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Incorporating Non-energy Benefits and Community Goals into Utility Cost Effectiveness Framework

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Fort Collins, Colorado

- **Population 175,000**
- **Municipal Electric Utility**
  - 2,000 miles, underground distribution lines
  - 55 square miles
  - ~320 MW peak demand
  - **Time-Of-Day pricing for all residential**
  - **Reliability 99.9965%**
- **Climate Action Plan Goals**
  - 20% reduction by 2020 (**actual 27%**)
  - **50% reduction by 2026**
  - 80% reduction by 2030
  - Carbon neutral by 2050
- **Home to**
  - Colorado State University
  - High tech industrial
  - Bikes, boats and beers (26 breweries)

OUR CLIMATE FUTURE

FORT COLLINS, COLORADO

Municipal Utility Program Implementation

- Governed by City Council
- Utilities administered at the Direction of the Executive Director

- Policy Drivers:
  - Decarbonization:
    - 100 % Renewable Electricity by 2030
    - 80% carbon emissions reduction by 2030, carbon neutral by 2050

- Traditional Evaluations methods:
  - Utility cost test, Participant cost test
  - Levelized cost of conserved energy
  - Portfolio level evaluation

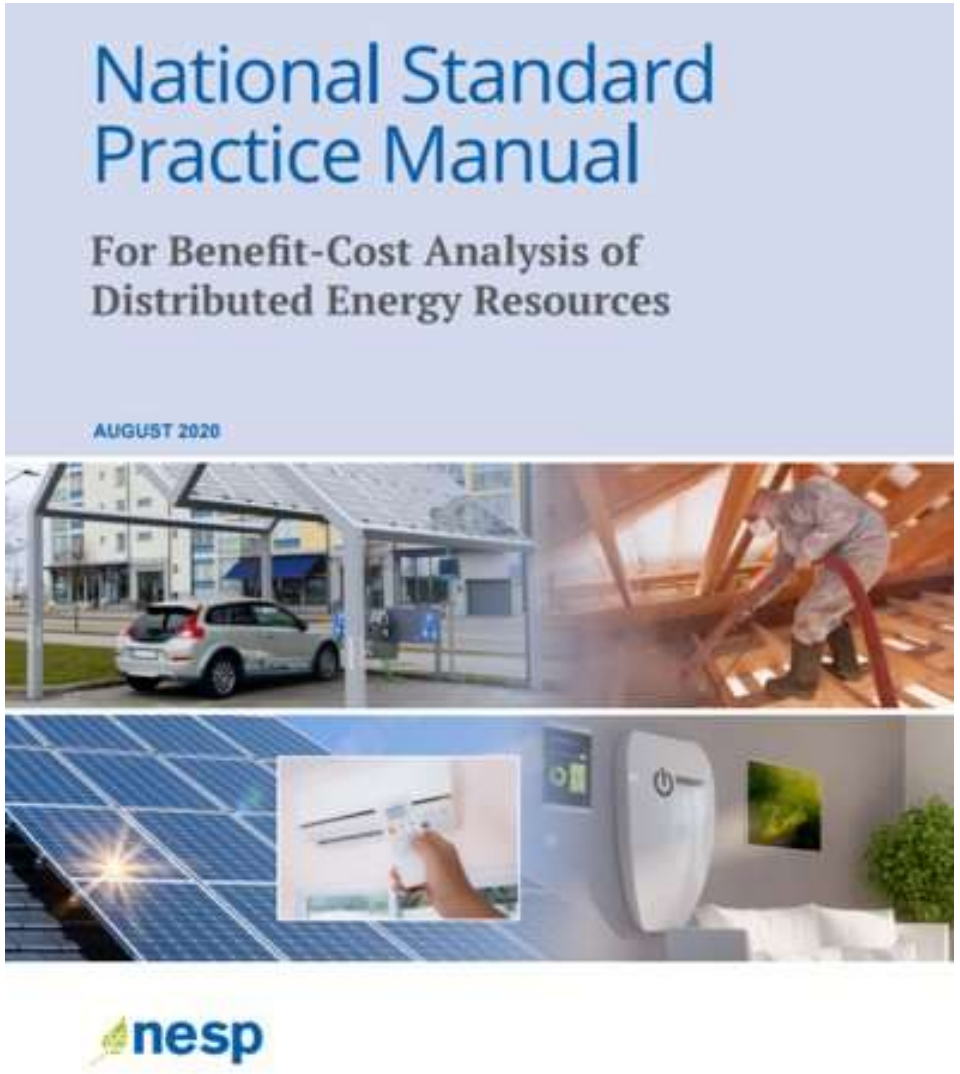
Solution Framework

- Purpose:
  - To guide development of jurisdictions' cost effectiveness test(s) for conducting benefit-cost analyses (BCAs) for distributed energy resources (DERs)

- Managed and funded by E4TheFuture (with support from US DOE via LBNL)

- Multiple co-authors
  - Extensive understanding of regulatory economics
  - Specialized expertise with different DERs

- Advisory Group
  - 45+ individuals
  - Diversity of perspectives
  - Input on Manual outline and drafts



NSPM Method for improving and updating structure

NSPM: Customer and Societal Benefits and Costs for consideration

Table S-4. Potential Benefits and Costs of DERs: Host Customer

Type	Host Customer Impact	Description
Host Customer	Host portion of DER costs	Costs incurred to install and operate DERs
	Host transaction costs	Other costs incurred to install and operate DERs
	Interconnection fees	Costs paid by host customer to interconnect DERs to the electricity grid
	Risk	Uncertainty including price volatility, power quality, outages, and operational risk related to failure of installed DER equipment and user error; this type of risk may depend on the type of DER
	Reliability	The ability to prevent or reduce the duration of host customer outages
	Resilience	The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions
	Tax incentives	Federal, state, and local tax incentives provided to host customers to defray the costs of some DERs
	Host Customer NEIs	Benefits and costs of DERs that are separate from energy-related impacts
	Low-income NEIs	Non-energy benefits and costs that affect low-income DER host customers

Table S-5. Potential Costs and Benefits of DERs: Societal

Type	Societal Impact	Description
Societal	Resilience	Resilience impacts beyond those experienced by utilities or host customers
	GHG Emissions	GHG emissions created by fossil-fueled energy resources
	Other Environmental	Other air emissions, solid waste, land, water, and other environmental impacts
	Economic and Jobs	Incremental economic development and job impacts
	Public Health	Health impacts, medical costs, and productivity affected by health
	Low-Income: Society	Poverty alleviation, environmental justice, and reduced home foreclosures
	Energy Security	Energy imports and energy independence

Fort Collins inputs and assumptions

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

CO2 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 CO2e 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

Example: Heat Pump replacement benefit / costs runs

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
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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
CC CHP | Gas furnace | CAC | CAC ROF | 80% Disp | Fort Collins	ROB	$ (5,027)	$ 1,800	$ 482	$ 67	$ 46	$ 4,950	0	26.6	3
14 SEER CHP | Gas furnace | CAC | CAC ROF | 100% Disp | Fort Collins	ROB	$ (1,681)	$ 2,707	$ 4,814	$ (70)	$ (17)	$ 1,350	10	31.0	1
16 SEER CHP | Gas furnace | CAC | CAC ROF | 100% Disp | Fort Collins	ROB	$ (3,135)	$ 2,353	$ 3,399	$ (20)	$ 35	$ 3,150	10	32.3	1
CC CHP | Gas furnace | CAC | CAC ROF | 100% Disp | Fort Collins	ROB	$ (6,112)	$ 2,337	$ 713	$ 63	$ 38	$ 5,850	10	32.4	1
14 SEER CHP | Gas furnace | CAC | CAC ER | 80% Disp | Fort Collins	RET	$ (3,247)	$ 2,033	$ 2,159	$ 1	$ 12	$ 3,029	0	25.8	3
16 SEER CHP | Gas furnace | CAC | CAC ER | 80% Disp | Fort Collins	RET	$ (4,855)	$ 1,777	$ 631	$ 61	$ 49	$ 4,829	0	26.7	3
CC CHP | Gas furnace | CAC | CAC ER | 80% Disp | Fort Collins	RET	$ (7,895)	$ 1,802	$ (2,097)	$ 164	$ 46	$ 7,529	0	26.6	2
14 SEER CHP | Gas furnace | CAC | CAC/Furnace ER | 100% Disp | Fort Collins	RET	$ (5,692)	$ 2,707	$ 1,203	$ 46	$ (17)	$ 4,960	10	31.0	1
16 SEER CHP | Gas furnace | CAC | CAC/Furnace ER | 100% Disp | Fort Collins	RET	$ (7,146)	$ 2,353	$ (211)	$ 92	$ 35	$ 6,760	10	32.3	1
CC CHP | Gas furnace | CAC | CAC/Furnace ER | 100% Disp | Fort Collins	RET	$ (10,123)	$ 2,337	$ (2,898)	$ 174	$ 38	$ 9,460	10	32.4	1

- **Single most important opportunity for building electrification**
- Best measures for existing furnace/AC are SEER 14 and SEER 16 ROB Heat Pumps. Early retirements are not as good, but OK (higher costs).
- Cold climate central heat pump economics are borderline – high incremental cost is not justified by performance improvement at this time. This would change dramatically for 100% displacement case if they did not need electric resistance backup heat and price of carbon was very high.
- RIM test results are high, which pay for high rebates

Promoting non-energy benefits through collaboration

- Collaboration and cross promotion with Fort Collins Healthy Homes Program
- Prioritize "Keep it" principles
  - Clean, Contaminant Free, Dry, Maintained, Pest Free, Ventilated, Comfortable, Safe
- Resources focused on Asthma, Radon, Mold, Lead, Pests, Asbestos, Chemical contaminants
- Enhanced online assessment
- https://healthyhomes.fcgov.com/

Promoting non-energy benefits through in-home testing

- All in-home assessment best practices:
  - Radon test deployment
  - Combustion appliance zone (CAZ) test with carbon monoxide monitoring
  - Garage to home air tightness measurements and recommendations

Building Air Tightness Testing						
CFM_{50}	1,301		ACH_{50}	4.7	XCEL ACH_N	0.42
Blower Door Location	Front		Baseline		CFM_{50}/FT^2 Floor Area	0.67
Advanced Pressure Diagnostics (open-a-door)						
Garage	48	CFM w/ door to garage open.			2,748	
CFM_{50} House/Garage	209	CFM_{50} Zone/OUTSIDE			1,651	
CFM_{50} Reduction Available	204	PERCENTAGE OF TOTAL LEAKAGE			16%	
Recommended Actions	Interface between house and garage must be air sealed.					
Pressure Diagnostics Notes						
ELA	174	Sq. Inches	1.2	Sq. Feet	13.2 by 13.2 inch square hole	
New home ELA	110	Sq. Inches	0.8	Sq. Feet		

Promoting non-energy benefits through Installation Standards

- Incorporate into program standards and requirements methods
  - Measure based requirements
  - Incentive design
  - Inclusion of non-conditioned spaces

- Photo documentation for quality assurance

Appendix P: Photo documentation guide

The purpose of this photo documentation guide is to establish a great paper trail of the before and after on our more important details in the program.

Energy efficiency measure	Expected photos	Example	Example	Example
Full vacuuming of the attic	Clean attic floor Top plates Bypasses Large holes			
Attic prep	Sealed top			

- Efficiency Works Rebate Service Provider Guide

IEQ partnership and study with Colorado State University

- **IEQ Study goal:**
  - To improve our understanding of the connections between community health and well-being from energy efficiency upgrades

- **Study Homes:**
  - 80 homes complete participation by end of 2021
  - Mix of owner- and renter-occupied homes
  - Mix of assessment only (the control group) & completed insulation and air sealing project (the test group)

Data Collection

IEQ

AWAIR Omni Sensor
- $PM_{2.5}$, TVOC, T, RH, CO_2
- 15-min resolution
- 5 sensors per household

Energy-use

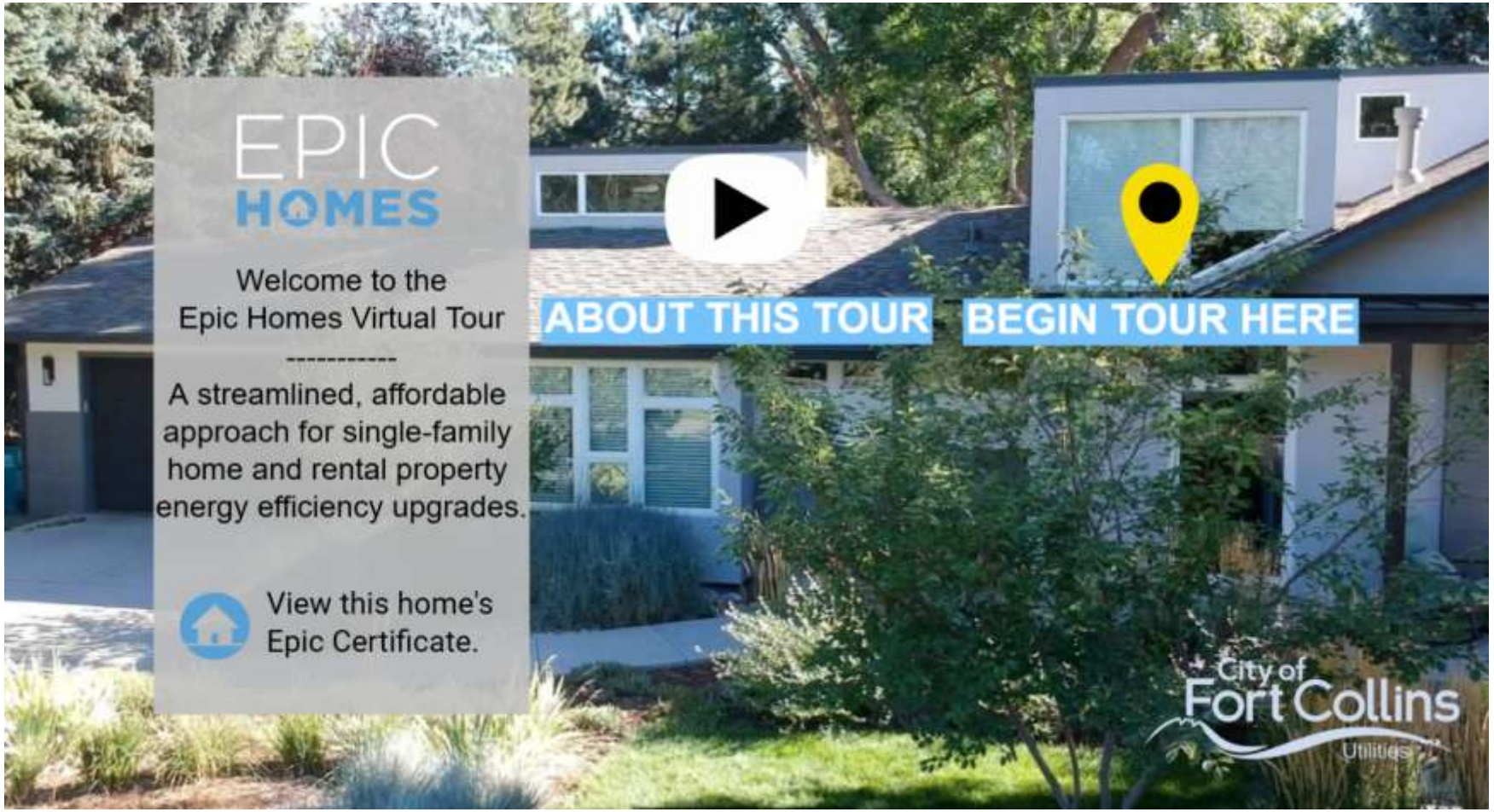
Sensor energy monitor
- Electricity usage per household device
- 1-min resolution

**Residential Environmental Quality & Energy-Use: Metrics for Energy Efficiency Retrofits*

Purgiel, A., Carter, E., Good, N., Guzman Diaz, F., Mehaffy, J., Montague, T.

Exploring other Community values and drivers

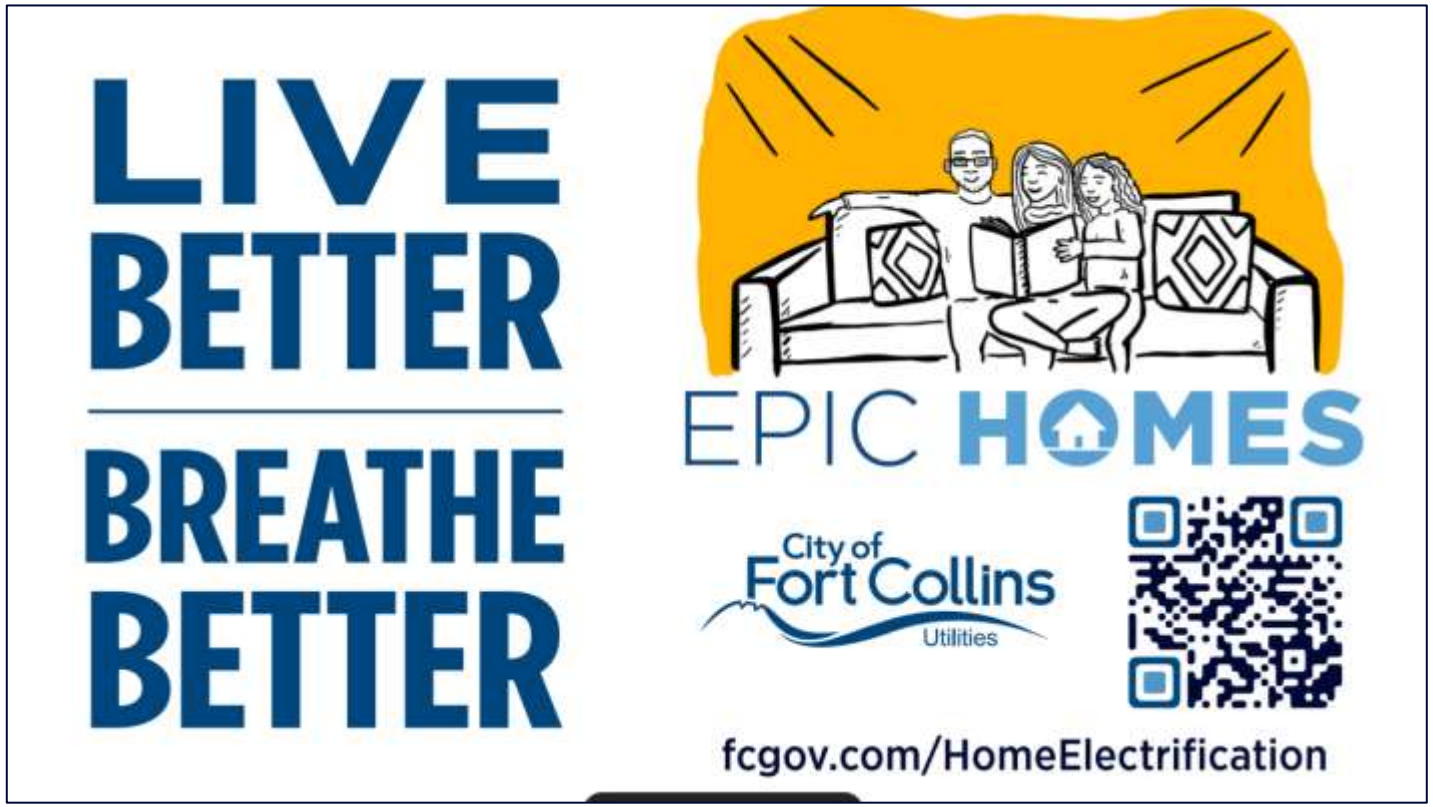
- Real estate ally network promoting value of energy efficiency
- Virtual Home tour – highlighting efficiency equipment



Where we're headed next

- Non-energy benefits become more and more valuable in all – electric homes
- Continue prioritizing historically underrepresented groups in program design
- Continued community education

Program direct mail example:



Thank you!

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