Rocky Mountain Utility Exchange

Community-specific Cost-benefit Evaluation Framework for Beneficial Electrification

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Objective	Direction for Fort Collins and Longmont to support climate goals
Problem Statement	How do we select/prioritize building electrification measures?
Proposed Solution	Jurisdiction-specific benefit-cost analysis of measures
Road Map	Phased approach of education, program design, and policy steps

Aspirational community carbon and energy goals

Fort Collins – Our Climate Future

- 80 % greenhouse gas (GHG) emissions reduction goal by 2030
- 100% renewable electricity goal by 2030
- 20+ year commitment to Climate Action, focusing on Mitigation, Resilience, Equity

Longmont

- 66% GHG emissions reduction goal by 2030
- 100% renewable electricity goal by 2030
- Climate Action Recommendations Report and Building Electrification Plan

Opportunity: Buildings make up ~66% of GHG emissions in Fort Collins and ~80% in Longmont
Challenge: Affordably decarbonize buildings

2040 building greenhouse gas emissions

Residential end uses make up about 75% of building gas consumption.

End Use	Existing/New	% of 2040 Residential GHG Emissions
Space heating	**Existing**	**52%**
Space heating	New	23%
Water heating	Existing	16%
Water heating	New	6%
Other	Existing	2%
Other	New	1%

Focus on existing residential space heating

- Progress toward community GHG emissions reduction goals
- Build in future grid flexibility
- Good place to start!

Research approach

National Inventory of Electrification Incentive Programs → Local Customer and Contractor Research on Heat Pumps → Cost effectiveness, net benefits, and carbon abatement costs → Recommend-ations for residential electrification measures

Development of community test

Problem

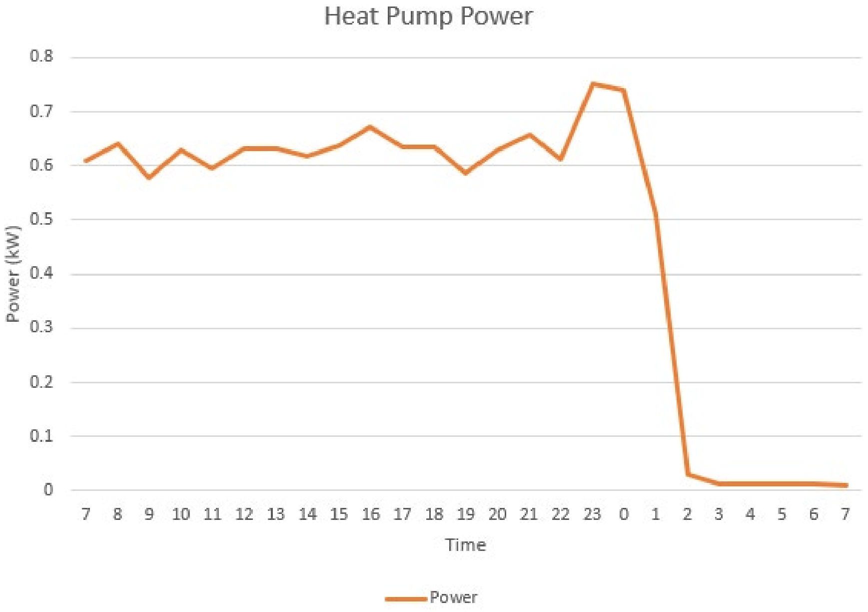
- Building electrification is different because electricity consumption increases
- Traditional benefit-cost approaches not great for our context

Solution

- Follow National Standard Practice Manual (NSPM) guidance for jurisdiction-specific test
- Work with stakeholders to agree on what to include

How do we keep people warm during extremely cold weather?

- Capacity of heat pumps drops
- Hybrid heat pumps use existing gas furnace (0 grid impacts)
- Full electrification heat pumps use electric resistance (10 kW+/home)



Measure Screening Criteria

- Participant Cost Test
- Ratepayer Impact Test
- Community Test
- GHG Abatement Cost
- Bill Savings and Incremental Cost
- Lifetime GHG Impacts
- Winter Peak Demand Impact

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Best opportunity: Replace burned out or new CAC with heat pump, leaving furnace for cold weather

VS

Pros: Only costs ~$200-$500 extra, saves 50-80% of load

Cons: Only applicable in situations where somebody was already buying a new CAC

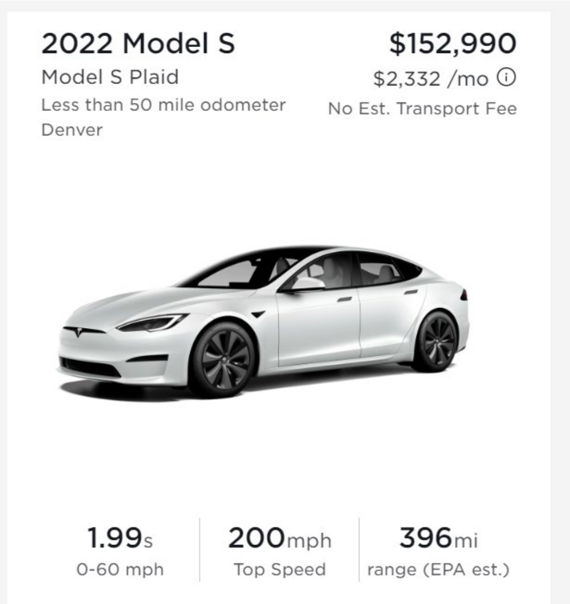
Full displacement with electric resistance = expensive for the utility and ratepayers

- Fort Collins/Longmont will become winter peaking sometime in 2030s.
- Each additional kW of winter peak costs $100+/year to meet with gas combustion turbines
- **Present value of capacity cost for 10 kW electric resistance was calculated as $17,000. Electric resistance heat is still a bad idea.**

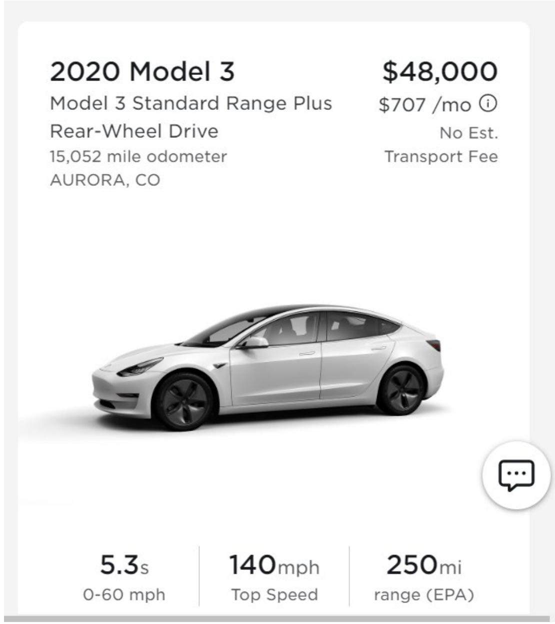
Adding heat pumps to homes with gas and without AC is a tough sell

There is no economic case to the customer with gas without the cooling benefits.

Cold climate heat pumps cost A LOT



VS



Consider for 100% displacement, but still need to solve backup heat problem

Phased recommendations

Phase 1:

Build market awareness, customer knowledge, and contractor capability

- *What would it take for contractors to almost always install a heat pump instead of an air conditioner?*
- Offer contractor training and downstream rebates for ALL heat pumps – not just cold climate
- Prioritize broad-based hybrid solutions

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Phased recommendations

Phase 2:

Throttle widespread adoption in most cost-effective applications

- Adopt codes for new construction
- Build midstream offerings (manufacturers/distributors)
- Improve heat pump economics through rate design

Phased recommendations

Phase 3:

Push toward zero carbon

- Adopt codes for heat pumps/heat pump water heaters in all new installations
- Require all-electric new homes
- Could happen sooner outside of regular code review/adoption cycles

What's next…

- Program and incentive redesign and development
- Continued contractor training and engagement/customer education
- Continued Building Code evaluations for each community
  - Fort Collins zero carbon building code by 2030;
  - Boulder County Code Cohort recommendations for zero carbon new construction by 2030 in Longmont
- Distribution impacts study using transformer-level AMI
  - Inform Fort Collins Utilities' design standards, update 2023 Electric Capacity fees
- And IRA impacts…

Thank you! Enjoy the Exchange!

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Appendix & backup slides

Market awareness: Contractors know something about heat pumps; customers do not!

Contractors:

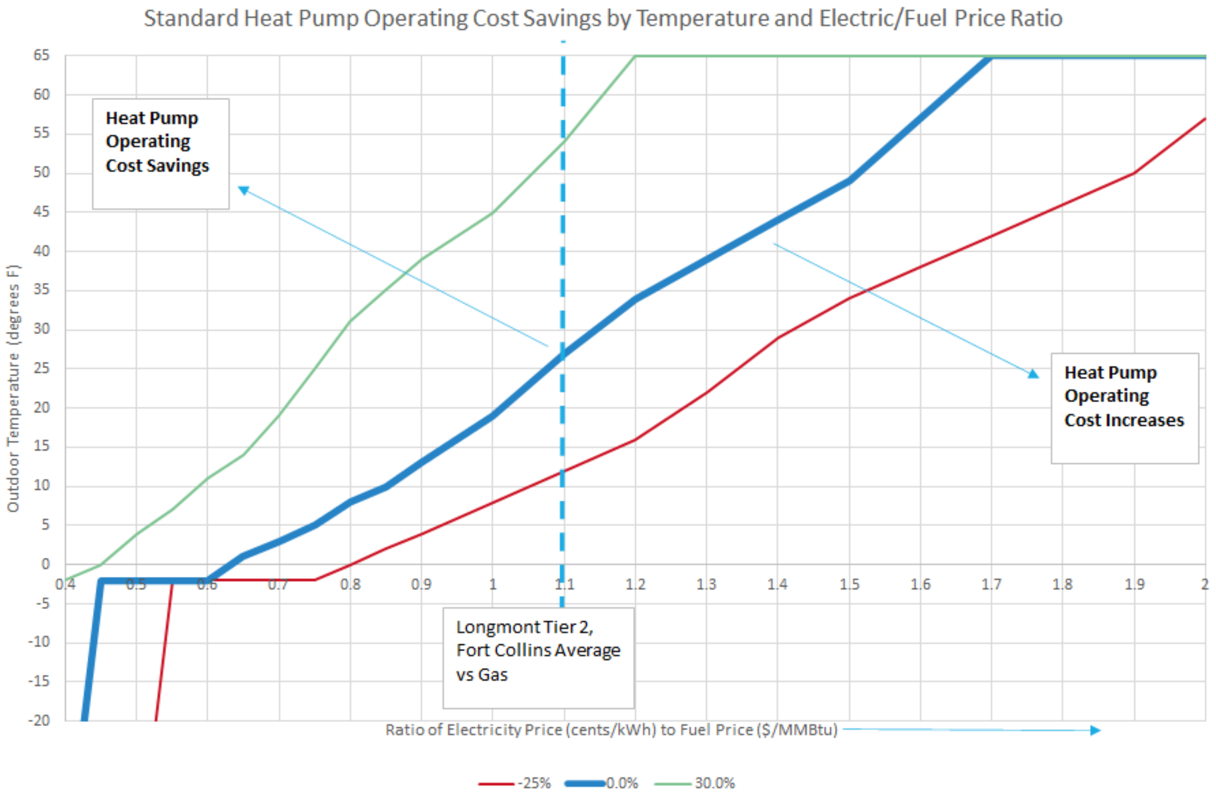
- Are aware of heat pump technology
- View heat pumps as opportunity
- Often recommend heat pumps for AC retrofits

- **Customers:**
  - 82% either <u>not very</u> or <u>not at all</u> familiar with heat pumps
  - Most replace equipment on failure and like-for-like (50% don't consider options)
  - Only 10% had contractors suggest heat pumps

Key Findings

- Existing space heating, water heating, and new buildings account for over 95% of 2040 GHG emissions from buildings
- Full electrification of heating adds ~10 kW winter peak demand per home
- Fort Collins has room for ~70 MW of additional winter peak demand, Longmont has room for ~ 50 MW
- Keeping electricity prices low relative to gas is the key to heat pump operating economics
- Partial displacement measures add significant electricity consumption w/out adding peak load – benefits pay for high rebates
- Partial displacement of furnaces with central heat pumps at all efficiency levels offers large carbon savings at low costs
- Proper controls configuration enables much higher GHG savings per heat pump

Operating Cost-effectiveness



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Existing Fossil Fuel Recommendations (near)

Focus on partial displacement heat pumps, water heating

- No requirement for full electrification
- No extra rebates for full electrification

Change heat pump/central AC rebates to promote heat pumps

- Stop incenting central AC; require heat pumps for central cooling efficiency rebates
- Remove cold climate requirement for central heat pumps
- Keep ductless rebates
- Offer new base rebate (e.g. $500-1000) for ANY heat pump installed, regardless of efficiency or commissioning
- Offer additional high efficiency rebate (e.g. $1000 more) for high efficiency heat pump with controls commissioning

Increase education and support

- Provide customer education/support focused on key benefits, payback, and set expectations
- Provide contractor training/support focused on promoting use of lower switchover temps
- Provide customer education/support focused on heat pump operations (scheduling, maintenance, differences vs gas furnace)

Existing Fossil Heating Recommendations (med/long)

Medium-term	Long-term
• Consider extra rebate incentives for early retirements of existing fossil equipment • Develop low-income heating program • Develop measures to incent use of proper controls to increase usage at colder temperatures (adding lockouts, lower switchover temps, etc.)	• For 2028 code implementation cycle, require all central AC installations be heat pumps • Develop additional offerings focused on full electrification based on improving technologies of various kinds

Measure Screening Details

PCT (Customer):

- Positive net benefits: customer comes out ahead w/out rebates, negative needs rebate to offset.
- For IQ, negative net benefit needs to be offset with incentive.

RIM (Ratepayer):

- Positive net benefits: ratepayer comes out ahead, negative is red flag
- Difference between Ratepayer – Customer = Max Incentive

Community:

- Includes emissions and non-energy benefits
- Positive net benefits: community comes out ahead

CO_2 Abatement Cost:

- (Community Test without GHG)/(tons of GHG)
- Lower is cheaper; compare to $76 in community test

Total Bill Savings; Incremental Cost

- Annual bill savings net of fossil and electric impacts; Positive is good;
- Upfront incremental cost to customer

Winter Peak Demand Impact

- Winter peak impact in kW
- $1700/kW cost not included in other tests

Lifetime GHG Impacts

- Tons of CO_2e saved over life of measure
- Results for measure implemented in 2022 with dropping electricity GHG impacts

Composite Measure Score

- 4/5 are high priority
- 3/2 are low priority or no impact
- 1 is to be avoided

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Best opportunity: Replace burned out or new CAC with heat pump, leaving furnace for cold weather

Standard and medium efficiency HP with 30 degree switchover (50% displacement)

Measure	Type	PCT	RIM	Community	CO2 Abatement Cost	Total Bill Savings	Incremental Cost	Winter Peak Demand Impact	Lifetime GHG impacts (tons CO2e)	Composite Measure Score
14 SEER CHP | Gas furnace | CAC | CAC ROF | 50% Disp | Fort Collins	ROB	$ (380)	$ 1,236	$ 2,774	$ (90)	$ 12	$ 450	0	15.9	4
16 SEER CHP | Gas furnace | CAC | CAC ROF - HE | 50% Disp | Fort Collins	ROB	$ (196)	$ 1,111	$ 2,895	$ (93)	$ 29	$ 450	0	16.3	4
16 SEER CHP | Gas furnace | CAC | CAC ROF | 50% Disp | Fort Collins	ROB	$ (2,196)	$ 1,111	$ 1,095	$ 18	$ 29	$ 2,250	0	16.3	3

Standard and medium efficiency HP with 20 degree switchover (80% displacement)

Measure	Type	PCT	RIM	Community	CO2 Abatement Cost	Total Bill Savings	Incremental Cost	Winter Peak Demand Impact	Lifetime GHG impacts (tons CO2e)	Composite Measure Score
14 SEER CHP | Gas furnace | CAC | CAC ROF | 80% Disp | Fort Collins	ROB	$ (381)	$ 2,033	$ 4,738	$ (99)	$ 12	$ 450	0	25.8	4
16 SEER CHP | Gas furnace | CAC | CAC ROF - HE | 80% Disp | Fort Collins	ROB	$ 10	$ 1,777	$ 5,010	$ (103)	$ 49	$ 450	0	26.7	5
16 SEER CHP | Gas furnace | CAC | CAC ROF | 80% Disp | Fort Collins	ROB	$ (1,990)	$ 1,777	$ 3,210	$ (35)	$ 49	$ 2,250	0	26.7	4

We want people to use heat pumps as much as possible – better controls are key!

Adding heat pumps to homes with gas and without AC is not very cost-effective

Measure	Type	PCT	RIM	Community	CO2 Abatement Cost	Total Bill Savings	Incremental Cost	Winter Peak Demand Impact (kW)	Lifetime GHG impacts (tons CO2e)	Composite Measure Score
14 SEER CHP | Gas furnace | No AC | RET | 50% Disp | Fort Collins	RET	$ (9,082)	$ 2,572	$ (1,839)	$ 217	$ (105)	$ 7,200	0	14.0	2
16 SEER CHP | Gas furnace | No AC | RET | 50% Disp | Fort Collins	RET	$ (10,932)	$ 2,405	$ (3,264)	$ 315	$ (90)	$ 9,000	0	14.2	2
CC CHP | Gas furnace | No AC | RET | 50% Disp | Fort Collins	RET	$ (13,542)	$ 2,073	$ (5,382)	$ 444	$ (52)	$ 11,700	0	15.0	2
14 SEER CHP | Gas furnace | No AC | RET | 80% Disp | Fort Collins	RET	$ (9,084)	$ 3,369	$ 124	$ 80	$ (105)	$ 7,200	0	23.9	3
16 SEER CHP | Gas furnace | No AC | RET | 80% Disp | Fort Collins	RET	$ (10,542)	$ 2,946	$ (1,029)	$ 126	$ (52)	$ 9,000	0	25.1	3

- Adding heat pumps to homes without AC generally has poor customer and community economics.
- Homes with propane would have a different

Cold climate heat pumps cost A LOT

Measure (Efficient name | Baseline heat name | Baseline cool name | Upgrade type | Displacement Case | City Name)	PCT	RIM	Communi	CO2 Abatement Co	Total Bill Saving	Incremental Co	Winter Peak Demand Impact (kW)	Lifetime GHG impacts (tons CO2e)	Composite Measure Score
CC CHP | Gas furnace | CAC | CAC ROF | 50% Disp | Fort Collins	$ (5,140)	$ 1,071	$ (1,572)	$ 181	$ 35	$ 4,950	0	16.4	2
CC CHP | Gas furnace | CAC | CAC ROF | 80% Disp | Fort Collins	$ (5,027)	$ 1,800	$ 482	$ 67	$ 46	$ 4,950	0	26.6	3
CC CHP | Gas furnace | CAC | CAC ROF | 100% Disp | Fort Collins	$ (6,112)	$ 2,337	$ 713	$ 63	$ 38	$ 5,850	10	32.4	1

- Economics are not very good
- Provide benefits, but incremental cost is much higher, sinking participant economics
- Consider for 100% displacement, but still need to solve backup heat problem

Adding heat pumps to propane-heated homes with boilers = mixed economics

Measure	Type	PCT	RIM	Community	CO2 Abatement Cost	Total Bill Savings	Incremental Cost	Winter Peak Demand Impact (kW)	Lifetime GHG impacts (tons CO2e)	Composite Measure Score
CC DHP | Gas boiler | Cooling blend | RET | 50% Disp | Fort Collins	RET	$ (13,391)	$ 1,906	$ (5,487)	$ 446	$ (38)	$ 11,700	0	15.2	3
CC DHP | Gas boiler | Cooling blend | RET | 80% Partial Disp | Fort Collins	RET	$ (13,279)	$ 2,635	$ (3,432)	$ 220	$ (27)	$ 11,700	0	25.4	3
CC DHP | Gas boiler | Cooling blend | RET | 100% Full Disp | Fort Collins	RET	$ (15,363)	$ 3,172	$ (4,102)	$ 216	$ (35)	$ 13,500	10	31.2	1
CC DHP | Gas boiler | Cooling blend | ROF/New Central Cooling | CC DHP | 100%	ROB	$ (10,363)	$ 3,172	$ 398	$ 72	$ (35)	$ 9,000	10	31.2	1
CC DHP | Propane boiler | Cooling blend | RET | 50% Disp | Fort Collins	RET	$ (9,725)	$ 1,906	$ (395)	$ 104	$ 312	$ 11,700	0	20.4	3
CC DHP | Propane boiler | Cooling blend | RET | 80% Partial Disp | Fort Collins	RET	$ (7,185)	$ 2,635	$ 5,030	$ (63)	$ 555	$ 11,700	0	34.0	4
CC DHP | Propane boiler | Cooling blend | RET | 100% Full Disp | Fort Collins	RET	$ (7,803)	$ 3,172	$ 6,397	$ (68)	$ 687	$ 13,500	10	41.8	1
CC DHP | Propane boiler | Cooling blend | ROF/New Central Cooling | CC DHP |	ROB	$ (2,803)	$ 3,172	$ 10,897	$ (175)	$ 687	$ 9,000	10	41.8	1

- A cold-climate ductless heat pump displacing propane boiler usage has poor participant economics (but maybe not so bad after the Inflation Reduction Act!)
- Other economics are strong

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Adding heat pumps to propane-heated homes with boilers = mixed economics

- A cold-climate ductless heat pump displacing propane boiler usage has mixed participant economics (but maybe not so bad after the Inflation Reduction Act!)
- Other economics are strong