



CLEAResult[®]

Weatherization to DER

CR Technical Problems





Weatherization Vs. Retrofits

Program Type	Weatherization	Deep Energy Retrofit
Goal	Reduce Energy Use and Bend the curve in demand growth	Reduce site energy use between 30 and 50%
Approach	“Peanut Butter” type program used to smear a layer over everything. Measures not necessarily included in a whole.	Targeted to a holistic goal typically combining shell improvements, HVAC, DHW, and ventilation
Impact	Widespread but shallow	Deep but narrow
Cost	Heavily subsidized by utility ratepayers with an average total expenditure of \$4,500 per home	\$50,000 - \$100,000 per home depending on the scope.

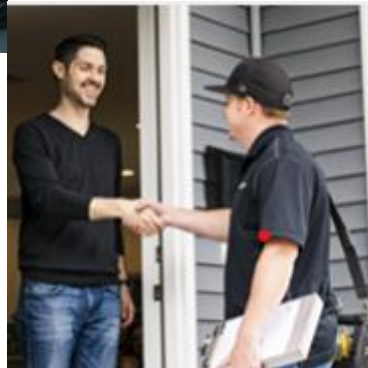
CR Weatherization Programs

Process:

Intake: >



Audit: >



Weatherization: >



Inspection:



Weatherization Programs

Measures:

Instant savings measures:

-Installed at Audit stage:

- LED Bulbs
- Aerators
- Shower heads
- Programable thermostats
- Smart power strips

Installed Measures:

-Installed at Weatherization:

- Air Sealing
- Blown or batt Attic insulation
- Knee wall Batt and Foam board
- Basement Rim band Insulation
- Blown in wall insulation (rockwool or Cellulose)

Weatherization Programs

Limitations:

Roadblocks:

- Knob and Tube
- Asbestos
- Combustion Safety
- Moisture

Programmatic Limitations:

- Cost effectiveness
- Risk
- Diminishing returns
- Occupant disruption

Political Limitations:

- Fuel Agnostic
- Vested Interests
- Libertarian



Targets of Opportunity

Occupied Buildings:

What can be done with limited disruption to residents:

-Change out HVAC equipment

Switching from Atmospheric Combustion equipment to heat pumps

-Air Sealing

Mostly working in unoccupied parts of the house

-Windows/Doors

Replaced from outside

-Attics

Separate from Conditioned space or bring inside?

-Basements

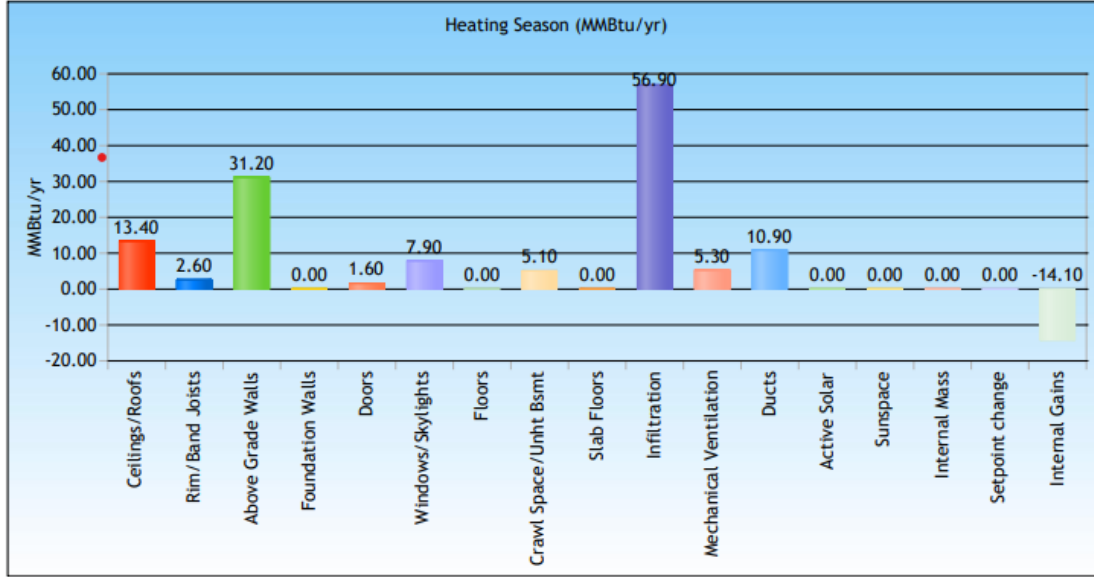
Separate from Conditioned space or bring inside?

-Rooftop PV

Done mostly from outside

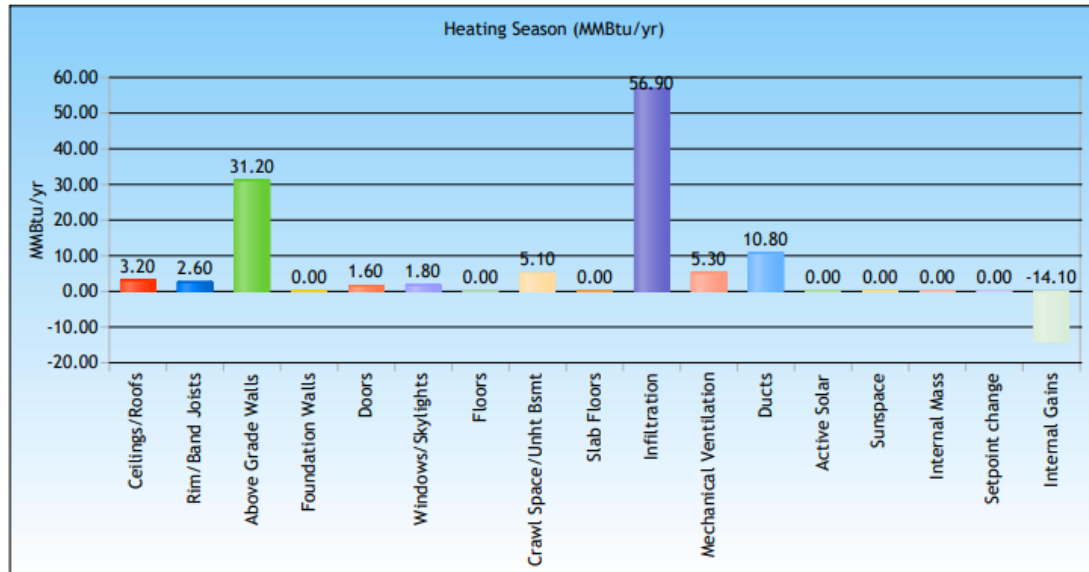


Targets of Opportunity



Ceiling R19
 Wall R11
 Window U0.36
 Infiltration 13 ACH50

120.7 MBTU Heating Season

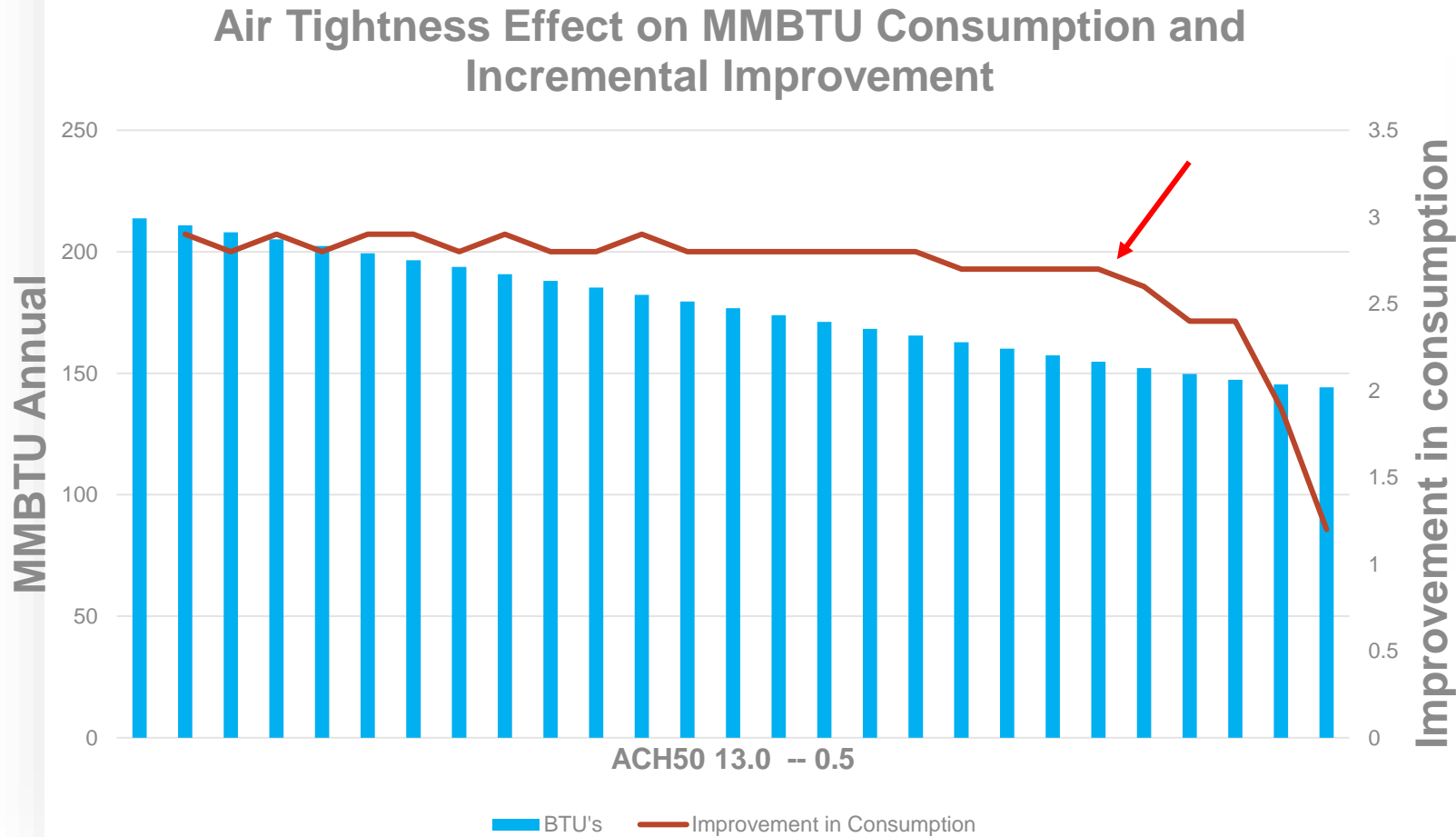


Ceiling R50
 Wall R11
 Window U0.20
 Infiltration 13 ACH50

104.4 MBTU Heating Season



Air Tightness Effect on MMBTU Consumption and Incremental Improvement



At about 3.0 ACH50 the improvement declines as the building becomes more Airtight.

CR Targets of Opportunity

Occupied Buildings:

What can be done with limited disruption to residents: -Change out HVAC equipment

Switching from Atmospheric Combustion equipment to heat pumps!

135,000 BTU atmospheric gas equipment (Boiler and Water Heater) needs a minimum of 1350 CFM make-up air to operate.

Benefits:

- No emissions from operation
- Take advantage of PV
- No issues of leaks, spills etc.
- Little or no induced infiltration



My 1895 Cape in New Bedford, MA (1350 X60)/14240 Cu. Ft. = 5.68 ACH50





Targets of Opportunity

Occupied Buildings:

- Limitations
 - Disruption to occupants
 - Cost
 - Roadblocks— Knob and Tube, Combustion Safety, Asbestos, Moisture, Structural issues
- What can be done with limited disruption to residents:
 - Attics
 - Change out HVAC equipment
 - Air Sealing
 - Basements
 - Windows/Doors
 - Solar

Targets of Opportunity

Occupied Buildings:

-What is difficult and expensive:

-Walls Why?

- Large surface area
- Changing openings, trim,
- Disruption
- Details become more difficult— Structure, roof overhang, field of view for occupants, property lines and setbacks.



Technical Problems Vs. Adaptive Challenges

Technical Problems:

1. Easy to identify
2. Often cut and dry
3. Can be solved by an expert
4. Relatively easy to get buy-in
5. Solutions can be implemented quickly even by edict

Adaptive Challenges:

1. Difficult to Identify
2. Require change in Values, Beliefs
3. Can not be solved by experts alone
4. People resist change and even acknowledging Challenges
5. Solutions require experimentation may take a long time to implement and require buy-in

Examples:

1. We need to reduce the carbon intensity of our housing stock
2. We know how = Reduce heating and cooling loads
3. We have known how to lower loads for decades
4. My bills will be lower/non-existent
5. Building code requires X

Examples:

1. What is the problem, climate change, lifestyle, technology, buy in, politics?
2. Climate Change is real, and we can do something about it
3. Public Policy makes, other stakeholders
4. Even if I believe, there is nothing I can do
5. Different groups may need different solutions,



Adaptive Challenges: How to Address them?

Step 1: Identify and Categorize stakeholders

Mapping your political landscape

Allies	Authorities	Dissenters	Opponents	Casualties
Most aligned with you in thought and action; have most to gain if you succeed	Most decision-making authority whose support and signaling are important	Naysayers and those who stir up trouble or make your work difficult	Against your position or are most threatened by your making progress on the challenge	Stand to lose the most if this is solved



Adaptive Challenges: How to Address them?

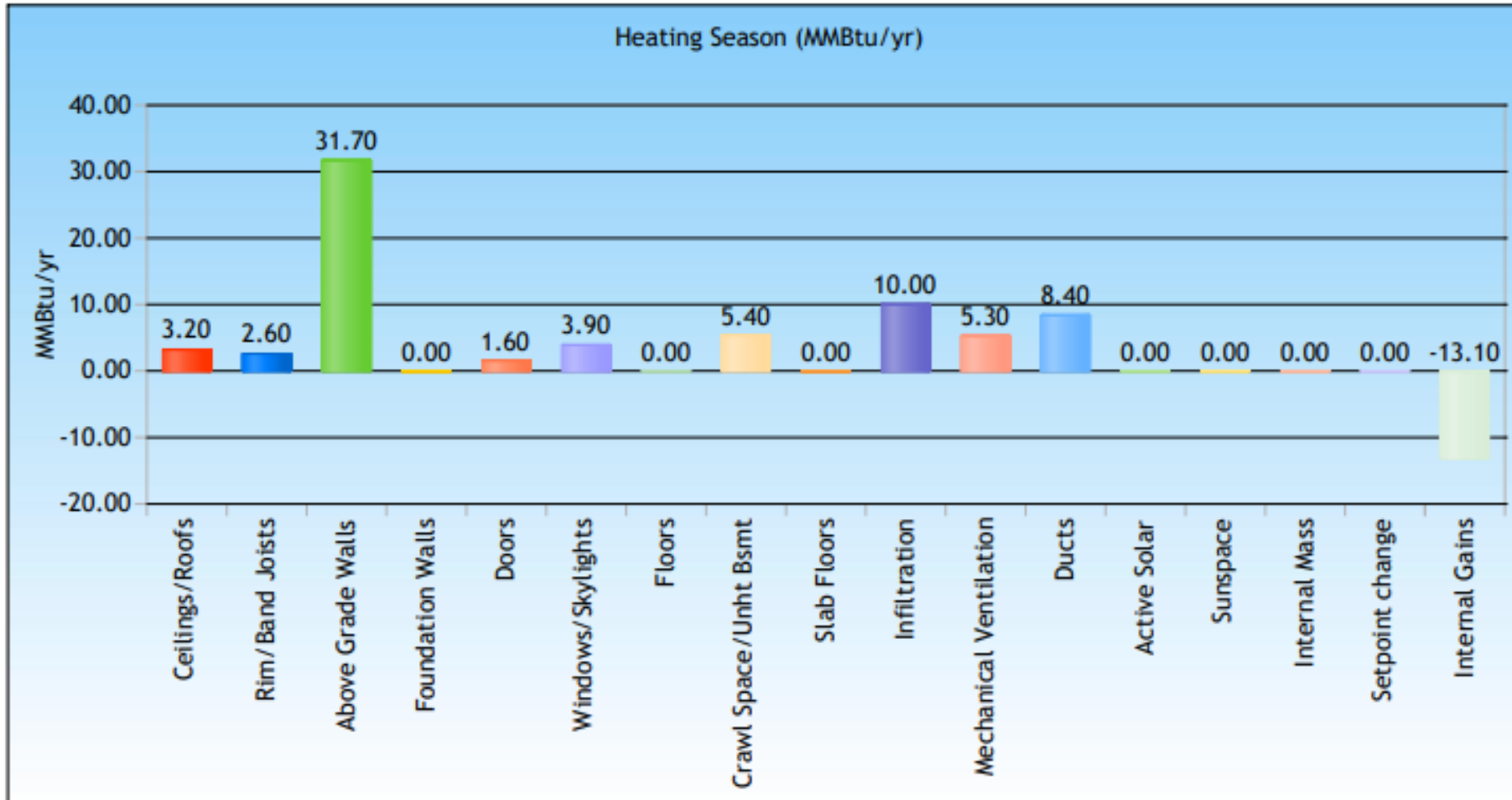
Step 2: Assess Stakeholders

Values, loyalties, losses: assessing stakeholders

Who are your stakeholders?	For each stakeholder, consider:	
	Values	Based on what you know or observe, what matters to this person? Do your best to avoid judgment and instead give voice to their perspective.
	Loyalties	Who are the people, teams or constituencies that this stakeholder may feel beholden to or responsible for? Who might make it difficult for them to support you? Who are they concerned about upsetting in the name of progress?
	Losses	If progress is made on your effort, what might this person lose? Losses might include identity, competence, comfort, reputation, time, status, security, power, independence and resources



What would it take for this to be enough?



Ceiling R50
Wall R11
Window U0.20
Infiltration 3.0 ACH50

59.1 MBTU Heating Season

A 15 KWH solar system (34 450w panals) makes this house net zero