:

A. Projects that demonstrate that it is not feasible for the project to fully meet the green building requirements and that the purposes of this chapter will have been achieved to the maximum extent possible shall be exempted only for the specific rating system prerequisite that has been determined to be infeasible.
B. Projects that demonstrate compliance with this code but which will conflict with the Cupertino General Plan and/or Municipal Code Ordinance, such as those requiring historic preservation as determined by the Director of Community Development; or
C. Projects that demonstrate compliance with this code but which will conflict with the California Building Standards Code; or
D. Projects with atypical energy-related design requirements and/or patterns of use that make compliance with the thresholds of this code infeasible.

16.58.280 Definitions.

Amend Section 202 of the 2019 California Green Building Standards Code to add or amend the

following definitions:

A. “Building Envelope” means the separation between the interior and the exterior environments of a building in order to provide structural integrity, moisture control, temperature control, and air pressure control. The principal physical components of the building envelope include the foundation, roof, walls, and windows.

B. “Decision maker” means the person or entity with final approval authority over the underlying project.

C. “Green Building Checklist” means a checklist, typically with prerequisites and credits and/or points that is developed by the administrators of green building certification systems and used to determine whether a development project can achieve certification.

D. “Green Point Rated (GPR)” means a residential green building rating system developed by Build It Green. Projects can use any of the adopted GPR checklists that most appropriately apply to the project type proposed.

E. “Leadership in Energy and Environmental Design (LEED)” means a green building rating system developed by the U.S. Green Building Council for residential and non-residential projects. Projects can use any of the adopted LEED checklists that most appropriately apply to the project type proposed.

F. “Minimum Green Building Requirement” means the minimum green building requirement that applies to a particular project, as listed in column 2 of Table 101.10.

G. “Required Verification” means the standards that correspond to the requirements of a particular green building rating system and project type, as listed in column 3 of Table 101.10, for which verification procedures are fully set forth in Section 102.3.

H. “Feasible” means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors.

I. “EV Capable” means a parking space linked to a listed electrical panel with sufficient capacity to provide at least 110/120 volts and 20 amperes to the parking space. Raceways linking the electrical panel and parking space only need to be installed in spaces that will be inaccessible in the future, either trenched underground or where penetrations to walls, floors, or other partitions would otherwise be required for future installation of branch circuits. Raceways must be at least 1” in diameter and may be sized for multiple circuits as allowed by the California Electrical Code. The panel circuit directory shall identify the overcurrent protective device space(s) reserved for EV charging as “EV CAPABLE.” Construction documents shall indicate future completion of raceway from the panel to the parking space, via the installed inaccessible raceways.

J. “Level 1 EV Ready Circuit” means a parking space served by a complete electric circuit with a minimum of 110/120 volt, 20-ampere capacity including electrical panel capacity, overprotection device, a minimum 1” diameter raceway that may include multiple circuits as allowed by the California Electrical Code, wiring, and either a) a receptacle labelled “Electric Vehicle Outlet” with at least a ½” font adjacent to the parking space, or b) electric vehicle supply equipment (EVSE).

K. “Level 2 EV Ready Circuit” means a parking space served by a complete electric circuit with 208/240 volt, 40-ampere capacity including electrical panel capacity, overprotection device, a minimum 1” diameter raceway that may include multiple circuits as allowed by the California Electrical Code, wiring, and either a) a receptacle labelled “Electric Vehicle Outlet” with at least a ½” font adjacent to the parking space, or b) electric vehicle supply equipment (EVSE) with a minimum output of 30 amperes.

L. “Electric Vehicle Charging Station (EVCS)” means a parking space that includes installation of electric vehicle supply equipment (EVSE) with a minimum output of 30 amperes connected to a Level 2 EV Ready Circuit. EVCS installation may be used to satisfy a Level

2 EV Ready Circuit requirement.

M. "Automatic Load Management Systems (ALMS)" means a control system which allows multiple Level 2 EV chargers to share a circuit or panel and automatically reduce power at each charger, providing the opportunity to reduce electrical infrastructure costs and/or provide demand response capability. ALMS is only allowed for Level 2 EVCS, Level 2 EV Ready, and Level 1 EV Ready Circuits. ALMS systems must be designed to deliver at least 1.4kW per charger. The connected amperage on-site shall not be lower than the required connected amperage per Part 11, 2019 California Green Building Code for the relevant building types.

N. "Affordable Housing" means residential buildings that entirely consist of units below market rate and whose rents or sales prices are determined by local agencies to be affordable based on area median income.

16.58.290 Tenant Improvements.

Amend Section 303.1.1 of the 2019 California Green Building Standards Code to read as follows:

303.1.1 Tenant improvements. Except as specified herein, the provisions of this code shall apply to the applicable tenant or occupant improvements to a project.

16.58.300 Compliance with local water-efficient landscape ordinance- Residential.

Add Section 4.304.1.1 of the 2019 California Green Building Standards Code to read as follows:

4.304.1.1 Compliance with local water-efficient landscape ordinance. Residential projects must comply with the City of Cupertino's Landscape Ordinance, pursuant to Chapter 14.15 of the Cupertino Municipal Code.

16.58.310 Compliance with local water-efficient landscape ordinance- Non-Residential.

Add Section 5.304.1.1 of the 2019 California Green Building Standards Code to read as follows:

5.304.1.1 Compliance with local water-efficient landscape ordinance. Non-residential projects must comply with the City of Cupertino's Landscape Ordinance, pursuant to Chapter 14.15 of the Cupertino Municipal Code.

16.58.400 Electric vehicle (EV) Charging - Residential.

Amend Section 4.106.4 of the 2019 California Green Building Standards Code to read as follows:

4.106.4 Electric vehicle (EV) charging for new construction. New construction shall comply with Sections 4.106.4.1 and 4.106.4.2 to facilitate future installation and use of EV chargers.

Exceptions:

1. Accessory Dwelling Units (ADU) and Junior Accessory Dwelling Units (JADU) without additional parking facilities.

Amend Section 4.106.4.1 of the 2019 California Green Building Standards Code to read as follows:

4.106.4.1 New one- and two-family dwellings and town- houses with attached private garages. For each dwelling unit, install a Level 2 EV Ready Circuit and Level 1 EV Ready Circuit.

Exception: For each dwelling unit with only one parking space, install a Level 2 EV Ready Circuit.

Amend Section 4.106.4.1.1 of the 2019 California Green Building Standards Code to read as follows:

4.106.4.1.1 Identification. The raceway termination location shall be permanently and visibly marked as “Level 2 EV-Ready”.

Amend Section 4.106.4.2 of the 2019 California Green Building Standards Code to read as follows:

4.106.4.2 New multifamily dwellings. The following requirements apply to all new multifamily dwellings:

1. For multifamily buildings with less than or equal to 20 dwelling units, one parking space per dwelling unit with parking shall be provided with a Level 2 EV Ready Circuit.
2. When more than 20 multifamily dwelling units are constructed on a building site:
    a. 25% of the dwelling units with parking space(s) shall be provided with at least one Level 2 EV Ready Circuit. Calculations for the required minimum number of Level 2 EV Ready spaces shall be rounded up to the nearest whole number.
    b. In addition, each remaining dwelling unit with parking space(s) shall be provided with at least a Level 1 EV Ready Circuit.

Exception: For all multifamily Affordable Housing, 10% of dwelling units with parking space(s) shall be provided with at least one Level 2 EV Ready Circuit. Calculations for the required minimum number of Level 2 EV Ready spaces shall be rounded up to the nearest whole number. The remaining dwelling units with parking space(s) shall each be provided with at least a Level 1 EV Ready Circuit.

Notes:

1. ALMS may be installed to decrease electrical service and transformer costs associated with EV Charging Equipment subject to review of the authority having jurisdiction.
2. Installation of Level 2 EV Ready Circuits above the minimum number required level may offset the minimum number Level 1 EV Ready Circuits required on a 1:1 basis.
3. The requirements apply to multifamily buildings with parking spaces including: a) assigned or leased to individual dwelling units, and b) unassigned residential parking.
4. Local jurisdictions may consider allowing exceptions through their local process, on a case by case basis, if a building permit applicant provides documentation detailing that the increased cost of utility service or on-site transformer capacity would exceed an average of $4,500 among parking spaces with Level 2 EV Ready Circuits and Level 1 EV Ready Circuits. If costs are found to exceed this level, the applicant shall provide EV infrastructure

up to a level that would not exceed this cost for utility service or on-site transformer capacity.

5. In order to adhere to accessibility requirements in accordance with California Building Code Chapters 11A and/or 11B, it is recommended that all accessible parking spaces for covered newly constructed multifamily dwellings are provided with Level 1 or Level 2 EV Ready Circuits.

Amend Section 4.106.4.2.2 of the 2019 California Green Building Standards Code to read as follows:

4.106.4.2.2 Electric vehicle charging space (EV space) dimensions. Applicants shall size EV spaces as specified by the Building Official.

Delete Section 4.106.4.2.3 of the 2019 California Green Building Standards Code in its entirety.

Delete Section 4.106.4.2.4 of the 2019 California Green Building Standards Code in its entirety

Delete Section 4.106.4.2.5 of the 2019 California Green Building Standards Code in its entirety.

16.58.420 Electric vehicle (EV) charging – Non-Residential.

Amend Section 5.106.5.3 of the 2019 California Green Building Standards Code to read as follows:

5.106.5.3 Electric vehicle (EV) charging. New construction shall comply with Section 5.106.5.3.1 or Section 5.106.5.3.2 to facilitate future installation and use of EV chargers.

Exception:

1. Where there is no commercial power supply.
2. Nonresidential tenant improvements.

Amend Section 5.106.5.3.1 of the 2019 California Green Building Standards Code to read as follows:

5.106.5.3.1 Office buildings: In nonresidential new construction buildings designated primarily for office use with parking:

1. When 10 or more parking spaces are constructed, 20% of the available parking spaces on site shall be equipped with Level 2 EVCS;
2. An additional 10% shall be provided with at least Level 1 EV Ready Circuits; and
3. An additional 30% shall be at least EV Capable.

Calculations for the required minimum number of spaces equipped with Level 2 EVCS, Level 1 EV Ready spaces and EV Capable spaces shall all be rounded up to the nearest whole number

Construction plans and specifications shall demonstrate that all raceways shall be a minimum of 1" and sufficient for installation of EVCS at all required Level 1 EV Ready and EV Capable spaces; Electrical calculations shall substantiate the design of the electrical system to include the rating of equipment and any on-site distribution transformers, and have sufficient capacity to simultaneously charge EVs at all required EV spaces including Level 1 EV Ready and EV Capable spaces; and service panel or subpanel(s) shall have sufficient capacity to accommodate the required number of dedicated branch circuit(s) for the future installation of the EVSE.

Notes:

1. ALMS may be installed to increase the number of EV chargers or the amperage or voltage beyond the minimum requirements in this code. The option does not allow for installing less electrical panel capacity than would be required without ALMS.

Amend Section 5.106.5.3.2 of the 2019 California Green Building Standards Code to read as follows:

5.106.5.3.2 Other nonresidential buildings: In nonresidential new construction buildings that are not designated primarily for office use, such as retail or institutional uses:

1. When 10 or more parking spaces are constructed, 6% of the available parking spaces on site shall be equipped with Level 2 EVCS;
2. An additional 5% shall be at least Level 1 EV Ready.

   Calculations for the required minimum number of spaces equipped with Level 2 EVCS and Level 2 EV Ready spaces shall be rounded up to the nearest whole number

   Exception: Installation of each Direct Current Fast Charger with the capacity to provide at least 80 kW output may substitute for 6 Level 2 EVCS and 5 EV Ready spaces after a minimum of 6 Level 2 EVCS and 5 Level 1 EV Ready spaces are installed.

Amend Section 5.106.5.3.3 of the 2019 California Green Building Standards Code to read as follows:

5.106.5.3.3 Clean Air Vehicle Parking Designation. EVCS qualify as designated parking as described in Section 5.106.5.2 Designated parking for clean air vehicles.

Notes:

1. The California Department of Transportation adopts and publishes the California Manual on Uniform Traffic Control Devices (California MUTCD) to provide uniform standards and specifications for all official traffic control devices in California. Zero Emission Vehicle Signs and Pavement Markings can be found in the New Policies & Directives number 13-01. www.dot.ca.gov/hq/traffops/policy/13-01.pdf.
2. See Vehicle Code Section 22511 for EV charging spaces signage in off-street parking facilities and for use of EV charging spaces.
3. The Governor's Office of Planning and Research published a Zero-Emission Vehicle Community Readiness Guidebook which provides helpful information for local governments, residents and businesses. www.opr.ca.gov/ docs/ZEV_Guidebook.pdf.
4. Section 11B-812 of the 2019 California Building Code requires that a facility providing EVCS for public and common use also provide one or more accessible EVCS as specified in Table 11B-228.3.2.1. Chapter 11B applies to certain facilities including, but not limited to, public accommodations and publicly funded housing (see section 1.9 of Part 2 of the California Building Code). Section 11B-812 requires that "Parking spaces, access aisles and vehicular routes serving them shall provide a vertical clearance of 98 inches (2489 mm) minimum." It also requires that parking spaces and access aisles meet maximum slope requirements of 1 unit vertical in 48 units horizontal (2.083 percent slope) in any direction at the time of new building construction or renovation. Section 11B-812.5 contains accessible route requirements.
5. It is encouraged that shared parking, EV Ready are designated as "EV preferred."

Delete Table 5.106.5.3.3 of the 2019 California Green Building Standards Code in its entirety.

Amend Section 5.106.5.3.4 of the 2019 California Green Building Standards Code to read as follows:

5.106.5.3.4 [N] Identification. The raceway termination location shall be permanently and visibly marked as "EV_Ready".

Delete Section 5.106.5.3.5 of the 2019 California Green Building Standards Code in its entirety.

Building Code Board of Appeals
Meeting Minutes
September 08, 2021
Electronic Meeting
6:30 PM

Berry called the meeting to order at 6:32 PM.

Roll Call was taken and the following members were present:

Board Members Present:	Chair Matt Berry Vice Chair Peter Geise Christian Dino Mason Gatto Steve Knapp
Board Members Absent:	
Staff Members Present:	Chad Root, Chief Building Official Rob Zuccaro, Dir. of Planning & Building Safety Elizabeth Schettler, Sen. Admin. Assistant Katie Baum, Sustainability Coordinator

Approval of Agenda:
Geise moved and **Knapp** seconded a motion to approve the agenda as prepared by staff. Motion passes unanimously by voice vote.

Public Comments on Items not on the Agenda:
None heard.

Discussion Items:
Recommendation on 2021 International Energy Conservation Code (IECC)
Root mentions to the board that tonight's meeting should focus on the EV charging portion of the code as well as focus on the energy conservation code.

Berry mentions that their review/recommendation should fall under three sections of the IECC: Energy savings in regards to construction, lighting, and the EV portion.

EV Charging Station
Root mentions that city staff, Katie Baum and Rob Zuccaro, are available for questions in regards to EV.

Gatto asks what the difference is between EV ready and EV installed.

Staff says the difference is between having just the conduit and the conductor to an outlet. EV ready just has a conduit. EV ready is more flexible. It can be a plug, outlet, or a box. EV install's intent affects more of the commercial side. Staff further describes the flexibility that EV ready provides for homeowners, and how it gives them the option to go to a level two but does not require them to.

Geise mentions that the definitions should be altered to more clearly describe the difference between the two. He would like to eliminate EV ready.

Baum mentions that EV install is one step further and actually requires the equipment. That is why there are tiers between EV ready and EV install. She then reviews the actual equipment needed for these tiers.

Geise says he would like to eliminate EV install for residential and allow the homeowner decide if they want the EV ready.

Board members discus multi-family with dedicated garages. Should they be treated the same as a single family unit? If it is a multi-family with a parking garage or parking lot, how does it relate to EV?

Geise thinks multi-family should be in the same tier as single family residential since currently multi-family is in separate tiers depending upon if it has dedicated parking spaces/garages or not.

Berry asks if a town home is a single family unit.

Zuccaro says that a duplex is considered as a single family unit.

Berry mentions that any shared parking spaces falls under the tier one.

Geise says that hotels, motels, and extended lodging will need a higher capacity of charging stations for the rooms.

Baum describes the intent of having multi-family without dedicated parking spaces or garages at the same level as hotel and motel. That is because most people will be charging overnight which will have a density that will need to have charging provided. The 10% of spaces requirement is so that multi-family without dedicated parking spaces or garages would still provide the residents with enough charging stations.

The board members further discuss what they believe is the appropriate percentage of spaces for EV installed, EV ready, and EV capable.

Zuccaro mentions that the EV charging station table just highlights the minimum requirements, but that this is staff's best guess of infrastructure as of right now. 35% of parking spaces would need some kind of infrastructure in regards to EV.

Geise mentions again that EV ready should be removed since the only difference between ready and capable is hooking up the outlet in the end.

Baum says that EV ready has the conductor already laid so that it can effectively go in and install the equipment on top of it. EV capable will take more work to get the conductor pulled and get the equipment on top of it.

Zuccaro asks the board that if they want to get rid of the ready, how would the 10% be distributed? Would you do 20% installed, 10% capable? Possibly, the opposite of that?

Dino says he would do more in capable and decrease the EV installed.

Berry comments that the overall percentages seem very large to him.

Gatto says he would recommend to split it - 5% in each and eliminate EV ready. The board needs to think about how many electric vehicles Louisville will have in the future instead of just looking at how many we have currently.

Berry asks that in regards to multi-family with only one dedicated parking space, does that mean it has to be ready or capable?

Zuccaro says that under zoning, the city requires two dedicated parking spaces for a single family unit or a duplex.

Berry asks that if a development has assigned parking, would every space need to be either ready or capable.

Zuccaro says yes, he believes that is the way it is written.

Knapp asks if this is table comparable with other cities.

Baum says this is similar to City of Lakewood's and City and County of Denver in terms of use. Lafayette is currently reviewing this right now.

Zuccaro says multi-family with two or more beds need two parking spaces. A studio or one bed only needs one parking space. He recommends that the table have separate line items in regards to multi-family for a studio/one bed or two beds or more, and its allocated parking spaces.

Geise asks how these percentages were determined.

Baum says they are based on land use and what the city anticipates EV will be at in the future. Any percentages or numbers are usually a best guess in what we can anticipate. This is relatively a best use guess.

Berry asks how many cities have actually adopted this.

Baum says Lakewood, Denver, Fort Collins, and Boulder have adopted this.

Berry asks what tiers or residential uses can the city expect the most growth in in regards to square feet?

Zuccaro says the most growth in square feet would definitely be on the commercial side. He estimates three-four million square feet for residential. Most residential is zoned for multi-family or townhome developments. The city would be looking at an additional 350 residential units.

Board members discuss various scenarios of likelihood of when/where people would charge their vehicles when they are away from their home or hotel.

Zuccaro mentions it would be less for commercial (of people needing to charge their vehicles), but it would most likely be more for the workers charging than the customers.

Berry makes a motion to recommend the following changes:

	EV Installed	EV- Ready	EV Capable
Residential Uses			
Single-Family unit	1 space		1 space
Multi-Family unit, with dedicated parking spaces or garages	1 space		1 space
Tier 1			
Multi-Family, without dedicated parking spaces or garages	15% of spaces	10% of spaces	15% of spaces
Hotel, Motel, Extended Stay Lodging Facility			
Tier 2 – Employment oriented uses	10% of spaces	10% of spaces	15% of spaces
Business and Professional Offices			
General research facilities, light industrial facilities including manufacturing, assembly, warehouse and fabrication			
Hospital			
Tier 3 – Service and Sales oriented uses	5% of spaces	10% of spaces	10% of spaces
Private and public recreational and social facilities, membership clubs, lodges, and fraternal organizations			
Religious institution			
Commercial amusement, indoor and outdoor			
Schools, including public, private, vocational or business			
Restaurant			
Retail			
Personal service			
Medical and dental clinics			

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- Remove EV ready from all tiers
- Change the parking space from one to two under EV capable for a single family unit
- Change the parking space from one to two under EV capable for a EV capable for multi-family
- Tier 1: 25% of spaces total (Remove EV ready)
- Tier 2: 25% of spaces total (Remove EV ready)
- Tier 3: 15% of spaces total (Remove EV ready)

Geise seconds the motion. Voice vote. All board members apart from Gatto vote to approve this recommendation. Motion passes 4-1.

Insulation

Root asks the board for thoughts or recommendations based on the proposed documents on the energy code as shown in the packet.

Knapp asks for staff to review the changes in the 2021 IECC.

Root explains that the changes in the code is trying to make equipment more efficient. Many cities have adopted this code verbatim.

Geise mentions concerns in regards to insulation. His pertain more specifically to the scenario of an older building being bought and then having to update it to the most recent energy code.

Berry says he could understand this if it was for a change of use. He also mentions that he does not see this in the proposed adoption. He asks staff if the prescriptive code is mainly used for remodels and change of uses.

Root says it is used in everything, including new construction.

Dino asks if Gatto has any experience with the blower door test.

Gatto says he does and they he does them on almost every project.

Dino asks what his experience has been with it.

Gatto says it has been a favorable experience and not difficult to reach all the thresholds.

Berry says that only relates to residential though.

Dino as well as the other board members speak more on blower door tests relating to multi-family buildings and the difficulty level of doing them.

Dino references Table C402.1.3 and recommends removing the practice of continuous insulation in the walls. He proposed keeping the R-value in the wall but not adding them together.

The board members continue to discuss the appropriate R-value for residential and commercial buildings.

Geise agrees with Dino and makes the same point for the mass.

Berry says he would rather have an R-19 as a system then it be continuous, in regards to mass.

Dino asks if there is an exception to this in regards to occupied space versus a vertical stair or a trash room, or a storage area.

Chad says yes and no. There is a thermal envelope for it. If it is a heated space, it has to be inside that thermal envelope.

Geise wants to make a motion to recommend keeping the roof insulation at R-49 and removing the R-5 insulation of the continuous from residential buildings.

The board members and staff continue to talk about the continuous for insulation in relation to different parts of buildings, residential and commercial.

Dino makes a motion to remove the continuous for insulation in its entirety from the commercial and residential tables. **Gatto** seconds the motion. Voice vote. Motion passes unanimously.

Baum asks about removing the continuous insulation. Does the board also want to move forward with decreasing the roof insulation from R60 to R49?

Berry mentions that the problem with continuous insulation is that it could provide worse problems down the road. He would not mind moving it from R60 to R49. In regards to the insulation tables for residential and commercial, language should be added that says that a minimum R value of this is the exception to the minimum R value of the roof, wall, or floor system.

Berry makes a motion to recommend having an exception to allow the system average to equate to the insulation table. **Geise** seconds. Motion passes unanimously by a voice vote.

Berry reminds the board that that motion does not get rid of the continuous.

Root asks if that that motion was for residential and commercial.

Geise says that is correct. The numbers should be as follows: 5 on residential, 7.5 on wood frame for commercial, and 9 in mass.

The board recommends to staff to change the continuous insulation to just R19.

Appliance Sufficiency
Root mentions that currently, the city requires gas and furnaces to be 90% efficient. The city does not have any requirements for on demand gas water heaters.

Berry and **Gatto** state they do not have any issues with this current city requirement.

Berry asks if a 3x3 space is required in front of a water heater.

Root says that in the code there is a requirement for 36 inches in front of mechanical.

Geise mentions that section C402.4.1 is confusing.

Root says that in the 2018 prescriptive code, 8% of the floor area should have light coming into the commercial buildings. You will have glass in the storefronts or skylights.

Board members and staff discuss code related to dark sky lighting.

Gatto asks if all lighting has to be LED.

Berry says that it can be SFL or LED.

Dino brings up exterior lighting controls for discussion. Do they have to be on a controlled dimmer? How long do they need to be lit?

Baum says that exterior lighting controls exempts lighting for covered vehicle entrances and exits, parking structures, and lighting control for dwelling units. It does not specifically say anything for parking lots. There are no requirements on when or how they turn on lights.

Dino brings up section C505.1 for discussion, and the board and staff discuss glazing requirements for storefront windows.

Dino wants to make a motion to have an exception for allowing entry egress requirements as required by code to be allowable in glazed storefront without affecting this. Geise seconds. No one votes on this motion.

The board recommends changing the word increase to decrease in regards to code section C505.1 “provided that there is not an increase in fenestration area.” Staff agrees with the board’s recommendation.

Dino brings up a discussion on code section C403.3.2 for HVAC equipment performance requirements

Root mentions that for commercial buildings, they have to verify that it will be 10% more efficient than the federal standard, which is 80% efficiency.

Dino asks staff to explain this sentence in the code section C403.3.2, “The efficiency shall be verified through certification under an approved certification program or, where a certification program does not exist, the equipment efficiency ratings shall be supported by data furnished by the manufacturer.”

Berry says he thinks that is related to very specialized equipment. Berry suggests removing the “or” in the above sentence so that it does not give another option.

Dino mentions just removing this portion of the sentence, “Where a certification program does not exist.”

Root says he will continue to look into the efficiencies and get back with the board on that.

The board mentions to staff that they would like to meet again on September 16 to review the final draft of the ordinance that includes the board's recommendations from this meeting.

Discussion Items for Next Meeting – September 16, 2021:
Recommendation on 2021 International Energy Conservation Code (IECC)

Staff Comments:
None heard.

Board Comments:
Berry mentions to the board that they should be cautious about being the first to adopt any kind of code in comparison to other cities.

Adjourn:
Knapp moved and **Geise** seconded a motion to adjourn the meeting. Motion passed unanimously by voice vote. The meeting was adjourned at 9:18 PM.

Building Code Board of Appeals

Meeting Minutes

September 16, 2021
Zoom Meeting Online
6:30 PM

Call to Order: **Berry** called the meeting to order at 6:35 PM.

Roll Call was taken and the following members were present:

Board Members Present:	Matt Berry Christian Dino Mason Gatto Steve Knapp
Board Members Absent:	Peter Geise
Staff Members Present:	Chad Root, Chief Building Official Elizabeth Schettler, Senior Administrative Assistant Jenny Lane, Permit Technician Katie Baum, Sustainability Coordinator Rob Zuccaro, Director of Planning and Building Safety

Approval of Agenda:
Knapp moved and **Gatto** seconded a motion to approve the agenda as prepared by staff. Voice vote. Motion passed 4-0.

Approval of Minutes:

Public Comments on Items not on the Agenda:
None heard.

Discussion Items:
Recommendation on 2021 International Energy Conservation Code

Berry suggested moving forward with the discussion from previous meeting.

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Root said there were some minor adjustments and suggested **Baum** address the EV changes. **Baum** discussed that recommendations from 9/8/21 BCBOA meeting. Instead, the Planning Commission decided in their meeting to make their own recommendation to increase the amount of EV capable and include the BCBOA recommendation of combining the EV ready percentages into EV capable percentages, indicating this would be the recommendation presented to City Council.

Zuccaro explained to group what the procedure is to make a formal recommendation regarding EV standards based on recommendations made by the Planning Commission or based on previous recommendation by BCBOA. **Berry** asked opinion of the board how they would like to proceed and what they would like to recommend to City Council.

Berry clarified that the Planning Commission changed the recommendation for tier one to increase in EV capable for multifamily and motel/hotel to 50%. EV capable is the conduit. **Dino** and **Berry** discuss challenges with repairs to concrete with a large amount of conduit underground. **Baum** clarified changes from 9/8/21 BCBOA meeting versus the recommended changes from the Planning Commission. **Dino**, **Berry**, and **Gatto** suggested recommending their original suggestions. **Knapp** disagreed, saying that having a larger EV capable percentage would make sense from a building perspective. **Baum** confirmed that retrofit costs are about 70% higher on average than when conduit is laid at the beginning of construction.

Baum and **Zuccaro** discussed the Planning Commission's intent behind increasing percentages, stating that the indication is that in 20-30 years electric vehicles will be the predominant vehicle and residents will need charging capabilities.

Berry, **Dino**, and **Zuccaro** discuss EV charging capabilities and planning for future infrastructure.

Gatto made a motion to revert back to recommendations from September 8, 2021. **Berry** seconded the motion. **Berry** called a vote. Voice vote. **Knapp** opposed.
Baum left the meeting.

Berry and **Dino** began reviewing anything still in question from previous document. **Berry** started reviewing reduced continuous insulation and minimum area of natural lighting.

Root explained the complete removal "electrification of buildings" due to preemption and the need to for code to meet Federal Standards because the City needs to meet Federal Standards but not exceed them, even as a Home Rule community, unless it is an "exception". **Berry** and **Root** discussed possibility of keeping the higher standard of 90% even if it exceeds Federal Standards.

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Zuccaro explained that the City Attorney that increasing to 90% the City would violate Federal Law and we cannot include it in our code. **Root** explained that with "electrification-only requirement" with an exception for gas installation at the higher percentage would be the only way to increase the requirement in the City's Code. **Zuccaro** recommended contacting other jurisdictions as to how they have implemented it and to investigate further.

Berry moved and **Knapp** seconded a motion to make a recommendation to maintain existing efficiency requirements of gas-fired appliances. Motion passed unanimously by voice vote.

Berry and **Dino** confirmed they are satisfied with occupancy sensor controls.

Dino, **Berry** and **Root** confirmed exterior lighting controls section is accurate at 60%.

Root and **Berry** do not exceed 30% fenestration for windows. Dino would like to see doors be storefront glazing as well. **Root** discussed having egress doors be exempt.

VOTE:
Dino moved and **Knapp** seconded a recommendation for exemption on entry and egress doors to be allowable for storefront. Passed unanimously by voice vote.

Dino discussed institute standards for installation stage in lieu of blower door test.

Berry pointed out in the section Design Criteria that snow load should be called "Roof Snow Load" or "Non-reduceable for roofs". **Root** and **Berry** agreed it should be "Non-Reduceable".

Berry explained that wind exposure C that in downtown or residential that Exposure B could be used. Root confirmed this is the case.

Dino recommendation that EVCS a portion should be in a desirable location but that not all, so they are spread out and not all be in front. Change to "a portion of" the EVCS. "A portion of the EVCSs inteneded for public use shall be submect to the following requirements.
Dino Motion; Knapp second; unanimous voice vote.

VOTE on IECC Adoption:
Berry moved and **Dino** seconded to adopt the 2021 IECC with the recommendations made during this meeting. Passed unanimously by voice vote.

Staff Comments:
None heard.

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Discussion Items for Next Meeting:
Not enough time to put packet together based on City Council meeting. No indication as to when the next meeting will take place.

Adjourn:
Berry moved and **Gatto** seconded a motion to adjourn the meeting. The meeting was adjourned at 8:05 PM.

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City of Louisville
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Planning Commission
Meeting Minutes
September 9th, 2021
Electronic Meeting
6:30 PM

Vice Chair Hoefner **called the meeting to order** at 6:30 PM.

Roll Call was taken and the following members were present:

Commission Members Present:	Steve Brauneis, Chair Dietrich Hoefner, Vice Chair Debra Williams, Secretary Ben Diehl Keaton Howe
Commission Members Absent:	Jeff Moline
Staff Members Present:	Lisa Ritchie, Interim Dir. of Planning & Building Amelia Brackett Hogstad, Planning Clerk

APPROVAL OF AGENDA

Brauneis moved and a motion to approve the September 9, 2021 agenda. General second. Motion passed unanimously by voice vote.

APPROVAL OF MINUTES

None.

PUBLIC COMMENTS ON ITEMS NOT ON THE AGENDA

None.

NEW BUSINESS – PUBLIC HEARING ITEMS

Electronic Vehicle Charging Infrastructure Code Amendment: A request for approval of a draft ordinance amending Title 17 of the Louisville Municipal Code concerning new requirements for electric vehicle charging infrastructure (Resolution No. 13, Series 2021).

- Applicant: City of Louisville
- Case Planner: Lisa Ritchie, Interim Director of Planning and Building Safety

All required public notice was met.

Ritchie described the proposed changes to Title 15 and Title 17, which would apply to all new development and would vary across zones, with redevelopment triggered only for an addition of 25% or more new square footage or added parking to an existing development. She described the intent of the changes as attempting to facilitate and

encourage EV and take away barriers. Ritchie noted that EV was cheaper to install during construction as opposed to during retrofitting. She described the three different categories of requirements: “installed,” “ready,” and “capable” spaces. Ready and capable spaces would not have a City trigger but were more for the purpose of reducing barriers to EV in the future. The only category that would achieve EV readiness on day one was “installed.” Ritchie also described the EV approaches of neighboring cities, stating that this proposal was in line with neighboring codes and went a bit further. She noted that there were standards relevant to ADA, public and private use, and service fees in the proposed changes.

Dietrich asked about the difference among residential requirements and stated that residential should be treated similarly regardless of whether it was single- or multi-family.

Hoefner asked about charging for e-bikes.

Ritchie replied that e-bike usage was allowed by code but these changes did not address e-bikes.

Hoefner stated that it was a sensible idea overall, with the caveat that tech changes quickly and he did not want to lock people into tech that would be rapidly out of date. He was more in favor of putting in ready and capable spaces than choosing winners and losers of charging tech.

Williams asked what would happen with shared parking.

Ritchie responded that multi-tenant buildings would look at the PUD collectively with some discretion in the language to determine the right number of stations if it was unclear within the tiers of uses. She did not know that they could make improvements on an adjacent property owner without their permission and stated that staff would have to work on that language.

Williams stated that she was thinking about square footage of different uses and noted that street parking and day/night usages issues would make the right number of stations harder to determine. She asked about tying the number to the size of the development.

Ritchie replied that staff would work with developers to prorate the use percentage to match the requirement with the proposed uses for a development.

Williams stated that she supported codifying a process for how to arrive at the numbers for mixed-use development.

Diehl asked for how this would apply to a place like Dakota Ridge.

Ritchie stated that for a multi-family property there would be designated parking spaces, e.g. a garage would have an EV requirement of one ready and one capable. Cases with surface lots, without designated spaces, would fall under the 10% threshold for the ready option, unless someone elected to install more. She added that staff had tried to determine the status of EV now and the best estimate statewide was that around 3.5%

of all vehicles had plug-in capabilities. Staff wanted to at least match that, and they had bumped it higher. She added that they could assume that Boulder County was higher than the 3.5% average.

Diehl asked for context from recent applications and staff conversations regarding EV.

Ritchie replied that staff had encouraged office users and that people were putting them in voluntary, but staff had not pushed beyond the level of encouragement because EV was not in the Code. Where an applicant showed interest, staff worked with them. She noted that Louisville was not the only community to do this and stated that retail users and others in Tier 3 might push back, but a lot of office users were already doing this. She added that the flipside to the requirement was the cost, especially considering that residential affordability.

Brauneis stated that the multi-family requirements with non-designated spaces struck him as fairly low and that EV-capable and EV in general was much cheaper to do during construction than later on. He thought the number could be higher.

Ritchie replied that the numbers were from California and Lakewood and that staff had found some much higher rates in other communities. For the Colorado/Front Range market, these numbers were on the high end.

Brauneis asked if Director Ritchie had found anything on the commercial side regarding internet access.

Ritchie replied that it was not something she had come across.

Brauneis noted the subjective language regarding desirable locations.

Ritchie responded that staff was fine leaving it somewhat flexible and setting the intent with the language to enable site specificity, to be reviewed at the PUD stage.

Brauneis stated that initially LEED required that EV be adjacent to the ADA spaces and then allowed spaces that were further out if there were roof spaces that were desirable. He stated that staff would need to be comfortable determining and enforcing with the language.

Ritchie noted that staff felt comfortable with the PUD process but noted that it was not a measurable metric.

Howe asked about voltage.

Ritchie replied that one 240 volt would be required and “capable” meant that there was a conduit and sufficient capacity but not charging receptacle.

Howe stated that he did not want to ask people to provide 240 volts when 120 volts was sometimes sufficient. He asked what the disadvantage would be for saving a level one charger would be appropriate for residential use.

Ritchie replied that they typically only charge 3-5 miles per hour and the intent with providing level two was to guarantee a full charge every morning.

Brauneis stated that level two was good for weekend travel.

Diehl asked about waivers.

Ritchie responded that residential would need a variance and commercial would need a waiver.

RJ Harrington, 457 East Raintree Court, disclosed that he had been driving primarily solar-powered electric since 2013 and he works on EV for a living and was involved with the City through EV projects. Harrington stated that the Colorado Energy Office had information on EV registration at the city- and county-level. There were one million vehicles in the state's plan for 2030 and the state was behind on achieving what was necessary on an annual basis. He noted that the Boulder County had higher EV than the state. He described charging stations in the City and suggested that multi-family developments offer electric car share. Harrington stated that most vehicles came with a cord to plug into the charger so EV-ready effectively meant EV-installed. He stated that utilities and the distribution grid needed to be considered to truly make a positive impact with EV. That could be ameliorated if the broader code required elements like solar requirements, for example on shading and carports. He added other considerations, including snow impacts, adequate lighting, and enforcement. He also discussed the circuit range and offered other suggestions for the language.

Ritchie described Boulder's EV code to follow up with Mr. Harrington's comments.

Brauneis stated that he thought it should be minimum 40 amp and noted that multi-family often got left behind and he wanted to avoid that.

Hoefner agreed that addressing multi-family was important and observed that Colorado was supposed to have an EV equity framework. He stated that offering EV to multi-family residents was an important equity consideration.

Diehl asked if Louisville should mirror the 40% of spaces in multi-family that Boulder had.

Hoefner stated that he might go higher, because the rate was100% for single-family so 40% was low by comparison.

Diehl stated that he liked the 100% rate, but noted that there were added costs for that that might affect residential affordability.

Hoefner stated that the state had set a goal of 100% EVs by 2050.

Diehl voiced support for increasing the rate to 100%.

Brauneis stated that he liked the sound of that change, but asked if it made sense in 2021.

Diehl stated that they always had the off-ramp of the PUD waiver.

Discussion of the wiring process during installation.

Howe stated that he wanted to recognize the stress put on utility companies and wondered if a 100% rate for multi-family would have the necessary electricity.

Hoefner replied that that was a problem for the electric utilities to deal with and they knew that EVs were coming in huge numbers.

Brauneis agreed with Commissioner Hoefner that it was in the utility companies' plans and was their job to figure out.

Discussion on percentages, in which it was weighed whether waivers could be used to encourage people to higher rates and the limitations of aspirational language was discussed, and the commissioners discussed a 35% requirement.

Diehl stated that going from 0 to up to 35% required was a pretty significant jump and could be revisited down the line.

Hoefner proposed 5%/10%/50% for multi-family to recognize changing technology and that not many folks today used EVs but that was expected to go up.

Howe stated that multi-family should have a high percentage of "capable" with conduits in and he wondered how the hotel/motel use would have to be installed incentive-wise.

Hoefner stated that the problem chicken and egg, problem is to get the capacity there so the hotel is ready to go and put in the charging station in.

Hoefner stated that they were trying to get the capacity high enough for eventual high demand, and that it might be cost-prohibitive to retrofit.

Brauneis stated that the hotels were more closely linked to the market and suggested 10/10/40% for discussion.

Hoefner confirmed that his proposed spread was for multi-family and hotel/motel, though he did not feel strongly about the hotel/motel level. He stated that they should go as high as they're comfortable for multi-family with parking lots because why should people there have less access than people in single-family homes.

Discussion about separating hotel/motel and multi-family categories, in which Hoefner stated that single and multi-family units should have the same amount of access and that he was not as concerned with hotel/motel amount being the same.

Diehl stated that he was fine with the 5/10/50% spread.

Brauneis proposed 10/10/50%.

Commissioners Hoefner and Diehl agreed.

Ritchie asked for feedback on Tier 2 and Tier 3.

Brauneis stated that he was comfortable with the current proposal for those tiers.

Diehl stated that the argument was for future-proofing these developments and it was cheaper to do the work at build. He asked if the state plan was to do 100% by 2050 then shouldn't we be aiming higher.

Brauneis stated that the cheapest place to charge was at home without fees. He didn't know that EV was needed at both ends of a commute.

Hoefner stated that Chair Brauneis's commute point was one argument for keeping the numbers lower. He observed that it was also possible that the technology overall would change to the point where charging at businesses was not relevant.

Diehl and Commissioner Howe agreed.

Brauneis made a motion and Hoefner offered a friendly amendment of a 10/10/50% spread for Tier 1. Diehl seconded. Motion passed unanimously by voice vote.

COMMISSIONER COMMENTS

Commissioners expressed appreciation for Interim Director Ritchie taking over the position.

STAFF COMMENTS

Ritchie shared information on the Old Town Overlay update and the Commission's involvement.

COMMISSIONER COMMENTS

None.

ADJOURN

Diehl moved and Brauneis seconded a motion to adjourn. Meeting adjourned at 7:55 PM.

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Louisville Sustainability Advisory Board

Meeting Minutes
August 18, 2021, Virtual Meeting
6:30 - 8:00pm

1. **Call to Order at 6:34 PM**
2. Roll Call
   A. 5 members plus 2 City of Louisville employees in attendance – **Laura, Josh, Todd, Tiffany, Seth, Katie Baum, Rob Zuccaro**
3. Approval of Agenda
   A. Todd Motion, Laura 2nd
4. Approval of Minutes
   A. Laura Motion, Tiffany 2nd
5. 6:37 PM Public Comment
   A. RJ Harrington – Pleased with getting the survey out. Found it on engage Louisville. Date stamp on Action together. The date still has an older date. No mention of the survey on the Louisville web page.
      i. Katie explained the survey is FB, Twitter, Next-door. Also was sent out on several email lists.
6. 6:40 PM LSAB Member Updates and Reports
   A. Tiffany – Students are going to walk in the Labor Day Parade. Help is needed on stuffing reusable bags with helpful flyer information.
   B. Laura – Excel sent out a rate increase letter in last month bill. The letter cited lots of sustainability costs in the letter. Laura thinks asking for a tax on the excel bill for sustainability funding is now a much harder ask. What other possibilities are there? Katie mentioned most other municipalities are doing a sales tax. Josh, have we ever looked at adding this the water bill as an option? Westminster is looking at on bill financing. Deb Fahey mentioned the CC4CA group just met with

Congressman Goose. His response was the most important thing we can do is contact our Senators for funding.

C. Todd – On the board for Mountain Parks Electric Coop – They have an optional donation that helps fund sustainability programs. This might be an option for funding
D. Josh – Attended the Parks and Open Space meeting – More sustainable landscaping mowing in the City. The issue has been brought up prior and the urgency has kind ebbed and flowed over time. No real action items were taken from the topic. Josh will get a general outline going for LSAB to give input on. Has a conversation with the major. The major is on board with having all new buildings be fossil free. Also discussed Dark Sky. There will be a new ordinance coming out. Lastly the Council is planning on putting on a ballot initiative to raise money for over/under passes.

7. 7:05 PM City Staff Update (10 min)

A. Katie – Last night council passed the September 20th Bike and Walk week programing. Currently 36 residential have been answered, only 3 commercial answered so far. Might be worth extended through September. Free reusable bag give-away was a smashing success at the Summer concert series last Thursday. 100 bags were given away in 30 minutes. There will be 400 more to give away next Friday 27th at the street fare. Bag tax is kicking off. There will be a new renewable action plan from Xcel Energy.

8. 7:15 PM Discussion Item: Building Code Update

Led by Katie Baum, Sustainability Coordinator with Rob Zuccaro, Director of Planning and Building Safety
This is taken form the 2021 work plan. Phase 1. Consideration of adoption of the 2021 IECC standards. Lots of discussion on funding and how can we help get these standards incorporated. Lot of discussion on residential upgrades. Maybe making the ordinance requirement size of the upgrade more aggressive. Effect more energy upgrades on more residential expansions.
RJ – Phase 1 introduced to Council on September 7th. When is Phase 2 going to roll out? We need to act quicker on Phase 2.
Katie – small request – A letter of support on the adoption of 2021 IECC standards – Tiffany and Laura are going to draft a letter. Letter needed by Sept 10th, drop dead date. Voted on submitting a letter of support. Tiffany made a motion, Laura 2nd.

9. 8:08 PM Discussion Item: Sustainability Newsletter

See Newsletter attached

Ideas? Do we like the idea? Maybe roll out quarterly. Lots of stories to come!!

10. 8:30 PM Discussion Item: Fall Outreach and Programming

Led by Katie Baum, Sustainability Coordinator
September 20th-26th Bike, Walk and Wheel week
September 24th - EV Ride and Drive
October 14th – Green Business Breakfast
November 15th – America Recycles Day (week)
Sustainable film series – Lafayette plans on running a film series with Broomfield. Thoughts on joining along. I think we are down for doing this as a group of towns.

11. Administration Tasks

A. Work Plan Review

i. Newsletter update – Tiffany and Todd will have some subjects to discuss
ii. Overview of Energy – Input on Work plan with Xcel. What do we want from Xcel?
iii. Dark Sky Ordinance discussion
iv. Phase 2 of IECC standards discussion
v. Survey results

B. Log Volunteer Hours

i. Laura - 10
ii. Seth - 3
iii. Todd - 5
iv. Tiffany - 5
v. Josh – 5

C. 2021 LSAB Secretary Schedule

2021 LSAB Meetings Schedule, Deadlines, Meeting Assignments. If you are unable to fulfill your assignment, you are responsible for finding a replacement. Secretaries to email meeting-minutes to LSAB Board Chair no later than 2 weeks before the next meeting.

Month	Meeting Date	Chair	Secretary
January	Wednesday, January 20, 2021	Laura	Mark
February	Wednesday, February 17, 2021	Laura	Seth
March	Wednesday, March 17, 2021	Laura	Tiffany
April	Wednesday, April 21, 2021	Laura	Todd
May	Wednesday, May 19, 2021	Laura	Josh
June	Wednesday, June 16, 2021	Laura	Mark

July	Wednesday, July 21, 2021	Laura	Dan
August	Wednesday, August 18, 2021	Laura	Seth
September	Wednesday, September 15, 2021	Laura	Tiffany
October	Wednesday, October 20, 2021	Laura	Todd
November	Wednesday, November 17, 2021	Laura	Josh
December	Wednesday, December 15, 2021	Laura	Dan

12. **Adjourn at 8:53 PM** Todd made motion, Josh 2nd.

City of Louisville
Sustainability Advisory Board

September 13, 2021

To: Mayor Stolzmann and Members of City Council
From: The Louisville Sustainability Advisory Board
Subject: Letter of Support for 2021 IECC Adoption and Further Recommendation

Dear Louisville City Council,

The members of the Louisville Sustainability Advisory Board (LSAB) would like to recommend the adoption of the 2021 International Energy Conservation Code (IECC) as presented to LSAB by City staff. While adoption of the IECC is commendable, we recommend further initiatives be strongly considered. Given the timely publication of the 2021 Intergovernmental Panel on Climate Change (IPCC) report, there should be no surprise about the bold action we are asking you to take.

As you know, residential and commercial buildings are responsible for about 40 percent of U.S. energy consumption and GHG emissions. The buildings we construct in Louisville today will be around for decades, even generations, to come. Every day a municipality or a state waits on adopting the new code means less efficient buildings continue to be built – locking in more greenhouse gas emissions.

Our recommendations include:

1) Adoption of the 2021 IECC with staff recommended amendments and additions
2) Adoption of Appendix CC Zero Energy Commercial Building Provisions and Appendix RC Zero Energy Residential Building Provisions.
3) Adoption of a building electrification mandate for both residential and commercial properties
4) Adoption of a solar installation requirement for commercial buildings
5) Building code and design guidelines updates that further incorporate sustainability, specifically focused on waste reduction

First, the 2021 IECC code also includes optional zero energy residential and commercial appendices which we would recommend the City of Louisville to adopt. It provides cities and states an opportunity to include zero energy building performance as a stretch code and illustrates what is within reach for the next code update. This stretch code describes the need for on- and off-site renewable energy, which is an opportunity to accelerate plans to adopt zero energy codes. We believe that cities who are serious about GHG emission reduction should adopt the 2021 IECC AND the zero energy codes. This adoption will align Louisville with other communities in our region, like the City of Denver, who is adopting zero energy base codes.

Integrating a zero-energy appendix into Louisville's adoption will make the energy code a more robust policy tool. This adoption can smooth the transition to zero energy for builders. Rather than picking and choosing our own net zero code language—leading to a patchwork of zero energy residential code approaches—adopting this appendix will provide a consistent language for local builders. Adoption of the most robust codes makes education, incentive programs, and implementation significantly more straightforward and cost-effective.

Adopting the appendix would require all new commercial and residential buildings to produce or procure enough renewable energy to achieve zero-net-carbon annually. Additionally, the appendix encourages on-site renewable energy systems, but also supports off-site renewable energy when on-site generation is not feasible.

Next, we encourage the City Council to move beyond the solar ready, EV ready, and mixed fuel requirements of the IECC. Here are some ways we would like to advocate for you to go even further:

Commercial:

- Commercial roofs that offer significant sq. ft. should be considered as prime candidates and highly encouraged to include:
  a) on-site solar installations, or
  b) vegetated roof

Residential:

- New building code should apply to the majority of residential new builds and renovations. The threshold of renovation should be lower to apply to more properties.
- No new natural gas installs for residential properties. We need to move away from natural gas. To avoid costly future retrofits, new buildings and additions should be electric only.

This leads to our final and maybe most important recommendation. We encourage Louisville to join municipalities across the nation who are adopting a building electrification mandate. There has never been a more important time for Louisville to step up in this area. Some of the most aggressive strategies in GHG reduction are being developed and implemented at the city level. When it comes to building decarbonization, cities have the ability to accelerate voluntary local and regional action. Many cities across the country are recognizing their leadership position when it comes to GHG emission reductions. We believe that Louisville should join these cities and set very aggressive goals and strategies to move decarbonization forward.

While we recognize the purpose of this recommendation be focused on the IECC, we foresee the need to further update Louisville's building code beyond just energy efficiency as well as design guidelines. Some LSAB recommendations on the IBC include:

- New commercial buildings should provide equal space for trash, recycling, AND compost.
- Hail resistance, class 4 shingles for new roofs.
- Waste diversion for construction and demolition. New buildings, additions, remodels, retrofits, demolitions, and deconstructions with a total interior space of over 2,500 square feet and new developments with multiple

buildings with a combined total interior space over 5,000 square feet should be highly encouraged (if not mandated) to recycle concrete, asphalt, untreated wood, metal, and cardboard, as well as remaining materials, such as doors, windows, cabinets, and fixtures. If there is a viable market for the recyclable material, Louisville should require that a certain % of that removed material gets recycled/reused. We recommend the highest percentage feasible.

Thank you for your service to our community. Please take this moment to act boldly on adopting and creating the building codes that will allow future generations in Louisville to have the best chance at a livable future.

Sincerely,

Laura Levesque-Catalano, Board Chair
Louisville Sustainability Advisory Board

From: Gena Cline <genacline@gmail.com>
Sent: Friday, October 1, 2021 11:00 AM
To: City Council <Council@louisvilleco.gov>
Subject: Change to Building Code

Dear Louisville City Council,

I understand that the city council will be considering changing Louisville's building code to require all developments be more environmentally responsible. That's wonderful news. I am writing in support of the change. These are buildings that will be around for the next hundred years, so it is important to take responsible action to protect the climate. The council needs to adopt the latest conservation code AND ensure that new buildings do not use fossil infrastructure.

Sincerely,
Gena Cline
222 Short Place
Louisville

From: Tiffany Boyd <tiffboyd@gmail.com>
Sent: Tuesday, October 5, 2021 10:45 PM

To: City Council <Council@louisvilleco.gov>; Ashley Stolzmann <ashleys@louisvilleco.gov>
Subject: Update to links in LSAB letter on IECC Zero Energy Home Appendix

Dear Louisville City Council,

We would like to send you some updated links that more accurately complete our LSAB letter dated September 7, 2021 for the Zero Energy Home Appendix.

https://www.energycodes.gov/sites/default/files/2021-07/Model_Policies_Zero-Res.pdf

Here is another article with more details:

https://newbuildings.org/wp-content/uploads/2018/10/nbi_Factsheet_ZEBuilding-Appendix-Factsheet_5.pdf

Thank you for your thoughtful work on this important issue in our community as we work together to take climate action.

Best regards,
Louisville Sustainability Advisory Board

--
Tiffany Boyd (she/her)
Founder/Director
Classrooms for Climate Action
Supporting teachers and students in local climate action
www.classroomsforclimateaction.org

I acknowledge that the land I live and work on is the traditional territory of the Arapaho, Cheyenne, and Ute.

2021 IECC and Reach Code Amendments

Ordinance No. 1816, Series 2021

City of Louisville
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City of Louisville
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What is the current building code landscape in Louisville in terms of building efficiency and sustainability?

2018 International Energy Conservation Code

- Adopted in full with no appendices

Prescriptive Energy and Design Criteria

- Sets a minimum acceptable standard as opposed to "performance" pathways
- Easier for compliance and enforcement

Solar Readiness

- Solar readiness for all residential and commercial

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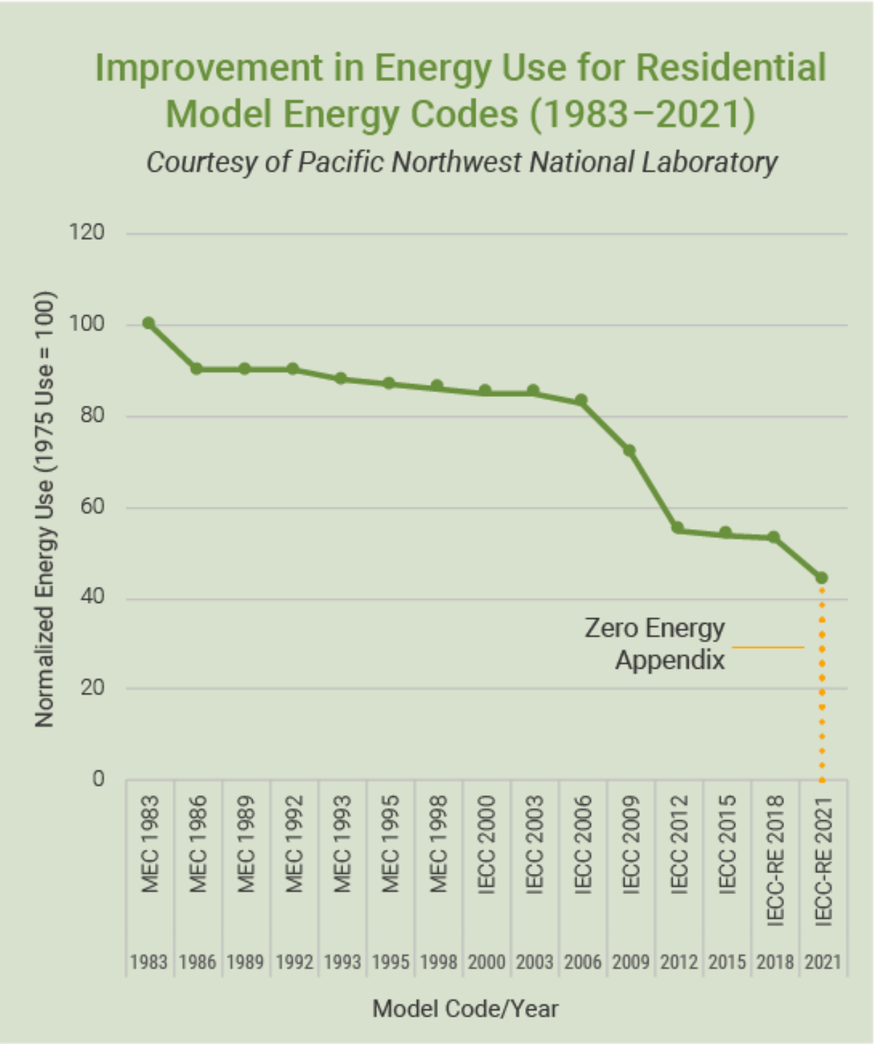
The IECC is updated every three years, often with increasing efficiency between code updates. Due to the nature of code development, the 2015 and 2018 IECC codes are only slightly more efficient than the 2012 IECC.

The 2021 IECC is the first edition with significant efficiency gains since 2012.



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2021 IECC: Residential

DOE has determined that the residential energy code resulted in a **9.38%** savings over the previous version.

CHANGES FROM 2018

BUILDING ENVELOPE
- Requires higher insulation values

HVAC SYSTEMS
- Ducts required to leakage teste
- Ventilation systems required to be tested
- Ventilations fans improved efficacy
- Energy recovery ventilation required in specific climate zones

LIGHTING AND POWER
- Increases lighting efficacy requirements
- Multifamily exterior lighting will meet commercial exterior lighting

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2021 IECC: Commercial

DOE has determined that the commercial energy code resulted in an appox. **4%** savings over the previous version.

SUMMARY CHANGES FROM 2018

BUILDING ENVELOPE
- Insulation increased
- Air barrier leakage testing required

HVAC SYSTEMS
- Updates equipment efficiency requirements
- Energy recovery ventilation is required for all non-transient dwelling units

SERVICE WATER HEATING
- Increases the thermal efficiency for service water heating equipment

LIGHTING AND POWER
- Increases the lighting efficacy requirements for dwelling unit lighting to encourage the use of LED lighting
- Requires occupancy sensors
- Requires metering for buildings 25,000 ft2 and greater and for six end use categories
- Reduces the allowed lighting power density W/ft2 values for whole building and space-by-space

RENEWABLES
- Revises the definition for “on-site renewables” for consistency with other national standards. Adds definition for bi gas and biomass

The following proposals were accepted into the code by Governmental member voting, remained intact through the challenge process, but ultimately were **removed** from the code by the ICC Board during the appeals process:

RESIDENTIAL

- Gas water heating is required to meet the minimum Uniform Energy Factor (UEF)
- Requires water heating systems using gas to not contain continuously burning pilot lights
- Electrical outlets required by all fossil fuel appliances
- Requires EV Capable or Ready charging stations for residential buildings

COMMERCIAL

- Requires EV Capable or Ready charging stations for high rise residential and commercial buildings

Ordinance 1816, Series 2021

City of Louisville
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Amendments from 1st Reading

CONSTRUCTION DOCUMENTS

Updated to require fuel source and renewable systems pathways (Sections C103.2 and R103.2)

BUILDING ELECTRIFICATION

Require all residential or commercial new construction to be all-electric OR be built with high efficiency HVAC equipment and with electric-ready infrastructure

GAS LIGHTING

Updated to prohibit gas-fired lighting appliances

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Amendments from 1st Reading

FENESTRATION

Added an exception to allow doors with fenestrations that exceed the maximum allowed fenestration requirement.

ROOF SNOW LOADS

Require roof snow loads to be maintained at 30 pounds per square foot.

EV CHARGINGI

Updated so that the provisions are enforced at the time of building permit. This clarifies that projects with Planned Unit Developments (PUDs) approved prior to the enactment of the ordinance would also need to comply if they have not obtained a building permit prior to the effective date of the ordinance.

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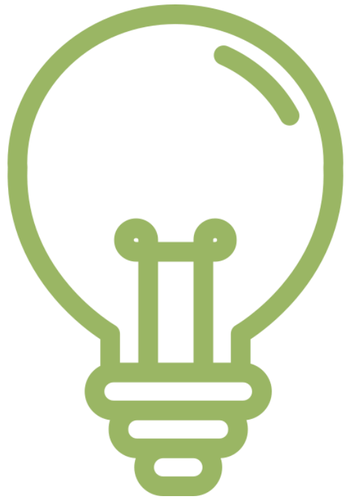
Adopts the 2021 IECC with Amendments



- Adopts the 2021 IECC for residential and commercial
- Amends the code to require prescriptive energy criteria

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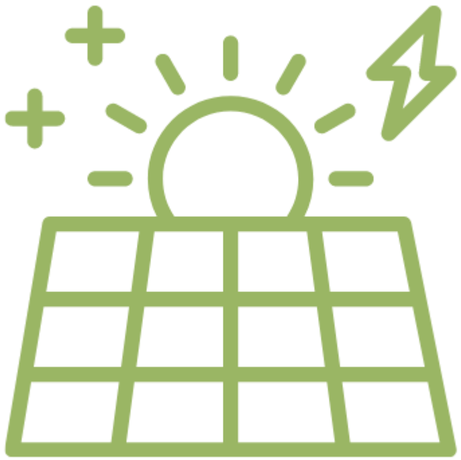
Solar Readiness



- Adopts the solar-ready zone appendices for residential, commercial, and multi-family
- Does not require solar to be installed. It does require the space for installing such a system, provide conduit pathways, adequate roof structural capacity, and shading requirements.

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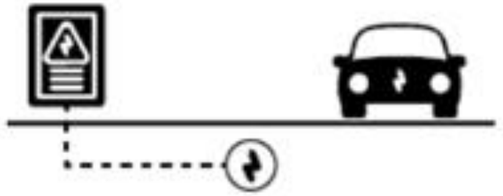
Electric Vehicle Readiness

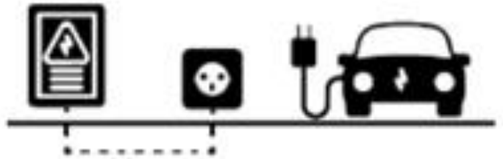
EV-Capable Parking Space: Electrical Panel Capacity & Conduit

- Install panel capacity and conduit (raceway) to accommodate the future build-out of EV charging with 208/240 V, 40-amp circuits.
- Rationale: Provide hard-to-retrofit elements during new construction while minimizing up-front cost.



EV-Ready Parking Space: Install full circuit

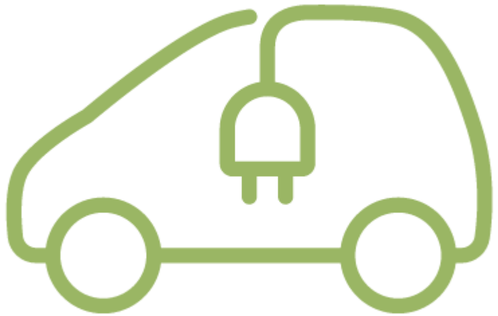
- Full circuit installations include 208/240V, 40-amp panel capacity, raceway, wiring, receptacle, and overprotection devices similar to a dryer circuit.
- Rationale: Full circuits are plug-and-play ready and minimize total costs and additional barriers to installing Electric Vehicle Supply Equipment (EVSE).



EV-Installed: Install EV Charging Station (also known as Electric Vehicle Supply Equipment or EVSE).

- Install charging stations during new construction.
- Rationale: Provide a visible signal that building supports EV charging and reduce future EV charger installation costs to zero.

Electric Vehicle Readiness



Louisville Reach Code & Zoning Amendment

- Adds electric vehicle infrastructure requirements for commercial, multi-family, and single-family residential in both the building and zoning code.
- Differentiates between three stages of infrastructure (EV Capable, EV Ready, and EVSE Installed) by building use to determine most appropriate facilities.

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Ordinance 1816

	EVSE Installed	EV Ready	EV Capable
Residential Uses			
Single-Family unit		1 space	1 space
Multi-Family unit, with dedicated parking spaces or garages		1 space	1 space
Tier 1			
Multi-Family, without dedicated parking spaces or garages	10% of spaces	10% of spaces	50% of spaces
Hotel, Motel, Extended Stay Lodging Facility			
Tier 2 – Employment oriented uses	7% of spaces	10% of spaces	15% of spaces
Business and Professional Offices			
General research facilities, light industrial facilities including manufacturing, assembly, warehouse and fabrication			
Hospital			
Tier 3 – Service and Sales oriented uses	5% of spaces	10% of spaces	10% of spaces
Private and public recreational and social facilities, membership clubs, lodges, and fraternal organizations			
Religious institution			
Commercial amusement, indoor and outdoor			
Schools, including public, private, vocational or business			
Restaurant			
Retail			
Personal service			
Medical and dental clinics			

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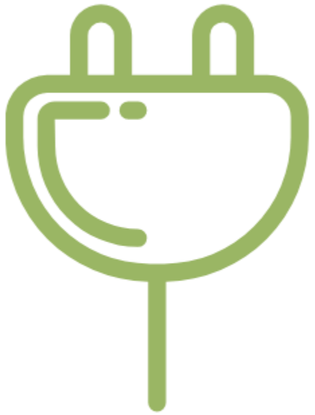
Building Electrification

Louisville Reach Code



- Requires all commercial, residential, and multi-family to be built to all-electric standards

OR

- Built with high-efficiency HVAC and electric-ready infrastructure to make retrofit less prohibitive
  - **Exemption:** Industrial and manufacturing uses, laboratories and clean rooms, or by Building Official

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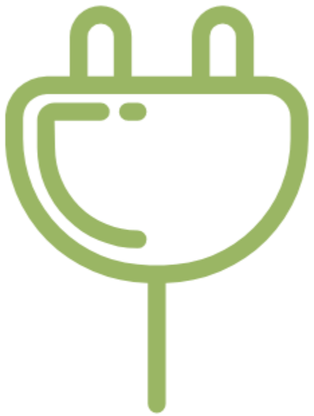
Building Electrification



Approach provides a workaround to the federal preemption which does not allow municipalities to require beyond the federal HVAC efficiency requirements unless presented as a secondary option.

If not presented as an option, the City would lose significant efficiency to gas HVAC equipment. Industrial and manufacturing uses are exempt from these requirements.

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Building Electrification

City Council requested additional background on building electrification and further policy discussion located in the staff report.

No other community in Colorado has adopted all-electric building code ordinances. The City and County of Denver is currently weighing this option and has adopted the goal of all new buildings achieving net zero energy by 2030.

Phase 2 of the building code update could include further review of all electric standards. If Council would like to incorporate this provision into the current ordinance, staff recommends the adoption be continued to allow public outreach and further research and analysis to bring back options for adoption.

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Zero Energy Appendices

City Council requested copies of the IECC Zero Energy Residential and Commercial Appendices.

If adopted as mandatory, Appendix CC Zero Energy Commercial Building Provisions and Appendix RC Zero Energy Residential Building Provisions would result in a residential or commercial building that has zero energy consumption over the course of a year by utilizing on-site and off-site renewable energy production.

Phase 2 of the building code update could include further review of this option or other building standards such as LEED Accreditation standards. If Council would like to incorporate this provision into the current ordinance, staff recommends the adoption be continued to allow public outreach and further research and analysis to bring back options for adoptions.

Code Adoption Recommendation

Staff recommends approval of Ordinance 1816, Series 2021, approving the 2021 IECC as amended.

City of Louisville
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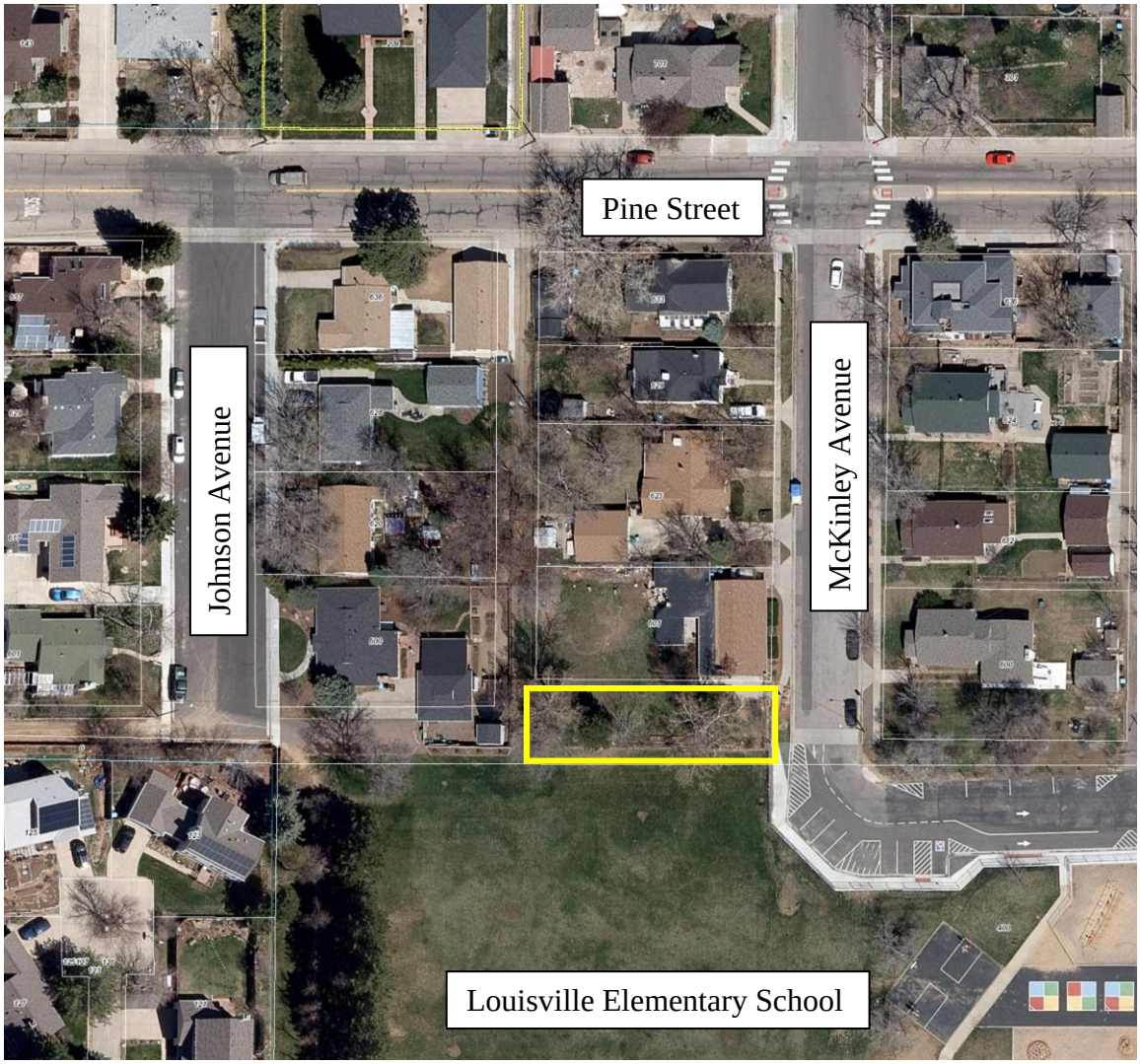
CITY COUNCIL COMMUNICATION
AGENDA ITEM 7C

SUBJECT: **ORDINANCE NO. 1817, SERIES 2021 – AN ORDINANCE APPROVING THE VACATION OF A 125-FOOT BY 30.60-FOOT WIDE RIGHT-OF-WAY LYING SOUTH OF LOT 9, BLOCK 10, LOUISVILLE HEIGHTS SUBDIVISION IN THE CITY OF LOUISVILLE (601 MCKINLEY AVENUE) – 2nd READING, PUBLIC HEARING (advertised *Daily Camera* 10/10/21)**

DATE: **OCTOBER 19, 2021**

PRESENTED BY: **LISA RITCHIE, AICP, INTERIM DIRECTOR OF PLANNING AND BUILDING SAFETY**

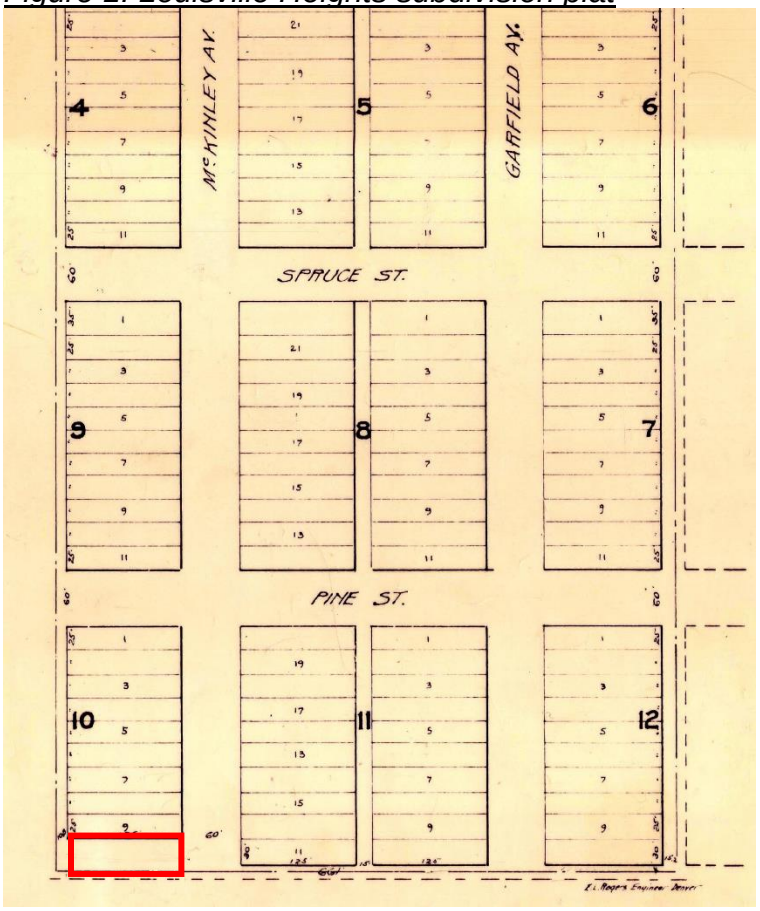
VICINITY MAP:



SUMMARY:
The applicant requests approval of a right of way vacation for property adjacent to 601 McKinley Avenue. The property was platted as right of way as part of the Louisville Heights subdivision in 1904 and has never been developed. The applicant purchased 601 McKinley Avenue in July of this year.

BACKGROUND:

Figure 1: Louisville Heights subdivision plat



The Louisville Heights subdivision was established in 1904 and created the streets, lots and blocks in the image to the left. The right of way area shown in red is the portion under consideration. With the exception of the portion shown in red, the remainder of the rights of way within this plat were all developed over time.

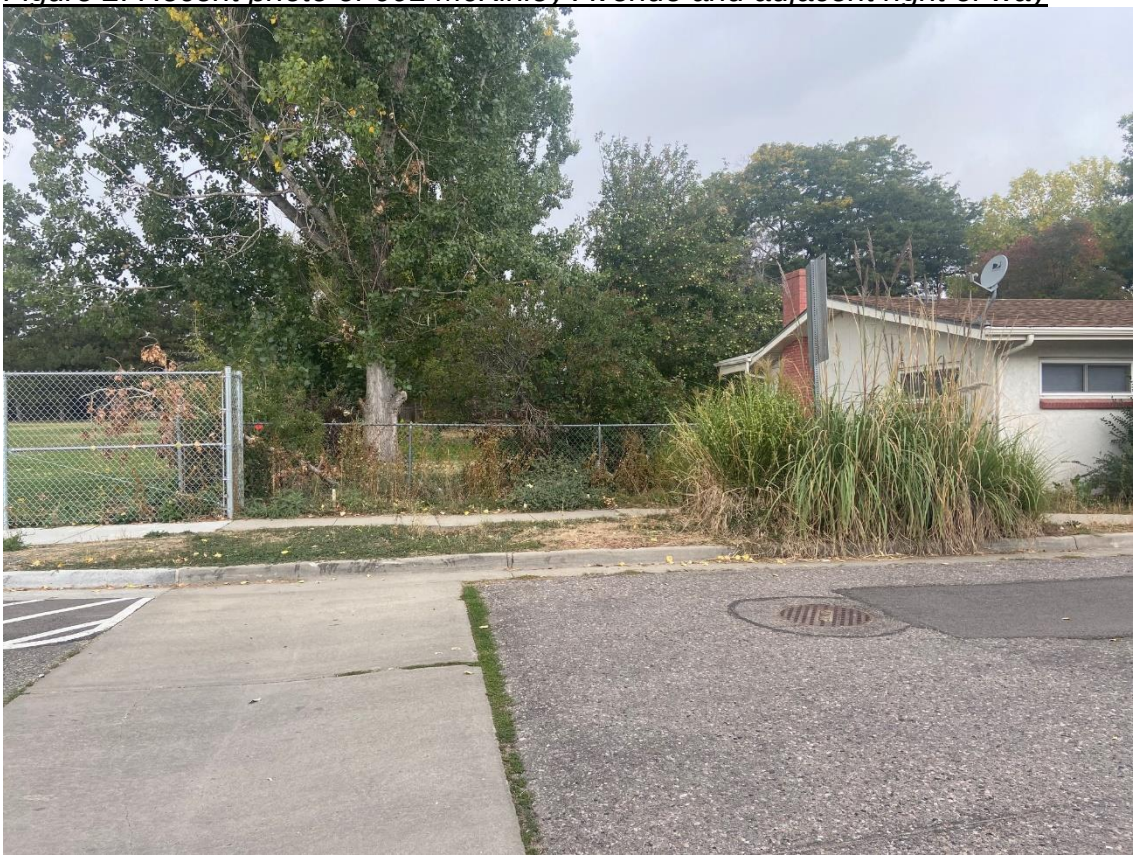
Staff assumes that this east/west right of way was established in anticipation of a future connection when the property to the west was developed. However, when the Corrigan Addition, established in 1908, developed immediately west of Louisville Heights, this right of way connection was not extended.

To the south of this area is property owned by Boulder Valley School District for Louisville Elementary School. The drive connection into Louisville Elementary from McKinley Avenue is private and not platted as right of way.

In 1984, the previous owner of 601 McKinley Avenue entered into a license agreement with the city to fence in the subject right of way for the purpose of landscaping and other incidental use. The city issued a fence permit and the property remains fenced in today. The license agreement is provided as an attachment.

The applicant purchased the property with the intent to redevelop the lot into a new single-family residence. The Historic Preservation Commission considered a demolition request by the applicant on August 16, 2021 and voted to place a 120-day stay on the demolition. This stay expires on November 10 of this year.

Figure 2: Recent photo of 601 McKinley Avenue and adjacent right of way

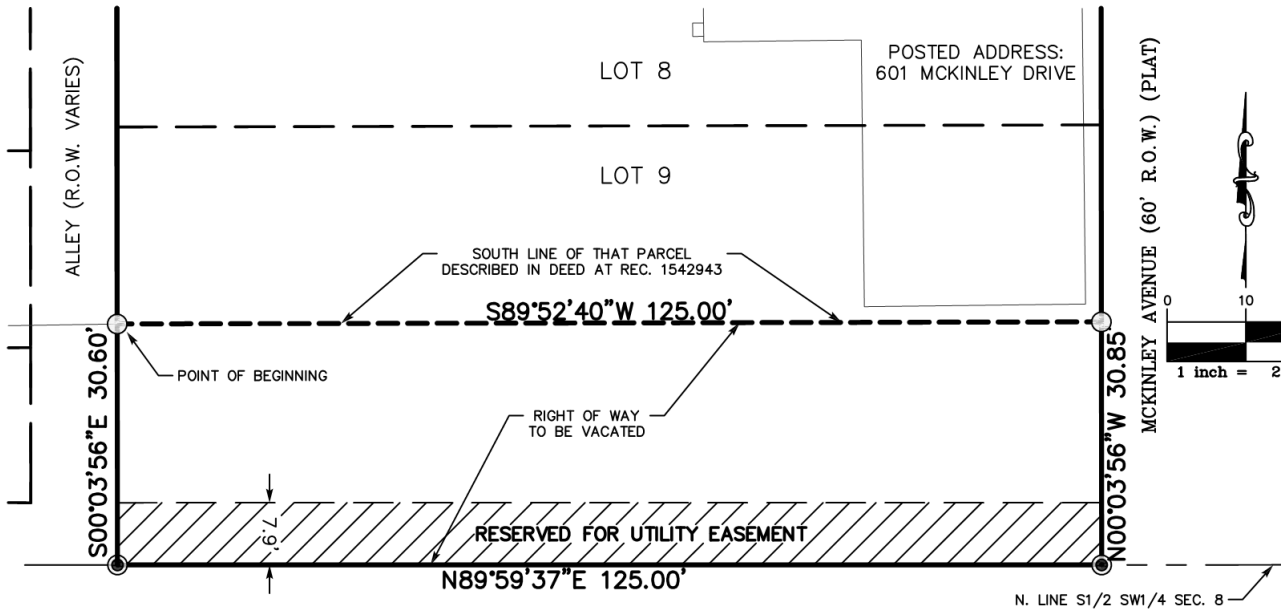


PROPOSAL:
The applicant requests approval of a right of way vacation for the property immediately south of 601 McKinley Avenue. The right of way was never developed and currently is fenced in for use by 601 McKinley Avenue pursuant to a license agreement approved by the city in 1984.

The right of way area for this request is 30.60' feet wide and 125' deep. The existing platted alley at the rear is not included within this vacation request. The request was evaluated by city staff and utility agencies. The city has a sanitary sewer line to the south of the right of way area located within BVSD property. Xcel has an underground electric utility line on the southern portion of the area to be vacated. The applicant coordinated with city staff and Xcel and the ordinance establishes a 7.9' wide utility easement on the southern portion of the vacated area to allow access for Xcel to the utility line and the city to maintain the sanitary line to the south.

Ownership of the property will vest consistent with Colorado Revised Statutes, which appears to result in ownership entirely with 601 McKinley Avenue.

Figure 3: Right of way vacation exhibit



ANALYSIS:
Vacation of right of way is permissible through approval of an ordinance by the city and consistent with Colorado Revised Statutes. Staff analyzed the request to determine if retaining the property as right of way was preferable to vacation of the property. One key area that was evaluated was whether or not this area could serve as a vehicular or bicycle and pedestrian connection through the neighborhood. Staff worked closely with the applicant's surveyor to understand the adjacent property lines, alleys and private lots and determined that there is no right of way or easement connectivity available to the east or west of this area.

As described above, the ordinance establishes a utility easement for the existing Xcel underground utility line and the existing city sanitary sewer line to the south. Public Works and Planning staff and the applicant's surveyor coordinated on the appropriate location and size of the proposed utility easement.

Staff finds that retention of the area for right of way is not needed for any current or future city purpose. Approval of the vacation request will also not result in loss of access to any property.

PUBLIC COMMENTS:
No public comments have been received to date.

FISCAL IMPACT:
There is no anticipated fiscal impact to the city of this right of way vacation. The property is currently fenced in and maintained by the owner of 601 McKinley Avenue.

STAFF RECOMMENDATION:
Staff recommends approval of Ordinance 1817, Series 2021 approving a right of way vacation for property adjacent to 601 McKinley Avenue and establishing a 7.9' wide utility easement on the southerly portion of the area to be vacated.

ATTACHMENTS:
1. Ordinance 1817, Series 2021
2. Application Materials
3. 1984 License Agreement to allow construction of a fence
4. Presentation

STRATEGIC PLAN IMPACT:

☒	**Financial Stewardship & Asset Management**	☐	**Reliable Core Services**
☐	**Vibrant Economic Climate**	☐	**Quality Programs & Amenities**
☐	**Engaged Community**	☐	**Healthy Workforce**
☐	**Supportive Technology**	☐	**Collaborative Regional Partner**

ORDINANCE NO. 1817
SERIES 2021

AN ORDINANCE APPROVING THE VACATION OF A 125-FOOT BY 30.60-FOOT WIDE RIGHT-OF-WAY LYING SOUTH OF LOT 9, BLOCK 10, LOUISVILLE HEIGHTS SUBDIVISION IN THE CITY OF LOUISVILLE

WHEREAS, by the plat of Louisville Heights, recorded in the Office of the Boulder County Clerk and Recorder on November 19, 1904 on plat book 2, page 226, there was dedicated to the City a 30.60-foot right-of-way, which 3,841 square foot area is hereafter referred to as the "Right-of-Way"; and

WHEREAS, proper application has been made to the City for the vacation of the Right-of-Way; and

WHEREAS, the City Council has determined that the Right-of-Way for which vacation has been requested is not and has not been used or required as a roadway or thoroughfare for the public; and

WHEREAS, the City Council has determined that the Right-of-Way for which vacation has been requested is not and will not be used for any public purposes other than the southerly 7.9-feet for the operation, maintenance, repair and replacement of public utilities; and

WHEREAS, the City Council has determined that the Right-of-Way for which vacation is requested is not being used or held for park purposes or for any other governmental purposes; and

WHEREAS, the City Council desires to approve the application and vacate the City's interest in the Right-of-Way described herein for which vacation is requested, subject to the reservation of an easement for public utilities;

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF LOUISVILLE, COLORADO:

Section 1. Subject to the provisions of Section 2 hereof, the City hereby vacates that certain 30.60-foot wide by 125-foot long right-of-way, running east-west and lying south of Lot 9, Block 10, Louisville Heights Subdivision, which 3,841 square foot area is hereafter referred to as the "Right-of-Way". Title to the vacated Right-of-Way shall vest in the manner provided by law.

Section 2. A Utility Easement is hereby reserved under, over, through and across the southerly 7.9-feet of the Right-of-Way for the operation, maintenance, repair and replacement of existing and future public utilities. Further, easements for existing public utilities, if any, shall not be altered or amended by virtue of this ordinance.

Section 3. The Mayor and City Manager, or either of them, is authorized to execute such additional documents as may be necessary to evidence the vacation of the Right-of-Way as set forth herein.

INTRODUCED, READ, PASSED ON FIRST READING, AND ORDERED PUBLISHED this 5th day of October, 2021.

_____
Ashley Stolzmann, Mayor

ATTEST:

_____
Meredyth Muth, City Clerk

APPROVED AS TO FORM:

_____
Kelly P.C.
City Attorney

PASSED AND ADOPTED ON SECOND AND FINAL READING, this 19th day of October, 2021.

_____
Ashley Stolzmann, Mayor

ATTEST:

_____
Meredyth Muth, City Clerk

EXHIBIT "A"

SHEET 1 OF 2

LOCATED IN THE SOUTHWEST QUARTER OF SECTION 8, TOWNSHIP 1 SOUTH, RANGE 69 WEST OF THE 6TH PRINCIPAL MERIDIAN, CITY OF LOUISVILLE, COUNTY OF BOULDER, STATE OF COLORADO

A PARCEL OF LAND LOCATED IN THE SOUTHWEST QUARTER OF SECTION 8, TOWNSHIP 1 SOUTH, RANGE 69 WEST OF THE 6TH PRINCIPAL MERIDIAN, CITY OF LOUISVILLE, COUNTY OF BOULDER, STATE OF COLORADO, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

CONSIDERING THE NORTH LINE OF THE SOUTH HALF OF THE SOUTHWEST QUARTER OF SAID SECTION 8 TO BEAR N89°59'37"E, A DISTANCE OF 2,637.51 FEET BETWEEN A FOUND 2" PIPE WITH 2.5" ALUMINUM CAP BEING THE SOUTH 1/16 CORNER OF SECTION 8 AND A FOUND 2.5" ALUMINUM CAP ON A 2" PIPE STAMPED "1/16TH" BEING THE C-S 1/16 CORNER OF SECTION 8, WITH ALL BEARINGS CONTAINED HEREIN RELATIVE THERETO.

A PORTION OF THE RIGHT OF WAY TO BE VACATED, SOUTH OF LOT 9, BLOCK 10, PER THE PLAT OF LOUISVILLE HEIGHTS RECORDED ON 11/19/1904 AT BOOK 2, PAGE 226.

COMMENCING AT SAID SOUTH 1/16 CORNER OF SECTION 8; THENCE N89°06'40"E A DISTANCE OF 1986.99 FEET TO THE POINT OF BEGINNING;

THENCE S00°03'56"E ALONG THE WEST LINE OF LOT 9, BLOCK 10, LOUISVILLE HEIGHTS EXTENDED SOUTH, A DISTANCE OF 30.60 FEET; THENCE N89°59'37"E, 125.00 FEET; THENCE N00°03'56"W, 30.85 FEET TO THE SOUTHEAST CORNER OF SAID LOT 9; THENCE S89°52'40"W ALONG THE SOUTH LINE OF SAID LOT 9, 125.00 FEET TO THE POINT OF BEGINNING.

SAID PARCEL CONTAINING 3,841 SQ.FT. OR 0.08 ACRES, MORE OR LESS.

I, EDGAR T. BRISTOW, A LAND SURVEYOR LICENSED IN THE STATE OF COLORADO, DO HEREBY STATE FOR AND ON BEHALF OF FLATIRONS, INC., THAT THIS PARCEL DESCRIPTION AND ATTACHED EXHIBIT, BEING MADE A PART THEREOF, WERE PREPARED BY ME OR UNDER MY RESPONSIBLE CHARGE, ARE ACCURATE TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF, ARE IN ACCORDANCE WITH APPLICABLE STANDARDS OF PRACTICE AND ARE NOT A GUARANTY OR WARRANTY, EITHER EXPRESSED OR IMPLIED. SAID PARCEL DESCRIPTION AND EXHIBIT WERE PREPARED AT THE REQUEST OF THE CLIENT AND ARE NOT INTENDED TO REPRESENT A MONUMENTED LAND SURVEY OR SUBDIVIDE LAND IN VIOLATION OF STATE STATUTE.

EDGAR T. BRISTOW
COLORADO P.L.S. #19588
PRESIDENT, FLATIRONS, INC.

JOB NUMBER: 21-75603
DRAWN BY: W. BECKETT
DATE: JULY 14, 2021

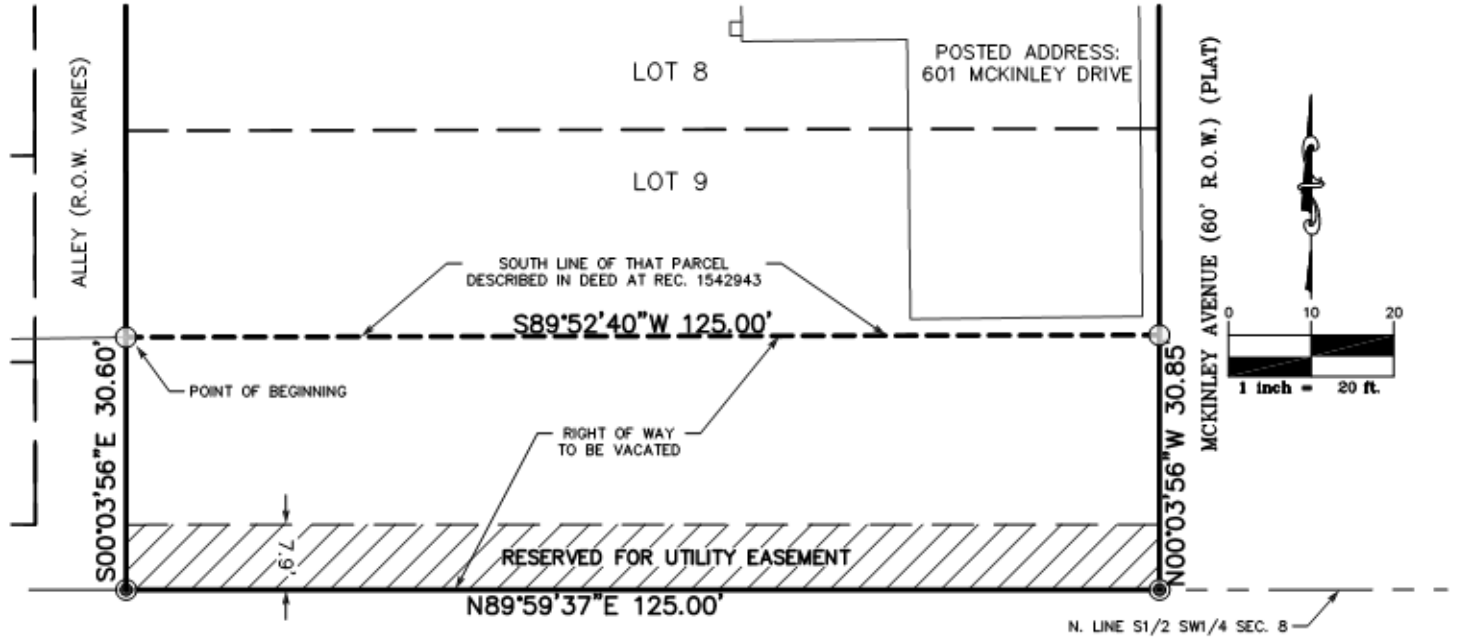
THIS IS NOT A "LAND SURVEY PLAT" OR "IMPROVEMENT SURVEY PLAT" AND THIS EXHIBIT IS NOT INTENDED FOR PURPOSES OF TRANSFER OF TITLE OR SUBDIVISIONS OF LAND. RECORD INFORMATION SHOWN HEREON IS BASED ON INFORMATION PROVIDED BY CLIENT.

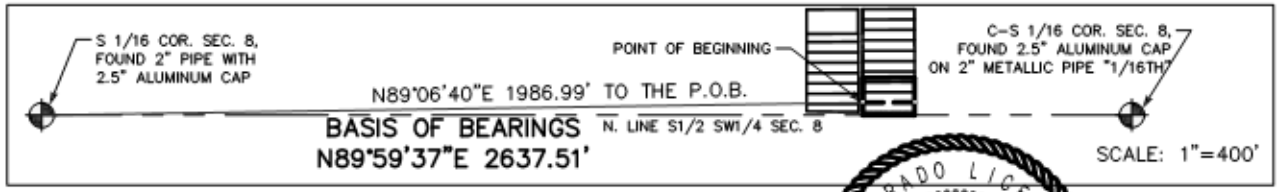
Flatirons, Inc.
Land Surveying Services
3825 IRIS AVE, STE 395
BOULDER, CO 80301
PH: (303) 443-7001
FAX: (303) 443-9830
www.FlatironsInc.com

SHEET 2 OF 2

EXHIBIT "A"

LOCATED IN THE SOUTHWEST QUARTER OF SECTION 8, TOWNSHIP 1 SOUTH, RANGE 69 WEST OF THE 6TH PRINCIPAL MERIDIAN, CITY OF LOUISVILLE, COUNTY OF BOULDER, STATE OF COLORADO





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COLORADO LICENSED
EDGAR THOMAS BRITTON
19588
PROFESSIONAL LAND SURVEYOR
7/14/21

Flatirons, Inc.
Land Surveying Services
3825 IRIS AVE, STE 395
BOULDER, CO 80301
PH: (303) 443-7001
FAX: (303) 443-9830
www.FlatironsInc.com

Cody Thompson
601 McKinley Ave
Louisville, CO 80027
September 30, 2021

Ms. Lisa Ritchie
Interim Director of Planning and Building Safety
749 Main St
Louisville, CO 80027

Hello Ms. Ritchie,

I would like to request a vacation of the right of way (ROW), adjacent the south border of 601 McKinley Ave. The ROW has been fenced in and treated and maintained as part of 601 McKinley since 1984 with a permit from the city. I would like to own the property and I will continue to maintain it. I acknowledge there will be a utility easement designated within the south end of that right of way per the planning department.

Thank you,

Cody Thompson

City of Louisville
COLORADO • SINCE 1878

Department of Planning and Building Safety

749 Main Street • Louisville CO 80027 • 303.335.4592 • www.louisvilleco.gov

ELECTRONIC LAND USE HEARING REQUEST CASE NO. _____

APPLICANT INFORMATION

Firm: _____
Contact: Cody Thompson
Address: 601 McKinley Ave
Louisivlle, CO 80027
Mailing Address: Suite E104 Box 285 4800 Baseline Rd.
Boulder, CO 80303
Telephone: 303-709-2749
Fax: _____
Email: codyt100@gmail.com

OWNER INFORMATION

Firm: _____
Contact: Cody Thompson
Address: 601 McKinley Ave
Louisville, CO 80027
Mailing Address: Suite E104 Box 285 4800 Baseline Rd
Boulder, CO 80303
Telephone: 303-709-2749
Fax: _____
Email: codyt100@gmail.com

REPRESENTATIVE INFORMATION

Firm: _____
Contact: _____
Address: _____
_____
Mailing Address: _____
_____
Telephone: _____
Fax: _____
Email: _____

PROPERTY INFORMATION

Common Address: 601 McKinley Ave Louisville, CO 80027
Legal Description: Lot 8,9 and 10' of 7 Blk 10
Subdivision Louisville Heights
Area: 7360 Sq. Ft.

TYPE (S) OF APPLICATION

- ☐ Annexation
- ☐ Zoning
- ☐ Preliminary Subdivision Plat
- ☐ Final Subdivision Plat
- ☐ Minor Subdivision Plat
- ☐ Preliminary Planned Unit Development (PUD)
- ☐ Final PUD
- ☐ Amended PUD
- ☐ Administrative PUD Amendment
- ☐ Special Review Use (SRU)
- ☐ SRU Amendment
- ☐ SRU Administrative Review
- ☐ Temporary Use Permit: _____
- ☐ CMRS Facility: _____
- ☐ Other: (easement / right-of-way; floodplain; variance; vested right; 1041 permit; oil / gas production permit)

I hereby request the public hearing(s) on this application be scheduled to be conducted by Electronic Participation in accordance with the attached Resolution No. 30, Series 2020, as adopted by the City Council on April 7, 2020, and in accordance with Resolution No. 38, Series 2020, as adopted by City Council on June 2, 2020 if such hearing(s) can be scheduled during a time period when in-person meetings are not being held due to a health epidemic or pandemic. I acknowledge that holding a quasi-judicial hearing by Electronic Participation may present certain legal risks and involves an area of legal uncertainty, and that having this application heard at a meeting held by Electronic Participation is optional and undertaken at my own risk. I also understand that in-person meetings are preferred for quasi-judicial hearings, and that even if electronic hearing(s) are scheduled, this application will be heard at an in-person meeting if in-person meetings have resumed by the scheduled hearing date(s). I further agree to defend and indemnify the City of Louisville in any action that may arise out of, or in connection with, conducting the hearing by Electronic Participation.

SIGNATURES & DATE

Applicant: _____
Print: Cody Thompson
Owner: _____
Print: Cody Thompson
Representative: _____
Print: _____

CITY STAFF USE ONLY

- ☐ Electronic Hearing Approved: _____
- ☐ Date(s) of Hearing(s): _____
_____

Cody Thompson
601 McKinley Ave
Louisville, CO 80027
September 30, 2021

Ms. Lisa Ritchie
Interim Director of Planning and Building Safety
749 Main St
Louisville, CO 80027

Hello Ms. Ritchie,

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Thank you,

Cody Thompson

Central File

LICENSE AGREEMENT

THIS LICENSE AGREEMENT is made and entered into this 30th day of July, 1984, by and betwen THE CITY OF LOUISVILLE hereinafter known as "CITY" and Alan Rolf Michelson hereinafter known as "LICENSEE". In consideration of the following mutual covenants and conditions, the parties agree as follows:

1. The City hereby grants to the Licensee a revocable license to occupy and use, subject to all of the terms of this Agreement, the following described premises:

601 McKinley (south 10' 7, 8-9, Block 10). Louisville Heights. and the dedicated alley Right-of-way.

And as shown on the map as Exhibit "A".

2. The premises may be occupied and used by Licensee solely for the purposes of landscaping AND FENCING said premises and maintaining said landscaping AND FENCING, and for incidental purposes related thereto. Said license shall continue until this Agreement is terminated as provided herein. No ~~Structures~~ shall be built within this area. M.M. AKS.

3. Licensee agrees that they do not and shall not at any time in the future, claim any ownership interest or estate in described premises by virtue of the occupancy and use of the described premises.

4. The City shall have an absolute right to enter onto the premises at anytime during the term of this license and for any purpose.

5. Licensee shall indemnify the City for any and all liability or personal injuries, property damage or for loss of life or property resulting from, or in any way connected with, the condition or use of the premises described in this license.

6. Either party may terminate this License Agreement at any time by giving written notice to the other party at least ten days prior to the date of termination. The City shall have absolutely no duty or obligation to reimburse Licensee for any improvements made by Licensee to the property during the term of this license. Furthermore, the City shall have no duty or obligation to reimburse Licensee for any loss, expenses or damages suffered by Licensee because of termination of this license by the City.

7. This license shall inure to the benefit of and be binding upon the successors of the parties hereto.

CITY OF LOUISVILLE

Norbert A. Meier

Norbert A. Meier, Mayor

899

ATTEST:

Cleo M. Mudrock
City Clerk

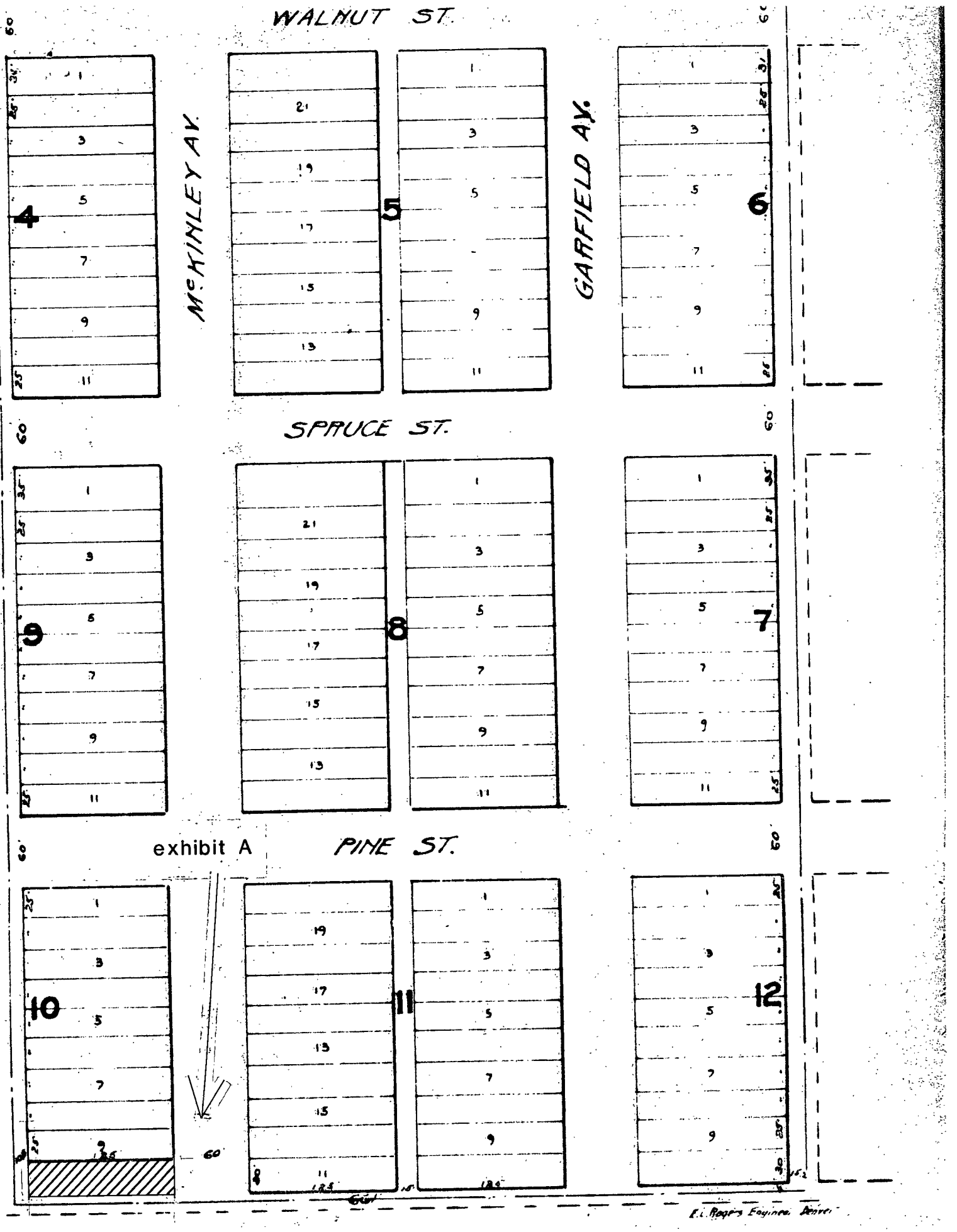
Alan Rolf Nicholson
Licensee

Licensee

Witnessed:

Meta Coleman
Meta Coleman, Notary Public
Boulder, Colorado
September 20, 1984

My Commission Expires November 11, 1985



State of Colorado
City and County of Denver } ss

State of Missouri
County of Jackson } ss

City Council

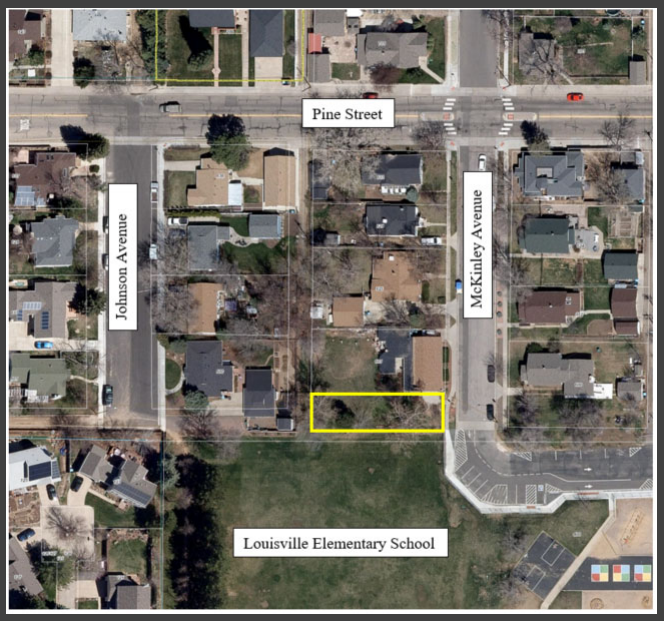
October 19, 2021

Right of Way Vacation
South of 601 McKinley Avenue

Ordinance 1817, Series 2021

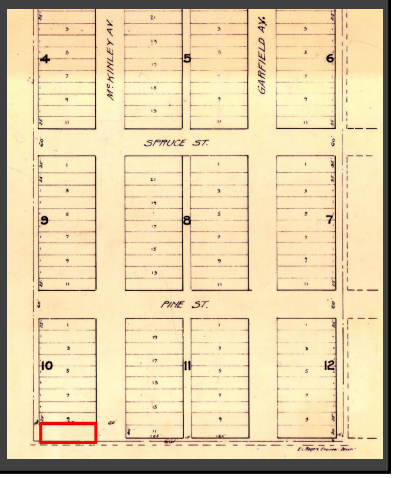
Right of Way
Vacation

Vicinity Aerial

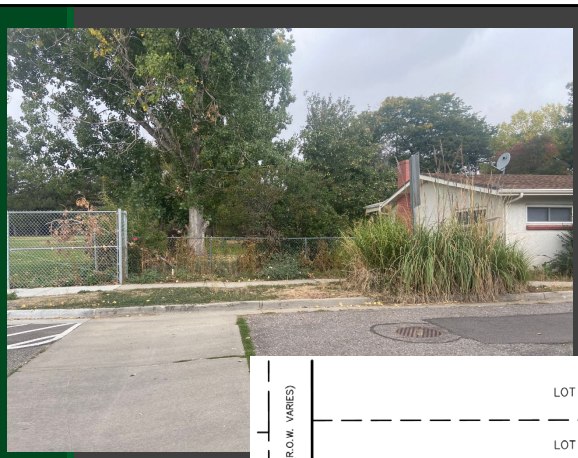


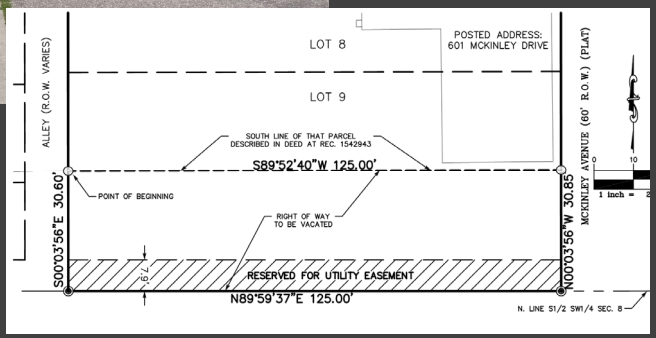
Right of Way
Vacation
Background

- Louisville Heights subdivision platted 1904
- Right of Way never developed
- License Agreement for fence in 1984
- Applicant purchased 601 McKinley Avenue
  - Intends to redevelop
  - Demo stay expires Nov. 10



Right of Way
Vacation
Proposal





903

Right of Way

Vacation

Recommendation

Staff recommends approval of Ordinance 1817, Series 2021

SUBJECT: **REVISED RECOMMENDED BUDGET FOR 2022, INCLUDING UPDATED CAPITAL IMPROVEMENTS PLAN FOR 2021-2026 & UPDATED LONG-TERM FINANCIAL PLAN FOR 2021-2026 – PUBLIC HEARING (advertised *Daily Camera* 10/10/21)**

DATE: **OCTOBER 19, 2021**

PRESENTED BY: **MEGAN DAVIS, INTERIM CITY MANAGER**
KEVIN WATSON, FINANCE DIRECTOR

SUMMARY

The City Manager's Recommended Operating & Capital Budget for 2022 was presented to City Council at its regular meeting on September 7, 2021. Based on discussions at that meeting and the Special Meetings on September 14 and September 28, staff has developed a 2022 Revised Recommended Budget for City Council and public discussion.

A public hearing is required prior to finalizing the City's annual budget. Staff hopes to receive any additional changes Council wants incorporated into the 2022 Operating & Capital Budget, which is scheduled for final adoption on November 1, 2021.

This communication presents the main financial components of the Revised Recommended Operating & Capital Budget for 2022, the Revised Capital Improvements Plan (C-I-P) for 2021-2026, and the Long-Term Financial Plan for 2021-2026.

Included within this communication are:

- A summary of changes to the City Manager's Recommended Operating & Capital Budget as presented on September 7, 2021;
- Revenue projections and assumptions for 2021 through 2026;
- Operating expenditure projections and targets for 2021 through 2026;
- An update on the 2021-2026 Capital Improvements Plan;
- Interfund transfer projections for 2022;
- A 2022 City-wide budget summary; and
- An updated Summary to the 2021-2026 Long-Term Financial Plan.

Attached to this communication are:

- An updated 2021-2026 Capital Improvements Plan summary table; and
- A table for each fund summarizing the Recommended 2022 Operating & Capital Budget.
- Updated 2021 Key Performance Indicators (KPIs) as presented to the Finance Committee on August 23, 2021.
- An update on the Priority Initiatives in the City of Louisville Strategic Plan.

SUMMARY OF CHANGES TO THE CITY MANAGER'S RECOMMENDED BUDGET

September 7, 2021
The City Manager's Recommended 2022 Operating & Capital Budget was presented at the September 7, 2021 regular City Council Meeting. Based on Council's discussions at the meeting, the following changes were made and presented at the September 14 Study Session:

- $1.5 million per year (2022-2026) was been added back to the Pavement Booster Program in the Capital Projects Fund.

- Adjustments were made to turnback percentages to help address the long-term projected revenue and expenditure imbalances.

September 14, 2021
Based on the discussion at the September 14 Study Session, the following additional changes were made and presented at the September 28 Study Session:

- Revenue sources were updated based on the latest trend analysis using actual collections through August 31. Other than the interfund transfers, the adjustments were relatively minor.

- A one-time $3 million transfer was added from the General Fund to the Capital Projects Fund to help fund the increases to the Pavement Booster Program.

- A one-time $5.2 million transfer was added from the American Rescue Plan Act Fund to the General Fund. This transfer anticipates at least $5.2 million of General Fund expenditures eligible for reimbursement from the Coronavirus State and Local Fiscal Recovery Funds.

- The amount of budgeted expenditures in the Recreation Center *Construction* Fund was reduced from $125,000 to $93,500. In addition, the transfer of the remaining funds to the Recreation Center *Debt Service* Fund was removed. The funds remaining in the Recreation Center *Construction* Fund will be available for future capital projects related to the Recreation Center Upgrade.

September 28, 2021
Based on the discussion at the September 28 Study Session, the following additional changes have been made and are presented for the Public Hearing:

- Additional amounts have been added to the operating budgets for streetscapes, parks, and open space maintenance. Specifically, the following amounts have been added to the General Fund and the Open Space & Parks Fund:

- General Fund - $100,000 for Streetscape Maintenance (101435-547030).
- Open Space & Parks Fund - $100,000 for Park Maintenance (201751-547030).
- Open Space & Parks Fund - $50,000 for Open Space Maintenance (201750-547030).

These amounts have been classified as recurring/ongoing operating costs within the Long-Term Financial Plan. These amounts and account allocations are subject to change/amendment per the final maintenance plan.

- Additional amounts have been added to the capital budgets for streetscapes, parks, and open space improvements. Specifically, the following amounts have been added to the Capital Projects Fund:
  - $300,000 for Median Improvements (301313-660103).
  - $300,000 for Park Improvements (301511-XXXXXX).
  - $150,000 for Open Space/Trail Improvements (301524-660081).

  These amounts and account allocations are subject to change/amendment per the final maintenance plan.

- The Museum Visitors Center – Design project ($200,000) has been removed from the Capital Projects Fund.

- An additional $50,000 has been added to the General Fund Museum Services operating budget (101610-540900) for community engagement and financial refinement related to the Museum Visitors Center project. An additional $12,500 has been added to the General Fund revenue budget for Museum Foundation contributions (101055-464144)

Additional Adjustments

The following additional adjustments were mentioned briefly by staff at the September 28 Study Session:

- At the September 27 Finance Committee Meeting, the Committee recommended that the Recreation Center Bond 2021 debt service levy (for collection in 2022) be set at 2.750 mills. Therefore, the 2021 levy has been reset from the previous recommendation of 2.250 mills to the current levy of 2.750 mills.

- Based on a Council directive to the Planning Department, as additional $80,000 was added to the $250,000 Comprehensive Plan budget for an Affordable Housing Study.

REVENUE PROJECTIONS/ASSUMPTIONS

Throughout the budget development process, numerous revenue projections for 2021 and assumptions for 2022 through 2026 have been adjusted based on the latest information.

Revenue projections for 2021 have been updated based on the latest information from September. Some of the more recent and significant changes to 2021 revenue projections are summarized below:

- **Sales Tax** revenue increase adjusted up from 10% to 11.5%.
- **Consumer Use Tax** revenue increase adjusted up from 2.5% to 5.5%.
- **Auto Use Tax** revenue increase adjusted up from 17.5% to 20%.
- **Building Use Tax** revenue increase adjusted up from 5.5% to 15%.
- **Lodging Tax** revenue increase adjusted up from 25% to 40%.
- **Construction Permit** revenue increase adjusted up from 9.7% to 17.6%.

The following table summarizes the updated revenue projections/assumptions by major revenue category for 2021 through 2026. These have been incorporated into the Recommended 2022 Operating & Capital Budget and 2021-2026 Long-Term Financial Plan.

All projections for construction-related revenue were initially based on forecasts by the Planning & Building Department. Construction-related revenue includes Building Use Tax, Construction Permits, Impact Fees, and Utility Tap Fees. The Public Works Department assisted with the projections for tap fees. The Finance Department has increased the projections for Building Use Tax and Construction Permit revenue due to current collections surpassing initial projections.

All projections for the revenue generated at the Recreation Center and Golf Course are based on forecasts by the Parks & Recreation Department. Golf Course User Fees include a consolidation of green fees, annual season passes, golf cart rentals, driving range fees, pro shop merchandise sales, daily rentals, golf lesson fees, club repair fees, and handicap fees.

Projections for Utility User Fees and Solid Waste & Recycling Fees are based on forecasts by the Public Works Department.

All remaining projections are based on the Finance Department's forecasts using trend analysis.

Summary of Revenue Assumptions for Major Revenue Sources
2021 - 2026

Revenue Category	2021 Estimate	2022 Budget	2023 Projection	2024 Projection	2025 Projection	2026 Projection	Percent of Change 2021	2022	2023	2024	2025	2026
Taxes:												
Sales Tax	17,565,190	18,794,760	19,734,500	20,425,200	21,140,080	21,879,990	11.5%	7.0%	5.0%	3.5%	3.5%	3.5%
Property Tax	5,519,890	6,059,500	6,112,560	6,292,220	6,347,540	6,564,330	1.4%	9.8%	0.9%	2.9%	0.9%	3.4%
Use Tax - Consumer	1,749,210	1,810,430	1,873,790	1,939,370	2,007,240	2,077,490	5.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Use Tax - Auto	1,823,480	1,914,660	2,010,390	2,080,750	2,153,570	2,228,940	20.0%	5.0%	5.0%	3.5%	3.5%	3.5%
Use Tax - Building Materials	1,959,250	1,532,520	1,205,330	1,576,940	1,480,120	1,382,580	15.0%	-21.8%	-21.3%	30.8%	-6.1%	-6.6%
Franchise Taxes	1,094,980	1,116,270	1,141,200	1,162,970	1,187,930	1,213,750	8.2%	1.9%	2.2%	1.9%	2.1%	2.2%
Lodging Tax	255,580	319,480	383,380	440,890	484,980	509,230	40.0%	25.0%	20.0%	15.0%	10.0%	5.0%
Specific Ownership Tax	283,750	292,260	301,030	310,060	319,360	328,940	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Licenses & Permits:												
Sales & Use Tax Licenses	86,630	90,960	95,510	100,290	105,300	110,570	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Construction Permits	925,000	790,180	694,570	829,800	789,140	749,290	17.6%	-14.6%	-12.1%	19.5%	-4.9%	-5.0%
Minor Building-Related Permits	250,010	262,510	275,640	289,420	303,890	319,080	-12.1%	5.0%	5.0%	5.0%	5.0%	5.0%
Intergovernmental Revenue:												
Highway Users Tax	554,480	619,000	625,190	631,440	637,750	644,130	-0.8%	11.6%	1.0%	1.0%	1.0%	1.0%
State Lottery	251,560	256,590	261,720	266,950	272,290	277,740	15.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Marijuana Tax	220,610	242,670	260,870	273,910	287,610	301,990	22.5%	10.0%	7.5%	5.0%	5.0%	5.0%
IGA - Superior Library	347,650	381,720	385,540	397,110	401,080	415,120	-0.9%	9.8%	1.0%	3.0%	1.0%	3.5%
Charges for Services:												
Water User Fees	5,945,660	5,967,820	5,967,820	5,997,540	6,057,480	6,057,480	-12.1%	0.4%	0.0%	0.5%	1.0%	0.0%
Water Tap Fees	1,550,300	702,200	2,665,610	4,186,350	2,146,010	1,568,210	-27.9%	-54.7%	279.6%	57.1%	-48.7%	-26.9%
Wastewater User Fees	3,877,150	3,956,050	4,072,930	4,213,780	4,409,650	4,585,670	-4.7%	2.0%	3.0%	3.5%	4.6%	4.0%
Wastewater Tap Fees	150,000	60,400	283,040	480,660	236,040	147,720	-38.9%	-59.7%	368.6%	69.8%	-50.9%	-37.4%
Storm Water User Fees	991,300	1,024,290	1,075,270	1,135,290	1,203,250	1,264,270	1.1%	3.3%	5.0%	5.6%	6.0%	5.1%
Solid Waste User Fees	1,659,340	1,691,140	1,687,740	1,709,670	1,731,920	1,754,510	0.5%	1.9%	-0.2%	1.3%	1.3%	1.3%
Recreation Center Fees	1,957,920	2,423,420	2,470,290	2,518,100	2,566,880	2,616,620	58.6%	23.8%	1.9%	1.9%	1.9%	1.9%
Golf Course User Fees	2,167,910	2,179,710	2,222,940	2,266,800	2,311,540	2,362,320	12.2%	0.5%	2.0%	2.0%	2.0%	2.2%
Developer Impact Fees	251,300	206,840	341,420	581,859	333,690	219,550	-58.8%	-17.7%	65.1%	70.4%	-42.7%	-34.2%
Fines & Forfeitures:												
Court Fines	63,960	60,760	60,760	63,800	66,990	70,340	-25.0%	-5.0%	0.0%	5.0%	5.0%	5.0%

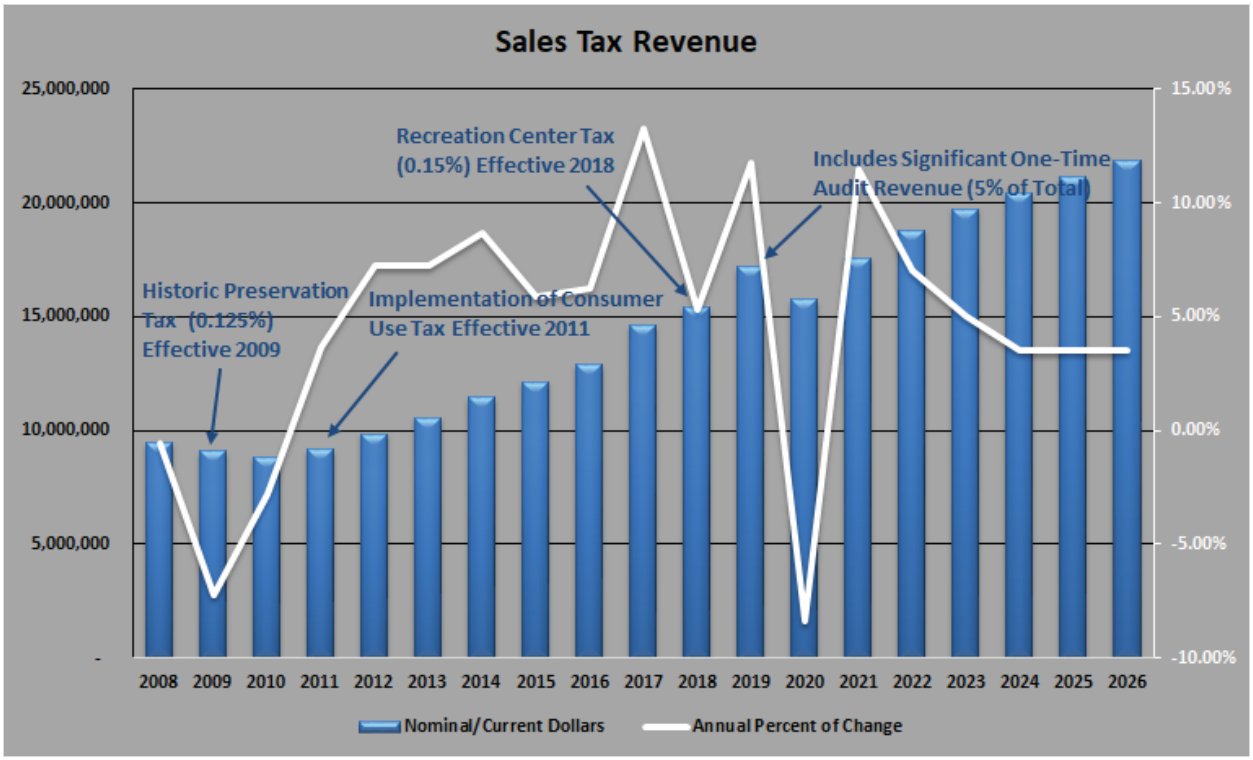
Sales Tax Revenue

Sales tax is a significant revenue source for the City and the projections/assumptions affect the City's main operating and capital funds:

- General Fund
- Open Space & Parks Fund
- Historic Preservation Fund
- Recreation Fund
- Capital Project Fund

The pandemic significantly impacted sales tax revenue in 2020. However, staff is projecting a healthy recovery for 2021 and continuing increases for 2022 through 2026.

The following table summarizes sales tax revenue history from the Great Recession to the 2020 Pandemic. Current projections/assumptions are shown for 2021 through 2026.



Assessed Valuation & Property Tax Revenue

The City has received its *preliminary* 2021 assessed valuation amounts from the Boulder County Assessor. These assessed valuations, multiplied by the mill levies, determine the amount of property tax revenue that will be collected in 2022.

The Assessor is reporting that the City of Louisville's gross assessed valuation increased by 9.8%, from $728,802,059 in 2020 to $800,216,959 in 2021. The City of Louisville's total net assessed valuation, which is the City's gross valuation less the Urban Revitalization District's incremental assessed valuation, also increased by approximately 9.8%, from $706,320,493 in 2020 to $775,368,866 in 2021.

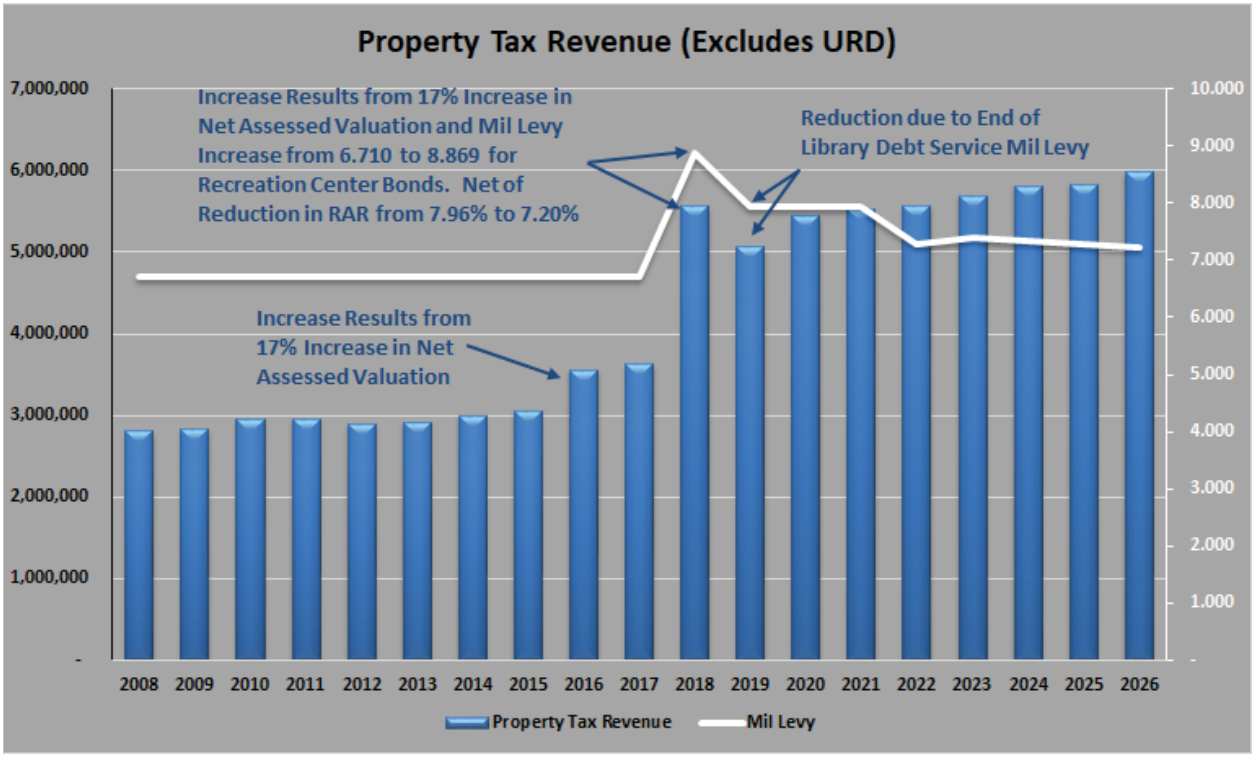
Please note that 2021 is a "re-assessment" year, so changes in valuation are due to both new construction and changes to actual values. New construction accounted for $10,345,074 of the total change.

For 2022 through 2026, staff is projecting an average annual increase in net assessed valuation of approximately 2.0%.

The City currently levies a total of 7.934 mills with two separate levies:

1. A 5.184 mill General Levy; and
2. A 2.750 mill Recreation Center Debt Service Levy.

Both the 5.184 mill General Levy and the 2.750 mill Debt Service levy are projected to remain at these levels through 2026. As previously stated, the Finance Committee recommended that the Recreation Center Bond debt service levy be permanently set at 2.750 mills. Therefore, the 2021 levy (for property tax revenue collection in 2022) has been reset from the previous recommendation of 2.250 mills to the current recommendation of 2.750 mills.



Senate Bill 21-293

To calculate property taxes, a property's *actual* value is multiplied by an assessment rate to determine its *assessed* value. The assessed value is then multiplied by the mill levy to determine the amount of property tax due. Currently, the assessment rate for residential property is 7.15 percent, and the assessment rate for most nonresidential property is 29.00 percent.

Senate Bill 21-293 temporarily reduces the assessment rates for certain classes of property for collection years 2023 and 2024:

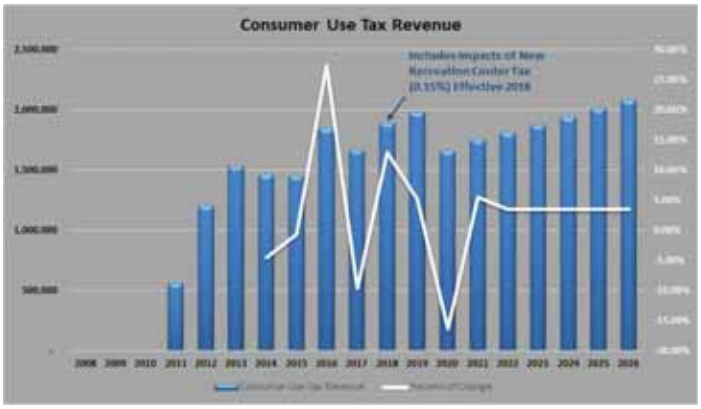
- The assessment rate for multifamily residential property is reduced to 6.80 percent;
- The assessment rate for all other residential property is reduced to 6.95 percent;

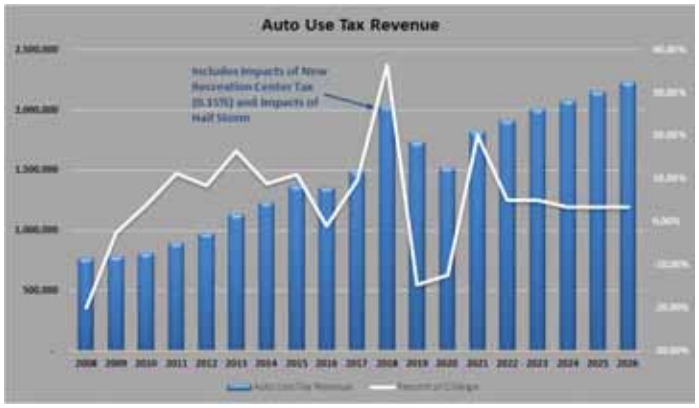
- The assessment rate for agricultural nonresidential property is reduced to 26.40 percent; and
- The assessment rate for nonresidential property used to produce renewable energy is reduced to 26.40.

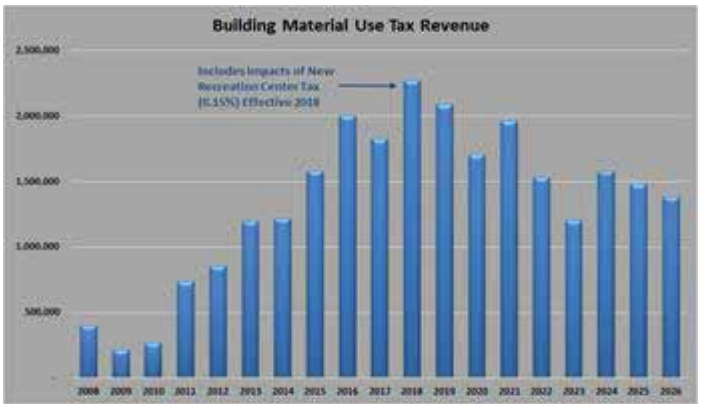
These changes in the assessment rates are for taxes collected in 2023 and 2024 and do not impact property tax revenue for 2022. The changes are projected to have a very small impact on the City's overall assessed valuation and property tax revenue. Slight adjustments to the projected assessed valuation have been incorporated into 2023 and 2024 revenue projections.

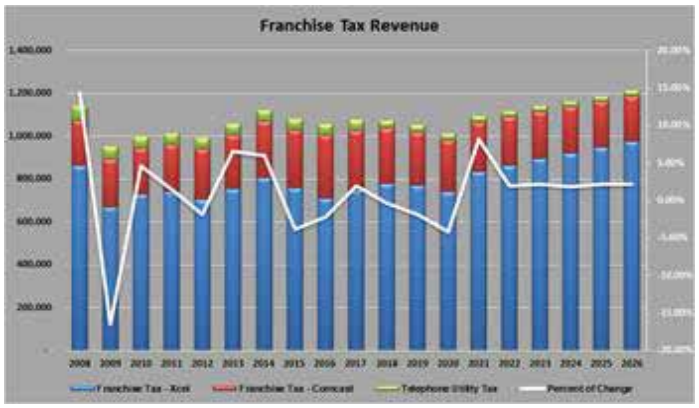
Other Revenue Projections

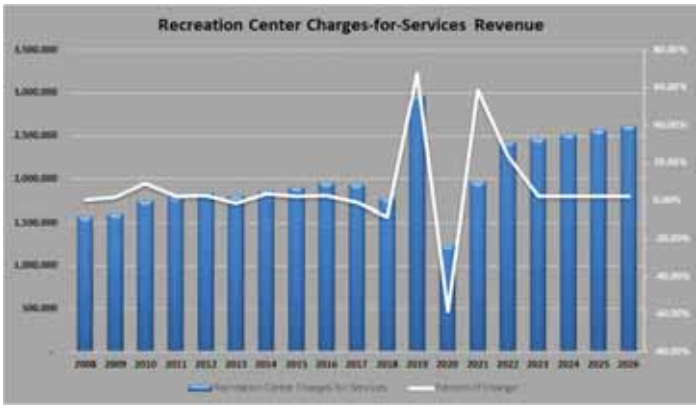
The following charts summarize just a few of the other more significant revenue assumptions that have been discussed with the Finance Committee and with the City Council.

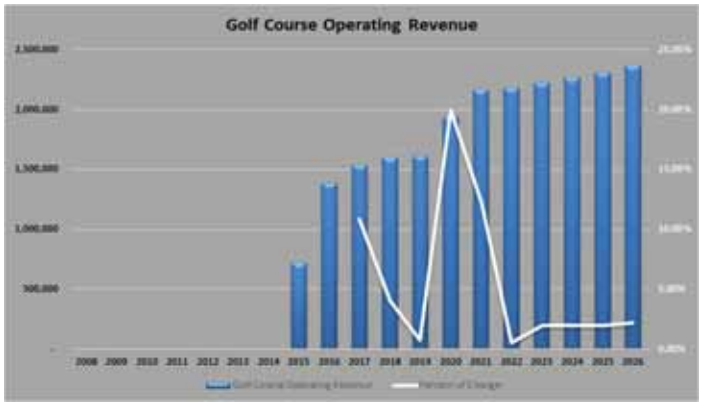












OPERATING EXPENDITURE PROJECTIONS/TARGETS

The following table summarizes the updated expenditure projections/targets for 2021 through 2026, which have been extracted from the Recommended 2022 Operating & Capital Budget and incorporated into the 2021-2026 Long-Term Financial Plan.

Summary of Expenditure Actuals, Estimates, and Targets for Major Expenditure Categories
2021 - 2026

Expenditure Category	2021 Estimate	2022 Budget	2023 Projection	2024 Projection	2025 Projection	2026 Projection	Percent of Change 2021	2022	2023	2024	2025	2026
Salaries & Wages:												
Regular Wages	14,990,400	16,948,630	17,541,810	18,155,780	18,687,760	19,341,830	6.9%	13.1%	3.5%	3.5%	2.9%	3.5%
Variable & Seasonal Wages	2,494,410	2,623,630	2,712,530	2,804,530	2,899,760	2,998,280	88.2%	5.2%	3.4%	3.4%	3.4%	3.4%
Overtime	489,960	476,530	488,480	500,690	513,200	525,990	-6.1%	-2.7%	2.5%	2.5%	2.5%	2.5%
Employee Benefits:												
Employee Insurance	2,343,110	2,689,770	2,877,970	3,079,390	3,294,890	3,525,470	15.2%	14.8%	7.0%	7.0%	7.0%	7.0%
FICA Expense	1,270,950	1,426,260	1,586,850	1,641,720	1,690,730	1,749,230	8.9%	12.2%	11.3%	3.5%	3.0%	3.5%
Retirement Contribution	867,720	975,210	989,070	1,023,410	1,053,290	1,089,860	6.5%	12.4%	1.4%	3.5%	2.9%	3.5%
Workers Compensation	200,090	239,450	239,450	239,450	239,450	239,450	-11.4%	19.7%	0.0%	0.0%	0.0%	0.0%
All Employee Compensation	22,673,880	25,385,350	26,442,030	27,450,840	28,384,950	29,475,980	12.3%	12.0%	4.2%	3.8%	3.4%	3.8%
Supplies:												
Chemicals	459,400	462,400	473,980	485,840	497,980	510,430	10.5%	0.7%	2.5%	2.5%	2.5%	2.5%
Vehicle Maintenance Supplies	222,350	213,310	218,710	224,220	229,840	235,570	9.6%	-4.1%	2.5%	2.5%	2.5%	2.5%
Street Supplies	175,820	170,700	175,830	181,100	186,540	192,140	5.5%	-2.9%	3.0%	3.0%	3.0%	3.0%
Uniforms & Clothing	111,580	109,630	111,820	114,050	116,310	118,600	-1.3%	-1.7%	2.0%	2.0%	2.0%	2.0%
Library Books & Media	60,900	95,960	97,880	99,840	101,830	103,870	-5.2%	57.6%	2.0%	2.0%	2.0%	2.0%
All Supplies	1,996,690	1,826,070	1,875,450	1,926,000	1,977,840	2,031,000	10.3%	-8.5%	2.7%	2.7%	2.7%	2.7%
Purchased/Contracted Services:												
Professional Services	3,841,490	3,803,800	3,442,950	3,639,900	3,784,200	3,997,190	29.3%	-1.0%	-9.5%	5.7%	4.0%	5.6%
Utilities	2,146,590	2,123,980	2,198,370	2,275,300	2,354,920	2,437,330	1.2%	-1.1%	3.5%	3.5%	3.5%	3.5%
Solid Waste Hauling	1,404,000	1,404,000	1,461,860	1,483,790	1,506,040	1,528,630	1.8%	0.0%	4.1%	1.5%	1.5%	1.5%
Parts, Repairs, & Maintenance	1,944,230	1,422,190	1,289,470	1,425,490	1,358,560	1,502,610	46.7%	-26.9%	-9.3%	10.5%	-4.7%	10.6%
Legal Services	572,360	528,500	539,070	549,850	560,840	572,060	14.3%	-7.7%	2.0%	2.0%	2.0%	2.0%
Insurance Premiums & Deductibles	743,380	802,320	858,480	901,410	946,460	993,780	13.9%	7.9%	7.0%	5.0%	5.0%	5.0%
Boulder Dispatch Services	346,700	348,980	354,210	359,520	364,910	370,380	12.3%	0.7%	1.5%	1.5%	1.5%	1.5%
All Purchased/Contracted Services	12,030,250	11,415,300	11,180,840	11,622,500	11,904,940	12,428,340	12.0%	-5.1%	-2.1%	4.0%	2.4%	4.4%

Wage & Benefit Recommendations

The 2022 Revised Recommended Budget includes average merit increases of 4% and a projection for market increases for employees whose positions are currently not consistent with the average market salary. Together, these inclusions account for an approximate $1.5 million increase in the City's employee compensation budget for 2022. These investments help support the City by maintaining an experienced and stable workforce, including the retention and attraction of employees, which is necessary to fulfill the level of service desired by Council and the community. In addition, these investments help reduce the costs and operational impacts of employee turnover.

The City is in the early stages of a pay equity study, to ensure compliance with SB19-085 Equal Pay for Equal Work Act. In early 2022, staff will provide an overview of the merits and markets compensation policy and the structure and history of the current compensation system. At that time, City Council can discuss how to approach compensation in the context of the pay equity study findings, current labor market conditions, desired service levels, and future employment needs and trends.

2022 Position Additions/Changes

The 2022 Revised Recommended Budget includes the annual impacts of all staff changes approved at the June 15, 2021 budget amendment. These included the following, many of which addressed cuts and staffing reconfigurations made in 2020 during COVID-19, as well as expanded services to support key program areas:

- Addition of full-time **Economic Vitality Specialist** position.
- Deletion of **HR Administration Support Specialist** position and addition of **HR Associate position.**
- Addition of **Information Technology Intern** position.
- Addition of part-time **Finance Bag Tax Compliance/Processing** position.
- Addition of **Assistant City Engineer** position.
- Conversion of **Preservation Planner** position from part-time to full-time
- Addition of **Senior Planner** position.
- Conversion of **Sustainability Specialist** position from part-time to full-time.
- Addition of **Parks Project Manager** position.
- Deletion of **3 full-time Librarian** positions and addition of **5200 hours for part-time Librarian** positions.
- Pay equity adjustments for part-time Museum positions.
- Additional seasonal hours for part-time **Golf Course Maintenance** positions.

The **Recovery Grants Manager** position was not included in the budget amendment, but was approved during the ARPA funding discussion with City Council. This is a termed position (through 2023) which is funded through the ARPA direct allocation, and is also expected to result in additional revenues through grants procurement.

In addition to the staffing changes that were included in the 2021 budget amendment outlined above, the 2022 Revised Recommended Budget includes the addition of new positions to address City Council priorities, and changes to other positions to meet new or changing programmatic needs. Of these positions, four are converting variable/part time positions to full time positions (Accounting Tech, Park Maintenance Techs, GIS Specialist/Coordinator), one replaces a previously termed positions (ERP Analyst = IT Data Analyst), two are a result of reduced consulting/contract services (GIS Specialist/Coordinator, ERP Analyst), and two are termed positions necessary to support the proposed bond issue (Engineer III an CIP Project Assistant). A description of each of these positions, how they are funded and allocated, is included below:

- Finance – **Accounting Tech II** (converted from part-time Bag Tax Compliance/Processing position) – This position will address two emerging needs within the City's sales tax system – the implementation of the City's Single Use Bag Tax collection and reporting system and with the implementation and maintenance of the State's Sales & Use Tax Software system (SUTS). The position is partially funded (50%) through the bag tax collections.

- IT – **GIS Specialist/Coordinator** – The City furloughed and then cut the part-time GIS coordinator in 2020 due to COVID-19. At this time, the City plans to bring the oversight and management of the Lucity Public Works asset management system internal to the IT department. There is an operational budget off-set for this position with a reduction in GIS contract services. This position will be allocated 55% to Utilities and 45% to IT.

- IT – **ERP Analyst** – The City has determined that internalizing the operationalization of the Lucity Public Works asset management system would provide greater system/application security, improve internal capacity to upgrade and expand the system, and develop the internal competencies to address future needs around this critical enterprise system. This will be partially funded through reductions in consulting services contracts in GIS and Public Works. This position will be allocated 55% to Utilities and 45% to IT.

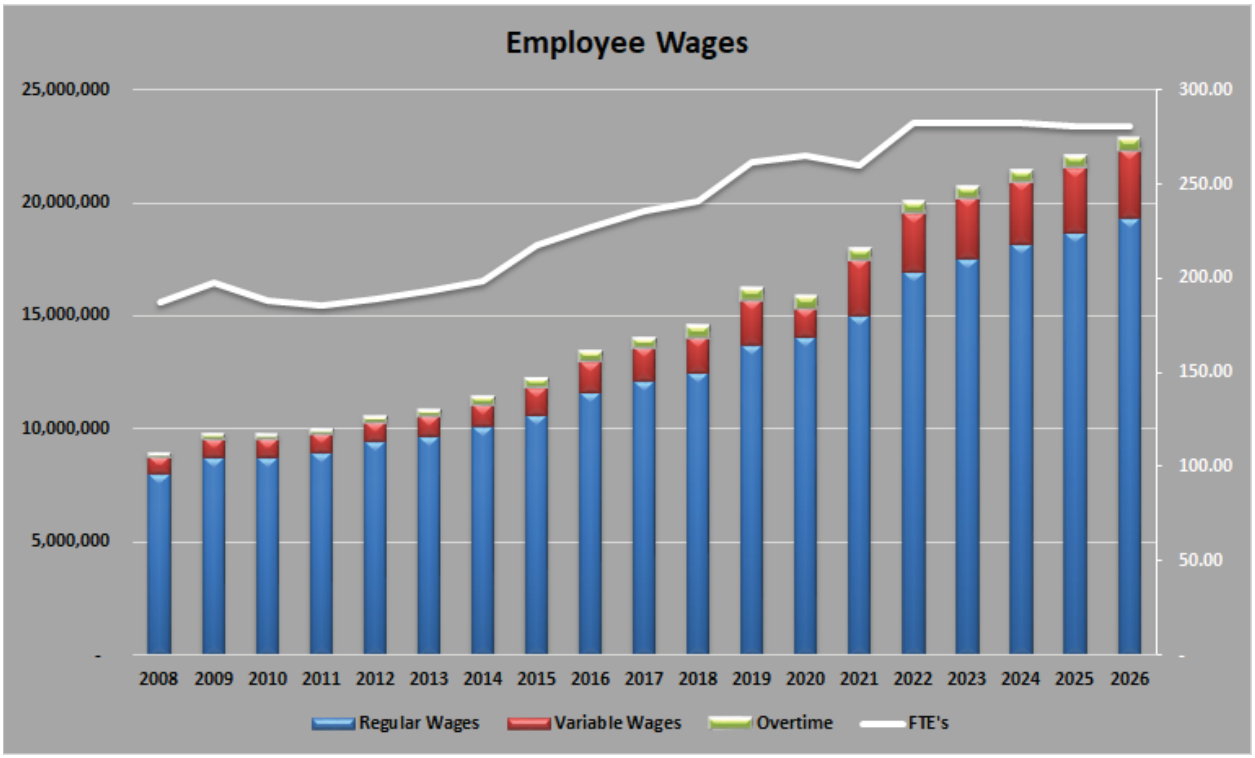
- Parks – **Park Maintenance Tech I** – The City has been unable to hire seasonal staff to perform the parks maintenance work necessary to support parks maintenance at the current level desired. These position costs are off-set through part-time variable hours equivalent to two full-time positions. The addition of two full-time tech positions will give the department year-round resources to continue to address needs in the off-season.

- Recreation – **Lead Lifeguard** – This position replaces a position that was furloughed then eliminated during COVID-19. The addition of this position includes an off-set which reduces part-time variable hours equivalent to one full-time position.

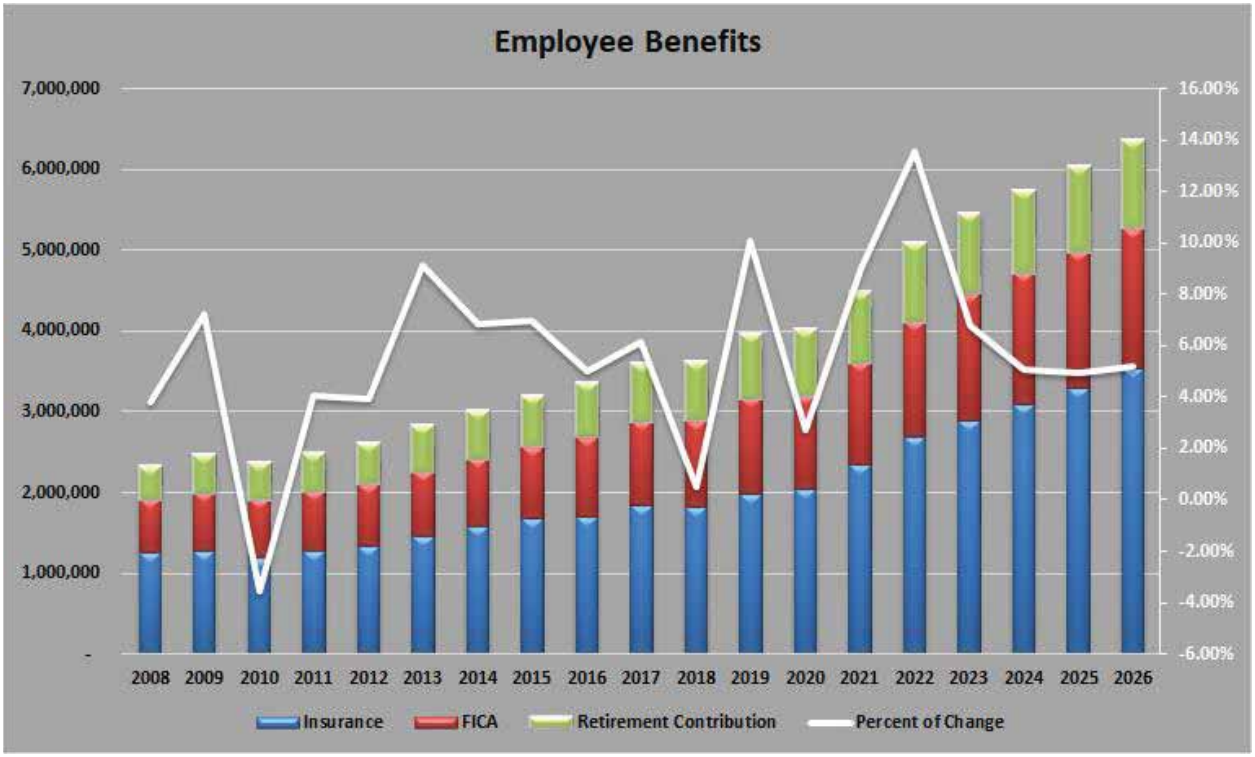
Two positions were discussed during the development and consideration of the transportation ballot measure. If passed, the implementation of the capital improvements on the required timeline will require engineering services and project management beyond the City's current capacity. Both positions will be termed for an estimated 3 – 5 years depending on the design and construction process, and are being allocated for funding through the Capital Projects Fund. The following two positions are included in the 2022 Revised Recommended Budget and the 2021-2026 financial forecast for the Capital Project Fund:

- Public Works – **Engineer III**
- Public Works – **C-I-P Project Assistant**

Employee wages and benefits are the City's largest operational cost category. The following chart summarizes a history and projection of full-time equivalents (FTEs) and total wage costs.

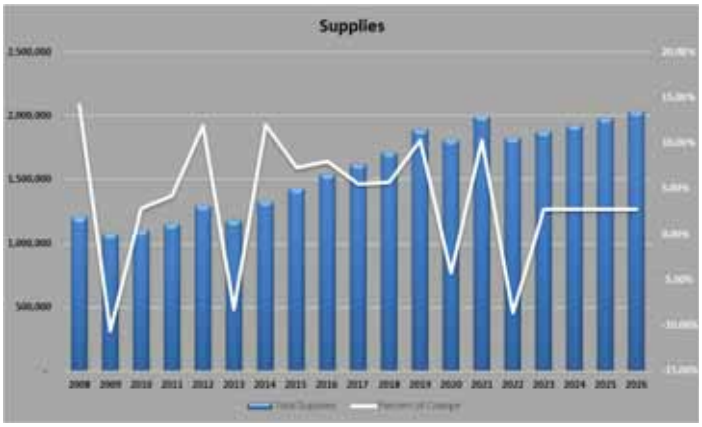


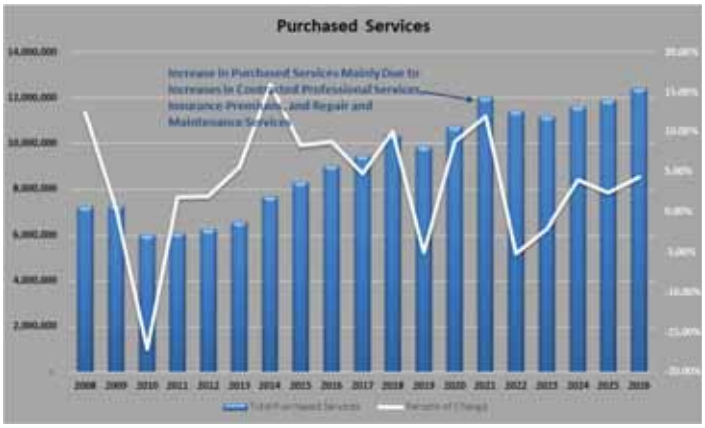
The next chart summarizes a history and projection of employee benefit costs. For this chart, benefits has been defined as FICA contributions, retirement contributions, and the City share of employee insurance premiums.



Other Operational Targets/Projections

The following charts present a history and projections for the other two major expenditure categories, Supplies and Purchased Services:





Office Space Needs

The steady growth of City programs and services, and staff necessary to support those services, has resulted in a shortage of adequate staff workspace. At this time, most City facilities are at capacity, and in some facilities (including City Hall and the Library) numerous remodels have occurred in the past years to incrementally expand available

offices. In 2017, staff brought forward a proposal to complete a redesign of City Hall, incorporating more office space, which was not advanced. The City had planned to complete a space needs assessment/study, which was delayed by COVID. Staff is still exploring the best solutions to address these needs, including the possibility of office space reconfiguration, teleworking and office sharing, relocating staff to other facilities, and temporary office space rentals.

Staff plans to bring forward a future 2021 budget amendment containing $50,000 for additional furniture and equipment and $50,000 for office space rental (or other measures to address space constraints). These costs are included in the fund financial forecasts. The 2022 Revised Recommended Budget contains $100,000 for office space rental, which is carried forward through 2026 in the fund financial forecasts.

Nite-at-the-Rec Program

The operational budget for the Recreation Center includes program changes and associated budget changes for the Nite-at-the-Rec (NAR) program. The 2022 Revised Recommended Budget reflects a decrease of the NAR operational budget by 50%. NAR had experienced low attendance prior to COVID-19 and Rec Center staff have been shifting to a youth and family program plan that includes greater variety in programming for more ages of kids and families. The new plan is to provide monthly programming targeting 3rd through 8th graders. Staff will utilize some existing programming that has been successful and introduce new programming as well. Projected program revenue has been added. At this time, the variable salaries necessary to support these programs are still reflected in the NAR budget line items/subprogram area. During the 2023-2024 biennial budget process the programs/subprograms will be reorganized to reflect the youth and family programming within the existing Rec program budgets.

The American Rescue Plan Act (ARPA)

The City has received $2,616,048 in 2021 of Coronavirus State and Local Fiscal Recovery Funds (CSLFRF) and expects to receive the same amount in 2022. These funds have, and will be, placed in the new American Rescue Plan Act Fund.

The U.S. Treasury Department's Interim Final Rule (IFR) categorizes eligible expenditures for governments into four main areas:

1. COVID-19 or a negative economic impact;
2. Premium pay for eligible workers;
3. Government service to the extent of the loss of revenue; and
4. Investments in water, sewer, and broadband infrastructure.

The details within each main category are fairly restrictive. The least restrictive, most flexible, category is *"3. Government service to the extent of the loss of revenue"*. To be eligible to use CSLFRF under this category, a government must meet the criteria for revenue loss. This involves a relatively complex calculation of the reduction in revenue due to the COVID-19 pandemic.

Staff have performed a preliminary calculation using the IFR's methodology and believes that the City's entire CSLFRF distribution ($5,232,097) *may* be eligible for reimbursement of government services. Staff are hopeful to get verification of the calculation prior to final adoption of the budget.

The IFR defines *government services* as:

- Directly provide services or aid to citizens.
- Maintenance pay-go of building.
    - Can be used on a capital project together with bond financing.
    - Can be used to start a project and finished later with other future revenue.
- Cybersecurity, healthcare service, school or education services, police, fire, or public safety.

As previously noted, a $5.2 million transfer is included from the American Rescue Plan Act Fund to the General Fund. This transfer anticipates at least $5.2 million of General Fund expenditures eligible for reimbursement from the CSLFRF. CSLFRF eligible costs do not need to be made in 2022. Eligible costs must be *obligated* by December 31, 2024 and *expended* by December 31, 2026.

CAPITAL IMPROVEMENTS PLAN UPDATE

Section 5.5 of the City's Financial Policies states:

> *A Six-Year Capital Improvement Plan will be presented to the City Council for consideration during the biennial budget development process. The annual capital budget will be based on the first year of the approved C-I-P.*

Attached to this Communication is a new Capital Improvements Plan (C-I-P) Summary Table that includes all requested adjustments and represents the new proposed C-I-P. All changes from the original 2021-2026 C-I-P, presented during the 2021-2022 biennial budget process, are highlighted in red.

The only change made since the September 28 Study Session has been the elimination of the Museum Visitors Center – Design project ($200,000) from the Capital Projects Fund.

INTERFUND TRANSFERS

The following table summarizes the inter-fund transfers included in the 2022 Revised Recommended Budget.

Inter-Fund Transfers Matrix
2022 Recommended Budget

Transfers Out	Transfers In: General Fund	OS&P Fund	Cemetery Fund	Recreation Fund	Capital Projects Fund	Total
General Fund	-	900,570 *a*	161,840 *b*	1,122,420 *c*	3,000,000 *d*	5,184,830
Cemetery Perpetual Care Fund	-	-	8,640 *e*	-	-	8,640
Historic Preservation Fund	164,980 *f*	-	-	-	-	164,980
American Rescue Plan Act	5,244,600 *g*	-	-	-	-	5,244,600
Capital Project Fund	-	-	-	135,860 *h*	-	135,860
Impact Fee Fund	-	19,740 *i*	-	-	194,400 *i*	214,140
Total	5,409,580	920,310	170,480	1,258,280	3,194,400	10,953,050

a *Annual recurring support for operations and capital.*
b *Annual recurring support for operations and capital.*
c *Annual recurring support for operations and capital.*
d *One-time transfer to help fund costs for capital projects.*
e *Annual recurring transfer of interest earned used to fund operations and capital.*
f *Annual recurring transfer for reimbursement of costs associated with Museum Services.*
g *Transfer of all CSLFR funds to cover eligible expenditures within the General Fund.*
h *Annual recurring support for capital.*
i *Annual transfer of impact fee revenue for projects eligible for this type of funding.*

CITY-WIDE 2022 BUDGET SUMMARY

Attached to this Communication is table for each fund summarizing its Recommended 2022 Operating & Capital Budget.

The following table summarizes the revenue, expenditures, and changes to fund balances for all funds as proposed in the 2022 Revised Recommended Operating & Capital Budget.

City of Louisville, Colorado
Summary of Revenue, Expenditures, and Changes to Fund Balances
All Funds
2022 Budget

Fund Number	Fund Description	Beginning Fund Balance	Revenue & Other Sources	Expenditures & Other Uses		Ending Fund Balance	Amount of Change	Percent of Change
101	**General**	**$ 10,390,111**	**$ 27,406,460**	**$ 25,331,110**	*[1]*	**$ 12,465,461**	**$ 2,075,350**	**20%**
	Special Revenue Funds:							
201	Open Space & Parks	**2,621,165**	4,591,610	5,645,760	*[2]*	**1,567,015**	(1,054,150)	-40%
202	Conservation Trust - Lottery	**162,722**	258,910	210,100		**211,532**	48,810	30%
203	Cemetery Perpetual Care	**673,309**	44,110	8,940		**708,479**	35,170	5%
204	Cemetery	**31,113**	243,850	241,550		**33,413**	2,300	7%
205	PEG Fees	**16,396**	25,360	50		**41,706**	25,310	154%
206	Parking Improvement	**94,763**	1,000	50		**95,713**	950	1%
207	Historic Preservation	**2,794,194**	861,270	590,780		**3,064,684**	270,490	10%
208	Recreation	**1,636,065**	4,744,520	4,203,290	*[3]*	**2,177,295**	541,230	33%
209	Amercian Rescue Plan Act	**2,623,550**	2,621,050	5,244,600		-	(2,623,550)	-100%
	Total Special Revenue Funds	**10,653,276**	**13,391,680**	**16,145,120**		**7,899,836**	**(2,753,440)**	**-26%**
	Capital Project Funds:							
301	Capital Projects	**379,616**	10,162,180	8,885,450		**1,656,346**	1,276,730	336%
302	Impact Fee	**27,983**	209,780	214,640		**23,123**	(4,860)	-17%
303	Recreation Center Construction	**215,046**	-	93,500		**121,546**	(93,500)	-43%
	Total Capital Project Funds	**622,646**	**10,371,960**	**9,193,590**		**1,801,016**	**1,178,370**	**189%**
	Debt Service Funds:							
402	Recreation Center Debt Service	**396,001**	2,136,550	1,742,800		**789,751**	393,750	99%
	Total Debt Service Funds	**396,001**	**2,136,550**	**1,742,800**		**789,751**	**393,750**	**99%**
	Enterprise Funds (WC Basis):							
501	Water Utility	**17,571,910**	7,028,640	8,398,160	*[4]*	**16,202,390**	(1,369,520)	-8%
502	Wastewater Utility	**5,513,956**	4,174,400	5,375,550	*[5]*	**4,312,806**	(1,201,150)	-22%
503	Stormwater Utility	**727,034**	1,035,890	907,710	*[6]*	**855,214**	128,180	18%
510	Solid Waste & Recycling Utility	**256,216**	1,694,590	1,628,130		**322,676**	66,460	26%
520	Golf Course	**588,773**	2,196,820	1,823,900	*[7]*	**961,693**	372,920	63%
	Total Enterprise Funds	**24,657,890**	**16,130,340**	**18,133,450**		**22,654,780**	**(2,003,110)**	**-8%**
	Internal Service Funds (WC Basis):							
602	Technology Management	**117,889**	54,360	75,400		**96,849**	(21,040)	-18%
603	Fleet Management	**150,063**	283,030	325,950		**107,143**	(42,920)	-29%
	Total Internal Service Funds	**267,952**	**337,390**	**401,350**		**203,992**	**(63,960)**	**-24%**
	Total All Funds	**$ 46,987,876**	**$ 69,774,380**	**$ 70,947,420**		**$ 45,814,836**	**$ (1,173,040)**	**-2%**

[1] Projected Expenditures Include a Projected Operational "Turnback" of 5.5% , which = 1,172,540
[2] Projected Expenditures Include a Projected Operational "Turnback" of 6.0% , which = 211,480
[3] Projected Expenditures Include a Projected Operational "Turnback" of 5.0% , which = 214,990
[4] Projected Expenditures Include a Projected Operational "Turnback" of 10.0% , which = 390,650
[5] Projected Expenditures Include a Projected Operational "Turnback" of 7.0% , which = 161,160
[6] Projected Expenditures Include a Projected Operational "Turnback" of 9.0% , which = 36,010
[7] Projected Expenditures Include a Projected Operational "Turnback" of 4.0% , which = 76,000

In the preceding table, note that staff has included the updated turnback percentages that were presented at the September 14 Study Session. As a reminder, "turnback" refers to a positive actual-to-budget variance at year end. Applying a turnback percentage accounts for the recognition that, due to budgetary limitations and controls, the main operating funds typically spend less than their total budget.

Summary of Actual and Targeted Operational Turnback
Selected Operating Funds

Fund Description	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Actual	2021 Target	2022 Target	2023 Target	2024 Target	2025 Target	2026 Target
General	2.6%	9.0%	9.7%	10.4%	4.3%	5.5%	5.5%	5.5%	4.5%	4.5%	4.5%
Open Space & Parks	5.5%	7.0%	11.7%	6.9%	6.6%	6.0%	6.0%	6.0%	5.0%	5.0%	5.0%
Recreation	N/A	N/A	N/A	-2.1%	3.6%	5.0%	5.0%	5.0%	4.0%	4.0%	4.0%
Water Utility	16.1%	33.1%	21.4%	20.4%	4.2%	10.0%	10.0%	10.0%	7.0%	7.0%	7.0%
Wastewater Utility	10.9%	7.6%	12.6%	15.4%	3.5%	7.0%	7.0%	7.0%	5.0%	5.0%	5.0%
Stormwater Utility	11.3%	19.4%	21.4%	7.8%	11.0%	9.0%	9.0%	9.0%	6.0%	6.0%	6.0%
Golf Course	16.5%	4.3%	-16.3%	11.9%	0.0%	4.0%	4.0%	4.0%	3.0%	3.0%	3.0%

LONG-TERM FINANCIAL PLAN SUMMARY

Section 5.5 of the City's Financial Policies states:

> *Six-year financial forecasts for each of the City's major operating funds will be presented to the City Council for consideration during budget development.*

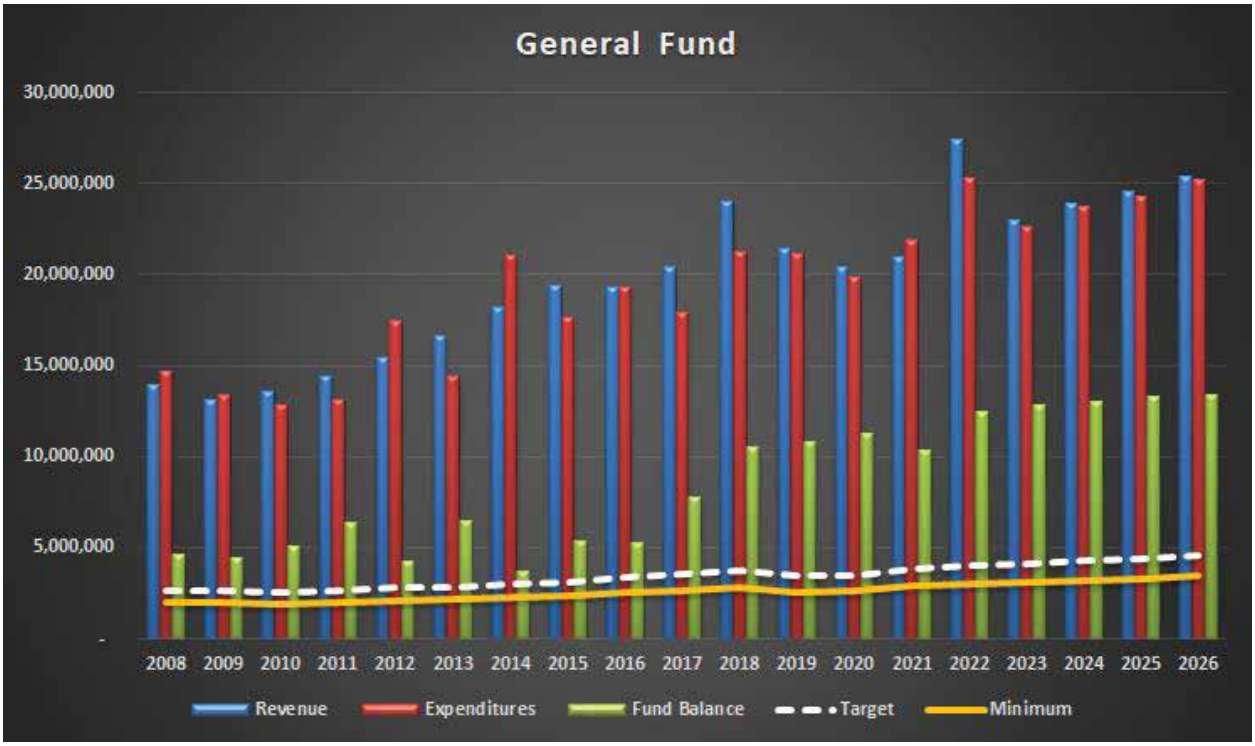
Staff have updated forecasts of revenue, expenditures, and reserves for all funds. However, staff has performed a more detailed review and has made more detailed forecasts for the major operating and capital funds, defined as:

- General Fund;
- Open Space & Parks Fund;
- Recreation Fund;
- Capital Projects Fund;
- Utility Funds; and
- Golf Course Fund

The forecasting model uses the 2022 budget as the base year and then applies the revenue assumptions, operating expenditure targets, proposed interfund transfers, and the updated Capital Improvements Plan to project revenue, expenditures, and fund balances (or working capital for proprietary funds) for years 2023 through 2026.

General Fund Long-Term Forecast

Incorporating the revenue assumptions, the operating expenditure targets, and the proposed interfund transfers outlined in the preceding discussion, the following chart summarizes a history and projection of revenue, expenditures, and fund balances for the General Fund.



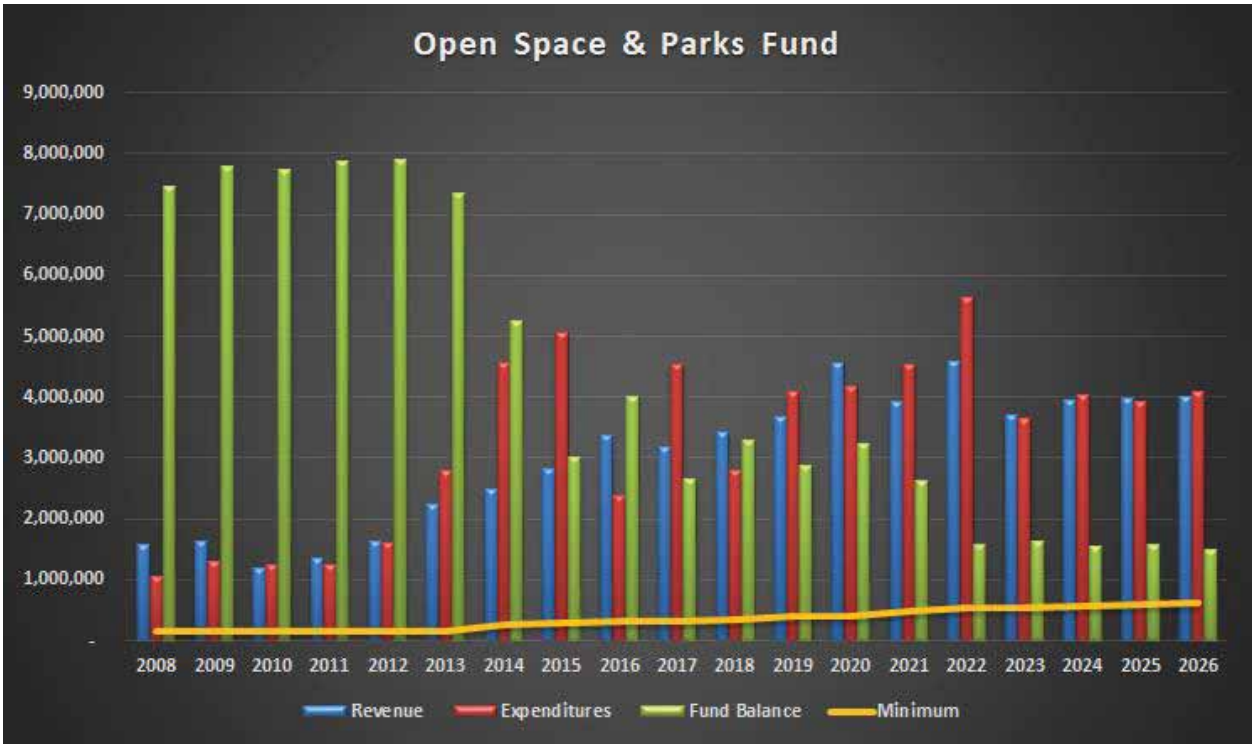
The City's Reserve Policy for the General Fund states,

> *The minimum unrestricted fund balance of the General Fund shall be maintained at or above 15% of current operating expenditures. For purpose of this policy, operating expenditures are defined as all expenditures less any interfund transfers to other funds, regardless of whether the transfers are considered recurring or non-recurring.*
>
> *While the minimum unrestricted fund balance is set at 15% of current operating expenditures, the targeted unrestricted fund balance will be at or above 20% of current operating expenditures.*

The projected General Fund balance at the end of 2026 is $13.4 million. This equates to 56% of projected operating expenditures and well above the targeted fund balance as currently defined in the Reserve Policy.

Open Space & Parks Fund Long-Term Forecast

Incorporating the revenue assumptions, the operating expenditure targets, the proposed interfund transfers, and the updated C-I-P projections outlined in the preceding discussion, the following chart summarizes a history and projection of revenue, expenditures, and fund balances for the Open Space & Parks Fund.



The City's Reserve Policy for the Open Space & Parks Fund states,

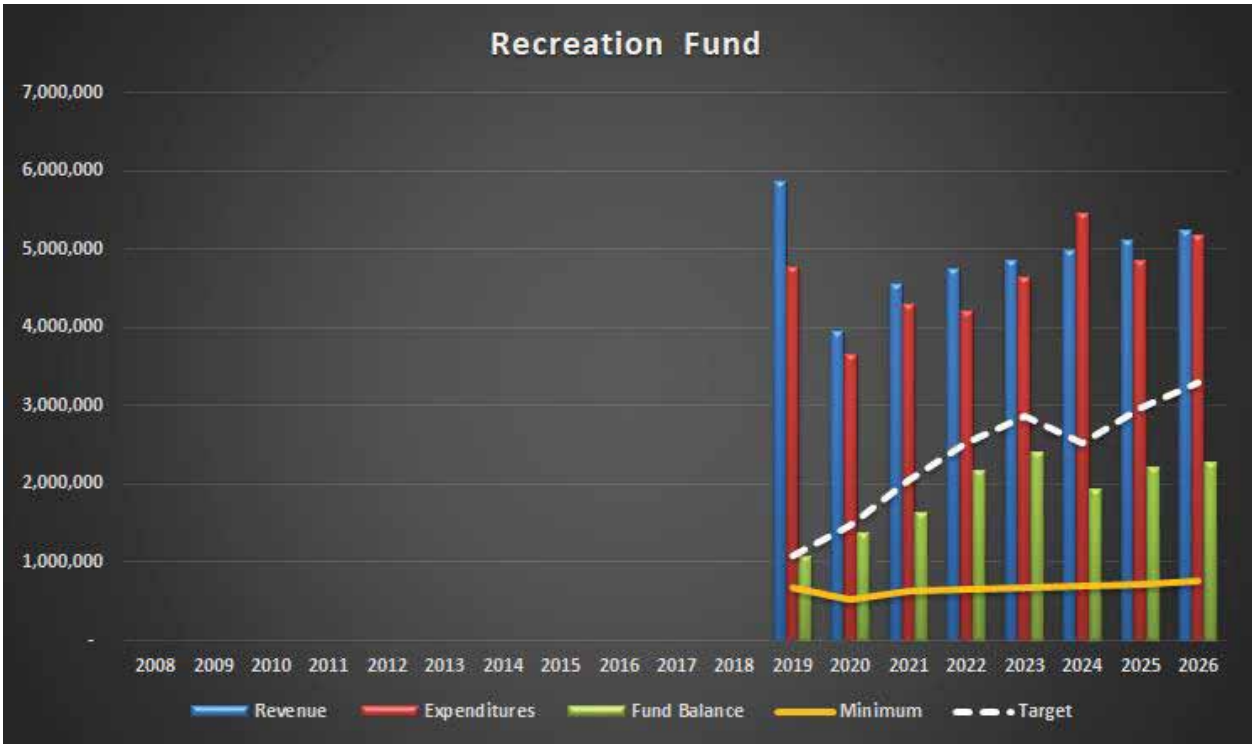
> *The minimum fund balance of the Open Space and Parks Fund shall be maintained at or above 15% of current operating expenditures. For purpose of this policy, operating expenditures include only open space and parks operations and exclude all interfund transfers and capital outlay.*
>
> *The Open Space & Parks Fund requires a recurring annual transfer from the General Fund to fund its operating deficit. This annual transfer will be calculated by taking the amount of funding provided by the General Fund for Parks in 2007 ($626,900) and inflating that amount on an annual basis by the regional Consumer Price Index for All Urban Consumers. The 2007 funding level for Parks is the starting point for the calculation, since that was the last year that Parks was funded within the General Fund.*

The City Council will annually consider interfund transfers of excess General Fund or Capital Project Fund balances to the Open Space & Parks Fund for property acquisition reserves.

The projected Open Space & Parks Fund balance at the end of 2026 is $1.5 million. This equates to 36% of projected operating expenditures and is well above the minimum fund balance as defined in the Reserve Policy.

Recreation Fund Long-Term Forecast

Incorporating the revenue assumptions, the operating expenditure targets, the proposed interfund transfers, and the updated C-I-P projections outlined in the preceding discussion, the following chart summarizes a history and projection of revenue, expenditures, and fund balances for the Recreation Fund.



The City's Reserve Policy for the Recreation Fund states,

The minimum fund balance of the Recreation Fund shall be maintained at or above 15% of current operating expenditures. For purpose of this policy, operating expenditures are defined as all expenditures, excluding interfund transfers and capital outlay.

In addition to maintaining an operating reserve, the Recreation Fund will also maintain a capital asset renewal and replacement reserve. The purpose of this

reserve is to accumulate funds for the timely renewal and replacement of Recreation Center and Memory Square Pool assets. The methodology for calculating this reserve will be approved by the Finance Committee.

It is the intent of the City Council that the dedicated sales tax and user fee revenues generated by the Recreation Center and Memory Square Pool facilities cover the operating costs for those facilities, fund the 15% minimum fund balance, and fund the capital asset renewal and replacement reserve. However, the City Council also recognizes that the dedicated sales tax and user fee revenues may not be sufficient and the Recreation Fund may also need to rely on annual General Fund transfers. The maximum annual General Fund transfer will be calculated by taking the General Fund subsidy for the Recreation Center/Memory Square Pool in 2017 ($986,300) and inflating that amount on an annual basis by the regional Consumer Price Index for All Urban Consumers. The 2017 General Fund subsidy level is the starting point for the calculation, since that is the last year that the Recreation Center and Memory Square Pool were funded within the General Fund.

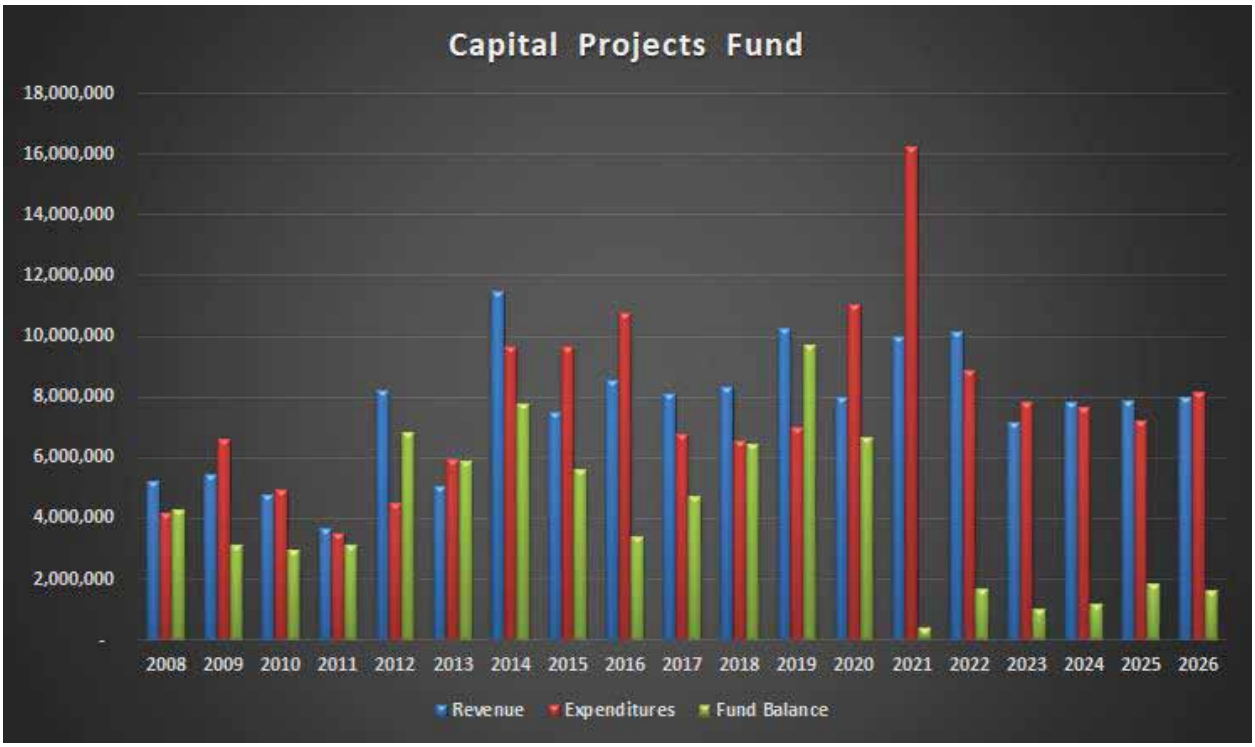
In addition to the annual General Fund transfer towards the annual operating costs, minimum fund balance requirements, and capital asset renewal and replacement reserves, this policy also authorizes an annual transfer from the Capital Projects Fund to the Recreation Fund in the amount of $125,000 for 2019 and each year thereafter inflated on an annual basis by the regional Consumer Price Index for All Urban Consumers. This transfer is restricted for capital outlay.

Closing the Recreation & Senior Center during the pandemic significantly affected the Recreation Fund revenue, expenditures, and resulting fund balances. Additional transfers of $432,000 in 2021 and $350,000 in 2022 were added in the 2021-2022 Biennial Budget to help keep the Recreation Fund reserves above the minuimum amounts as defined in the Reserve Policy.

The projected Recreation Fund balance at the end of 2026 is $2.3 million, well above the 15% of operating expenditures, but not covering all the renewal and replacement reserve.

Capital Projects Fund Long-Term Forecast

Incorporating the revenue assumptions, the operating expenditure targets, the proposed interfund transfers, and the updated C-I-P projections outlined in the preceding discussion, the following chart summarizes a history and projection of revenue, expenditures, and fund balances for the Capital Projects Fund.



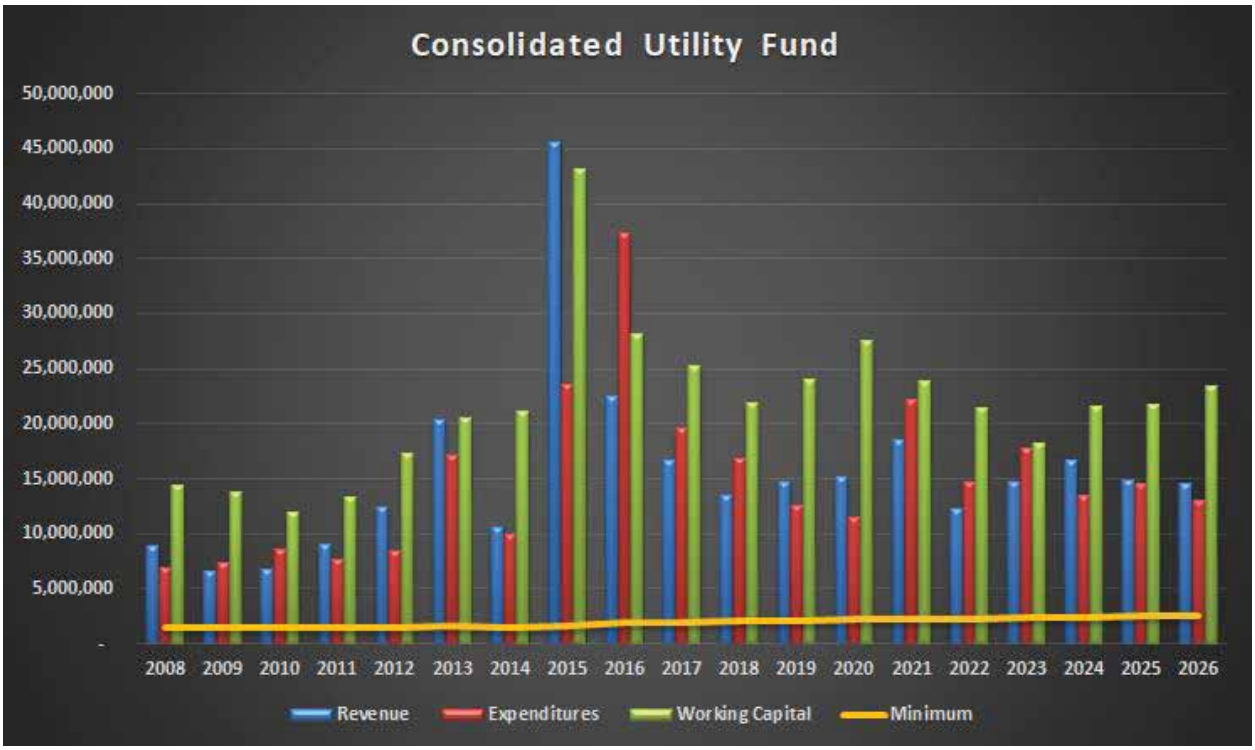
Large fluctuations in revenue, expenditures, and fund balances within capital project funds are typical. The City's Financial Policies do not specify a minimum level of reserves for the Capital Projects Fund. However, staff attempt to keep an annual fund balance of $1 million or greater.

The fund balance is projected to decline to approximately $380,000 at the end of 2021 (assuming no carry-forward of unspent project budgets), but increase to approximately $1.6 million by the end of 2026.

Please note that the projection includes transferring $1.5 million per year, for 2023 through 2026, to assist with debt service on the anticipated transportation bonds.

Consolidated Utility Fund Long-Term Forecast

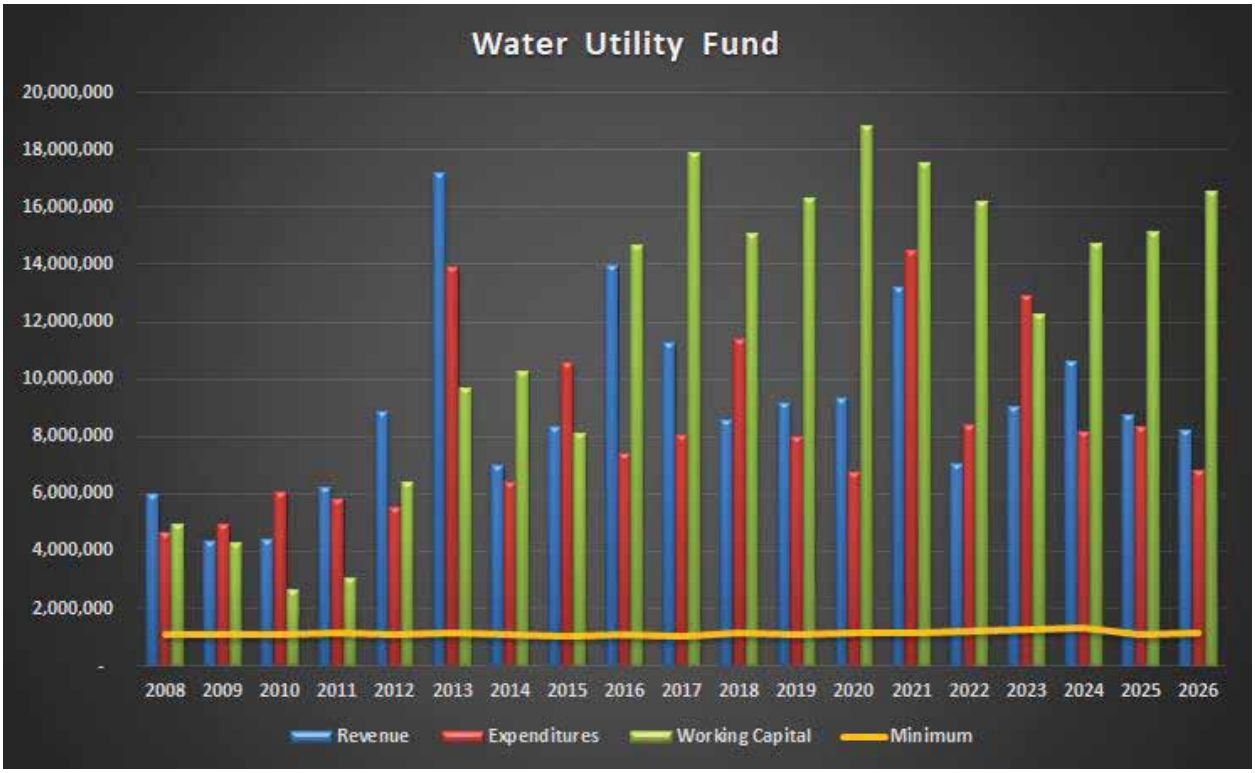
The Consolidated Utility Fund consists of the Water Utility Fund, the Wastewater Utility Fund, and the Storm Water Utility Fund. Incorporating the revenue assumptions, the operating expenditure targets, and the updated C-I-P projections outlined in the preceding discussion, the following chart summarizes a history and projection of revenue, expenditures, and reserves (defined as working capital) for the Consolidated Utility Fund.

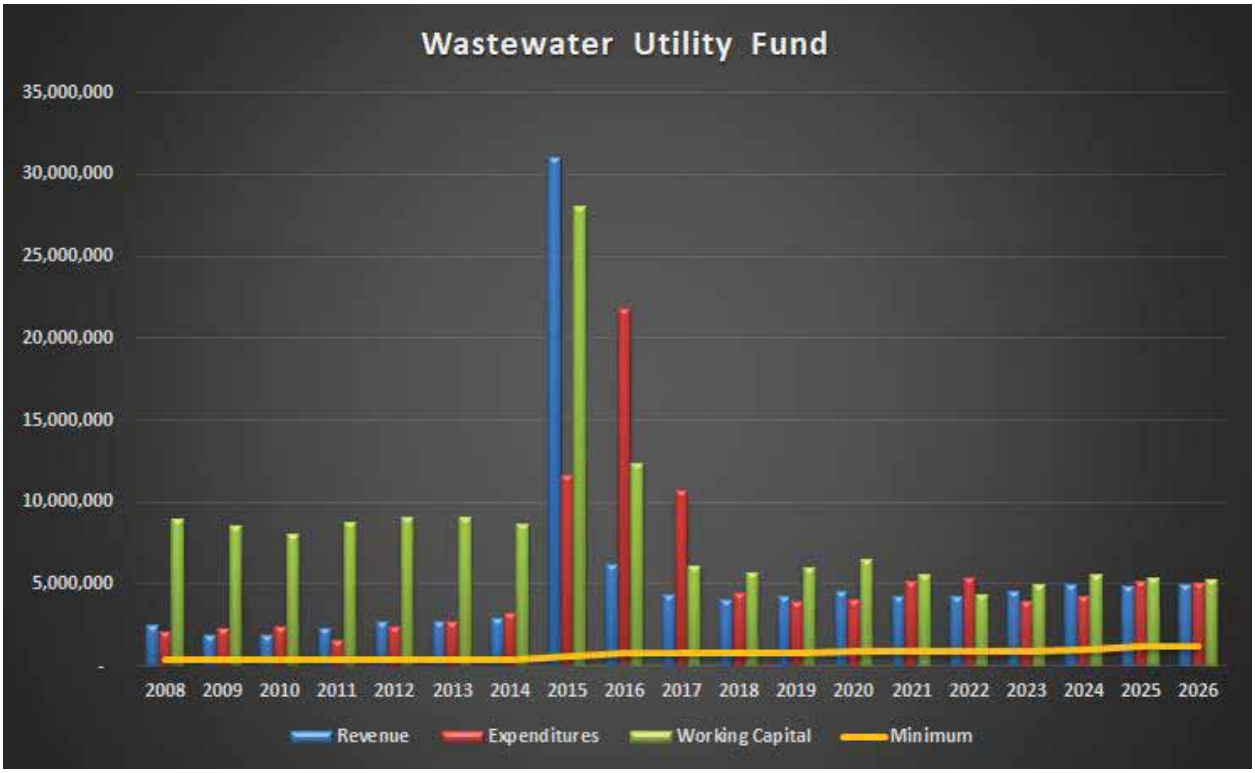


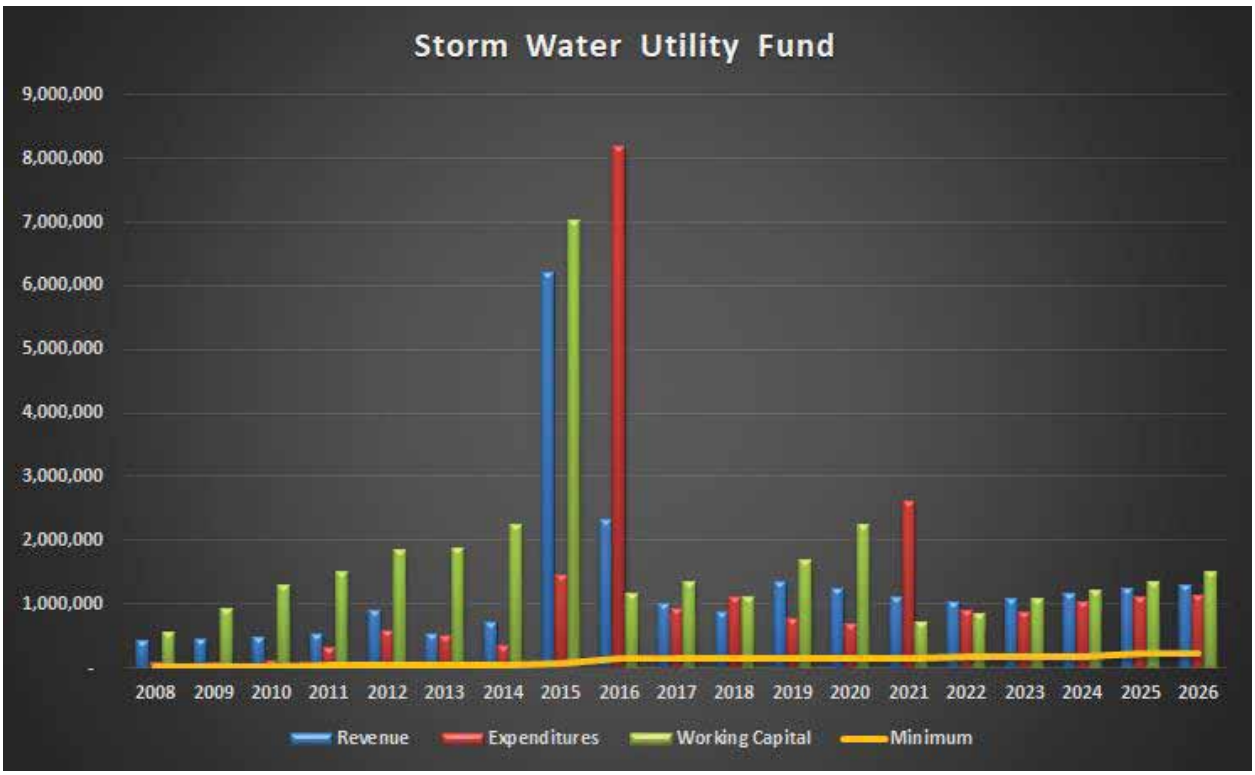
The City's Reserve Policy for the Utility Funds states,

> *The minimum working capital for the Water, Wastewater, and Storm Water Utility Funds shall be maintained at or above 25% of current operating expenses, as measured on the City's budgetary basis. For purpose of this policy, operating expenses are defined as all budgetary-basis expenses, excluding interfund transfers and capital outlay.*

The Consolidated Utility Fund reserves are expected to remain well above the 25% minimum level as defined in the Reserve Policy. All the individual utility funds are also expected to remain in full compliance with the reserve policy. The following three charts summarize a history and projection of revenue, expenditures, and reserves (defined as working capital) for the individual Water, Wastewater, and Stormwater Utility Funds.

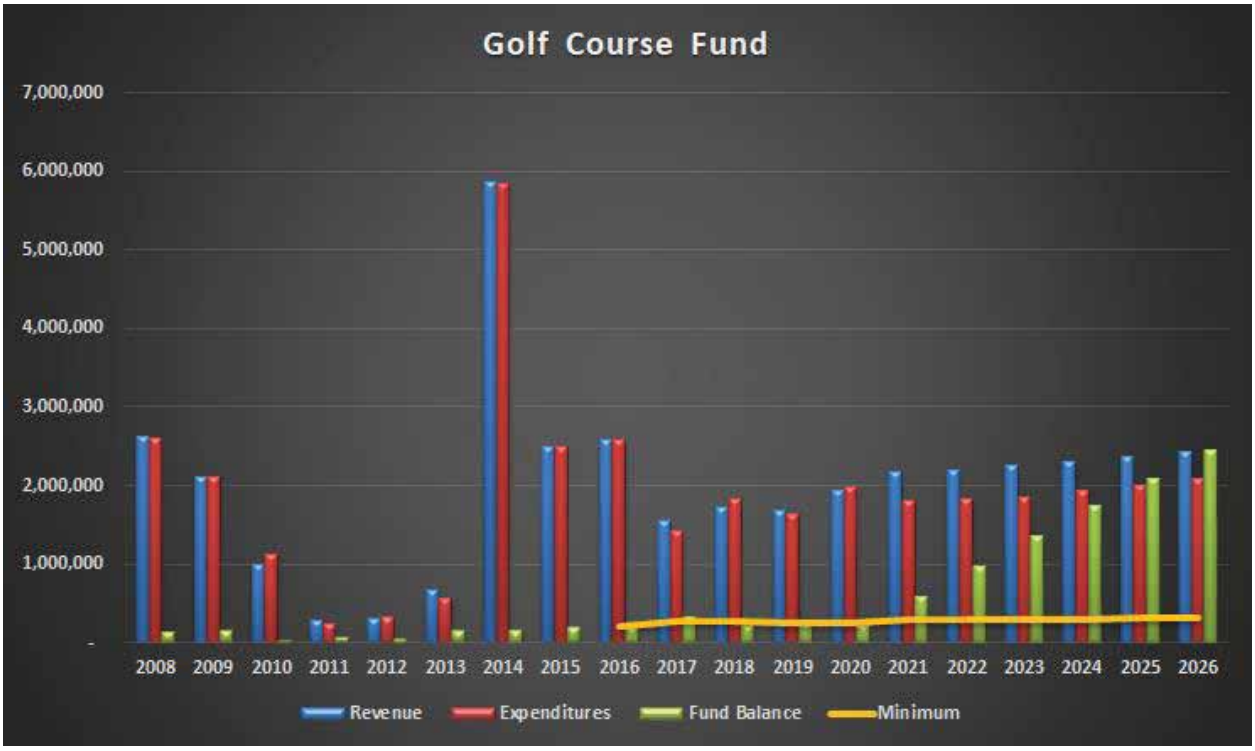

Water Utility Fund
20,000,000
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
-
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026
Revenue
Expenditures
Working Capital
Minimum


Wastewater Utility Fund
35,000,000
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
-
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026
Revenue
Expenditures
Working Capital
Minimum


Storm Water Utility Fund
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026
Revenue
Expenditures
Working Capital
Minimum

Golf Course Fund Long-Term Forecast

Incorporating the revenue assumptions, the operating expenditure targets, and the updated C-I-P projections outlined in the preceding discussion, the following chart summarizes a history and projection of revenue, expenditures, and reserves (defined as working capital) for the Golf Course Fund.



Effective April 1, 2010, the City entered into a license agreement with Western Golf Properties. Under this agreement, all operational revenue and expenses were accounted for by Western Golf Properties. Other than capital outlay, the only expenses recorded by the City were loan repayments to the Wastewater Utility fund. The only revenue recorded by the City was license payments from Western Golf Properties.

The revenue and expense spikes in 2014 reflect the flood reconstruction efforts and the related grants. The City reassumed operations at the golf course in mid-2015.

The revenue and expenses in 2015-2016 are significantly higher than 2017-2018 due to transfers-in from the General Fund and Capital Projects Fund and transfers-out to the Wastewater Utility Fund.

The City's Reserve Policy for the Golf Course Fund states,

> *The minimum working capital balance of the Golf Course Fund shall be maintained at or above 15% of current operating expenditures. For purpose of this policy, operating expenditures are defined as all expenditures, excluding interfund transfers and capital outlay.*

Beginning in 2021, the Golf Course capital budget was moved to the Capital Projects Fund. With this change, the revenues generated by the Golf Course appear sufficient to meet the operating expenses over the long term. The projected Golf Course Fund reserves in 2026 are $2.4 million, approximately 114% of that year's estimated operating expenditures.

RECOMMENDATION

Staff recommends that City Council hold a public hearing for presentation and discussion of the 2020 Revised Recommended Operating & Capital Budget and provide staff with any changes to be incorporated for final adoption on November 1, 2021.

ATTACHMENTS

1. Updated 2021-2026 Capital Improvements Plan summary table
2. 2022 Revised Recommended Budget by Fund
3. Presentation
4. 2021 Key Performance Indicators Update
5. 2021 Strategic Plan Priority Initiatives Update

STRATEGIC PLAN IMPACT

☒	**Financial Stewardship & Asset Management**	☒	**Reliable Core Services**
☐	**Vibrant Economic Climate**	☐	**Quality Programs & Amenities**
☐	**Engaged Community**	☐	**Healthy Workforce**
☐	**Supportive Technology**	☐	**Collaborative Regional Partner**

Six-Year
Capital Improvements Plan
2021 – 2026

Summary of Projects Presented as 2022 Revised Recommended Budget

October 19, 2021

City of Louisville, Colorado
Six-Year Capital Improvement Plan
For the Years 2021 Through 2026

Open Space & Parks Fund

Project Account	Project Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
201511-630071	Parks and Open Space Signs	30,000	30,000	15,000	-	-	-	-	15,000
201511-630133	Freeze Resistant Drinking Fountains	22,500	22,580	-	-	-	-	-	-
201511-630135	Cottonwood Park Development	330,000	330,000	-	-	-	-	-	-
201511-640001	Machinery & Equipment (%)	4,100	43,320	60,000	45,000	45,000	45,000	45,000	240,000
201511-630157	Park Site Furnishing Replacements	25,000	25,000	25,000	-	-	-	-	25,000
201511-640142	Wood Chipper (%)	-	-	42,500	-	-	-	-	42,500
(New)	Community Park Irrigation Replacement	-	-	500,000	-	-	-	-	500,000
201522-630155	Russian Olive Removal and Tree Planting	42,500	42,500	-	-	-	-	-	-
201522-630156	Retaining Wall Replacement	100,000	100,000	-	-	-	-	-	-
201522-640000	Motor Vehicle/Road Equipment (%)	45,000	36,220	-	-	-	-	-	-
201522-640001	Machinery & Equipment (%)	27,000	23,260	10,000	-	-	-	-	10,000
201524-660279	Soft Surface Trail Management Plan	400,000	400,000	180,000	150,000	150,000	150,000	150,000	780,000
201528-660067	Hwy 42 Multi-Use Underpass	15,500	15,500	-	-	-	-	-	-
201528-660277	104th Empire Trail & Shoulder Improvement	465,000	465,000	1,500,000	-	-	-	-	1,500,000
(Operating)	PROST Master Plan	-	-	-	-	225,000	-	-	225,000
	Total Open Space & Parks Fund	**1,506,600**	**1,533,380**	**2,332,500**	**195,000**	**420,000**	**195,000**	**195,000**	**3,337,500**
		-	-	-	-	-	-	-	

Conservation Trust - Lottery Fund

Project Account	Project Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
202511-630048	Playgrounds (%)	25,000	25,000	145,000	120,000	120,000	120,000	120,000	625,000
202511-640001	Parks Equipment Replacement (%)	60,000	60,000	-	-	-	-	-	-
202511-660015	Open Space & Parks Signs (%)	30,000	30,000	15,000	-	-	-	-	15,000
202511-660106	Park Landscape Renovations	-	-	50,000	-	-	-	-	50,000
	Fishing Pond Improvements	-	-	-	-	35,000	300,000	-	335,000
	BMX Drainage	-	-	-	-	55,000	-	-	55,000
	Bench Replacement	-	-	-	-	-	-	15,000	15,000
	Total Conservation Trust - Lottery Fund	**115,000**	**115,000**	**210,000**	**120,000**	**210,000**	**420,000**	**135,000**	**1,095,000**
		-	-	-	-	-	-	-	

Cemetery Fund

Project Account	Project Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
204799-630101	Irrigation Improvements (%)	29,480	29,480	-	-	-	-	-	-
204799-640001	Machinery & Equipment (%)	10,000	10,000	10,000	7,500	7,500	7,500	7,500	40,000
204799-640142	Wood Chipper (%)	-	-	4,250	-	-	-	-	4,250
	Total Cemetery Fund	**39,480**	**39,480**	**14,250**	**7,500**	**7,500**	**7,500**	**7,500**	**44,250**
		-	-	-	-	-	-	-	

Historic Preservation Fund

Project Account	Project Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
207542-620109	Miners' Cabins Relocation	192,990	192,990	-	-	-	-	-	-
207542-620113	Historical Museum Structural Work (%)	60,850	60,850	-	-	-	-	-	-
	Total Historic Preservation Fund	**253,840**	**253,840**	**-**	**-**	**-**	**-**	**-**	**-**

Recreation Fund

Project Account	Project Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
208535-620128	Aquatics Amenity Updates	15,000	15,000	12,000	11,000	-	-	-	23,000
208535-640144	Pump Replacements	-	-	15,000	15,000	15,000	15,000	-	60,000
208538-630101	Irrigation Improvements (%)	167,030	167,030	-	-	-	-	-	-
208538-640001	Parks Equipment Replacement (%)	10,000	10,000	10,000	7,500	7,500	7,500	7,500	40,000
208539-620129	Family Locker Room Doors	6,500	6,500	-	-	-	-	-	-
208539-620135	Imperial/Hecla Room Divider	-	-	11,500	-	-	-	-	11,500
208539-640123	Rec Center Equipment Replacement	70,000	70,000	70,000	70,000	100,000	125,000	152,000	517,000
208539-640143	Radio System for Staff	7,000	7,000	-	-	-	-	-	-
	Turf Gym Door Replacement	-	-	-	13,000	-	-	-	13,000
(Operating)	Piano Replacement	-	-	-	6,700	-	-	-	6,700
(Operating)	Trash, Recycle, & Compost Bins	-	-	-	8,000	-	-	-	8,000
	Turf Gym Shade Structure	-	-	-	40,000	-	-	-	40,000
(Operating)	Brooks and Crown Room Doors	-	-	-	6,630	-	-	-	6,630
	Mirrors & Barre in Mt Elbert Studio	-	-	-	26,000	-	-	-	26,000
	Underwater LED Lights	-	-	-	12,000	-	-	-	12,000
(Operating)	Doors to Gendered Locker Rooms	-	-	-	6,500	-	-	-	6,500
	Controller Connectivity	-	-	-	23,000	-	-	-	23,000
	Memory Pool Heaters	-	-	-	40,000	-	-	-	40,000
	Recreation Center Cameras	-	-	-	33,000	-	-	-	33,000
(Operating)	Poll Pace Clocks	-	-	-	-	6,400	-	-	6,400
	Pump Room Layout	-	-	-	10,000	-	-	-	10,000
	Pool Vacuums	-	-	-	-	13,000	-	-	13,000
	Hydroxyl Radicals	-	-	-	-	71,000	-	-	71,000
	Miracote Deck	-	-	-	-	37,000	-	-	37,000
	Chlorine Enclosure	-	-	-	26,000	-	-	-	26,000
	Recreation Center HVAC Replacement	-	-	-	25,000	720,000	-	-	745,000
(Operating)	Memory Chlorinators	-	-	-	-	6,000	-	-	6,000
	Central Pressure Washing	-	-	-	-	-	39,000	-	39,000
	Pool Diving Blocks	-	-	-	-	-	14,000	-	14,000
	Pool Feature Refresh	-	-	-	-	-	-	65,000	65,000
	Pool Furniture	-	-	-	-	-	-	25,000	25,000
	Memory Furniture	-	-	-	-	-	-	37,000	37,000
	Lifeguard Chairs	-	-	-	-	-	-	7,000	7,000
	Raise Lap Pool	-	-	-	-	-	-	52,500	52,500
	Total Recreation Fund	**275,530**	**275,530**	**118,500**	**379,330**	**975,900**	**200,500**	**346,000**	**2,020,230**

Capital Projects Fund

Project Account	Project Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
301103-620133	Building Energy Efficiency	600,000	600,000	-	-	-	-	-	-
301103-660025	Decorative Streetlight LED Conversion	120,000	120,000	120,000	120,000	120,000	120,000	-	480,000
301103-630131	Recycling Cans for Park Sites (%)	5,000	4,810	-	-	-	-	-	-
301103-640030	Electric Vehicle Charging Station	46,400	46,400	-	-	-	-	-	-
301173-650035	ERP System	-	640	-	-	-	-	-	-
301173-650097	City-Wide Surveillance Refresh	-	-	-	50,000	-	-	-	50,000
301173-650102	Server Backup Solution Refresh	85,000	85,000	-	-	-	-	-	-
301173-650103	City-Wide Security Additions	75,000	75,000	-	-	-	-	-	-
301173-650104	City-Wide WiFi Refresh	38,000	38,000	-	-	-	-	-	-
301173-650111	External IT Security Audit	-	-	-	(moved to operations for 2022)			-	-
301173-650112	EnerGov Records to LaserFiche	20,700	20,700	-	-	-	-	-	-
301173-660258	Middle Mile Fiber	333,130	50,000	283,130	275,430	147,870	-	-	706,430
301191-620134	City Hall Elevator Modernization	-	-	135,000	-	-	-	-	135,000
301191-620136	Lactation Pod	12,000	11,000	-	-	-	-	-	-
301191-620137	Planning Dept. Improvements	-	80,000	-	-	-	-	-	-
301191-650109	Fleet Scan Tool Replacement	10,000	6,370	-	-	-	-	-	-
301191-650110	City Hall Mass Notification System	65,000	65,000	-	-	-	-	-	-
301211-620116	Police Dept Basement Restrooms & Lockers	640,000	949,730	-	-	-	-	-	-
301211-640145	Taser Replacements	78,100	78,100	-	-	-	-	-	-
301211-640150	Fingerprint Machine	-	17,400	-	-	-	-	-	-
301211-650105	Additional Features for BRAZO System	11,000	11,000	11,000	-	-	-	-	11,000
301211-650106	Bi-Directional 700-800 Amplifier	187,000	187,000	-	-	-	-	-	-
301211-650107	Communication Equipment for EOC	27,500	13,500	2,000	2,000	2,000	2,000	2,000	10,000
301211-650108	Police Data Storage Server	55,000	55,000	-	-	-	-	-	-
301211-650113	In-Car Video System	62,370	68,000	31,940	31,940	31,940	31,940	31,940	159,700
301219-620120	Police Dept Electrical Work	25,000	45,000	-	-	-	-	-	-
301219-620131	Police Carport with Solar	85,000	85,000	-	-	-	-	-	-
301311-630138	Bus Stop Improvements	80,480	80,480	-	-	-	-	-	-
301311-660202	Railroad Quiet Zones	3,253,500	3,253,500	-	-	-	-	-	-
301312-630144	Transportation Master Plan	332,930	707,930	1,300,000	-	-	-	-	1,300,000
301312-640000	Motor Vehicle/Road Equipment	187,600	187,600	-	-	-	-	-	-
301312-660012	Pavement Booster Program	4,430,250	4,430,250	5,150,000	3,680,000	4,130,000	4,160,000	4,010,000	21,130,000
301312-660022	Concrete Replacement	106,270	106,270	96,000	98,400	100,800	104,400	108,000	507,600
301312-660064	Bridge Inspection Follow-Up Repairs	205,000	205,000	-	-	-	-	-	-
301312-660222	SH42 Short Intersection Construction	327,130	327,130	-	-	-	-	-	-
301312-660256	Downtown Ornamental Light Replacement	24,000	26,450	-	-	-	-	-	-
301312-660278	SBR Pedestrian Improvements	1,359,800	1,359,800	-	-	-	-	-	-
301312-660280	Street Lighting Safety Upgrades	29,900	29,900	61,100	93,600	63,700	98,800	33,800	351,000
301312-660288	Future 42 Study	729,060	729,060	-	-	-	-	-	-
301313-660103	Median Improvements	-	-	300,000	-	-	-	-	300,000
301313-660254	Utility Undergrounding	1,161,200	1,161,200	-	-	-	-	-	-
301314-640135	Snow & Ice Attachment	31,500	31,500	-	-	-	-	-	-
301314-640140	Sander Box Leg Kit	-	9,200	-	-	-	-	-	-
301511-630048	Playground Replacement (%)	-	-	30,000	30,000	30,000	30,000	30,000	150,000
301511-640001	Parks Equipment Replacement (%)	20,000	20,000	20,000	15,000	15,000	15,000	15,000	80,000
301511-640142	Wood Chipper (%)	-	-	38,250	-	-	-	-	38,250
(New)	Park Improvements	-	-	300,000	-	-	-	-	300,000
301524-630158	Fence Replacement - 1501 Empire	45,000	45,000	-	-	-	-	-	-
(New)	Open Space/Trail Improvements	-	-	150,000	-	-	-	-	150,000

(continued)

Capital Projects Fund (continued)

Project Account	Project Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
301537-620132	Golf Maintenance Facility Improvements	147,500	147,500	-	-	-	-	-	-
301537-630161	Driving Range Improvements	40,000	40,000	-	-	-	-	-	-
301537-640001	Machinery & Equipment	4,100	4,100	-	-	-	-	-	-
301537-640146	Golf Course Pond Aerator	11,000	11,000	-	-	-	-	-	-
301551-640030	Library Electric Vehicle Charging Station	20,000	20,000	-	-	-	-	-	-
(New)	Library Plaza Improvements	-	-	122,500	-	-	-	-	122,500
301552-620113	Historical Museum Structural Work (%)	24,400	24,400	-	-	-	-	-	-
301552-620130	Museum HVAC Replacement	38,400	38,400	-	-	-	-	-	-
301553-620114	Center for the Arts Restoration	46,620	46,620	-	-	-	-	-	-
301553-630159	Front Street Plaza - Phase I	-	-	-	120,000	-	-	-	120,000
301553-630160	Front Street Plaza - Phase II	-	-	-	120,000	-	-	-	120,000
301651-630137	Downtown Patio Program Expansion	-	-	12,000	-	12,000	-	-	24,000
	700-800 Mobile Radios	-	-	-	-	-	-	283,650	283,650
	700-800 Portable Radios	-	-	-	-	-	-	334,880	334,880
	Taser Replacements	-	-	-	-	-	-	125,820	125,820
	Bridge Inpections & Repairs	-	-	-	75,000	-	75,000	-	150,000
	Golf Maintenance Facility Improvements	-	-	-	-	227,000	25,000	-	252,000
	Replace Shoretel VOIP Phone System	-	-	-	125,000	-	-	-	125,000
	VRTX Server Cluster Replacement	-	-	-	135,000	-	-	-	135,000
	Golf Equipment Replacement	-	-	-	581,950	-	-	-	581,950
	Replacement of Network Switches	-	-	-	-	80,000	-	-	80,000
	Police & Court HVAC Replacement	-	-	-	-	200,000	-	-	200,000
	Police 7 Court Roof Replacement	-	-	-	-	225,000	-	-	225,000
	City Hall HVAC Replacement	-	-	-	-	-	195,000	-	195,000
	Cart Path Repair	-	-	-	-	-	25,000	25,000	50,000
	City Hall Roof Replacement	-	-	-	-	-	-	190,000	190,000
	Library HVAC Replacement	-	-	-	-	-	-	376,000	376,000
	Library Roof Replacement	-	-	-	-	-	-	250,000	250,000
	Total Capital Projects Fund	**15,236,840**	**15,754,940**	**8,162,920**	**5,553,320**	**5,385,310**	**4,882,140**	**5,816,090**	**29,799,780**
		-	-	-	-	-	-	-	

Recreation Center Construction Fund

Project Account	Project Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
303120-620106	Rec Center Construction	-	-	93,500	-	-	-	-	93,500
	Total Recreation Center Construction Fund	**-**	**-**	**93,500**	**-**	**-**			**93,500**
		-	-	-	-	-	-	-	

Water Utility Fund

Project Account	Project Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
501498-640000	Motor Vehicle/Road Equipment (%)	169,650	169,650	-	-	-	-	-	-
501498-640001	Machinery & Equipment (%)	-	-	54,390	-	-	-	-	54,390
501498-640045	Meters	79,280	79,280	-	-	-	-	-	-
501498-640147	Backhoe Replacement (%)	78,750	73,090	-	-	-	-	-	-
501498-640148	Chemical Mixing Equipment Replacement	-	-	32,500	-	-	-	-	32,500
501498-660122	Pump R and R	84,000	84,000	276,000	17,000	-	-	-	293,000
501498-660124	Valve R and R	35,000	42,000	-	-	-	-	-	-
501498-660182	Water Line Replacement	1,960,780	1,960,780	391,000	540,500	724,500	494,500	500,000	2,650,500
501498-660205	PRV Replacement	100,000	250,000	-	-	-	-	-	-
501498-660237	Water Tank Int Structure Maint	377,320	426,500	30,000	-	-	-	30,000	60,000
501498-660259	Floride Equipment Replacement	238,930	350,000	-	-	-	-	-	-
501498-660282	HBWTP Recycle Tank Maintenance	195,000	195,000	-	-	-	-	-	-
501499-620119	Utilities Electrical Assessment (%)	132,500	132,500	100,000	-	-	-	-	100,000
501499-620136	Lactation Pod	12,000	11,000	-	-	-	-	-	-
501499-630146	Marshall Lake Sediment Control	600,000	-	710,000	-	-	-	-	710,000
501499-660190	NCWCD-Windy Gap Firming Proj	1,500,000	378,000	630,960	679,290	511,790	511,720	1,177,000	3,510,760
501499-660211	Howard Diversion Upgrades	122,630	122,630	-	-	-	-	-	-
501499-660212	SCWTP Recycle Pond Maintenance	29,000	29,000	-	-	-	-	-	-
501499-660236	SBR Ditch Lining	279,970	325,000	218,500	143,750	-	-	-	362,250
501499-660237	WTP Tank Cleaning & Evaluation	50,000	50,000	-	-	-	-	-	-
501499-660240	Howard Berry Weather Station	-	8,520	-	-	-	-	-	-
501499-660243	Louisville Pipeline Flow Control	-	-	-	-	-	-	-	-
501499-660260	WTP Vault Painting	142,280	142,280	-	-	-	-	-	-
501499-660261	WTP Raw Water Study	196,980	196,980	-	-	-	-	-	-
501499-660275	NCWCD SWSP Transmission Capacity	3,140,000	3,140,000	-	-	-	-	-	-
501499-660283	Process Pipe Evaluation	-	-	80,000	50,000	50,000	50,000	-	230,000
501499-660284	Utility Master Plan (%)	-	-	125,000	-	-	-	-	125,000
501499-660289	Raw Water Infrastructure	1,000,000	1,000,000	-	-	-	-	-	-
501499-670000	Water Rights Acquisition	1,050,000	1,050,000	1,250,000	1,250,000	250,000	500,000	500,000	3,750,000
	Harper Lake Pump Station	-	-	-	-	95,000	2,320,000	-	2,415,000
	Louisville Lateral Ditch Piping	-	-	-	3,120,000	-	-	-	3,120,000
	Filter Media Replacement	-	-	-	616,000	-	-	-	616,000
	Meter Replacement	-	-	-	1,560,000	1,560,000	-	-	3,120,000
	WTP Vehicle Replacement	-	-	-	80,000	50,000	-	-	130,000
	HBWTP Drying Beds Maintenance	-	-	-	-	-	221,000	-	221,000
	Instrumentation Replacement	-	-	-	-	-	-	260,000	260,000
(New)	Channel/Ditch Maintenance	-	-	-	10,000	10,000	10,000	10,000	40,000
(New)	Reservoir Inundation Map Update	-	-	-	60,000	-	-	-	60,000
(New)	FlowCAM	-	-	-	175,000	-	-	-	175,000
(New)	As-Built Drawing Update	-	-	-	-	40,000	-	-	40,000
(New)	High Zone Tank Security	-	-	-	-	-	60,000	-	60,000
	Total Water Utility Fund	**11,574,070**	**10,216,210**	**3,898,350**	**8,301,540**	**3,291,290**	**4,167,220**	**2,477,000**	**22,135,400**
		-	-	-	-	-	-	-	

Wastewater Utility Fund

Project Account	Project Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
502498-660183	Sewer Utility Lines	629,180	629,180	299,000	437,000	540,500	632,500	460,000	2,369,000
502498-660265	Reuse System Equipment Replacement	44,740	44,740	-	-	-	-	-	-
502499-620119	Utilities Electrical Assessment (%)	132,410	132,410	100,000	-	-	-	-	100,000
502499-640149	Secondary Process Probes	105,000	105,000	-	-	-	-	-	-
502499-660262	WWTP Additional Influent Pump	48,020	48,020	-	-	-	-	-	-
502499-660267	WWTP Aeration Basin & Reuse Mixers	454,140	454,410	-	-	-	-	-	-
502499-660271	OPS Lift Station Painting	49,100	49,100	-	-	-	-	-	-
502499-660284	Utility Master Plan (%)	-	-	125,000	-	-	-	-	125,000
502499-660285	WWTP Solids Handling Upgrades	220,000	220,000	1,430,000	-	-	-	-	1,430,000
502499-660286	WWTP Painting	60,000	60,000	-	-	-	-	-	-
	WWTP Vehicle/Equipment Replacement	-	-	-	-	50,000	-	-	50,000
	Total Wastewater Utility Fund	**1,742,590**	**1,742,860**	**1,954,000**	**437,000**	**590,500**	**632,500**	**460,000**	**4,074,000**
		-	-	-	-	-	-	-	

Storm Water Utility Fund

Project Account	Project Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
503499-630096	Detention Pond Maintenance	357,530	357,530	158,000	124,000	150,000	170,000	174,000	776,000
503499-630150	Drainageway "A-1" Garfield/Cottonwood	1,301,460	1,301,460	-	-	-	-	-	-
503499-640001	Machinery & Equipment	-	-	23,310	-	-	-	-	23,310
503499-640147	Backhoe Replacement (%)	31,500	29,340	-	-	-	-	-	-
503499-660287	Storm Water Quality Master Plan Capital	338,640	338,640	100,000	100,000	100,000	100,000	100,000	500,000
(Operating)	Storm Water Master Plan Update	-	-	-	-	120,000	-	-	120,000
	Total Storm Water Utility Fund	**2,029,130**	**2,026,970**	**281,310**	**224,000**	**370,000**	**270,000**	**274,000**	**1,419,310**
		-	-	-	-	-	-	-	

Technology Management Fund

Project Account	Project Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
602120-650015	Computer-Hardware	75,000	75,000	75,000	75,000	75,000	75,000	75,000	375,000
	Total Technology Management Fund	**75,000**	**75,000**	**75,000**	**75,000**	**75,000**	**75,000**	**75,000**	**375,000**
		-	-	-	-	-	-	-	

Fleet Management Fund

Project Account	Project Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
603120-640000	Motor Vehicle/Road Equipment	99,960	99,960	-	-	-	-	-	-
603211-640000	Motor Vehicle/Road Equipment	136,780	136,780	150,450	165,500	182,050	200,260	220,280	918,540
603312-640000	Motor Vehicle/Road Equipment	257,250	257,250	-	-	-	-	-	-
603511-640000	Motor Vehicle/Road Equipment	210,000	210,000	175,100	95,480	136,590	39,390	-	446,560
	Vehicle/Equipment Repalcement - Rec Bus	-	-	-	-	-	-	95,000	95,000
	Total Fleet Management Fund	**703,990**	**703,990**	**325,550**	**260,980**	**318,640**	**239,650**	**315,280**	**1,460,100**
		-	-	-	-	-	-	-	

All Funds

Fund Description	2021 Budget	2021 Estimate	2022 Budget	2023 Planned	2024 Planned	2025 Planned	2026 Planned	5-Year Totals
Open Space & Parks Fund	1,506,600	1,533,380	2,332,500	195,000	420,000	195,000	195,000	3,337,500
Conservation Trust - Lottery Fund	115,000	115,000	210,000	120,000	210,000	420,000	135,000	1,095,000
Cemetery Fund	39,480	39,480	14,250	7,500	7,500	7,500	7,500	44,250
Historic Preservation Fund	253,840	253,840	-	-	-	-	-	-
Recreation Fund	275,530	275,530	118,500	379,330	975,900	200,500	346,000	2,020,230
Capital Projects Fund	15,236,840	15,754,940	8,162,920	5,553,320	5,385,310	4,882,140	5,816,090	29,799,780
Water Utility Fund	11,574,070	10,216,210	3,898,350	8,301,540	3,291,290	4,167,220	2,477,000	22,135,400
Wastewater Utility Fund	1,742,590	1,742,860	1,954,000	437,000	590,500	632,500	460,000	4,074,000
Storm Water Utility Fund	2,029,130	2,026,970	281,310	224,000	370,000	270,000	274,000	1,419,310
Technology Management Fund	75,000	75,000	75,000	75,000	75,000	75,000	75,000	375,000
Fleet Management Fund	703,990	703,990	325,550	260,980	318,640	239,650	315,280	1,460,100
Total for All Funds	**33,552,070**	**32,737,200**	**17,465,880**	**15,553,670**	**11,644,140**	**11,089,510**	**10,100,870**	**65,854,070**

Summary of 2022 Recommended Budget by Fund

Schedules of Revenue, Expenditures, and Changes to Fund Reserves

Presented for City Council Review
October 19, 2021

General Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	2022 % Of 2019 Actual	2022 % Of 2021 Estimate
Revenue:							
Taxes:							
Property Taxes	3,301,562	3,554,671	3,613,280	3,606,640	3,959,220	119.9%	109.8%
Sales Taxes (Net of BAP's)	9,400,752	8,616,538	8,772,660	9,621,970	10,182,080	108.3%	105.8%
Use Taxes (Net of BAP's)	2,516,887	2,162,128	2,147,940	2,459,260	2,543,980	101.1%	103.4%
Franchise Taxes	1,054,850	1,011,685	1,014,470	1,094,980	1,116,270	105.8%	101.9%
Other Taxes	908,059	575,223	574,680	639,330	812,990	89.5%	127.2%
Licenses & Permits:							
Construction Permits (Net of BAP's)	917,864	698,157	1,008,700	826,270	790,180	86.1%	95.6%
Other Licenses & Permits	924,672	577,073	550,410	509,280	528,580	57.2%	103.8%
Intergovernmental Revenue:							
Recurring State-Shared Revenue	1,481,898	1,352,284	1,353,350	1,390,480	1,518,080	102.4%	109.2%
Non-Recurring Grants/Contributions	25,241	1,099,775	2,255,000	136,470	32,000	126.8%	23.4%
Charges for Services:							
Other Charges for Services	176,083	139,818	239,420	141,550	222,570	126.4%	157.2%
Fines & Forfeitures	157,594	92,764	122,590	67,160	70,760	44.9%	105.4%
Miscellaneous Revenue	469,609	417,634	239,660	262,980	220,170	46.9%	83.7%
Other Financing Sources	-	6,106	-	18,800	-		0.0%
Interfund Transfers	79,210	80,840	164,860	178,420	5,409,580	6829.4%	3031.9%
Total Revenue	**21,414,282**	**20,384,695**	**22,057,020**	**20,953,590**	**27,406,460**	**128.0%**	**130.8%**
Expenditures:							
General Government:							
City Manager	362,203	382,969	395,860	413,990	570,640	157.5%	137.8%
Economic Development	203,073	260,934	331,670	335,250	371,790	183.1%	110.9%
City Attorney	408,720	343,339	400,000	400,000	400,000	97.9%	100.0%
City Clerk & Municipal Court	585,180	525,085	594,760	605,570	641,040	109.5%	105.9%
Human Resources	566,774	578,605	683,180	692,550	672,270	118.6%	97.1%
Information Technology	748,389	777,906	839,200	845,560	856,930	114.5%	101.3%
Finance, Accounting, & Tax	725,342	640,498	755,630	773,190	821,880	113.3%	106.3%
Planning & Building Safety	1,264,923	1,129,974	1,474,340	1,311,810	1,757,790	139.0%	134.0%
General Administration Service	1,534,619	2,154,950	2,337,570	2,487,340	2,134,380	139.1%	85.8%
Public Safety	5,585,633	5,706,524	6,795,190	6,811,190	7,059,470	126.4%	103.6%
Public Works	2,903,099	2,822,093	3,524,650	3,618,050	3,395,310	117.0%	93.8%
Culture & Recreation:							
Library & Museum Services	2,148,636	1,917,411	1,999,010	1,993,080	2,443,680	113.7%	122.6%
Parks & Recreation Services	177,702	144,536	206,640	209,190	185,140	104.2%	88.5%
Debt Service	8,943	8,604	8,510	8,510	8,500	95.0%	99.9%
Interfund Transfers	3,910,220	2,498,190	2,433,580	2,488,030	5,184,830	132.6%	208.4%
Total Expenditures	**21,133,456**	**19,891,618**	**22,779,790**	**22,993,310**	**26,503,650**	**125.4%**	**115.3%**
Revenue Over/(Under) Expenditures	**280,825**	**493,077**	**(722,770)**	**(2,039,720)**	**902,810**		
Projected Turnback	**N/A**	**N/A**	**1,119,040**	**1,127,790**	**1,172,540**		
Beginning Fund Balance	**10,528,139**	**10,808,964**	**11,302,041**	**11,302,041**	**10,390,111**		
Ending Fund Balance	**10,808,964**	**11,302,041**	**11,698,311**	**10,390,111**	**12,465,461**		

Open Space & Parks Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	2022 % Of 2019 Actual	2022 % Of 2021 Estimate
Revenue:							
Taxes:							
Sales Taxes	1,766,284	1,618,529	1,644,240	1,804,660	1,930,990	109.3%	107.0%
Use Taxes	599,737	507,044	528,840	571,590	543,660	90.6%	95.1%
Intergovernmental Revenue	3,500	1,001,135	335,000	335,000	1,132,000	32342.9%	337.9%
Miscellaneous Revenue:							
Land Dedication Fees	166,955	205,359	-	182,850	-	0.0%	0.0%
Other Miscellaneous Revenue	133,939	88,923	60,760	76,220	64,660	48.3%	84.8%
Other Financing Sources	10,390	10,544	-	11,050	-	0.0%	0.0%
Interfund Transfers	981,840	1,117,466	1,007,630	941,840	920,300	93.7%	97.7%
Total Revenue	**3,662,644**	**4,548,999**	**3,576,470**	**3,923,210**	**4,591,610**	**125.4%**	**117.0%**
Expenditures:							
Central Fund-Wide Charges	317,982	344,538	375,210	378,500	396,740	124.8%	104.8%
Snow & Ice Removal	91,685	93,143	103,050	107,280	114,150	124.5%	106.4%
Open Space Administration & Operations	342,815	369,021	487,410	489,060	552,700	161.2%	113.0%
Open Space Acquisition	8,919	4,076	4,180	4,180	4,340	48.7%	103.8%
Open Space Education & Outreach	186,742	185,226	166,020	181,300	252,050	135.0%	139.0%
Open Space Trail Maintenance	88,514	94,217	126,030	125,000	124,840	141.0%	99.9%
Open Space New Trails	19,091	20,488	24,770	24,890	24,390	127.8%	98.0%
Parks Administration & Operations	1,631,816	1,521,250	1,874,740	1,879,430	2,055,530	126.0%	109.4%
Capital - Snow & Ice Removal	4,035	33,228	-	-	-	0.0%	
Capital - Parks	127,114	33,685	411,600	450,900	642,500	505.5%	142.5%
Capital - Open Space Maintenance	34,973	-	214,500	201,980	10,000	28.6%	5.0%
Capital - Open Space Education & Outreach	44,652	3,563	-	-	-	0.0%	
Capital - Open Space Trail Maintenance	308,211	(60,179)	400,000	400,000	180,000	58.4%	45.0%
Capital - Open Space New Trails	868,446	1,539,890	480,500	480,500	1,500,000	172.7%	312.2%
Total Expenditures	**4,074,997**	**4,182,144**	**4,668,010**	**4,723,020**	**5,857,240**	**143.7%**	**124.0%**
Revenue Over/(Under) Expenditures	**(412,353)**	**366,856**	**(1,091,540)**	**(799,810)**	**(1,265,630)**		
Projected Operating Turnback	**N/A**	**N/A**	**189,680**	**191,380**	**211,480**		
Beginning Fund Balance	**3,275,092**	**2,862,739**	**3,229,595**	**3,229,595**	**2,621,165**		
Ending Fund Balance	**2,862,739**	**3,229,595**	**2,327,735**	**2,621,165**	**1,567,015**		

Conservation Trust - Lottery Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	2022 % Of 2019 Actual	2022 % Of 2021 Estimate
Revenue:							
Intergovernmental Revenue:							
Recurring State-Shared Lottery Proceeds	252,436	218,749	227,200	251,560	256,590	101.6%	102.0%
Miscellaneous Revenue	3,398	(92)	620	700	2,320	68.3%	331.4%
Total Revenue	**255,834**	**218,657**	**227,820**	**252,260**	**258,910**	**101.2%**	**102.6%**
Expenditures:							
Administration & Operations	57	19	100	100	100	175.8%	100.0%
Capital - Parks	84,318	364,536	115,000	115,000	210,000	249.1%	182.6%
Total Expenditures	**84,375**	**364,555**	**115,100**	**115,100**	**210,100**	**249.0%**	**182.5%**
Revenue Over/(Under) Expenditures	**171,460**	**(145,898)**	**112,720**	**137,160**	**48,810**		
Beginning Fund Balance	**-**	**171,460**	**25,562**	**25,562**	**162,722**		
Ending Fund Balance	**171,460**	**25,562**	**138,282**	**162,722**	**211,532**		

Cemetery Perpetual Care Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Licenses & Permits:							
Burial Permits	22,505	33,365	34,770	34,770	35,470	157.6%	102.0%
Miscellaenous Revenue	15,280	9,310	4,920	4,920	8,640	56.5%	175.6%
Total Revenue	**37,785**	**42,675**	**39,690**	**39,690**	**44,110**	**116.7%**	**111.1%**
Expenditures:							
Administration & Operations	293	302	300	300	300	102.6%	100.0%
Interfund Transfers	15,280	9,310	4,920	4,920	8,640	56.5%	175.6%
Total Expenditures	**15,573**	**9,612**	**5,220**	**5,220**	**8,940**	**57.4%**	**171.3%**
Revenue Over/(Under) Expenditures	**22,212**	**33,063**	**34,470**	**34,470**	**35,170**		
Beginning Fund Balance	**583,564**	**605,776**	**638,839**	**638,839**	**673,309**		
Ending Fund Balance	**605,776**	**638,839**	**673,309**	**673,309**	**708,479**		

Cemetery Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Licenses & Permits:							
Burial Permits	22,505	33,365	34,770	34,770	35,470	157.6%	102.0%
Charges for Services:							
Burial Fees (Open & Close Fees)	41,705	35,360	43,010	36,420	37,510	89.9%	103.0%
Miscellaneous Revenue	1,047	387	210	220	390	37.3%	177.3%
Interfund Transfers	111,530	137,610	169,040	178,880	170,480	152.9%	95.3%
Total Revenue	**176,787**	**206,722**	**247,030**	**250,290**	**243,850**	**137.9%**	**97.4%**
Expenditures:							
Administration & Operations	171,288	197,297	206,440	209,210	227,300	132.7%	108.6%
Capital - Parks	11,425	7,500	39,480	39,480	14,250	124.7%	36.1%
Total Expenditures	**182,713**	**204,797**	**245,920**	**248,690**	**241,550**	**132.2%**	**97.1%**
Revenue Over/(Under) Expenditures	**(5,926)**	**1,925**	**1,110**	**1,600**	**2,300**		
Beginning Fund Balance	**33,513**	**27,587**	**29,513**	**29,513**	**31,113**		
Ending Fund Balance	**27,587**	**29,513**	**30,623**	**31,113**	**33,413**		

PEG Fees Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Charges for Services:							
PEG Fees - Comcast	28,458	25,016	27,000	25,000	25,000	87.8%	100.0%
Miscellaenous Revenue	111	103	130	100	360	324.4%	360.0%
Total Revenue	**28,569**	**25,119**	**27,130**	**25,100**	**25,360**	**88.8%**	**101.0%**
Expenditures:							
Administration & Operations	2	3	50	50	50	2451.0%	100.0%
Interfund Transfers	25,000	25,000	20,000	20,000	-	0.0%	0.0%
Total Expenditures	**25,002**	**25,003**	**20,050**	**20,050**	**50**	**0.2%**	**0.2%**
Revenue Over/(Under) Expenditures	**3,567**	**115**	**7,080**	**5,050**	**25,310**		
Beginning Fund Balance	**7,664**	**11,231**	**11,346**	**11,346**	**16,396**		
Ending Fund Balance	**11,231**	**11,346**	**18,426**	**16,396**	**41,706**		

Parking Improvement Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	2022 % Of 2019 Actual	2022 % Of 2021 Estimate
Revenue:							
Charges for Services:							
Parking Imprvement Fee	91,305	-	-	-	-	0.0%	
Miscellaenous Revenue	1,169	1,393	1,000	1,000	1,000	85.6%	100.0%
Total Revenue	**92,474**	**1,393**	**1,000**	**1,000**	**1,000**	**1.1%**	**100.0%**
Expenditures:							
Administration & Operations	8	45	50	50	50	664.0%	100.0%
Total Expenditures	**8**	**45**	**50**	**50**	**50**	**664.0%**	**100.0%**
Revenue Over/(Under) Expenditures	**92,466**	**1,347**	**950**	**950**	**950**		
Beginning Fund Balance	**-**	**92,466**	**93,813**	**93,813**	**94,763**		
Ending Fund Balance	**92,466**	**93,813**	**94,763**	**94,763**	**95,713**		

Historic Preservation Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Taxes:							
Sales Taxes	588,761	539,510	548,080	601,550	643,660	109.3%	107.0%
Use Taxes	199,874	169,015	176,240	190,530	181,220	90.7%	95.1%
Miscellaneous Revenue	62,745	43,127	21,270	21,120	36,390	58.0%	172.3%
Loan Repayments	3,709	68,823	-	5,650	-	0.0%	0.0%
Total Revenue	**855,089**	**820,475**	**745,590**	**818,850**	**861,270**	**100.7%**	**105.2%**
Expenditures:							
Administration & Operations	132,521	133,501	157,850	160,470	150,800	113.8%	94.0%
Historic Preservation Incentives	136,353	395,326	275,000	316,100	275,000	201.7%	87.0%
Historic Preservation Acquisitions	-	15,010	253,840	253,840	-		0.0%
Interfund Transfers	54,210	55,840	144,860	158,420	164,980	304.3%	104.1%
Total Expenditures	**323,084**	**599,677**	**831,550**	**888,830**	**590,780**	**182.9%**	**66.5%**
Revenue Over/(Under) Expenditures	**532,005**	**220,798**	**(85,960)**	**(69,980)**	**270,490**		
Beginning Fund Balance	**2,111,371**	**2,643,377**	**2,864,174**	**2,864,174**	**2,794,194**		
Ending Fund Balance	**2,643,377**	**2,864,174**	**2,778,214**	**2,794,194**	**3,064,684**		

Recreation Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Taxes:							
Sales Taxes	703,632	647,265	655,010	721,700	772,220	109.7%	107.0%
Use Taxes	233,325	200,591	205,880	226,880	213,820	91.6%	94.2%
Intergovernmental Revenue	57,840	161,502	141,100	146,600	80,000	138.3%	54.6%
Charges for Services	2,908,975	1,086,157	991,790	1,811,320	2,343,420	80.6%	129.4%
Miscellaneous Revenue	93,321	199,881	66,360	83,640	76,780	82.3%	91.8%
Other Financing Sources	1,400	-	-	-	-	0.0%	
Interfund Transfers	1,860,360	1,652,560	1,543,880	1,571,630	1,258,280	67.6%	80.1%
Total Revenue	**5,858,853**	**3,947,956**	**3,604,020**	**4,561,770**	**4,744,520**	**81.0%**	**104.0%**
Expenditures:							
Central Fund-Wide Charges	43,718	62,800	69,100	72,470	76,000	173.8%	104.9%
Recreation Center Building Maintenance	840,861	734,708	874,310	874,310	876,970	104.3%	100.3%
Recreation Center Management	577,540	404,130	555,230	555,230	587,560	101.7%	105.8%
Recreation Center Aquatics	820,282	568,596	792,600	768,480	813,810	99.2%	105.9%
Fitness & Wellness	342,991	299,450	356,900	364,590	400,010	116.6%	109.7%
Youth Activities	347,693	254,506	322,760	333,910	343,630	98.8%	102.9%
Memory Square Pool	218,579	130,221	180,380	180,380	197,460	90.3%	109.5%
Youth Sports	220,705	189,372	211,990	214,190	228,400	103.5%	106.6%
Adult Sports	41,439	37,855	41,300	41,300	43,050	103.9%	104.2%
Seniors	461,616	350,005	321,260	321,260	334,300	72.4%	104.1%
Senior Meals	164,268	287,947	227,070	230,470	177,490	108.0%	77.0%
Nite at the Rec	102,646	66,825	290	-	38,520	37.5%	
Memory Square Building Maintenance	38,170	18,889	32,920	33,670	33,220	87.0%	98.7%
Athletic Fields Maintenance	216,427	131,479	139,140	240,580	149,360	69.0%	62.1%
Capital - Senior Services	-	670	-	-	-		
Capital - Aquatics	129,031	89,100	15,000	15,000	27,000	20.9%	180.0%
Capital - Athletic Fields	79,898	22,303	177,030	177,030	10,000	12.5%	5.6%
Capital - Recreation Center Building	131,358	11,604	83,500	83,500	81,500	62.0%	97.6%
Total Expenditures	**4,777,224**	**3,660,460**	**4,400,780**	**4,506,370**	**4,418,280**	**92.5%**	**98.0%**
Revenue Over/(Under) Expenditures	**1,081,630**	**287,496**	**(796,760)**	**55,400**	**326,240**		
Projected Operating Turnback	**N/A**	**N/A**	**206,260**	**211,540**	**214,990**		
Beginning Fund Balance	**-**	**1,081,630**	**1,369,125**	**1,369,125**	**1,636,065**		
Ending Fund Balance	**1,081,630**	**1,369,125**	**778,625**	**1,636,065**	**2,177,295**		

American Rescue Plan Act Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Intergovernmental Revenue	-	-	-	2,616,050	2,616,050		100.0%
Miscellaenous Revenue	-	-	-	7,500	5,000		66.7%
Total Revenue	**-**	**-**	**-**	**2,623,550**	**2,621,050**		**99.9%**
Expenditures:							
Administration & Operations	-	-	-	-	-		
Interfund Transfers	-	-	-	-	5,244,600		
Total Expenditures	**-**	**-**	**-**	**-**	**5,244,600**		
Revenue Over/(Under) Expenditures	**-**	**-**	**-**	**2,623,550**	**(2,623,550)**		
Beginning Fund Balance	**-**	**-**	**-**	**-**	**2,623,550**		
Ending Fund Balance	**-**	**-**	**-**	**2,623,550**	**-**		

Capital Projects Fund
2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	2022 % Of 2019 Actual	2022 % Of 2021 Estimate
Revenue:							
Taxes:							
Sales Taxes (Net of BAP's)	4,696,997	4,308,269	4,383,180	4,810,990	5,091,040	108.4%	105.8%
Use Taxes (Net of BAP's)	2,265,781	1,718,857	1,923,550	1,869,370	1,765,290	77.9%	94.4%
Intergovernmental Revenue	78,245	1,436,414	2,611,590	2,611,590	-	0.0%	0.0%
Charges for Services	27,167	-	25,000	-	32,000	117.8%	
Miscellaneous Revenue:							
URD Contributions	948,107	-	170,000	187,000	-	0.0%	0.0%
Land Dedication Fees	281,901	-	-	-	-	0.0%	
Other Miscellaneous Revenue	346,319	171,153	105,720	127,210	79,440	22.9%	62.4%
Interfund Transfers	1,597,369	331,939	516,510	354,370	3,194,410	200.0%	901.4%
Total Revenue	**10,241,887**	**7,966,632**	**9,735,550**	**9,960,530**	**10,162,180**	**99.2%**	**102.0%**
Expenditures:							
Central Fund-Wide Charges	325,068	325,489	355,800	355,800	586,670	180.5%	164.9%
Capital - Sustainability	30,166	-	771,400	771,210	120,000	397.8%	15.6%
Capital - City Clerk	7,771	-	-	-	-	0.0%	
Capital - Community Design	590	-	-	-	-	0.0%	
Capital - Information Technology	269,976	190,403	551,830	269,340	283,130	104.9%	105.1%
Capital - General Facilities	10,026	-	87,000	162,370	135,000	1346.5%	83.1%
Capital - Patrol & Investigations	150,142	535,682	1,060,970	1,380,290	44,940	29.9%	3.3%
Capital - Police Department Building Maintenance	192,116	11,648	110,000	130,000	-	0.0%	0.0%
Capital - Planning & Engineering	127,408	97,041	3,333,980	3,333,980	-	0.0%	0.0%
Capital - Transportation	5,160,123	9,398,508	7,731,940	8,109,390	6,607,100	128.0%	81.5%
Capital - Streetscapes	108,552	18,244	1,161,200	1,161,200	300,000	276.4%	25.8%
Capital - Snow & Ice Removal	20,912	18,583	31,500	40,700	-	0.0%	0.0%
Capital - Parks	25,034	251,813	20,000	20,000	388,250	1550.9%	1941.3%
Capital - Open Space Trail Maintenance	308,211	(58,529)	45,000	45,000	150,000	48.7%	333.3%
Capital - Open Space New Trails	24,248	-	-	-	-	0.0%	
Capital - Adult Activities	18,241	-	-	-	-	0.0%	
Capital - Golf Course	3,925	-	202,600	202,600	-	0.0%	0.0%
Capital - Library Services	13,568	-	20,000	20,000	122,500	902.8%	612.5%
Capital - Museum Services	29,802	68,496	62,800	62,800	-	0.0%	0.0%
Capital - Cultural Arts & Special Events	2,098	3,023	46,620	46,620	-	0.0%	0.0%
Capital - Business Retention & Development	24,000	24,000	-	-	12,000	50.0%	
Interfund Transfers	125,000	127,440	128,900	131,900	135,860	108.7%	103.0%
Total Expenditures	**6,976,978**	**11,011,841**	**15,721,540**	**16,243,200**	**8,885,450**	**127.4%**	**54.7%**
Revenue Over/(Under) Expenditures	**3,264,909**	**(3,045,210)**	**(5,985,990)**	**(6,282,670)**	**1,276,730**		
Beginning Fund Balance	**6,442,587**	**9,707,496**	**6,662,286**	**6,662,286**	**379,616**		
Ending Fund Balance	**9,707,496**	**6,662,286**	**676,296**	**379,616**	**1,656,346**		

Impact Fee Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Charges for Services:							
Impact Fees - Transportation	233,872	331,939	531,840	175,000	194,060	83.0%	110.9%
Impact Fees - Parks & Trails	153,230	272,696	126,010	75,000	12,650	8.3%	16.9%
Impact Fees - Library	-	5,926	3,700	1,300	130		10.0%
Miscellaenous Revenue	17,069	7,308	5,520	3,350	2,940	17.2%	87.8%
Total Revenue	**404,172**	**617,869**	**667,070**	**254,650**	**209,780**	**51.9%**	**82.4%**
Expenditures:							
Administration & Operations	393	236	500	500	500	127.2%	100.0%
Interfund Transfers	748,013	604,635	669,660	421,870	214,140	28.6%	50.8%
Total Expenditures	**748,406**	**604,871**	**670,160**	**422,370**	**214,640**	**28.7%**	**50.8%**
Revenue Over/(Under) Expenditures	**(344,235)**	**12,997**	**(3,090)**	**(167,720)**	**(4,860)**		
Beginning Fund Balance	**526,941**	**182,706**	**195,703**	**195,703**	**27,983**		
Ending Fund Balance	**182,706**	**195,703**	**192,613**	**27,983**	**23,123**		

Recreation Center Construction Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Intergovernmental Revenue	471,775	-	-	-	-	0.0%	
Miscellaneous Revenue:							
Interest Earnings	11,934	4,997	-	2,000	-	0.0%	0.0%
Contributions from HPF	23,332	-	-	-	-	0.0%	
Insurance Recovery	347,167	-	-	-	-	0.0%	
Interfund Transfers:							
Transfer from Impact Fee Fund	247,414	-	-	-	-	0.0%	
Total Revenue	**1,101,622**	**4,997**	**-**	**2,000**	**-**	**0.0%**	**0.0%**
Expenditures:							
Administration & Operations	411	131	-	-	-	0.0%	
Capital Outlay - Recreation	3,663,918	56,540	-	-	93,500	2.6%	
Interfund Transfers	-	-	-	-	-		
Total Expenditures	**3,664,329**	**56,671**	**-**	**-**	**93,500**	**2.6%**	
Revenue Over/(Under) Expenditures	**(2,562,707)**	**(51,674)**	**-**	**2,000**	**(93,500)**		
Beginning Fund Balance	**2,827,427**	**264,720**	**213,046**	**213,046**	**215,046**		
Ending Fund Balance	**264,720**	**213,046**	**213,046**	**215,046**	**121,546**		

Recreation Center Debt Service Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Taxes	1,760,880	1,886,607	1,916,770	1,918,250	2,105,280	119.6%	109.8%
Miscellaneous Revenue	13,344	11,674	15,520	15,920	31,270	234.3%	196.4%
Interfund Transfers	-	-	-	-	-		
Total Revenue	**1,774,223**	**1,898,281**	**1,932,290**	**1,934,170**	**2,136,550**	**120.4%**	**110.5%**
Expenditures:							
Administration & Operations	614	663	600	600	600	97.7%	100.0%
Debt Service:							
Principal	680,000	705,000	735,000	735,000	765,000	112.5%	104.1%
Interest	1,062,000	1,034,800	1,006,600	1,006,600	977,200	92.0%	97.1%
Total Expenditures	**1,742,614**	**1,740,463**	**1,742,200**	**1,742,200**	**1,742,800**	**100.0%**	**100.0%**
Revenue Over/(Under) Expenditures	**31,609**	**157,818**	**190,090**	**191,970**	**393,750**		
Beginning Fund Balance	**14,604**	**46,213**	**204,031**	**204,031**	**396,001**		
Ending Fund Balance	**46,213**	**204,031**	**394,121**	**396,001**	**789,751**		

Water Utility Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Intergovernmental Revenue	-	5,000	-	-	-		
Charges for Services:							
User Fees	5,607,511	6,765,376	5,984,630	5,945,660	5,967,820	106.4%	100.4%
Tap Fees	2,853,800	2,148,976	2,994,530	1,550,300	702,200	24.6%	45.3%
Miscellaneous Revenue	708,898	401,576	234,590	318,510	358,620	50.6%	112.6%
Other Financing Sources	-	2,750	5,400,000	5,400,000	-		0.0%
Total Revenue	**9,170,209**	**9,323,678**	**14,613,750**	**13,214,470**	**7,028,640**	**76.6%**	**53.2%**
Expenditures:							
Central Fund-Wide Charges	490,537	549,019	576,520	581,530	703,480	143.4%	121.0%
Utility Billing	133,414	148,759	148,790	148,790	154,020	115.4%	103.5%
Water Utility Engineering	75,392	70,451	79,610	79,610	109,170	144.8%	137.1%
Water Plant Operations	1,317,251	1,296,321	1,277,340	1,277,340	1,421,590	107.9%	111.3%
Raw Water Operations	668,341	811,650	746,520	814,970	767,710	114.9%	94.2%
Water Distribution	438,944	509,729	528,510	533,510	551,200	125.6%	103.3%
Water Treatment Plant Building Maintenance	239,961	247,402	199,520	215,520	199,310	83.1%	92.5%
Debt Service	980,550	986,282	978,620	978,620	983,980	100.3%	100.5%
Replacement Capital - Public Works	2,444,548	127,595	3,318,710	3,630,300	783,890	32.1%	21.6%
Capital - Public Works	1,196,829	2,025,753	8,255,360	6,585,910	3,114,460	260.2%	47.3%
Total Expenditures	**7,985,767**	**6,772,963**	**16,109,500**	**14,846,100**	**8,788,810**	**110.1%**	**59.2%**
Revenue Over/(Under) Expenditures	**1,184,442**	**2,550,715**	**(1,495,750)**	**(1,631,630)**	**(1,760,170)**		
Projected Operating Turnback	**N/A**	**N/A**	**355,680**	**365,130**	**390,650**		
Beginning Working Capital	**15,103,253**	**16,287,695**	**18,838,410**	**18,838,410**	**17,571,910**		
Ending Working Capital	**16,287,695**	**18,838,410**	**17,698,340**	**17,571,910**	**16,202,390**		

Wastewater Utility Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Charges for Services:							
User Fees	3,742,153	4,136,283	3,905,500	3,927,150	4,006,050	107.1%	102.0%
Tap Fees	248,160	245,560	319,500	150,000	60,400	24.3%	40.3%
Miscellaneous Revenue	229,723	123,998	89,330	92,330	107,950	47.0%	116.9%
Other Financing Sources	6,000	-	-	-	-	0.0%	
Total Revenue	**4,226,036**	**4,505,841**	**4,314,330**	**4,169,480**	**4,174,400**	**98.8%**	**100.1%**
Expenditures:							
Central Fund-Wide Charges	358,823	418,092	437,090	441,500	521,300	145.3%	118.1%
Utility Billing	111,805	124,747	121,790	121,790	127,020	113.6%	104.3%
Wastewater Utility Engineering	93,604	58,007	72,210	72,210	96,790	103.4%	134.0%
Wastewater Collections	234,627	249,920	253,330	256,200	244,590	104.2%	95.5%
Wastewater Treatment Plant Operations	856,436	864,444	904,760	910,050	890,550	104.0%	97.9%
Pretreatment	125,876	148,458	152,200	152,200	121,510	96.5%	79.8%
Wastewater Treatment Plant Building Maint	281,011	327,423	315,120	342,770	300,500	106.9%	87.7%
Debt Service	1,208,391	1,268,657	1,282,240	1,282,240	1,280,450	106.0%	99.9%
Replacement Capital - Public Works	569,287	319,742	673,920	673,920	299,000	52.5%	44.4%
Capital - Public Works	24,959	201,372	1,068,670	1,068,940	1,655,000	6630.8%	154.8%
Total Expenditures	**3,864,819**	**3,980,861**	**5,281,330**	**5,321,820**	**5,536,710**	**143.3%**	**104.0%**
Revenue Over/(Under) Expenditures	**361,217**	**524,979**	**(967,000)**	**(1,152,340)**	**(1,362,310)**		
Projected Operating Turnback	**N/A**	**N/A**	**157,960**	**160,770**	**161,160**		
Beginning Working Capital	**5,619,330**	**5,980,547**	**6,505,526**	**6,505,526**	**5,513,956**		
Ending Working Capital	**5,980,547**	**6,505,526**	**5,696,486**	**5,513,956**	**4,312,806**		

Storm Water Utility Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Licenses & Permits	1,200	300	2,000	2,000	2,000	166.7%	100.0%
Intergovernmental Revenue	400,000	250,000	100,000	100,000	-	0.0%	0.0%
Charges for Services	914,281	980,279	984,900	991,300	1,024,290	112.0%	103.3%
Miscellaneous Revenue	32,240	22,340	4,180	10,970	9,600	29.8%	87.5%
Total Revenue	**1,347,721**	**1,252,919**	**1,091,080**	**1,104,270**	**1,035,890**	**76.9%**	**93.8%**
Expenditures:							
Storm Water Utility Engineering	38,608	18,442	20,060	32,470	46,810	121.2%	144.2%
Storm Water Administration & Operations	306,723	308,165	329,510	331,160	353,340	115.2%	106.7%
Debt Service	247,502	259,845	262,620	262,620	262,260	106.0%	99.9%
Capital - Public Works	175,775	114,041	2,029,130	2,026,970	281,310	160.0%	13.9%
Total Expenditures	**768,607**	**700,494**	**2,641,320**	**2,653,220**	**943,720**	**122.8%**	**35.6%**
Revenue Over/(Under) Expenditures	**579,113**	**552,425**	**(1,550,240)**	**(1,548,950)**	**92,170**		
Projected Operating Turnback	**N/A**	**N/A**	**31,460**	**32,730**	**36,010**		
Beginning Working Capital	**1,111,716**	**1,690,830**	**2,243,254**	**2,243,254**	**727,034**		
Ending Working Capital	**1,690,830**	**2,243,254**	**724,474**	**727,034**	**855,214**		

Solid Waste & Recycling Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	2022 % Of 2019 Actual	2022 % Of 2021 Estimate
Revenue:							
Charges for Services:							
User Fees	1,473,659	1,413,012	1,418,970	1,418,970	1,440,260	97.7%	101.5%
Administration Fees	155,955	156,299	156,000	156,000	156,000	100.0%	100.0%
Hazardous Waste Fees	62,855	74,817	62,860	74,820	85,330	135.8%	114.0%
Other Fees	11,691	7,484	9,550	9,550	9,550	81.7%	100.0%
Miscellaneous Revenue	8,459	3,045	2,860	1,400	3,450	40.8%	246.4%
Total Revenue	**1,712,620**	**1,654,655**	**1,650,240**	**1,660,740**	**1,694,590**	**98.9%**	**102.0%**
Expenditures:							
Administration & Operations	122,914	134,609	154,520	144,520	152,900	124.4%	105.8%
BC Household Hazardous Waste	50,703	69,859	71,230	71,230	71,230	140.5%	100.0%
Professional Services - Solid Waste Hauling	1,484,070	1,379,794	1,404,000	1,404,000	1,404,000	94.6%	100.0%
Total Expenditures	**1,657,687**	**1,584,262**	**1,629,750**	**1,619,750**	**1,628,130**	**98.2%**	**100.5%**
Revenue Over/(Under) Expenditures	**54,933**	**70,393**	**20,490**	**40,990**	**66,460**		
Beginning Working Capital	**89,900**	**144,833**	**215,226**	**215,226**	**256,216**		
Ending Working Capital	**144,833**	**215,226**	**235,716**	**256,216**	**322,676**		

Golf Course Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Intergovernmental Revenue	-	910	-	-	-		
Charges for Services:							
Green Fees	865,120	1,164,624	1,050,000	1,258,800	1,283,980	148.4%	102.0%
Annual Season Passes	176,512	216,956	190,000	236,000	236,000	133.7%	100.0%
Golf Cart Rentals	219,795	222,265	231,750	232,000	236,400	107.6%	101.9%
Driving Range Fees	111,124	97,135	118,450	129,110	131,690	118.5%	102.0%
Pro Shop Merchandise Sales	108,697	99,919	108,700	120,000	122,410	112.6%	102.0%
Other Charges for Services	129,492	131,309	157,960	192,000	169,230	130.7%	88.1%
Miscellaneous Revenue	70,808	6,210	10,190	2,890	17,110	24.2%	592.0%
Total Revenue	**1,681,549**	**1,939,329**	**1,867,050**	**2,170,800**	**2,196,820**	**130.6%**	**101.2%**
Expenditures:							
General & Marketing	118,202	150,203	143,580	147,720	153,060	129.5%	103.6%
Golf Operations & Pro Shop	741,346	728,873	724,110	779,800	803,090	108.3%	103.0%
Golf Course Maintenance	665,143	666,600	821,700	826,180	843,830	126.9%	102.1%
Golf Clubhouse Operations & Maintenance	96,259	100,271	110,370	125,470	99,920	103.8%	79.6%
Capital - Parks & Recreation	11,196	333,591	-	-	-	0.0%	
Total Expenditures	**1,632,145**	**1,979,537**	**1,799,760**	**1,879,170**	**1,899,900**	**116.4%**	**101.1%**
Revenue Over/(Under) Expenditures	**49,404**	**(40,209)**	**67,290**	**291,630**	**296,920**		
Projected Operating Turnback	**N/A**	**N/A**	**71,990**	**75,170**	**76,000**		
Beginning Working Capital	**212,778**	**262,182**	**221,973**	**221,973**	**588,773**		
Ending Working Capital	**262,182**	**221,973**	**361,253**	**588,773**	**961,693**		

Technology Management Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	% Of 2019 Actual	% Of 2021 Estimate
Revenue:							
Replacement Contributions	70,666	-	53,030	53,030	53,030	75.0%	100.0%
Miscellaenous Revenue	5,812	2,878	1,190	960	1,330	22.9%	138.5%
Total Revenue	**76,478**	**2,878**	**54,220**	**53,990**	**54,360**	**71.1%**	**100.7%**
Expenditures:							
Administration & Operations	357	477	400	400	400	112.1%	100.0%
Capital - Equipment Replacment	48,815	89,205	75,000	75,000	75,000	153.6%	100.0%
Total Expenditures	**49,172**	**89,682**	**75,400**	**75,400**	**75,400**	**153.3%**	**100.0%**
Revenue Over/(Under) Expenditures	**27,306**	**(86,803)**	**(21,180)**	**(21,410)**	**(21,040)**		
Beginning Fund Balance	**198,796**	**226,102**	**139,299**	**139,299**	**117,889**		
Ending Fund Balance	**226,102**	**139,299**	**118,119**	**117,889**	**96,849**		

Fleet Management Fund

2022 Proposed Budget

	2019 Actual	2020 Actual	2021 Current Budget	2021 Latest Estimate	2022 Proposed Budget	2022 % Of 2019 Actual	2022 % Of 2021 Estimate
Revenue:							
Replacement Contributions	350,796	87,730	281,430	281,430	281,430	80.2%	100.0%
Miscellaenous Revenue	49,265	11,376	2,970	5,000	1,600	3.2%	32.0%
Other Financing Sources	-	23,541	-	-	-		
Total Revenue	**400,061**	**122,647**	**284,400**	**286,430**	**283,030**	**70.7%**	**98.8%**
Expenditures:							
Administration & Operations	306	341	400	400	400	130.7%	100.0%
Capital - Equipment Replacment	306,505	214,847	703,990	703,990	325,550	106.2%	46.2%
Total Expenditures	**306,811**	**215,188**	**704,390**	**704,390**	**325,950**	**106.2%**	**46.3%**
Revenue Over/(Under) Expenditures	**93,250**	**(92,541)**	**(419,990)**	**(417,960)**	**(42,920)**		
Beginning Fund Balance	**567,313**	**660,564**	**568,023**	**568,023**	**150,063**		
Ending Fund Balance	**660,564**	**568,023**	**148,033**	**150,063**	**107,143**		

Public Hearing
2022 Recommended Operating & Capital Budget

October 19, 2021

2022 Budget Adoption Process

- An initial 2022 Operating & Capital Budget was *informally* approved by City Council during the 2021-2022 Biennial Budget process.
- The City's Charter requires City Council adoption of an annual budget each year.
- An updated 2022 Operating & Capital Budget will be presented to Council for *formal* adoption on November 1, 2021

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2022 Budget Adoption Process

- The initial City Manager's Recommended 2022 Operating & Capital Budget was presented at the September 7, 2021 regular City Council Meeting.
- The City Council held Study Sessions on September 14 and September 28, which resulted in the City Manager's Revised Recommended 2022 Operating & Capital Budget presented for Public Hearing.

Summary Packet Contents

- Discussions Included Within the Communication
  - Summary of Changes from City Manager's Recommended Budget Presented on September 7.
  - Summary of Revenue Projections and Assumptions.
  - Summary of Operating Expenditure Projections and Targets.
  - Capital Improvements Plan Update.
  - Interfund Transfers Recommended for 2022.
  - City-Wide 2022 Budget Summary for All Funds.
  - Long-Term Financial Plan Summary.

Summary Packet Contents

- Attachments To the Communication
  - Updated 2021-2026 Capital Improvements Plan (C-I-P) Summary Table (page xxx). This table summarizes the Recommended C-I-P by fund. All changes to the original 2021-2026 C-I-P approved in November 2020 have been highlighted.
  - Summary of the 2022 Recommended Budget by Fund (page xxx). A separate schedule of revenue, expenditures, and changes to fund balance (or working capital for proprietary funds) is presented for each fund. The recommended budget amounts have been highlighted.
  - Updated 2021 Key Performance Indicators (page xxx). KPIs as presented to the Finance Committee on August 23, 2001.
  - Updated Priority Initiatives in the Strategic Plan (page xxx).

Summary of Changes to City Manger's Recommended Budget

- Summary of Changes from September 28 Study Session
  - $250,000 has been added to operating budgets for streetscapes, parks, and open space maintenance.
  - $750,000 has been added to capital budgets for streetscapes, parks, and open space improvements.
  - $200,000 Museum Visitors Center – Design project has been removed from the Capital Improvements Plan (Capital Projects Fund).
  - $50,000 has been added to the General Fund Museum Services operating budget for community engagement and financial refinement related to the Museum Visitors Center project.
  - $12,500 has been added to the General Fund revenue budget for Museum Foundation contributions.

Summary of Changes to City Manger's Recommended Budget

- Summary of Changes from September 28 Study Session (continued)
  - At their September 27 meeting, the Finance Committee recommended that the Recreation Center Bond 2021 debt service levy (for collection in 2022) be maintained at 2.750 mills. Therefore, the 2021 levy has been reset from the previous recommendation of 2.250 mills.
  - $80,000 has been added to the $250,000 Comprehensive Plan budget for an Affordable Housing Study.

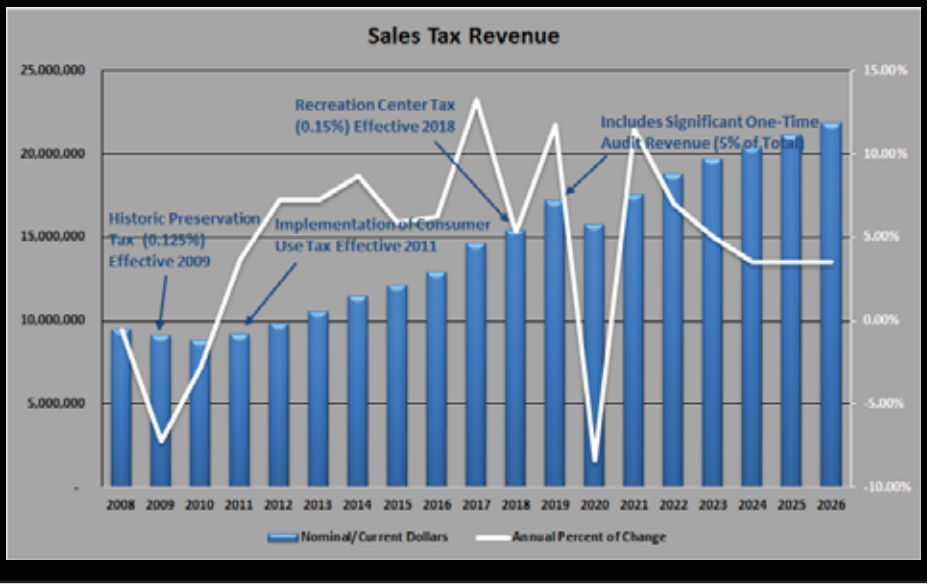
Summary of Changes to City Manger's Recommended Budget

- Summary of Changes from September 28 Study Session (continued)
  - Sales Tax revenue increase adjusted up from 10% to 11.5%.
  - Consumer Use Tax revenue increase adjusted up from 2.5% to 5.5%.
  - Auto Use Tax revenue increase adjusted up from 17.5% to 20%.
  - Building Use Tax revenue increase adjusted up from 5.5% to 15%.
  - Lodging Tax revenue increase adjusted up from 25% to 40%.
  - Construction Permit revenue increase adjusted up from 9.7% to 17.6%.

Revenue Projections/Assumptions

- Sales Tax Revenue
  - Sales tax is a significant revenue source for the City and the projections/assumptions affect the City's main operating and capital funds:
    - General Fund (2.000%)
    - Open Space & Parks Fund (0.375%)
    - Historic Preservation Fund (0.125%)
    - Recreation Fund (0.150%)
    - Capital Project Fund (1.000%)
  - The pandemic significantly impacted sales tax revenue in 2020 (-8.4%). However, staff is projecting a healthy recovery for 2021 (11.5%) and continuing for 2022 (7%).

Revenue Projections/Assumptions



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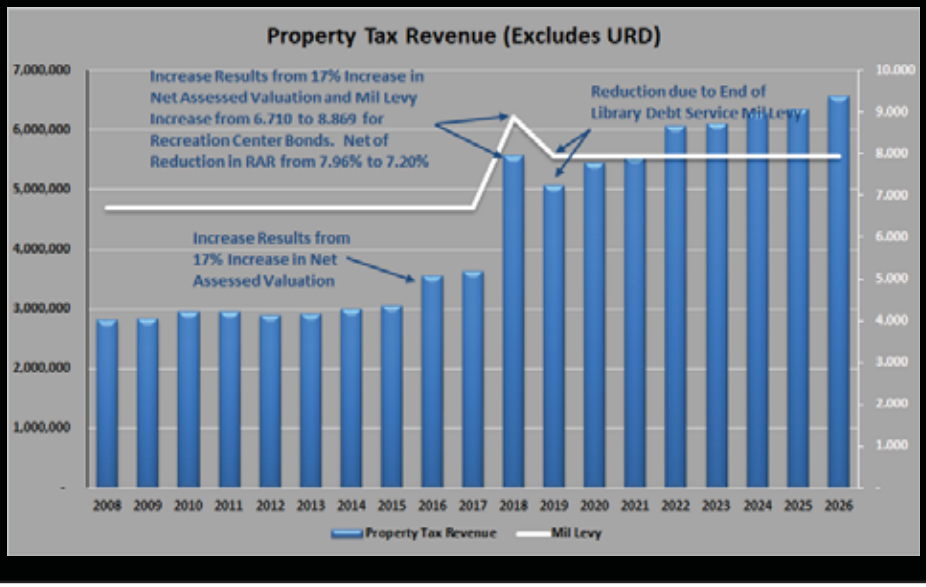
Revenue Projections/Assumptions

- Property Tax Revenue
  - Property tax revenue is determined by the City's assessed valuation multiplied by the City's mill levy.
  - The preliminary assessed valuation received from the Boulder County Assessor show a 9.8% increase in the City's total net assessed valuation. The final assessed valuation is typically received in late November.
  - The City's proposed mill levy for 2021 (for collection in 2022) is proposed at 7.934 mills:
    - 5.184 mill General Levy
    - 2.750 mill Recreation Center Debt Service Levy.

Revenue Projections/Assumptions



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Revenue Projections/Assumptions (page xxx)

Revenue Category	2021 Estimate	2022 Budget	2023 Projection	2024 Projection	2025 Projection	2026 Projection	Percent of Change 2021	2022	2023	2024	2025	2026
Taxes:												
Sales Tax	17,585,190	18,794,760	19,734,500	20,425,200	21,140,080	21,879,990	11.5%	7.0%	5.0%	3.5%	3.5%	3.5%
Property Tax	5,519,890	6,059,500	6,112,560	6,292,220	6,347,540	6,564,330	1.4%	9.8%	0.9%	2.9%	0.9%	3.4%
Use Tax - Consumer	1,749,210	1,810,430	1,873,790	1,939,370	2,007,240	2,077,490	5.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Use Tax - Auto	1,823,480	1,914,660	2,010,390	2,080,750	2,153,570	2,228,940	20.0%	5.0%	5.0%	3.5%	3.5%	3.5%
Use Tax - Building Materials	1,959,250	1,532,520	1,205,330	1,576,940	1,480,120	1,382,580	15.0%	-21.8%	-21.3%	30.8%	-6.1%	-6.6%
Franchise Taxes	1,094,860	1,116,270	1,141,200	1,162,970	1,187,930	1,213,750	8.2%	1.9%	2.2%	1.9%	2.1%	2.2%
Lodging Tax	255,560	319,450	383,380	445,880	484,960	509,230	40.0%	25.0%	20.0%	15.0%	10.0%	5.0%
Specific Ownership Tax	283,750	292,260	301,030	310,060	319,360	328,940	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Licenses & Permits:												
Sales & Use Tax Licenses	86,630	90,960	95,510	100,290	105,300	110,570	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Construction Permits	925,000	790,180	694,570	629,600	709,140	749,290	17.6%	-14.6%	-12.1%	19.5%	-4.8%	-5.3%
Minor Building-Related Permits	250,010	262,510	275,640	289,420	303,890	319,080	-12.1%	5.0%	5.0%	5.0%	5.0%	5.0%
Intergovernmental Revenue:												
Highway Users Tax	554,480	619,000	625,190	631,440	637,750	644,130	-0.8%	11.6%	1.0%	1.0%	1.0%	1.0%
State Lottery	251,560	256,590	261,720	266,960	272,290	277,740	15.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Marijuana Tax	220,810	242,670	260,870	273,910	287,610	301,990	22.5%	10.0%	7.5%	5.0%	5.0%	5.0%
IGA - Superior Library	347,850	381,720	385,540	397,110	401,080	415,120	-0.9%	9.8%	1.0%	3.0%	1.0%	3.5%
Charges for Services:												
Water User Fees	5,940,660	5,967,820	5,967,820	5,997,540	6,057,480	6,057,480	-12.1%	0.4%	0.0%	0.5%	1.0%	0.0%
Water Tap Fees	1,550,300	702,200	2,665,610	4,186,350	2,146,010	1,568,210	-27.9%	-54.7%	279.6%	57.1%	-48.7%	-26.9%
Wastewater User Fees	3,877,150	3,956,650	4,072,930	4,213,780	4,409,650	4,585,670	-4.7%	2.0%	3.0%	3.5%	4.6%	4.0%
Wastewater Tap Fees	150,000	60,400	283,040	480,660	236,040	147,720	-36.9%	-59.7%	368.6%	69.8%	-50.9%	-37.4%
Storm Water User Fees	991,300	1,024,290	1,075,270	1,135,290	1,203,250	1,264,270	1.1%	3.3%	5.0%	5.6%	6.0%	5.1%
Solid Waste User Fees	1,659,340	1,691,140	1,687,740	1,709,670	1,731,920	1,754,510	0.5%	1.9%	-0.2%	1.3%	1.3%	1.3%
Recreation Center Fees	1,967,920	2,423,420	2,470,290	2,518,100	2,566,880	2,616,620	50.6%	23.8%	1.9%	1.9%	1.9%	1.9%
Golf Course User Fees	2,167,910	2,179,710	2,222,940	2,266,800	2,311,540	2,362,320	12.2%	0.5%	2.0%	2.0%	2.0%	2.2%
Developer Impact Fees	251,300	206,840	341,420	581,859	333,690	219,550	-58.8%	-17.7%	65.1%	70.4%	-42.7%	-34.2%
Fines & Forfeitures:												
Court Fines	63,960	60,760	60,760	63,800	66,990	70,340	-25.0%	-5.0%	0.0%	5.0%	5.0%	5.0%

Expenditure Projections/Targets

- Future expenditure projections are referred to as "targets" rather than "assumptions" to reflect the greater control management has over expenditures versus revenue.
- Wages and benefits are the City's largest operation cost category. Recommendations for 2022 wages and benefits include:
  - Average merit increases of 4%.
  - Projection for market increases (for employees whose positions are currently not consistent with the average market salary).
  - An increase in full-time Equivalents (FTEs) from 260 (initial 2021 budget) to 282. Details of staffing changes are presented on pages xxx-xxx.

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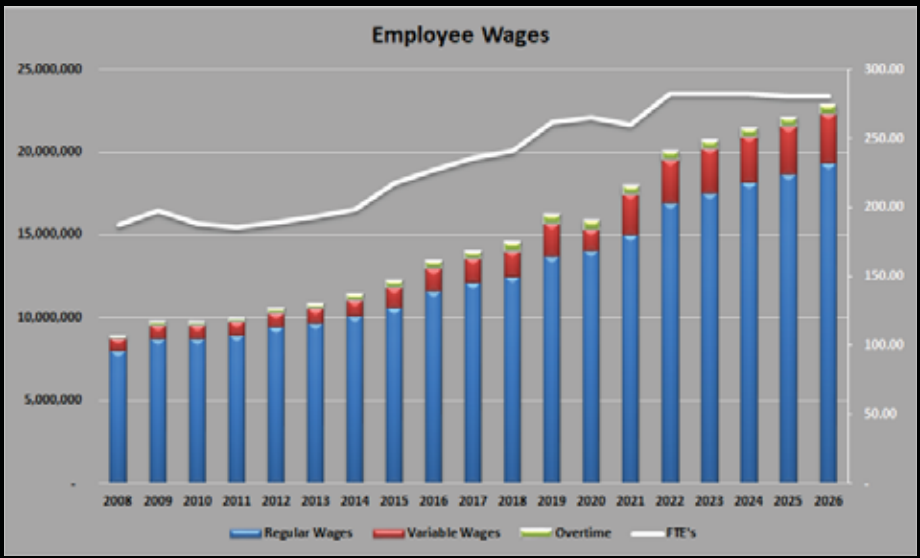
Expenditure Projections/Targets



Expenditure Projections/Targets

- Future expenditure projections/targets are adjusted by operational "turnback" percentages. Turnback refers to positive actual-to-budget variance at year end. Applying turnback percentages account for the recognition that, due to budgetary limitations and controls, the main operating funds typically spend less than their total budget.

Summary of Actual and Targeted Operational Turnback
Selected Operating Funds
2016-2026

Fund Description	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Actual	2021 Target	2022 Target	2023 Target	2024 Target	2025 Target	2026 Target
General	2.6%	9.0%	9.7%	10.4%	4.3%	5.5%	5.5%	5.5%	4.5%	4.5%	4.5%
Open Space & Parks	5.5%	7.0%	11.7%	6.9%	6.6%	6.0%	6.0%	6.0%	5.0%	5.0%	5.0%
Recreation	N/A	N/A	N/A	-2.1%	3.6%	5.0%	5.0%	5.0%	4.0%	4.0%	4.0%
Water Utility	16.1%	33.1%	21.4%	20.4%	4.2%	10.0%	10.0%	10.0%	7.0%	7.0%	7.0%
Wastewater Utility	10.9%	7.6%	12.6%	15.4%	3.5%	7.0%	7.0%	7.0%	5.0%	5.0%	5.0%
Stormwater Utility	11.3%	19.4%	21.4%	7.8%	11.0%	9.0%	9.0%	9.0%	6.0%	6.0%	6.0%
Golf Course	16.5%	4.3%	-16.3%	11.9%	0.0%	4.0%	4.0%	4.0%	3.0%	3.0%	3.0%

Expenditure Projections/Targets (page xxx)

Expenditure Category	2021 Estimate	2022 Budget	2023 Projection	2024 Projection	2025 Projection	2026 Projection	Percent of Change 2021	2022	2023	2024	2025	2026
Salaries & Wages:												
Regular Wages	14,990,400	16,948,630	17,541,810	18,155,780	18,687,760	19,341,830	6.9%	13.1%	3.5%	3.5%	2.9%	3.5%
Variable & Seasonal Wages	2,494,410	2,623,630	2,712,530	2,804,530	2,899,760	2,998,200	88.2%	5.2%	3.4%	3.4%	3.4%	3.4%
Overtime	489,960	476,530	488,460	500,690	513,200	525,990	-6.1%	-2.7%	2.5%	2.5%	2.5%	2.5%
Employee Benefits:												
Employee Insurance	2,343,110	2,689,770	2,877,970	3,079,390	3,294,890	3,525,470	15.2%	14.8%	7.0%	7.0%	7.0%	7.0%
FICA Expense	1,270,950	1,426,260	1,586,850	1,641,720	1,699,730	1,749,230	8.9%	12.2%	11.3%	3.5%	3.0%	3.5%
Retirement Contribution	867,720	975,210	989,070	1,023,410	1,053,290	1,089,860	6.5%	12.4%	1.4%	3.5%	2.9%	3.5%
Workers Compensation	200,890	239,450	239,450	239,450	239,450	239,450	-11.4%	19.7%	0.0%	0.0%	0.0%	0.0%
All Employee Compensation	22,673,880	25,385,350	26,442,030	27,450,840	28,384,950	29,475,980	12.3%	12.0%	4.2%	3.8%	3.4%	3.8%
Supplies:												
Chemicals	459,400	462,400	473,960	485,840	497,980	510,430	10.5%	0.7%	2.5%	2.5%	2.5%	2.5%
Vehicle Maintenance Supplies	222,350	213,310	218,710	224,220	229,840	235,570	9.6%	-4.1%	2.5%	2.5%	2.5%	2.5%
Street Supplies	175,820	170,700	175,830	181,100	186,540	192,140	5.5%	-2.9%	3.0%	3.0%	3.0%	3.0%
Uniforms & Clothing	111,580	109,630	111,820	114,050	116,310	118,600	-1.3%	-1.7%	2.0%	2.0%	2.0%	2.0%
Library Books & Media	60,900	95,960	97,880	99,840	101,830	103,870	-5.2%	57.6%	2.0%	2.0%	2.0%	2.0%
All Supplies	1,996,690	1,826,070	1,875,450	1,926,000	1,977,840	2,031,000	10.3%	-8.5%	2.7%	2.7%	2.7%	2.7%
Purchased/Contracted Services:												
Professional Services	3,841,490	3,803,800	3,442,950	3,639,900	3,784,200	3,997,190	29.3%	-1.0%	-9.5%	5.7%	4.0%	5.6%
Utilities	2,146,590	2,123,960	2,196,370	2,275,300	2,354,920	2,437,330	1.2%	-1.1%	3.5%	3.5%	3.5%	3.5%
Solid Waste Hauling	1,404,000	1,404,000	1,461,860	1,483,790	1,506,040	1,528,630	1.8%	0.0%	4.1%	1.5%	1.5%	1.5%
Parts, Repairs, & Maintenance	1,944,230	1,422,190	1,269,470	1,425,490	1,358,560	1,502,610	46.7%	-26.9%	-9.3%	10.5%	-4.7%	10.6%
Legal Services	572,360	528,500	539,070	549,850	560,840	572,060	14.3%	-7.7%	2.0%	2.0%	2.0%	2.0%
Insurance Premiums & Deductibles	743,380	802,320	858,460	901,410	946,460	993,780	13.9%	7.9%	7.0%	5.0%	5.0%	5.0%
Boulder Dispatch Services	346,700	348,980	354,210	359,520	364,910	370,380	12.3%	0.7%	1.5%	1.5%	1.5%	1.5%
All Purchased/Contracted Services	12,030,250	11,415,300	11,180,840	11,622,500	11,904,940	12,428,340	12.0%	-5.1%	-2.1%	4.0%	2.4%	4.4%

Capital Improvements Plan

- Section 5.5 of the City's Financial Policies requires a Capital Improvement Plan be presented to the City Council for consideration during the biennial budget development process.
- The initial 2021-2026 Capital Improvements Plan was developed during the 2021-2022 biennial budget process, approved by City Council, and published in the 2021-2022 Biennial Operating & Capital Budget document.
- The updated 2021-2026 Capital Improvements Plan is summarized on pages xxx-xxx of the packet and includes:
  - All changes approved at the June 15, 2021 budget amendment.
  - Additional changes proposed with the 2022 budget. All these changes have been highlighted in the Capital Improvements Plan Summary Table.

Interfund Transfers

Inter-Fund Transfers Matrix
2022 Proposed Budget

Transfers Out	Transfers In: General Fund	OS&P Fund	Cemetery Fund	Recreation Fund	Capital Projects Fund	Total
General Fund	-	900,570 a	161,840 b	1,122,420 c	3,000,000 d	5,184,830
Cemetery Perpetual Care Fund	-	-	8,640 e	-	-	8,640
Historic Preservation Fund	164,980 f	-	-	-	-	164,980
American Rescue Plan Act	5,244,600 g	-	-	-	-	5,244,600
Capital Project Fund	-	-	-	135,860 h	-	135,860
Impact Fee Fund	-	19,740 i	-	-	194,400 i	214,140
Total	5,409,580	920,310	170,480	1,258,280	3,194,400	10,953,050

a *Annual recurring support for operations and capital.*
b *Annual recurring support for operations and capital.*
c *Annual recurring support for operations and capital.*
d *One-time transfer to help fund costs for capital projects.*
e *Annual recurring transfer of interest earned used to fund operations and capital.*
f *Annual recurring transfer for reimbursement of costs associated with Museum Services.*
g *Transfer of all CSLFR funds to cover eligible expenditures within the General Fund.*
h *Annual recurring support for capital.*
i *Annual transfer of impact fee revenue for projects eligible for this type of funding.*

2022 Revised Recommended Budget

- A City-wide budget summary table is presented on page xxx of the packet.
- A table for each fund summarizing budgeted revenue, expenditures and the resulting changes to fund balances is presented on pages xxx-xxx of the packet.

Long-Term Financial Plan

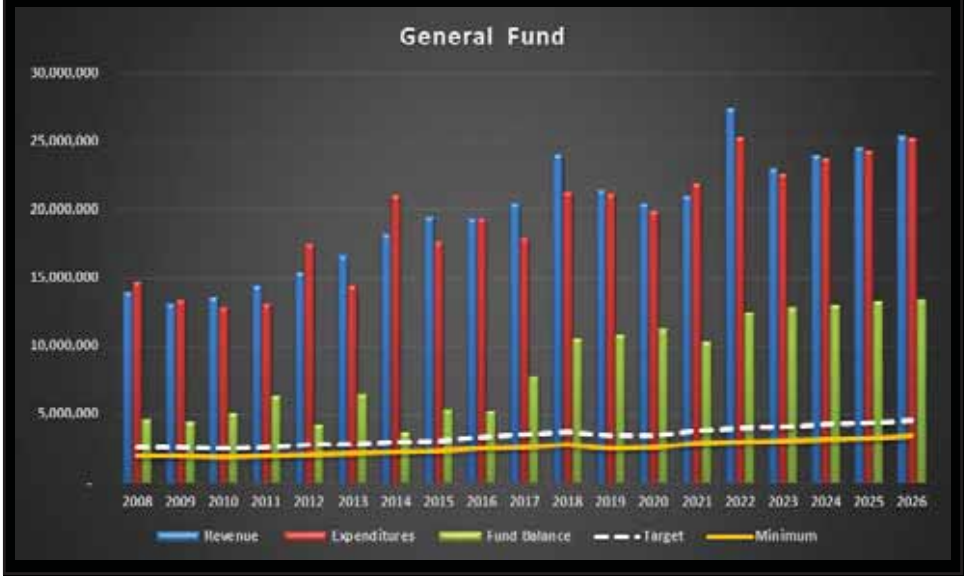
- Section 5.6 of the City's Financial Policies requires a six-year financial forecast for each of the City's major operating funds be presented to the City Council for consideration during budget development.
- The major operating funds are define as the:
  - General Fund;
  - Open Space & Parks Fund;
  - Recreation Fund;
  - Capital Projects Fund;
  - Utility Funds; and
  - Golf Course Fund

Long-Term Financial Plan

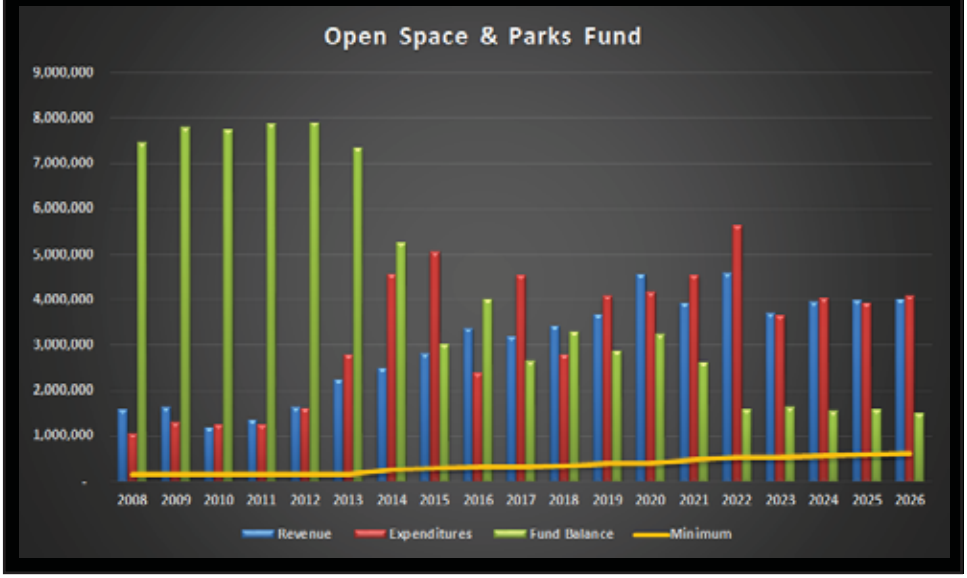
- The forecasting model uses the 2022 budget as the base year and then applies the:
  - revenue assumptions;
  - operating expenditure targets;
  - proposed interfund transfers;
  - and updated Capital Improvements Plan

  to project revenue, expenditures, and fund balances (or working capital for proprietary funds) for years 2023 through 2026.

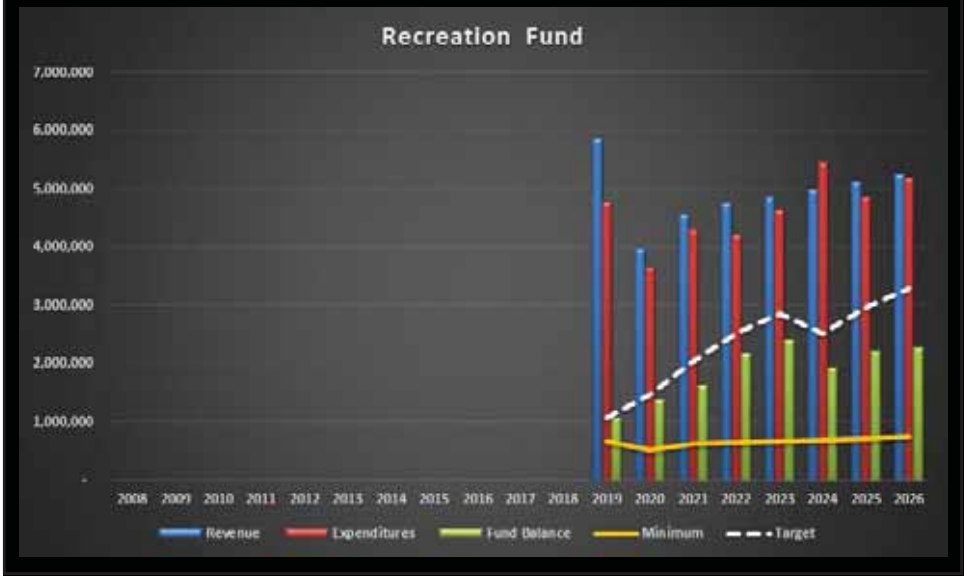
Long-Term Financial Plan



Long-Term Financial Plan



Long-Term Financial Plan



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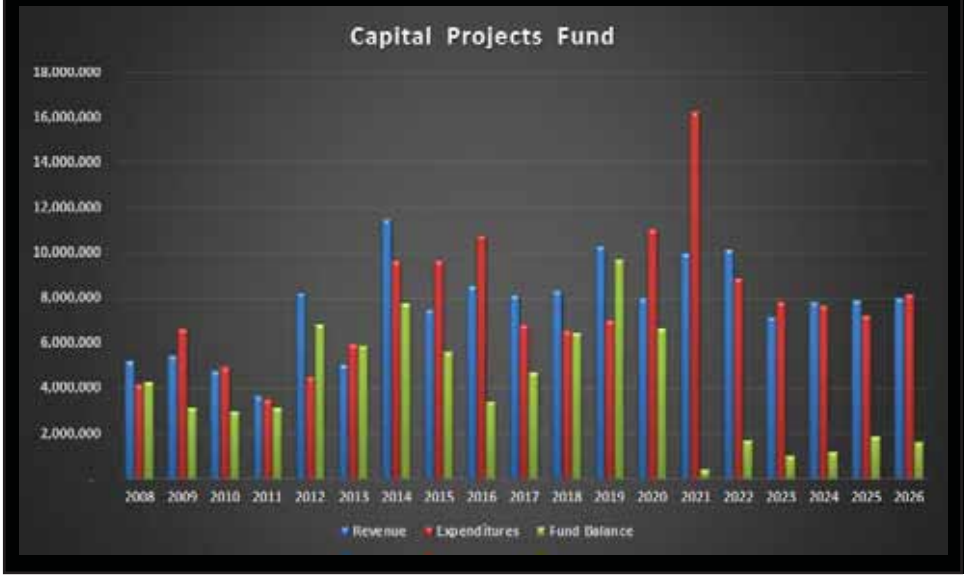

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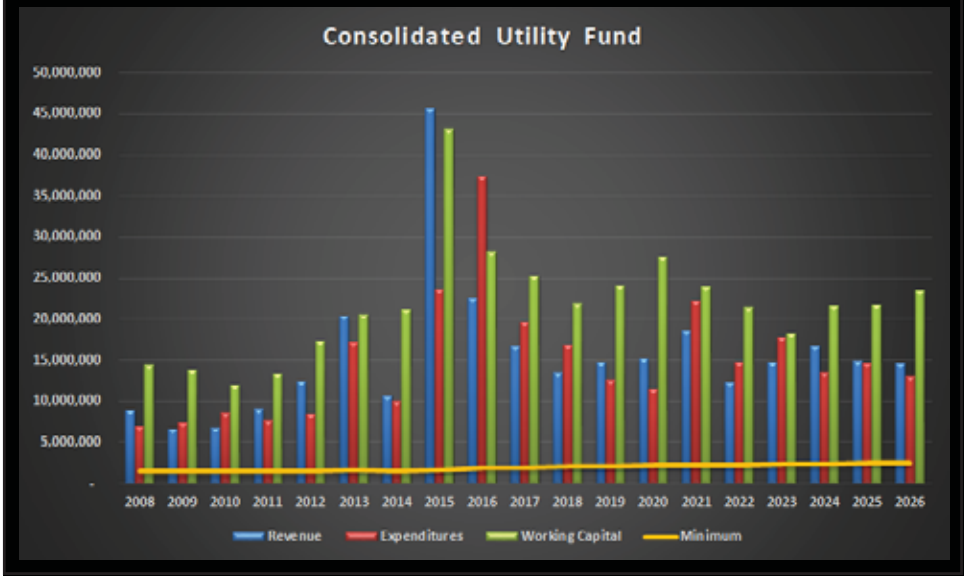
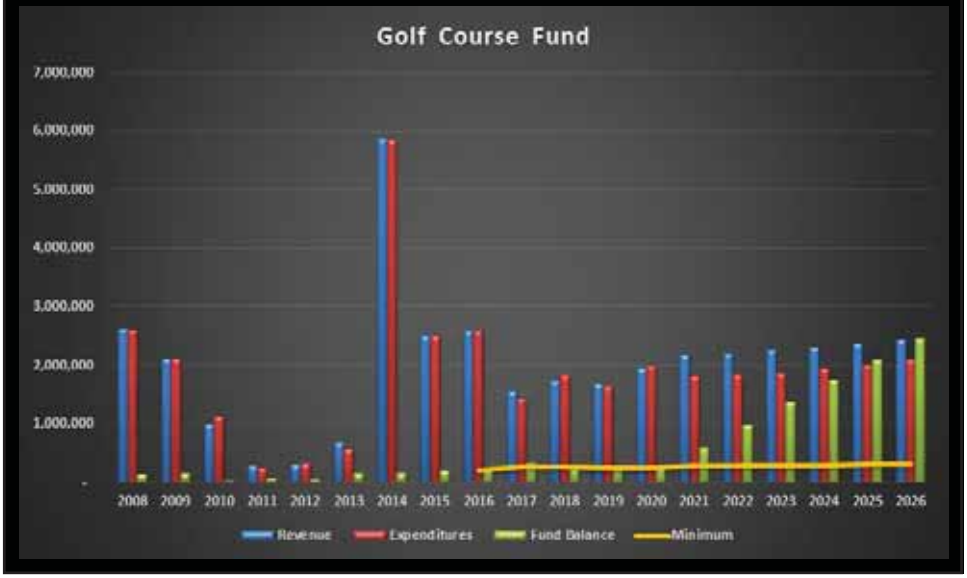


Long-Term Financial Plan



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Final Budget Adoption

- More information on any of the budget topics can be provided at the November 1 City Council Meeting.
- On November 1, City Council will be presented with three Resolutions:
  - A Resolution Adopting the Budget.
  - A Resolution Appropriating Funds.
  - A Resolution Levying Property Tax

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STRATEGIC PLAN - 2021-2022 PRIORITY INITIATIVES PROGRESS UPDATE

Progress Key:	In Progress	Scheduled	Delayed	Completed

Financial Stewardship and Asset Management

Complete a comprehensive systems upgrade on the Tyler-munis financial enterprise system. (Administration & Support Services)

- System upgrades for MUNIS/IAN were completed in early October.

Adjust finances, fees and budget in response to COVID-19 related economic impacts. Respond to economic impacts with necessary budgetary and organizational changes. (Administration & Support Services)

- Revenue projections were adjusted for the 2022 budget development process based on recent trend analysis of the economic recovery. Some of the positions/services that were reduced during 2020 were restored in 2021 or are budgeted to be restored in 2022. Staff continues to monitor revenue and expenditure impacts related to COVID-19.

Reliable Core Services

Complete SH 42 4 lane 30% conceptual design plan and pursue funding/budget for corridor improvements. (Transportation)

- Data collection is completed. Alternatives are currently being developed and reviewed by partner agencies. Alternative will be presented to councils, external stakeholders, and the public for input and identification of preferred design for 30% design effort.

Install/implement transportation infrastructure improvements that foster mobility for all ages and abilities and reduce safety impacts, consistent with the Transportation Master Plan. (Transportation)

- Completed crossing improvements on Washington Ave., Eisenhower Dr., and Century Dr.; Striped bike lanes underway on Centennial Dr., Century Pl., and Century Dr.; South Boulder Rd. at-grade improvement project in final design will submit to CDOT for approval later in 2021 for construction in 2022. South Boulder Rd./Main St. quiet zone complete and crossing improvements underway. Conceptual design for six underpass locations complete for ballot initiative. Via Appia lane reduction design options under development for consideration in 2022.

Continue work on raw water supply projects such as SWSP Capacity Upgrade, Windy Gap Firming, Water Acquisition, and Marshall Lake Sediment Control/Removal. (Utilities)

- The SWSP and Windy Gap Firming Project are both under construction and are scheduled for completion in 2022 and 2025 respectively. Water rights acquisition are progressing with 13 CBT units of new water supply purchased at the beginning of 2021. Marshall Lake Sediment Control efforts are on hold pending the success of a complimentary initiative lead by our project partner the Farmers Reservoir and Irrigation Company (FRICO).

Complete the Police Department renovations to incorporate an emergency operations center in the existing facility. (Public Safety & Justice)

- Updated project budget and scope was approved by Council in September. Work scheduled to commence onsite in October this year.

Incorporate sustainable practices in City operations, facilities, programs and services in an effort to support the City's Sustainability Action Plan goals and to serve as a role model for the community. (Utilities, Administration & Support Services)

- Replacing all non-LED lighting fixtures in City facilities scheduled for 2021. Replacing Hot water Heaters throughout the city that are past their life expectancy with High-Efficiency units scheduled for 2021 and 2022. Reinsulating the Arts Center and Austin Neihoff to a minimum of R-38 scheduled for 2021. Completed benchmarking of all City facilities on the Energy Star portfolio manager and completed building audits with Xcel.

	Continue to review Police Department and Municipal Court operations, approaches and policies to support an equitable approach to community safety, resources and referrals around community mental health needs, and promote a fair and equitable justice system. (Public Safety & Justice)
	• Police Department hands out information cards regarding The Louisville-Superior Food Bank, mental health, addiction and housing services; has in-house mental health clinician for the community; and meets regularly with Centennial Peaks and Avista Hospitals. Department has updated policies and procedures on Police Accountability to reflect new legislation and contemporary police standards. In 2021, the Department hired Crime Prevention Coordinator to promote community safety.
	Vibrant Economic Climate
	Develop Economic Vitality Strategic Plan, including tools and programs focused on increasing retail sales and attracting and inviting a more diverse customer base and sources of revenue to the City. (Economic Prosperity)
	• City Council adopted EVSP in 2020. In 2021, the City developed priority targets to guide business recruitment efforts and developed new marketing materials to assist in attraction activity. An evaluation of the Business Assistance Program also seeks to align incentives with recruitment targets and strategic plan goals. Business attraction is also now tracked through a customer relationship management platform.
	Develop business retention support programs to assist those most economically impacted from the COVID-19 pandemic. (Economic Prosperity)
	• The City has funded three grant programs focused on Louisville small businesses since the start of the pandemic. Two COVID-19 impact surveys of Louisville businesses were also administered to create understanding of the local needs. Pandemic support continues to be a prevalent theme in regular business retention visits.
	Quality Programs and Amenities
	Replace and enhance the playground and restroom facilities at Cottonwood Park. (Parks)
	• Three potential designs will be provided to PPLAB and the community in October to determine a preferred alternative. Construction scheduled to begin late November or early December with completion in early 2022.
	Evaluate programming and services during COVID-19 recovery to understand financial impacts and implement program adjustments. (Administration & Support Services)
	• Operations and expenses were reduced in all program areas in anticipation of revenue reductions, including staff furloughs and elimination of positions. As revenue impacts were tracked and public health orders adjusted, programs, services and staffing were also adjusted accordingly.
	Increase diverse and inclusive program offerings, and utilize marketing and outreach strategies to grow attendance and participation in all City arts and cultural activities. (Cultural Services, Administration & Support Services)
	• Staff in all cultural services departments are working on increasing diversity and inclusivity in programming and added many diverse programs in 2021. The new Arts and Special Events Program Manager is looking to increase the diversity of the LCC as slots open up, in an effort to build this value into the cultural infrastructure.
	Implement ongoing, annual soft surface trail management program to ensure that residents and users have a safe and enjoyable experience when using the City's trail system. (Open Space & Trails)
	• Resurfacing of Davidson Mesa trails scheduled for 2021, currently in the RFP phase. Anticipate work staring in November.

	Engaged Community
	Continue to grow subscribers to City outlets through resources like redesigned website, expanded social media and eNewsletter. (Administration & Support Services)
	• Continuing to use print and online resources to increase subscribers through promoted and organic content. Between October 2020 and October 2021, we saw a 22% increase in subscribers to the Monthly Community Update email newsletter.
	Support efforts to promote Louisville's vibrant economic climate during COVID-19 recovery. (Economic Prosperity)
	• In 2020 and 2021 Outdoor Dining programs responded to the need for outdoor and expanded restaurant space and helped sustain businesses limited by capacity restrictions. The City and the Chamber of Commerce also sponsored the Keep It Local prize draw campaign to encourage and reward people for patronizing local business types most affected by the pandemic (hospitality, fitness providers, and small retailers)
	Begin the 10-year Comprehensive Plan update, including a robust public engagement process that encourages
	• Project is anticipated to start mid-year 2022, with completion in 2023. Anticipate project including broad public engagement strategy including multiple public meetings, focus group, online engagement, etc.
	Engage the community in dialog and learning around diversity, inclusion and racial equity. Develop communications plans that reflect diversity within the community. (Administration & Support Services)
	• The City established an Equity, Diversity and Inclusion (EDI) task force in 2021. All City EDI Task Force and other EDI engagement has included spanish and ASL translation. The City also engaged a consultant to conduct an equity assessment for the organization, which included staff focus group input. Additional staff training and creating action items to implement the assessments recommendations will be next steps**.**
	Continue to share critical information with City staff and community related to COVID-19 recovery and public health guidelines. (Administration & Support Services)
	• Emails, website, social media, and building signage with the latest public health information updated regularly. Regular COVID updates were shared through Mayor's message to community members and Economic Vitality newsletter to businesses.
	Healthy Workforce
	Grow the Learning and Development program in key areas, including diversity, inclusion and racial equity. (Administration & Support Services)
	• Delivered supervisor training, videos, job aids, change management & communications around new technologies (including Executime time keeping system); Trained 91% of Supervisors in All Supervisor Training; Completed DiSC assessments w/ HR, Library, Museum, Water & Planning; Delivered quarterly Green Belt training in alignment with the Data/KPI initiative; Coordinated EDI focus groups & surveys w/ TEP, provided EDI results to Management team and at All-Employee meeting.
	Integrate the utilization of Key Performance Indicators (KPIs) into regular business operations, and support further development of a data-driven, innovative organization. (Administration & Support Services)
	• Hired consultant to update and refine KPIs. Established KPI data champions for all departments, trained staff on use data and meet regularly.

	Supportive Technology
	Prioritize, plan and enhance middle mile infrastructure. (Administration & Support Services)
	• Fiber and conduit installation linking the CCGC Maintenance Shops to the City network is scheduled for 2021. Middle mile infrastructure work has been delayed due to staffing shortages and competing projects in 2021. Budgets have been pushed forward into future years.
	Continuously improve on providing stable technological infrastructure that supports telework and enhances network and data security. Train employees to have an awareness of malware and how to mitigate attacks and protect data. (Administration & Support Services)
	• All workers needing telework setups have been provided with the appropriate equipment. 2021 replacement and refresh are almost 100% complete. All core servers have been moved to a new VSAN environment (2021 Capital Project). Security has been enhanced to provide additional monitoring and external support.
	Provide stable application environments to continuously improve process and data collection. Document and catalog data categories with an emphasis on appropriate retention and protection of Personally Identifiable Information (PII). (Administration & Support Services)
	• Staff continues to roll out ExecuTime time keeping to automate the timekeeping process. ExecuTime Project is approximately 80% complete. MUNIS/IAN upgraded in October 2021. Staff has implemented Laserfiche Forms and have two successful form deployments.
	Collaborative Regional Partner
	Leverage regional partnerships to support transportation improvements, economic vitality, affordable housing, and human services investments for City residents. (Administration & Support Services)
	• Continue to be stay engaged and collaborate with surrounding jurisdictions and regional groups such as RTD, Boulder County Housing Authority, the NW MCC, DRGOG, the RMMACNR, and Commuting Solutions. Worked with Boulder County Housing and Human Services on COVID response investments.
	Engage with the Regional Transportation District and other transportation partners to explore ways to support and improve transit access in the community. Continue to support and advocate for funding and completion of all RTD FastTracks commitments, including Northwest Rail. (Transportation, Administration & Support Services)
	• Participating in RTD Northwest Peak Rail Feasibility Study. Continue to engage with RTD on service plan changes and priorities. Completing the Highway 42 Design Study, which includes consideration of transit priority, transit stops, and enhance multi-modal connectivity.

City of Louisville
COLORADO • SINCE 1878

FINANCE COMMITTEE COMMUNICATION

SUBJECT: **ANNUAL PERFORMANCE MEASURES UPDATE**

DATE: **AUGUST 23, 2021**

PRESENTED BY: **MEGAN DAVIS, DEPUTY CITY MANAGER**
HEATHER BALSER, CITY MANAGER

SUMMARY:
Staff is providing the annual performance measures update, which includes the City's Community Indicators and Key Performance Indicators (KPIs). The City adopted its first program-based budget in 2016. The budget was organized into 10 program areas and 38 sub-programs. To measure the City's progress in achieving the goals and objectives of the programs and sub-programs, the City adopted KPIs for each sub-program. The KPIs were used for the 2017/2018 and 2019/2020 biennial budgets.

In 2020, the City hired a consultant to help refine the KPIs to review the vision for the program, identify current challenges with the KPIs, educate staff on their purpose and solicit input on what information is used to make decisions, consider best practices for performance measures and metrics from similar communities, support the City's Strategic Plan and improve the final product used by staff and Council for decision-making.

The KPIs include workload measures that show the quantity or volume of products, services or efforts involved; efficiency measures that demonstrate the resources used to accomplish an outcome, level of productivity or cost per unit; and effectiveness measures that indicate how well a sub-program is accomplishing the goals and objectives of each program and sub-program. Each effectiveness measure has a target listed.

In addition to the refined KPIs, the consultant recommended the inclusion of Community Indicators. These measures evaluate the City's progress in meeting the goals of the Strategic Plan and the Critical Success Factors, which the City must achieve to accomplish the organization's vision of being 'dedicated to providing a vibrant, healthy community with the best small town atmosphere'. These measures focus on community outcomes and may or may not be in the City's direct control. However, they do show progress made in certain areas and changes experienced by those who live, work and visit Louisville.

ATTACHMENT(S):
1. 2021 Community Indicators & Key Performance Indicators

Community Indicators

Purpose

The purpose of the Community Indicators is to evaluate the City's progress towards achieving the goals in the Strategic Plan and our Critical Success Factors. Critical Success Factors are items that the City must achieve for the organization's vision of being 'dedicated to providing a vibrant, healthy community with the best small town atmosphere'.

These measures focus on community outcomes and align with each Critical Success Factor. Some of these measures may not be in the City's direct control but will show progress and changes experienced by those who live, work and visit Louisville.

INDICATOR	UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Financial Stewardship & Asset Management					
Debt Service Ratio (Debt Service Expenditures/Total Operating Expenditures)	$/$	12.5%	11.5%	11.5%	11.0%
Capital Spending as a Percentage of Total Expenditures	%	27.7%	35.0%	25.0%	25.0%
Bond Rating	Rating	AA+	AA+	AA+	AA+
Reliable Core Services					
Response Time for Emergency Response Services from Initial Call	Minutes	3.8	3.8	3.8	3.8
Average Commute Time	Minutes	N/A	23	23	23
Miles of Bicycle Paths and Lanes per 100,000 Population	#/100,000 Population	72.1	80.8	88.9	88.6
Total Water Consumption per Capita	Gallons/Day/ Capita	135	148	148	148
Percentage of Water Loss (Unaccounted for Water)	%	8.6%	8%	8%	8%
Vibrant Economic Climate					
City's Unemployment Rate	Rate	9.80	4.70	4.0	3.70
Assessed Value of Commercial/Industrial Properties as a Percentage of Total Assessed Value of All Properties	%	N/A	93	93	93
Number of Businesses per 100,000 Population	#	.009	.009	.009	.009
Percentage of City Population Living Below the National Poverty Line	%	N/A	6%	6%	6%
Jobs/Housing Ratio	#/#	1.55	1.55	1.55	1.56
Vacancy Rate by Sector	Office %	18.06	20.75	18.0	16.25
	Retail %	20.96	36.08	28.75	20.75
	Industrial %	32.04	45.63	32.5	21.25
Quality Programs & Amenities					
Number of Cultural Institutions and Sporting Facilities per 100,000 Population	#/100,000 Population	N/A	10	10	10
Percentage of Municipal Budget Allocated to Cultural and Sporting Facilities	%	17%	18%	18%	18%

INDICATOR	UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Annual Number of Cultural Events per 100,000 Population (i.e. Exhibitions, Festivals, Concerts)	#/100,000 Population	N/A	48	100	100
Square Feet of Public Indoor Recreation Space per Capita	#/Capita	5.05	5.05	5.04	5.02
Acres of Public Outdoor Recreation Space per Capita	#/Capita	0.11	0.11	0.11	0.11
Engaged Community					
Number of Registered Voters as a Percentage of Voting Age Population	%	95%	95%	95%	965%
Voter Participation in Last Municipal Election as a Percentage of Registered Voters	%	86%	85%	85%	85%
Number of Internet Connections per 100,000 Population	#/100,000 Population	N/A	92,006	92,227	92,448
Number of Mobile Phone Connections per 100,000 Population	#/100,000 Population	N/A	94,006	94,232	94,458
Healthy Workforce					
Workers' Compensation Rating from Provider	Rating	.99	.99	.97	.95
Percentage of Employees that Participate in Wellness Program	%	44%	61%	70%	75%
Number of Nominations for City's Value (ICARE) Awards	#	P2P – 61 CM – 8	P2P – 45 CM – 8	P2P – 50 CM – 10	P2P – 60 CM – 12
Percentage of Employees with a Performance Review of Exceeds or Higher	%	96.25%	98%	95%	95%
Number of Training Hours per Full-Time Employee	#/FTE	9.5	12	14	16
Full-Time Employee Retention Rate	Rate	89.53	86.5%	87.5%	90%
Supportive Technology					
Network Availability	%	99.99%	99.99%	99.99%	99.99%
IT Budget vs. Total Organizational Budget as a Percentage	%	2.13%	1.60%	2.03%	N/A
Number of Datasets Supported and Net Increase/Decrease in Datasets	#/#	43/0	46/3	48/2	N/A
Performance Measures Updated in the Last Two Years	#	500	150	150	150
Collaborative Regional Partner					
Progress Update on Current Collaborative Policy Issue(s) Being Addressed or Partnership(s)	#	10	10	9	9

*Unemployment statistics not available for cities below 25,000 population. Data provided for Boulder County from Department of Labor & Employment.
**Only have access to 2021 data for assessed value of commercial/industrial properties as percentage of total assessed value of all properties.
***Public indoor recreation space totals 105,000 square feet.
****The City has 335 Park acres and 695 Open Space acres (solely owned by the City) but has joint ownership in a total of 2,000 Open Space acres.

Administration & Support Services Key Indicators
City Clerk/Public Records Sub-Program

Goals

Ensure inclusive, responsive, transparent, friendly, fiscally responsible, effective and efficient governance, administration, and support.

Objectives

Provide efficient and transparent processes for residents to access public documents and notice of public hearings/events. Transparent, consistent and responsive management of the licensing authority and special events permits.

INDICATOR	UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload					
Percentage Change in Number of Licenses and Permits Processed	%	-5%	5%	2%	2%
Efficiency					
Percentage of Public Record Requests Responded to within 24 Hours of Filing Request	%	19.5%	25%	30%	30%
Percentage of Meeting Minutes Completed within the Deadline	%	100%	100%	100%	100%
Notes:					

Administration & Support Services Key Indicators
Facilities Maintenance Sub-Program

Goals

Ensure inclusive, responsive, transparent, friendly, fiscally responsible, effective and efficient governance, administration, and support.

Objectives

Provide and manage facilities that maintain efficient and effective operations and promote environmental and economic sustainability.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
Percentage Change in British Thermal Units (BTUs) per Square Foot for All City Facilities		%	17%	17%	17%	17%
Percentage Change in Water Usage for All City Facilities		%	51%	51%	51%	51%
Percentage Change in Fuel Consumption by City Fleet Vehicles		%	104%	100%	100%	100%
Effectiveness						
Percentage Change in Greenhouse Gas (GHG) Emissions for All City Facilities	Target = -3%	MTC02	-13%*	10%	-3%	-3%

*GHG emissions are measured in MTCO2 and capture emissions from electricity and natural gas usage at nine major City facilities: Library, Recreation Center, Police, City Hall, City Services, Wastewater, North Water Treatment, South Water Treatment, and Golf Clubhouse. Due to COVID-19 and reduction in facility usage, the significant reduction in emissions related to building energy consumption in 2020. From 2020 to 2021, there will likely be a significant increase back to full occupancy and use.

Administration & Support Services Program Key Indicators
Finance, Accounting & Tax Administration Sub-Program

Goals

Ensure inclusive, responsive, transparent, friendly, fiscally responsible, effective and efficient governance, administration, and support.

Objectives

Provide financial services in an efficient and effective manner and financial reporting that is accurate, timely, relevant, and transparent. Develop, maintain, and monitor financial policies and internal controls to ensure the safeguarding of public assets and organizational compliance with laws, regulations, and Council directives. Provide an efficient, effective, and transparent budget developing, reporting, and monitoring process. Provide other financial services, such as long-term financial planning, debt administration, cash and investment management, cash disbursements, cash collections, and front counter services.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
City-Wide Revenue Forecast Accuracy Percentage		%	99.4%	95%	95%	95%
City-Wide Expenditure Forecast Accuracy Percentage		%	74.7%	75%	75%	75%
Number of Audit Findings, Comments and Adjustments		#	1	0	0	0
Effectiveness						
Bond Rating	Target = AA+	Rating	AA+	AA+	AA+	AA+
Recipient of GFOA Award for CAFR and Budget Development	Target = Yes	Yes/No	Yes	Yes	Yes	Yes
Notes:						

Administration & Support Services Program Key Indicators
Governance & Administration Sub-Program

Goals

Ensure inclusive, responsive, transparent, friendly, fiscally responsible, effective and efficient governance, administration, and support.

Objectives

Governance based on thorough understanding of the community's diverse interests executed through clear and effective policy direction. Administration that supports informed policy making, ensures the City has the financial capacity to sustain Council adopted levels of service, monitors and manages service delivery to maintain effectiveness and efficiency, and promotes a healthy organizational culture.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Effectiveness						
Employee Satisfaction Survey Question: Rating of City Leadership	Target = 5	Rate 1 to 5	3.75	3.75	4	4
Community Survey Question: Rating of Overall Performance of City Government	Target = 5	% Excellent or Good	4	4	4	4

*Last employee satisfaction survey was conducted in 2020.
**Last Citizen Survey was conducted in 2020.

Administration & Support Services Program Key Indicators
Human Resources & Organizational Development Sub-Program

Goals

Ensure inclusive, responsive, transparent, friendly, fiscally responsible, effective and efficient governance, administration, and support.

Objectives

Be an employer of choice, with low employee turnover and high morale. Attract and retain highly qualified and dedicated employees by providing competitive compensation and benefits, effective employee training, and ongoing career and professional development opportunities. Maintain a positive work environment through regular position classification and review, workforce planning, salary administration and employee relations. Maintain a safe workplace through employee safety training.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
Average Days from Position Close to Offer Made		#	30	30	27	25
Percentage of Performance Appraisals Completed On Time		%	51.2%	60%	65%	70%
Effectiveness						
Full-Time Employee Retention Rate	Target > 90%	%	89.53%	86.5%	87.5%	90%
Annual Training Hours per Full-Time Employee	Target > 20 hours	#	9.5	12	14	16
Workers' Compensation Rating from Provider	Target <.90	Rating	.99	.99	.97	.95
Employee Satisfaction Survey Question: Rating of Overall Workplace Climate	Target >3.75 (very positive)	1 to 5	3.83	3.9	4	4
*Last employee satisfaction survey was conducted in 2020.						

Administration & Support Services Program Key Indicators
Information Technology Sub-Program

Goals

Ensure inclusive, responsive, transparent, friendly, fiscally responsible, effective and efficient governance, administration, and support.

Objectives

Maintain a secure and connected network ensuring all users have appropriate technological resources to effectively perform their jobs. Provide outstanding internal customer service to efficiently resolve employee help desk issues.

INDICATOR		UNIT	2020 ACTUAL*	2021 ESTIMATED**	2022 PROJECTED***	2023 PROJECTED
Workload						
Percentage Change in Number of Tickets Addressed +		% From Previous Year	+30.75%	+10.00%	+10.00%	N/A
Percentage Change in Number of Devices Supported ++		% From Previous Year	+10.67%	1.74%	3.62%	N/A
Efficiency						
Information Technology Operating Budget as a % of Overall City Budget		% IT/General Fund	3.64%	3.70%	3.76%	N/A
Infrastructure Availability		% of Time	99.99%	99.99%	99.99%	99.99%
Effectiveness						
Internal Survey Question: Overall Performance Rating of IT Services/Support	Target = HIGH	HIGH - MED - LOW Rating	HIGH	HIGH	HIGH	HIGH

* 2020 IT Budget = $752,280
* 2020 General Fund Budget = $20,688,970
\+ 2019 Total IT Tickets = 1,925
\+ 2020 Total IT Tickets = 2,517
\+ 2021 Total IT Tickets (projected) = 2,769
\+ 2022 Total IT Tickets (projected) = 3,046
++ 2019 Total Devices Supported = 1,350
++ 2020 Total Devices Supported = 1,494
++ 2021 Total Devices Supported = 1,520
++ 2022 Total Devices Supported = 1,575
** 2021 IT Budget = $783,140
** 2021 General Fund Budget = $21,170,970
*** 2022 IT Budget = $793,020
*** 2022 General Fund Budget = $21,083,020

Administration & Support Services Program Key Indicators
Legal Support Sub-Program

Goals

Ensure inclusive, responsive, transparent, friendly, fiscally responsible, effective and efficient governance, administration and support.

Objectives

Effective, cost efficient and responsive legal advice for City Council, Management, and staff in legal matters pertaining to their official powers and duties. Represent the City in all legal proceedings, finalize all legal documents for the City.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
Percentage Change in Cost of Annual Legal Fees		%	6%	5%	5%	5%
Effectiveness						
Internal Survey Question: Customer Service Satisfaction with Legal Services	Target = 5	Rating	4	4	4	4
Notes:						

Administration & Support Services Program Key Indicators
Public Information & Involvement Sub-Program

Goals

Ensure inclusive, responsive, transparent, friendly, fiscally responsible, effective and efficient governance, administration, and support.

Objectives

Easy and timely access to all relevant information about City programs and services.
Processes that give anyone interested opportunities to get involved and influence decision making.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Effectiveness						
Number of Monthly Website Visitors	Target = 35,000	#	27,315	27,000	28,000	29,000
Number of Social Media Followers	Target = 15,000	#	7,602	8,500	9,000	9,500
Open/Click-Through Rates for Social Media Posts and eNewsletters	Target = 60%/40%	%	48%/27%	48%/27%	48%/27%	48%/27%
Community Survey Question: Rating of City Response to Citizen Complaints or Concerns	Target = 100%	% Excellent or Good	75%	75%	75%	75%

*Last Community Survey was conducted in 2020.

Administration & Support Services Program Key Indicators
Sustainability Sub-Program

Goals

Ensure inclusive, responsive, transparent, friendly, fiscally responsible, effective and efficient governance, administration, and support.

Objectives

Use environmental, economic, and human resources to meet present and future needs without compromising the ecosystems on which we depend. Actively pursue energy efficient upgrades to realize cost savings and reduce environmental impacts.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Effectiveness						
Community Greenhouse Gas (GHG) Emissions	Target = 150,000	MTCO2e	148,583	147,097	144,155	141,272
Community Water Use per Capita	Target = 45,000	Gallons/Capita	55,192	53,000	53,000	53,000
Residential Waste Diversion Rate	Target = 55%	%	39%	40%	42%	44%
Commercial Waste Diversion Rate	Target = 35%	%	15%	16%	17%	18%

* Estimated and projected figures based off of a continuous 2% decrease as seen between 2018 and 2019 Community Energy Reports.
**Residential waste diversion rate includes all residential waste (single-family city contract, single-family non-city contract, multi-family) reported through Boulder County's ReTRAC database. In 2020, single-family residences under the City's contract had a waste diversion rate of 47%.
***Commercial waste diversion rate includes all commercial waste reported by haulers through Boulder County's ReTRAC database.

Community Design Program Key Indicators
Community Design Sub-Program

Goals

Sustain an inclusive, family-friendly community with a small-town atmosphere, effective and efficient building services and effective preservation of the City's historic structures through a voluntary system.

Objectives

A well-connected and safe community that is easy for all people to walk, bike, or drive in. Neighborhoods that are rated highly by residents and thriving commercial areas. An open and inclusive long-range planning process with significant public participation.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Effectiveness						
Community Survey Question: Rating of Overall Appearance of Louisville	Target = 95%	% Excellent or Good	91%	89%	91%	92%
Community Survey Question: Rating of Ease Walking in Louisville	Target = 95%	% Excellent or Good	91%	93%	93%	94%
Community Survey Question: Rating of Public Input Process on City Planning Issues	Target = 85%	% Excellent or Good	66%	70%	73%	75%
*Last Community Survey conducted in 2020.						

Community Design Program Key Indicators
Development Review Sub-Program

Goals

Sustain an inclusive, family-friendly community with a small-town atmosphere, effective and efficient building services and effective preservation of the City's historic structures through a voluntary system

Objectives

Review development applications and enforce the building, zoning and subdivision laws of the city to promote public health, safety, comfort, convenience, prosperity, general welfare and consumer protection.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
Average Time from Submittal to City Council Public Hearing		Days	185	165	160	160
Percentage of First Staff Comments Provided within 10 Business Days for Building Permits		%	79%	95%	95%	9%
Percentage of Building Inspections that Roll Over to the Following Day		%	.01	0.5	0.5	0.5
Effectiveness						
Community Survey Question: Rating of Louisville Planning & Building Safety Department	Target = 100%	Rating	76%	80%	82%	85%

* Last Community Survey was conducted in 2020.

Community Design Program Key Indicators
Historic Preservation Sub-Program

Goals

Sustain an inclusive, family-friendly community with a small-town atmosphere, effective and efficient building services and effective preservation of the City's historic structures through a voluntary system.

Objectives

Provide incentives to preserve the historic character of old town to encourage the promotion and preservation of Louisville's history and cultural heritage. Provide incentives and processes to preserve historic buildings.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Effectiveness						
Community Survey Question: Rating of Preservation of Historic Character of Old Town	Target = 90%	% Excellent or Good	79%	81%	83%	85%
Percentage of Historic Assessments that Result in Landmarking	Target = 50%	% Excellent or Good	42%	49%	48%	48%
Percentage of Demolition Stays that Result in Preservation	Target = 25%	% Excellent or Good	25%	25%	25%	25%

*Last Community Survey conducted in 2020.

Cultural Services Program Key Indicators
Cultural Arts & Special Events Sub-Program

Goals

Provide services, facilities and activities that inform, involve, engage and inspire the community and preserve the community heritage. Continue City sponsored events.

Objectives

High-quality, diverse community-wide special events, public art, cultural arts programming for residents of and visitors to Louisville. Provide facilities for community cultural arts programming.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
City Facility Utilization Rates		%	N/A	Arts Center – 249/365 Steinbaugh – 83/365	Arts Center – 330/365 Steinbaugh – 180/365	Arts Center – 330/365 Steinbaugh – 180/365
Effectiveness						
Number of Events in Different Geographic Areas	Target = 15	#	N/A	6	10	10
Average Number of Attendees per Outdoor Event	Target = 15,000	#	N/A	11,000	12,000	13,000
Average Number of Attendees per Indoor Event	Target = 80	#	N/A	60	65	70
Community Survey Question: Rating of Opportunities to Attend Cultural Activities	Target = 100%	% Excellent or Good	72%	72%	72%	72%
Community Survey Question: Rating of Opportunities to Participate in Special Events and Community Activities	Target = 100%	% Excellent or Good	90%	90%	90%	90%

*Last Community Survey was conducted in 2020.
** Most events cancelled in 2020 due to COVID-19.
***Outdoor special events include 4th of July, Labor Day, Street Faire and Summer Concerts.

Cultural Services Program Key Indicators
Library Services Sub-Program

Goals

Provide services, facilities and activities that inform, involve, engage and inspire the community and preserve the community heritage.

Objectives

Provide information and technology to all members of the community, with assistance from an approachable, knowledgeable staff. Foster lifelong learning by delivering wide-ranging, hands-on learning activities and programs to all ages. Practice and reinforce the skills needed for reading readiness with young children so that they are poised to be successful learners when they enter school.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
Total Circulation (Number of Checkouts and Renewals)		#	317,353	385,000	450,000	550,000
Circulation per Registered Borrower		#/Borrower	13.79	15.5	18	21
Library Visits per Capita		#/Capita	1.7	2.6	5.3	6.6
Percentage Change in Number of Sessions on Public Computers		%	0	20	0	0
Effectiveness						
Average Number of Attendees per Program	Target = 40	#	15.4	21	24	25
Community Survey Question: Rating of Overall Performance of Louisville Public Library	Target = 95%	% Excellent or Good	97%	97%,	97%	97%

*Last Community Survey conducted in 2020.

Cultural Services Program Key Indicators
Museum Services Sub-Program

Goals

Provide services, facilities and activities that inform, involve, engage and inspire the community and preserve the community heritage.

Objectives

Promote, collect, preserve, and interpret the history of Louisville, with emphasis on the coal mining period from 1877-1955. Make historical artifacts and documents accessible both physically and virtually. Educate children and adults about Louisville's past through programs, displays, and publications.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
Percentage Change in Number of Historic Photos and Documents Catalogued and Accessible		%	4.3%	3%	3%	3%
Effectiveness						
Average Number of Attendees per Program	Target = 22	#	28.2	50	60	60
Percentage Change in Number of Museum Visitors	Target = -84%	%	-88%	66%	5%	5%
Percentage Change in Number of Views of Digital Photos and Documents	Target = 11.4%	%	29%	5%	5%	5%
Community Survey Question: Rating of Overall Performance of Louisville Historical Museum	Target = 95%	% Excellent or Good	95%	95%	95%	95%

*Last Community Survey conducted in 2020.

Economic Prosperity Program Key Indicators
Business Retention and Development Sub-Program

Goals

Promote a thriving business climate that provides job opportunities, facilitates investment, and produces reliable revenue to support City services.

Objectives

Maintain positive business relationships throughout the community and assist property owners, brokers, and companies in finding locations and/ or constructing new buildings in the City. Attract and retain a diverse mix of businesses that provide good employment opportunities for Louisville residents.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Effectiveness						
Commercial Vacancy Rate (Office, Retail, Industrial)	Target = 20%	% Office	18.06	20.75	18.0	16.25
		% Retail	20.96	36.08	28.75	20.75
		% Industrial	32.04	45.63	32.5	21.25
In-City Sales Tax Per Square Foot of Retail Space	Target = $8.00	$/Sq Ft	7.38	7.52	7.50	7.63
In-City Sales & Use Tax per Capita	Target = $600	$/Capita	542	554	554	565
Percentage of Business Assistance Package Incentive Dollars Rebated to Tax Generated	Target = 25%	%	18	223	59	32
Business Assistance Package Incentive Dollars Rebated Per Job Added	Target = $2,000	$	1,619	5,821	3,498	4,342
Community Survey Question: Rating of Overall Economic Health of Louisville*	Target = 88%	% Excellent or Good	84%	84%	84%	84%
Business Satisfaction Survey Rating	Target = 75%	Rating	N/A	N/A	N/A	N/A

*Last Community Survey conducted in 2020; question first asked in 2020.
**Business Satisfaction Survey not yet developed; anticipated to be administered in 2022.

Open Space & Trails Program Key Indicators
Acquisition Sub-Program

Goals

Acquire candidate properties as they become available and preserve, enhance and maintain native plants, wildlife, wildlife and plant habitat, cultural resources, agriculture, scenic vistas, and appropriate passive recreation.

Objectives

Maintain an up-to-date list of high-priority candidate parcels for acquisition. Based on the owner's expressed interests, contact each property owner and determine the most effective strategy for voluntary acquisition of or easement on each candidate parcel. Maintain contact with each property owner consistent with their expressed interests. Voluntarily acquire candidate parcels at a price reflecting the current market value for the comparable property (considering all development restrictions, size, location, existing development, and other relevant factors). Maintain funding for acquisition consistent with adopted Council policy.

INDICATOR	UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload					
Number of Parcels Ranked by OSAB	#	39	42	44	46
Effectiveness					
Percentage Change in Number of Acres/Parcels Acquired	%	0%	6%	0%	0%

*Includes "high priority parcels", "low priority parcels", and "considered but not selected parcels."
**% based on a total of 1,050 acres (355 parks/695 open space).
***% increase based on an acquisition of 2.62 acres of trail corridor related to the St. Louis Parish Development and 58.6 acres related to the Redtail Ridge Development (39.4 open space, 15.6 park, 3.6 trail corridors).

Open Space & Trails Program Key Indicators
Education and Outreach Sub-Program

Goals

Acquire candidate properties as they become available and preserve, enhance and maintain native plants, wildlife, wildlife and plant habitat, cultural resources, agriculture, and scenic vistas, and appropriate passive recreation

Objectives

To inform and educate residents and visitors about the City's diverse Open Space properties and the many benefits associated with these lands. To involve residents and visitors in activities that encourage understanding and stewardship of these lands.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Effectiveness						
Average Number of Participants per Education Program	Target = 30	#	14	20	90	90
Volunteer Hours Donated	Target = 1,400	#	864.25	950	1,200	1,300
Percentage Change in Number of Participants for Digital Engagement Programs and Social Media	Target = 10%	%	48%	25%	15%	15%

*Education and volunteer program offerings and attendance significantly decreased in 2020 and 2021 due to the COVID-19 pandemic and social distancing requirements.

**Large events are expected to restart in 2022, which is projected to return average participant numbers to their historical precedent.

***Volunteer programs included: Adopts, OSAB, Weed Whackers, Photo Points, and Group Projects (counting each group project). Raptor monitoring and Burrowing Owl surveys were canceled in 2020 due to volunteer restrictions during the breeding season. Volunteer programs were not permitted between April and June.

****Followers on Facebook estimated % increase each year.

Open Space & Trails Program Key Indicators
Maintenance and Management Sub-Program

Goals

Acquire candidate properties as they become available and preserve, enhance and maintain native plants, wildlife, wildlife and plant habitat, cultural resources, agriculture, scenic vistas, and appropriate passive recreation.

Objectives

Manage the City's Open Space properties in a manner consistent with good stewardship and sound ecological principles that benefit citizens of Louisville by promoting native plants, wildlife, wildlife and plant habitat, cultural resources, agriculture, and scenic vistas, and appropriate passive recreation.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
Open Space Expenditures per Acre		$/Acre	$660	$865	$878	$905
Effectiveness						
Percentage of Acres Free of High Priority Weeds	Target = 85%	%	83%	83%	80%	85%
Community Survey Question: Rating of Maintenance of Open Space	Target = 93%	% Excellent or Good	93%	95%	95%	95%

*Last Community Survey conducted in 2020.
**Derived from the Trails Maintenance + Open Space Admin & Operations Sub Program Budgets. 3% expenditure inflation included in 2023 projection.

Open Space & Trails Program Key Indicators
New Trails and Trail Maintenance Sub-Program

Goals

Acquire candidate properties as they become available and preserve, enhance and maintain native plants, wildlife, wildlife and plant habitat, cultural resources, agriculture and scenic vistas and appropriate passive recreation.

Objectives

Construct the highest priority new trails and trail connections to enhance the trail system in a manner consistent with City Council adopted plans. Maintain all trails to a satisfactory level to encourage recreation and to enable safe walking, running and bike riding around Louisville.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
Total Trail Miles in Open Space and Parks		#	32	32	34	34
Efficiency						
Percentage of Planned Trail Connections and Crossings Completed		%	69%	69%	74%	74%
Effectiveness						
Community Survey Question: Rating of Maintenance of Trail System	Target = 90%	% Excellent or Good	94%	94%	94%	94%

*Last Community Survey conducted in 2020.
**2022/2023 Projections include the anticipated completion of the 2.2 mile 104th St Connector Trail.
***Percentage of planned trail connections completed is based off current trails, plus planned off street connections from TMP.

Parks Program Key Indicators
Cemetery Sub-Program

Goals

Provide well-maintained parks and landscaped areas that are easy to walk to and enjoyable to visit or see; sports facilities that are fully used and properly maintained; and a final resting place that meets community needs

Objectives

Provide a suitable final resting place that meets community needs.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
Percentage of Plots Available		%	51	51	50	50
Projected Years of Supply Relative to Demand		#	20	20	19	19
Efficiency						
Average Cost to Inter		$	1,330	1,330	1,330	1,369
Effectiveness						
Community Survey Question: Rating of Maintenance of Louisville Cemetery	Target = 100%	% Excellent or Good	87%	87%	87%	87%
*Last Community Survey conducted in 2020.						

Parks Program Key Indicators
Parks Sub-Program

Goals

Provide well-maintained parks and landscaped areas that are easy to walk to and enjoyable to visits or see; sports facilities that are fully used and properly maintained.

Objectives

Well-maintained, popular parks and facilities to provide multiple outdoor opportunities - for residents and visitors to Louisville to enjoy.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
Acres of Park per 1,000 Residents		#	17	17	17	17
Efficiency						
Parks Expenditures per Acre		$/Acre	4,285	4,285	4,800	4,800
Effectiveness						
Community Survey Question: Rating of Overall Performance of Parks Division*	Target = 100%	% Excellent or Good	92%	92%	92%	92%

*Last Community Survey conducted in 2020.

Public Safety Program Key Indicators
Code Enforcement Sub-Program

Goals

Police and other City staff working with the community to help ensure safety, satisfy residents' expectations that individuals observe the City's Municipal Code and State Law, and a justice system that is fair, effective, and efficient.

Objectives

Judiciously enforce the municipal code; including parking, junked vehicles, uncontrolled weeds, and stray dogs. Work with residents and the business community to achieve compliance with City ordinances. Emphasize education and voluntary compliance over punitive enforcement through the Courtesy Notice program.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
Percentage of Cases Brought into Voluntary Compliance		%	96.25%	96.25%	96.25%	96.25%
Average Number of Days from Complaint to Investigation		#	3	3	3	3
Effectiveness						
Community Survey Question: Rating of Municipal Code Enforcement Issues	Target =	% Excellent or Good	72%	72%	72%	72%
*Last Community Survey conducted in 2020.						

Public Safety & Justice Program Key Indicators
Municipal Court Sub-Program

Goals

Police and other City staff working with the community to help ensure safety, satisfy residents' expectations that individuals observe the City's Municipal Code and State Law, and a justice system that is fair, effective, and efficient.

Objectives

Maintain accurate permanent records of citations and payments, administer fair and competent hearings, treat all citizens fairly and equally.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
Percentage of Total Cases Requiring Court Hearing		%	94%	75%	75%	75%
Average Caseload per FTE		#	450	700	750	750
Efficiency						
Average Time for Resolution of Cases		Days	45	30	30	30
Effectiveness						
Customer Survey Question: Rating of Customer Satisfaction	Target = 5	Rating	4	5	5	5

*Surveys are completed on paper in Court. In 2020, court sessions were limited or were held virtually so the number of surveys in very small from before the pandemic.
** Ticket numbers down significantly for 2020 due to pandemic.

Public Safety & Justice Program Key Indicators
Patrol and Investigation Sub-Program

Goals

Police and other City staff working with the community to help ensure safety, satisfy residents' expectations that individuals observe the City's Municipal Code and State Law, and a justice system that is fair, effective, and efficient.

Objectives

Maintain community safety and a low crime rate through community engagement, effective patrol and efficient response times. Emphasize prevention-oriented police services by engaging community groups in effective partnerships.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
Percentage Change in Number of Calls for Service/Officer-Initiated Activity		%	-21.96% from 2019	+12.75%	+12.75%	+12.75
Efficiency						
Response Time for Priority 1 Calls		Minutes	3.8	3.8	3.8	3.8
Effectiveness						
Crime Rate for Part 1 and Part 2 Crimes	Target =	Rate	Part I crimes – 530 Part II crimes – 74	+25%	+25%	+5%
Average Clearance Rate	Target =	Rate	Part I crimes – 58%	Part I crimes – 65%	Part I crimes – 65%	Part I crimes – 65%
Community Survey Question: Rating of Communication Regularly with Community Members	Target =	% Excellent or Good	69% Excellent or Good	69% Excellent or Good	69% Excellent or Good	69% Excellent or Good
Community Survey Question: Rating of Overall Performance of Louisville Police Department	Target =	% Excellent or Good	88% Excellent or Good	88% Excellent or Good	88% Excellent or Good	88% Excellent or Good
Community Survey Question: Rating of Visibility of Patrol Cars	Target =	% Excellent or Good	89% Excellent or Good	89% Excellent or Good	89% Excellent or Good	89% Excellent or Good

*Part I crimes = 2,523.81/100,000 residents & Part II crimes = 352.88/100,000 residents
**Last Community Survey conducted in 2020.

Recreation Program Key Indicators
Adult Activities Sub-Program

Goals

Promote resident's and visitors' physical, mental and social well-being through a broad range of high-quality, reasonably priced recreation and leisure activities for people of all ages, interests, and ability levels.

Objectives

Encourage physical activity, intellectual stimulation, and social well-being by offering adult sports leagues, adult educational programs, and other events.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
Adults Programs Cost Recovery per Class/Program		$/Class or Program	24%	29%	30%	31%
Effectiveness						
Average Number of Participants per Program	Target = 10	#/Program	14	10	11	11
Customer Survey Results: Customer Satisfaction after Program Completion	Target = 5	Rating	5	5	5	5
Community Survey Question: Current Recreation Programs for Adults	Target = 92%	% Excellent or Good	92%	92%	92%	92%

*Last Community Survey conducted in 2020.
**Athletic field maintenance expenditures not included.
***2020 participation was up as a result of online attendance.

Recreation Program Key Indicators
Aquatics Sub-Program

Goals

Promote resident's and visitors' physical, mental and social well-being through a broad range of high-quality, reasonably priced recreation and leisure activities for people of all ages, interests, and ability levels.

Objectives

Provide comprehensive aquatics programming that meets the community's needs through highly accessible, enjoyable, and varied opportunities for learning and recreation. Offer a safe, responsive and welcoming aquatics environment that promotes the health and well-being of residents and visitors.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
Aquatics Program Cost Recovery Rate		$/Program	6%	13%	16%	19%
Effectiveness						
Average Number of Participants per Program (Excluding Open Swim)	Target = 300	#	148.5	253	389	389
Average Number of Open Swim and Memory Square Pool Attendees	Target = 15,000 Total	#	Open Swim 8,900 Total Attendance N/A	Open Swim 35,600 Total Attendance 15,500	Open Swim 42,700 Total Attendance 15,500	Open Swim 42,700 Total Attendance 15,500

Program Participants Average:
- Swim Group Lessons - 316
- Private Lessons - 78
- Swim Teams - 45
- Jan and Feb Swim Clinics -144
- One Special Events - 300
- Red Cross – 8

Program Participant Average: 2021
- Swim Group Lessons - 891
- Private Lessons - 120
- Swim Teams -115
- Swim Clinics - 288
- Special Events - 100
- Red Cross – 8

Program Participant Average: 2022/23
- Swim Group Lessons – 1,340
- Private Lessons - 420
- Swim Teams - 115
- Swim Clinics - 288
- Special Events - 163
- Red Cross – 8

Recreation Program Key Indicators
Golf Course Sub-Program

Goals

Promote residents' and visitors' physical, mental and social well-being through a broad range of high-quality, reasonably priced recreation and leisure activities for people of all ages, interests, and ability levels.

Objectives

Provide an enjoyable yet challenging course for residents and visitors of all skill levels. Attract and retain golfers by offering competitive rates and amenities, continuous maintenance, and professional management. Operate as an Enterprise by generating sufficient revenue to cover operations, debt service, and capital replacement.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
Cost Recovery Rate		$	1.234	1.122	1.20	1.20
Effectiveness						
Rounds of Golf per Playable Day	Target = 160	#/Day	136	157	160	160
Revenue per Playable Day	Target = $8,700	$/Day	$8,152	$8,300	$8,500	$8,700
Customer Survey Results: Customer Satisfaction on Golf Course Quality at Conclusion of Each Round	Target = 4	Rating	4	4	4	4
Notes:						

Recreation Program Key Indicators
Senior Activities and Services Sub-Program

Goals

Promote resident's and visitors' physical, mental and social well-being through a broad range of high-quality, reasonably priced recreation and leisure activities for people of all ages, interests, and ability levels.

Objectives

Encourage physical activity, intellectual stimulation, and social well-being through programs and services for persons 60 and older.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
Senior Activities Cost Recovery Rate per Class/Program/Activity		$/Class or Program or Activity	39%	37%	37%	37%
Effectiveness						
Average Number of Participants per Program	Target = 1,500	#	1,241	1,300	1,500	1,700
Community Survey Question: Rating of Current Programs and Services for Seniors	Target = 95%	% Excellent or Good	95%	95%	95%	95%
Customer Survey Results: Customer Satisfaction after Program Completion	Target = 4.5	Rating	4.5	4.9	4.9	4.9

*Last Community Survey conducted in 2020.
**Avg number of parts/program includes all Programs/Classes, Drop-In Activities (including coffee served), Day Trips, Special Events, Community Resource Contacts, and Brooks Café Lunch.

Recreation Program Key Indicators
Youth Activities Sub-Program

Goals

Promote resident's and visitors' physical, mental and social well-being through a broad range of high-quality, reasonably priced recreation and leisure activities for people of all ages, interests, and ability levels.

Objectives

Provide programs that stimulate physical, social, and cognitive skills for the youth of Louisville. Encourage community responsibility through volunteer service that supports the well-being of the community. Provide an individualized learning environment in which each child may grow and learn at their own pace.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
Youth Activities Cost Recovery Rate per Class/Program/Activity		$/Class or Program or Activity	31%	70%	71%	75%
Effectiveness						
Average Number of Participants per Program	Target = 350	#	302	344	364	387
Community Survey Question: Rating of Current Recreation Programs for Youth	Target = 92%	% Excellent or Good	95%	95%	95%	95%

*Last Community Survey conducted in 2020. *Participation number does not include Touch-a-Truck for 2020 & 2021.
*Athletic field maintenance expenditures not included.

Transportation Program Key Indicators
Transportation Infrastructure Maintenance Sub-Program

Goals

A safe, well-maintained, effective and efficient multi-modal transportation system at a reasonable cost.

Objectives

Conserve natural resources by maintaining streets cost-effectively before they reach a point of rapid failure. To ensure a high quality of life and to provide services equitably, no street will be in poor condition. Streets and intersections are monitored, maintained, and adequately lit to move people, bikes and cars safely and efficiently. All arterial and collector streets have marked bicycle lanes. All streets have well maintained sidewalks.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
Percentage of Arterials and Collectors Marked with Bicycle Lanes		%	46%	52%	54%	54%
Percentage of Streets with Sidewalks		%	95%	95%	97%	97%
Effectiveness						
Overall Pavement Condition Index (PCI)	Target = 75	PCI	68.4%	69.1%	70.4%	71.1%
Percentage of Street Miles with PCI Lower than 35	Target = 0	%	2.2%	3.9%	1.4%	0.8%
Community Survey Question: Rating of Street Maintenance in Louisville	Target = Excellent	% Excellent or Good	64%	64%	64%	645

*Last Community Survey conducted in 2020.

Transportation Program Key Indicators
Planning and Engineering Sub-Program

Goals

A safe, well-maintained, effective and efficient multi-modal transportation system at a reasonable cost.

Objectives

Design infrastructure to adopted standards that meets the transportation needs of the City. Collaborate with partner agencies (RTD, CDOT) to ensure residents have adequate multimodal transportation options. Proactively redesign the street network as regulations and technology change our transportation needs over time.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
Percentage Change in Number of Active Projects		%	140%	17%	-29%	-30%
Effectiveness						
Percentage Change in Number of Traffic Accidents	Target = N/A	%	-62%	28%	50%	33%
Percentage Change in Number of Pedestrian/Bicycle Accidents	Target = N/A	%	100%	0%	0%	0%
*2020 Reduction in traffic volumes/accidents due COVID. Traffic Accidents in 2020 = 94, Pedestrian/Bike Accidents in 2020 = 2.						

Transportation Program Key Indicators
Snow & Ice Removal Sub-Program

Goals

A safe well-maintained, effective and efficient multi-modal transportation system at a reasonable cost.

Objectives

Safe traveling conditions for pedestrians and motorists; cost effective snow and ice control services; assist Police, Fire and Emergency Medical Services in fulfilling their duties; safe, passable streets, school bus routes and hard surface trails; safe access to City facilities; and snow cleared within 24 hours from sidewalks that are the City's responsibility.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
Number of Category II to IV Snow Events		#	15	12	12	12
Efficiency						
Average Cost per Snow Event		$/Event	$12,000	$10,000	$10,000	$10,000
Effectiveness						
Average Response Time per Snow Event	Target = 1 hr	Days	1hr	1hr	1hr	1hr
Community Survey Question: Rating of Snow Removal/Street Sanding	Target = Excellent	% Excellent or Good	52%	52%	52%	52%

*Last Community Survey conducted in 2020.

Transportation Program Key Indicators
Streetscapes Sub-Program

Goals

To provide a safe, well-maintained, effective, and efficient multi-modal transportation system at a reasonable cost.

Objectives

Safe, visually appealing, appropriately lit, and inviting streets, sidewalks, and publicly-owned areas adjacent to streets and sidewalks.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
Percentage Change in Miles/Acres of Streetscape Maintained		%	0	0	0	0
Efficiency						
Cost per Square Foot Maintained		$/Sq Ft	$.21/Sq Ft	$.21/Sq Ft	$.21/Sq Ft	$.22/Sq Ft
Effectiveness						
Community Survey Question: Rating of Maintenance of Medians and Street Landscaping	Target = 80%	% Excellent or Good	86%	86%	86%	86%
Rating of Streetlighting, Signage and Street Markings	Target = N/A	Rating	81%	81%	81%	81%

*Last Community Survey conducted in 2020.
**Staff currently maintains 2,308,500 sq ft of streetscapes.
***Cost per Sq ft calculated used the total streetscape budget by the area supported.
****Used 3% budget escalation for the 2023 projection.

Utilities Program Key Indicators
Solid Waste, Recycling, and Composting Sub-Program

Goals

Ensure safe, reliable, great tasting water; properly treated wastewater; effective stormwater control; successfully managed solid waste; and competitive prices for all services.

Objectives

Enable residents to dispose of their solid waste in a convenient, environmentally responsible, cost effective manner.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
Cost per Ton Sent to Landfill		$/Ton	$193.79	$199	$205	$211
Effectiveness						
Percentage of Waste Diverted from Landfill	Target = N/A	%	47%	44.3%	46%	46%
Tonnage of Waste Sent to Landfill	Target = N/A	#	3,513	1,746.71 through June 30, 2021	3,500	3,500
Community Survey Question: Rating of Solid Waste/Trash Services	Target = Excellent	% Excellent or Good	81%	81%	81%	81%
Community Survey Question: Rating of Fees for Water/ Sewer/Trash	Target = Excellent	% Excellent or Good	70%	70%	70%	70%

*Last Community Survey conducted in 2020.

Utilities Program Key Indicators
Stormwater Sub-Program

Goals

Ensure safe, reliable, great tasting water; properly treated wastewater; effective stormwater control; successfully managed solid waste; and competitive prices for all services.

Objectives

Maintain our storm water system to protect Coal Creek specifically and the natural and built environment generally. Proactively reduce pollutants in the water by educating the public, sweeping the streets, maintaining an efficient & effective storm water system and leveraging intergovernmental partnerships.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
Percentage Change in Number of Illicit Discharges		%	-33%	50%	0%	0%
Percentage of Inlets Cleaned as Scheduled		%	100%	100%	100%	100%
Percentage of Street Sweeping Completed as Scheduled		%	100%	100%	100%	100%
Effectiveness						
Compliance with State and Federal Standards	Target = Yes	Yes/No	Yes	Yes	Yes	Yes
Community Survey Question: Rating of Storm Drainage (Flood Management)	Target = 100%	% Excellent or Good	88%	88%	88%	88%

*Last Community Survey conducted in 2020.

Utilities Program Key Indicators
Wastewater Sub-Program

Goals

Ensure safe, reliable, great tasting water; properly treated wastewater; effective stormwater control; successfully managed solid waste; and competitive prices for all services.

Objectives

Protect public health and the environment by collecting and treating wastewater in compliance with Federal, State, and Local laws.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Efficiency						
Treatment Cost per 1,000 Gallons		$/1,000 Gallons	$1.34	$1.40	$1.40	$1.40
Percentage of Sewer Line Jetting and Cleaning Completed as Scheduled		%	100%	100%	100%	100%
Effectiveness						
Compliance with State and Federal Standards	Target = Yes	Yes/No	Yes	Yes	Yes	Yes
Community Survey Question: Rating of Wastewater (Sewage System)	Target = 100%	% Excellent or Good	91%	91%	91%	91%

*Last Community Survey conducted in 2020.

Utilities Program Key Indicators
Water Sub-Program

Goals

Ensure safe, reliable, great tasting water; properly treated wastewater; effective stormwater control; successfully managed solid waste; and competitive prices for all services.

Objectives

Consistently provide safe and great tasting water, routinely testing quality for compliance with State and Federal Standards. Operate and maintain facilities efficiently, allowing for reasonable and equitable rates while maintaining optimal quality.

INDICATOR		UNIT	2020 ACTUAL	2021 ESTIMATED	2022 PROJECTED	2023 PROJECTED
Workload						
Annual Potable Water Produced		Gallons	1,148,000,000	1,200,000,000	1,200,000,000	1,200,000,000
Efficiency						
Cost per Million Gallons per Day Billed		$/Million Gallons/Day Billed	$97.17	$125	$125	$125
Percentage of Water Main Flushing Completed as Scheduled		%	100%	100%	100%	100%
Percentage of Water Main Valves Exercised as Scheduled		%	100%	100%	100%	100%
Percentage of Unaccounted Potable Water		%	9%	6%	6%	6%
Effectiveness						
Compliance with State and Federal Standards	Target = Yes	Yes/No	Yes	Yes	Yes	Yes
Community Survey Question: Rating of Quality of Louisville Water	Target = 100%	% Excellent or Good	88%	88%	88%	88%

*Last Community Survey conducted in 2020.

SUBJECT: **LOCAL LICENSING AUTHORITY FESTIVAL PERMITS**

i. **ORDINANCE NO. 1818, SERIES 2021 – AN ORDINANCE AMENDING CHAPTER 5.08 OF THE LOUISVILLE MUNICIPAL CODE TO AUTHORIZE THE LOCAL LICENSING AUTHORITY TO ISSUE FESTIVAL PERMITS AND TO UPDATE STATUTORY REFERENCES IN THE CHAPTER – 2nd READING, PUBLIC HEARING (advertised *Daily Camera* 10/10/21)**

ii. **RESOLUTION NO. 73, SERIES 2021 – A RESOLUTION APPROVING A FESTIVAL PERMIT FEE**

DATE: **OCTOBER 5, 2021**

PRESENTED BY: **MEREDYTH MUTH, CITY CLERK**
GENNY KLINE, DEPUTY CITY CLERK / SECRETARY, LOCAL LICENSING AUTHORITY

SUMMARY:
On May 19, 2021, the Colorado General Assembly passed Senate Bill 21-082; it was signed by Governor Polis on May 28, 2021. The bill has changed the rules related the liquor licensing of festivals. Previously, festivals were limited to winery licensees but the bill amends the regulations to include the following license types: Beer & Wine, Hotel & Restaurant, Tavern, Brew Pub, Vintner's, Distillery Pub, Manufacturer's (beer, wine or spirits), Wholesaler or Limited Wineries.

The bill allows already licensed establishments to sell or serve alcohol at a festival event (up to nine per year) just as they would in their established premises. An applicant is also allowed to invite other licensees from anywhere in the state to participate in the festival.

The new law requires the applicant to apply with the state for a permit. If the City does not implement parallel local licensing requirements, the state has the ability to grant the permit, with the stipulation that the festival organizer notify the municipality 10 days prior to the event. Staff recommends the creation of a local permitting process that would allow staff and the Local Licensing Authority the ability to review the event and place appropriate conditions as needed.

The proposed ordinance creates a process for the LLA to review and approve festival permits. It also updates references in the LMC to the appropriate sections and articles of the Colorado Revised Statutes which were moved a few years ago from Title 12 to

Title 44. The proposed resolution sets the application fee for a festival permit at $150. The fee can be updated annually when Council sets fees.

The Louisville Local Licensing Authority reviewed the proposed ordinance and resolution at their September 27, 2021 meeting and recommends approval.

FISCAL IMPACT:
None

PROGRAM/SUB-PROGRAM IMPACT:
This ordinance supports the Clerk's Office goals by helping to ensure effective and efficient governance as it relates to liquor licensing.

RECOMMENDATION:
Hold a public hearing and approve the ordinance on second reading and approve the resolution.

ATTACHMENT(S):
1. Ordinance
2. Resolution

STRATEGIC PLAN IMPACT:

☐	**Financial Stewardship & Asset Management**	☒	**Reliable Core Services**
☐	**Vibrant Economic Climate**	☐	**Quality Programs & Amenities**
☐	**Engaged Community**	☐	**Healthy Workforce**
☐	**Supportive Technology**	☐	**Collaborative Regional Partner**

ORDINANCE NO. 1818
SERIES 2021

AN ORDINANCE AMENDING CHAPTER 5.08 OF THE LOUISVILLE MUNICIPAL CODE TO AUTHORIZE THE LOCAL LICENSING AUTHORITY TO ISSUE FESTIVAL PERMITS AND TO UPDATE STATUTORY REFERENCES IN THE CHAPTER

WHEREAS, the Colorado General Assembly recently enacted SB 21-082 authorizing certain liquor licensees, including bars and restaurants, to apply for festival permits allowing them to hold up to nine festivals in a twelve-month period; and

WHEREAS, SB 21-082 allows the City to create a local permit system for festivals; and

WHEREAS, if the City decides not to implement a permit system, the licensee need only obtain a state permit to hold the festival; and

WHEREAS, City Council believes that requiring a local permit for festivals is in the best interest of the City because it affords the City an opportunity to review, comment on, and consider appropriate conditions for festivals occurring within the City; and

WHEREAS, the City Council desires to amend Section 5.08.030 of the Louisville Municipal Code to authorize the Local Licensing Authority to issue festival permits; and

WHEREAS, the City Council finds that Chapter 5.08 should additionally be amended to reflect the recodification of the liquor laws which were relocated from Title 12 to Title 44 of the Colorado Revised Statutes.

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF LOUISVILLE, COLORADO:

Section 1. Section 5.08.010 of the Louisville Municipal Code is hereby amended to read as follows (words to be deleted are ~~stricken through~~; words to be added are underlined):

Sec. 5.08.010. Definitions.

The definitions of words and phrases used in this chapter shall have the meanings set forth in ~~title 12, articles, 46, 47, and 48,~~ title 44, articles 3 through 5, C.R.S., as they currently exist or may hereafter be amended, and such definitions are incorporated herein by reference.

Section 2. Section 5.08.030 of the Louisville Municipal Code is hereby amended to read as follows (words to be deleted are ~~stricken through~~; words to be added are underlined):

Sec. 5.08.030. - Classes of licenses.

For the purpose of regulating the sale of alcohol beverages, the local licensing authority, in its discretion, upon application made to it in the prescribed form, may issue and grant to the applicant those licenses to sell alcohol beverages that the local licensing authority is authorized to issue pursuant to ~~title 12, articles, 46, 47, and 48,~~ title 44, articles 3 through 5, C.R.S., as they currently exist or may hereafter be amended, including but not limited to, the following classes of licenses, subject to the provisions and restrictions of sale as to manner, place, and license fee as provided by this Chapter.

[subsections A – K to remain the same]

L. Festival permit. A festival permit may be issued to the licensees identified in C.R.S. § 44-3-404. A separate local festival permit is required for each festival. No more than nine (9) permits may be issued to a single licensee during a twelve-month period.

Section 3. Section 5.08.060 of the Louisville Municipal Code is hereby amended to read as follows (words to be deleted are ~~stricken through~~; words to be added are underlined):

Sec. 5.08.060. Special event permits; generally.

The local licensing authority may issue a special event permit for the sale, by drink only, of alcohol beverages to organizations qualifying under C.R.S. § 44-5-101 ~~12-48-101~~ et seq. The local licensing authority may, by resolution, elect to issue special events permits without notifying the state licensing authority to obtain its approval or disapproval of applications for special events permits, which such resolution may be repealed or amended from time to time.

Section 4. Subsections A, C, D and E of Section 5.08.075 of the Louisville Municipal Code are hereby amended to read as follows (words to be deleted are ~~stricken through~~; words to be added are underlined):

Sec. 5.08.075. Liquor tastings.

A. The city hereby authorizes tastings to be conducted by retail liquor store licensees in accordance with this section and pursuant to section 44-3-301 ~~12-47-301~~, C.R.S. Within the city, it is unlawful for any person or licensee to conduct tastings unless a permit has been obtained in accordance with this section. The local licensing authority is authorized to issue tasting permits in accordance with the requirements of this section.

C. Tastings shall be subject to the following limitations:

1. Tastings shall be conducted only by a person who has completed a server training program that meets the standards established by

the Liquor Enforcement Division of the Colorado Department of Revenue and who is a retail liquor store licensee, or an employee of a licensee, and only on a licensee's licensed premises.

2. The alcohol used in tastings shall be purchased through a licensed wholesaler, licensed brew pub, licensed distillery pub or winery licensed pursuant to section 44-3-403 ~~12-47-403~~, C.R.S., at a cost that is not less than the laid in cost of such alcohol. Such suppliers shall have licenses from the city to the extent required by this section and section 44-3-301 ~~12-47-301~~, C.R.S.

[subsections 3 – 13 to remain same]

D. A violation of a limitation specified in this section or of section 44-3-301(10) ~~12-47-301(10)~~ or section 44-3-901 ~~12-47-801~~, C.R.S., by a retail liquor store licensee, whether by the licensee, the licensee's employees or agents, or otherwise shall be the responsibility of the retail liquor store licensee who is conducting the tasting.

E. A retail liquor store licensee conducting a tasting shall be subject to the same revocation, suspension, and enforcement provisions as otherwise apply to the licensee and are imposed by the local licensing authority. The local licensing authority shall conduct a hearing with regard to any violations of this section in accordance with the requirements of this Code, the authority's bylaws and rules of procedure, and section 44-3-601 ~~12-47-601~~, C.R.S.

Section 5. Section 5.08.076 of the Louisville Municipal Code is hereby amended to read as follows (words to be deleted are ~~stricken through~~; words to be added are underlined):

Sec. 5.08.076. Art gallery permits.

A. The local licensing authority is authorized to issue an art gallery permit to a person operating an art gallery that offers complimentary alcohol beverages for consumption only on the premises in accordance with the requirements and limitations set forth in section 44-3-424 ~~12-47-422~~, C.R.S. An art gallery that wishes to offer complimentary alcohol beverages shall submit an application for an art gallery permit to the local licensing authority annually. The local licensing authority may reject the permit application if the applicant fails to establish that it is able to offer complimentary alcohol beverages without violating the provisions of section 44-3-424 ~~12-47-422~~, C.R.S. or creating a public safety risk to the neighborhood.

B. An art gallery permit may be suspended or revoked if the permittee violates any of the provisions of section 44-3-424 ~~12-47-422~~, C.R.S. or any rule adopted thereunder. The local licensing authority shall conduct a hearing with regard to any such alleged violations in accordance with the requirements of this

code, the authority's bylaws and rules of procedure, and section 44-3-601 ~~12-47-601~~, C.R.S.

Section 6. Section 5.08.130.A of the Louisville Municipal Code is hereby amended to read as follows (words to be deleted are ~~stricken through~~; words to be added are underlined):

Sec. 5.08.130. Powers of the authority.

A. The authority shall have all the powers possible of a local licensing authority as set forth in C.R.S. §§ 44-3-101 ~~12-46-101~~ et seq., 44-4-101 ~~12-47-101~~ et seq., and 44-5-101 ~~12-48-101~~ et seq., as from time to time amended, and in this Code.

Section 7. If any portion of this ordinance is held to be invalid for any reason, such decision shall not affect the validity of the remaining portions of this ordinance. The City Council hereby declares that it would have passed this ordinance and each part hereof irrespective of the fact that any one part be declared invalid.

Section 8. The repeal or modification of any provision of the Municipal Code of the City of Louisville by this ordinance shall not release, extinguish, alter, modify, or change in whole or in part any penalty, forfeiture, or liability, either civil or criminal, which shall have been incurred under such provision, and each provision shall be treated and held as still remaining in force for the purpose of sustaining any and all proper actions, suits, proceedings, and prosecutions for the enforcement of the penalty, forfeiture, or liability, as well as for the purpose of sustaining any judgment, decree, or order which can or may be rendered, entered, or made in such actions, suits, proceedings, or prosecutions.

Section 9. All other ordinances or portions thereof inconsistent or conflicting with this ordinance or any portion hereof are hereby repealed to the extent of such inconsistency or conflict.

INTRODUCED, READ, PASSED ON FIRST READING, AND ORDERED PUBLISHED this 5th day of October, 2021.

_____
Ashley Stolzmann, Mayor

ATTEST:

_____
Meredyth Muth, City Clerk

APPROVED AS TO FORM:

_____
Kelly PC, City Attorney

PASSED AND ADOPTED ON SECOND AND FINAL READING this 19th day of October, 2021.

_____
Ashley Stolzmann, Mayor

ATTEST:

_____
Meredyth Muth, City Clerk

RESOLUTION NO. 73
SERIES 2021

A RESOLUTION APPROVING A FESTIVAL PERMIT FEE

WHEREAS, Sections 5.08.040 and 5.08.050 of the Louisville Municipal Code authorize the City Council to establish by resolution local fees for the various categories of liquor licenses; and

WHEREAS, the City Council approved an ordinance authorizing the Local Licensing Authority to begin issuing festival permits to certain liquor licensees; and

WHEREAS, the City Council has determined that it should establish a festival permit fee as provided herein.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF LOUISVILLE, COLORADO:

Section 1. The City Council hereby approves the following fee for festival permits issued pursuant to Section 5.08.030.L of the Louisville Municipal Code:

Festival permit fee: $150.00

PASSED AND ADOPTED this 19th day of October, 2021.

_____
Ashley Stolzmann, Mayor

ATTEST:

_____
Meredyth Muth, City Clerk

City of Louisville
COLORADO • SINCE 1878

CITY COUNCIL COMMUNICATION
AGENDA ITEM 7F

SUBJECT: **CITY MANAGER RECRUITMENT UPDATE**

DATE: **OCTOBER 19, 2021**

PRESENTED BY: **DENNIS MALONEY, MAYOR PRO TEM**
DEB FAHEY, CITY COUNCIL

SUMMARY:
Mayor Pro Tem Maloney and Councilmember Fahey will give an update on the city manager recruitment process.

FISCAL IMPACT:
None

RECOMMENDATION:
Informational item

ATTACHMENT(S):
1. Tentative timeline

City of Louisville, CO
City Manager Executive Recruitment
Scope and Timeline

Below is the proposed scope and timeline for this executive recruitment. The scope of this project includes multiple phases or milestones with specific deliverables as presented below. Once both parties have signed and agreed to the terms of this project, the Lead Consultant will schedule a kickoff meeting to finalize the timeline. The dates below are for discussion purposes only. If you find these dates acceptable, we can use the proposed timeline. Otherwise, we will update the project timeline to accommodate your need.

Project milestone	Deliverables	Target date
Profile development, marketing, recruitment and outreach campaign development and approval	– Baker Tilly completes on-site interviews or virtual meetings to develop candidate profile and recruitment brochure; – Baker Tilly sends draft recruitment brochure to the City – The City returns draft recruitment brochure (with edits) to Baker Tilly	**August 30, 2021 – September 10, 2021**
Nationwide Search Begins	– Baker Tilly launches nationwide recruitment, marketing and outreach campaign; – BT collects applications and acknowledges receipt and updates applicants on timeline.	**October 1, 2021**
First Review of Applications, Classification and Assignments… Semifinal Report	– Application review begins; BT classifies applications, assigns Due Diligence (DD) questionnaire, Candidate Questionnaire (CQ) and one-way video interviews (HV). – Candidates complete and returns DD, CQ, and HV. – Client completes TTI Benchmark (optional) – Baker Tilly prepares semifinal report and forwards with link to one-way videos to client for selection of finalists. – Baker Tilly is available to support city officials, if requested, to discuss selection of finalists. Survey option may be available. – Client provides names of four finalists to Baker Tilly.	**October 29, 2021**
Background Report, Reference Report, Media and Online Presence Report, and Leadership Assessment	- Baker Tilly notifies applicants on individual status and schedules interviews. - Baker Tilly secure authorizations to conduct background, criminal, credit, driving and related background report checks. BT completes academic verifications, media report, contacts at least four references. - Four finalists complete TTI Assessment. - BT works with client to develop interview process, suggests interview questions, and candidate evaluation matrix.	**November 15, 2021**
Virtual or in-person interviews	– City designated panels interview four finalists (virtual or in person). Panels may include residents, stakeholders, and other groups. – City council interview finalists... – City identifies finalist and extends employment offer	**November 17, 2021** **November 19, 2021**
Finalist Accepts Offer	– The City extends employment offer to selected candidate	**November 26, 2021**
New City Manager Begins	– Depending on current employment status, or contractual requirements. 2 weeks min – 30 days	**December 13, 2021** **January 3, 2022**