



BUREAU OF ENERGY AND
TECHNOLOGY POLICY

Slides for day 1 of this 2-day session
are in a separate deck

September 23, 2022

Heat Pump Barriers & Market Strategies - Continued

Technical Session 2 (Day 2)
CT 2022 Comprehensive Energy Strategy

Session is being
recorded



Logistics & Housekeeping

- This session is being recorded
- Please include your name and affiliation (if any) in your Zoom icon
- Please turn off your audio and video except when speaking
- To enter the queue to provide verbal comment, use Zoom's *raise hand* feature (more details will be provided later)
- Use the chat function to ask questions about presentations or procedures.

Today's Agenda – Morning (Technical Session 2 Cont'd)

General Introduction & Recap

9:00-9:20 am

Public Comment

9:20-9:35 am

Co-Delivery of Heat Pumps with Other Measures

9:35-10:30 am

Q&A

10:30-10:45 am

Incentives and Measure Delivery

10:45 -11:30 am

Q&A

11:30-11:45 pm

Wrap Up

11:45-11:55 pm

-----LUNCH-----

12:00-1:00 pm

Technical Session 3: Building Thermal Decarbonization Support Strategies - Starts at 1 pm

Click on agenda section heading to
jump to corresponding slides

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UPCOMING TECHNICAL SESSIONS



Session 3: Building thermal decarbonization – Support strategies

This Afternoon: Friday, Sept. 23, 2022, from 1 p.m. to 5 p.m. ET



Session 4: Building thermal decarbonization – Economic potential & technology targets

Thursday, Oct. 6, 2022, from 9 a.m. to 5 p.m. ET

Other sessions on Electric Demand Response and Alternative Fuels to be announced for October



More information on the CES webpage:
<https://portal.ct.gov/DEEP/Energy/Comprehensive-Energy-Plan/Comprehensive-Energy-Strategy>

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| Technical Session | Meeting Date(s) | Deadline for Written Comments |
|-------------------|--|-----------------------------------|
| 2 | Sept. 22, 2022 9 a.m. - 5 p.m. ET Sept. 23, 2022 9 a.m. - noon ET | Oct. 7, 2022, at 5:00 p.m. ET |
| 3 | Sept. 23, 2022 1 p.m. - 5 p.m. ET | Oct. 7, 2022, at 5:00 p.m. ET |
| 4 | Oct. 6, 2022 9 a.m. - 5 p.m. ET | Oct. 21, 2022, at 5:00 p.m. ET |

Written Comment Opportunities

- After each technical session DEEP is accepting written comments – deadlines vary
- Please see the August 18th [notice](#) for submission instructions and specific questions for which DEEP is seeking responses
- More information on the CES web page:
<https://portal.ct.gov/DEEP/Energy/Comprehensive-Energy-Plan/Comprehensive-Energy-Strategy>

WELCOME & INTRODUCTIONS

Thanks for joining our technical session today!

Comprehensive Energy Strategy Scope & Objectives

- **Scope:** electricity, thermal energy, and fuels for transportation
- **Objectives:**
 - Examine future energy needs in the state and identify opportunities to reduce costs, ensure reliable energy availability, and mitigate public health and environmental impacts of CT's energy use
 - Provide recommendations for legislative and administrative actions to aid in achievement of interrelated environmental, economic, security, and reliability goals

BETP Mission: to manage energy, telecommunication, and broadband policy issues and program deployment with the goal of establishing a clean, economical, equitable, resilient, and reliable energy future for all residents.

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DEEP's Approach to the 2022 CES

5 Key Lenses

- **Climate** – meeting greenhouse gas reduction obligations under Global Warming Solutions Act
- **Equity** – energy decisions that produce equitable outcomes
- **Affordability** – energy decisions that produce affordable outcomes
- **Economic development** – workforce development; economic competitiveness
- **Reliability & Resilience** – energy system improvements and load balancing

Key Strategies

- Build on and/or modify findings and recommendations of 2013 and 2018 CESs
- Consider emerging issues not addressed in a prior CES
- Rely on results from recent, major quantitative studies where appropriate rather than duplicate efforts

3 Key Factors

- The carbon intensity of the electric grid
- Need for emission-reduction solutions that facilitate climate change adaptation, resilience, and energy security
- Fuel price volatility

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Tentative CES Development Timeline

- **September 2022** – Technical Sessions 1-3
- **October 2022** – Technical Sessions 4-6
- **November 2022** – Technical Sessions 7 & 8
- **October 2022 – January 2023** – Drafting & Public Comment Periods for at least 3 White Papers
 - White papers to be based on topics covered in technical sessions
- **Q1 & Q2 of 2023** – CES Drafting, Public Comment Opportunities, & Listening Sessions

Technical Session Topics

1. **Hard-to-Decarbonize End Uses**
2. **Heat Pump Market Barriers & Strategies**
3. **Building Thermal Decarbonization Support Strategies**
4. **Building Thermal Decarbonization – Economic Potential & Technology Targets**
5. **Electric Demand Response**
6. **Alternative Fuels**
7. **Natural Gas Planning & Policies**
8. **Carbon Pricing & Low-Carbon Incentives**

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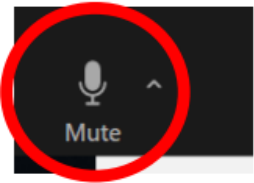
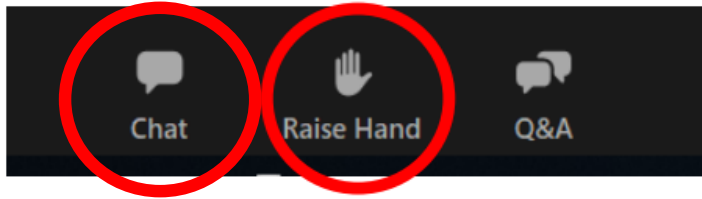


Recap of Yesterday

- **Topics Discussed**
 - Heat Pump Market Overview
 - Barriers to Heat Pump Adoption
 - Market Transformation Approaches including marketing, workforce development, consumer support and education
 - Heat pump deployment in affordable housing



Questions and Comments



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of the
screen**

At the conclusion of each panel DEEP will hold a brief question and answer period.

If you have a question for a presenter, please drop it into the chat to Jeff Howard. DEEP will pose as many questions as time allows to the speakers. Clarifying questions will be prioritized. Leading questions will not be accepted.

If you would like to make a comment during the public comment periods:

- Please use the “Raise Hand” feature if you would like to speak
- After any interested elected officials have provided their comments, you will be invited to provide your comment in the order the hands were raised
- Please unmute yourself, state your name and affiliation
- Given time limitations, please limit your comment to 2 minutes.
- After your comments, please remember to click the “Mute” button

General Public Comment

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Co-Delivery of Heat Pumps with Other Supportive Measures

Melissa Kops – CT Green Building Council

Amy Boyd – Acadia Center

Ravi Malhotra – International Center for Appropriate and
Sustainable Technology

Click on agenda section heading to
jump to corresponding slides

(speaker order may vary)

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CT Green Building Council

Companion Measures for Heat Pumps and Electrification

September 23, 2022

Melissa Kops AIA, LEED AP BD+C, LFA
Board Advisor
CT Green Building Council

Proper weatherization addresses all three forms of thermal movement through the building envelope.

Conduction - directly through materials.

Insulation resists thermal movement through conduction

Radiation - line of sight transfer of heat across space

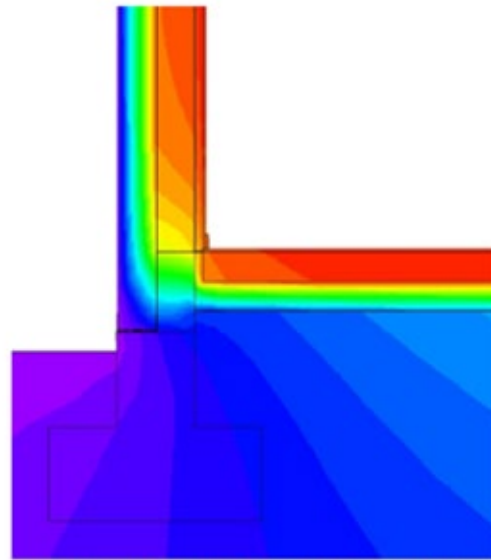
The insulation levels of the building enclosure contribute to the temperature of the interior surfaces. For example cold window surfaces cause us to feel uncomfortable because they draw heat from us.

Convection - through air movement

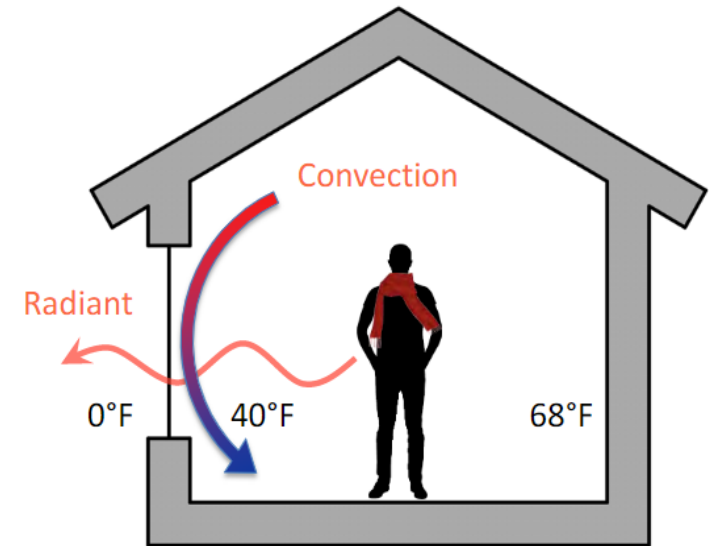
Air sealing resists heat transfer through convective air infiltration. Cold surfaces such as windows can cause internal convective loops that can be remediated with perimeter heating.

Companion Measure: Weatherization

Thermal movement happens in three different ways



THROUGH CONDUCTION,...



THROUGH CONVECTION, ...
AND THROUGH RADIATION.

Thermal comfort is achieved through a combination of factors

If one of these factors is not ideal, the others have to compensate.

Historically high temperature radiant heat was used to compensate for cold surfaces and drafty buildings.

Heat Pumps and thermal comfort:

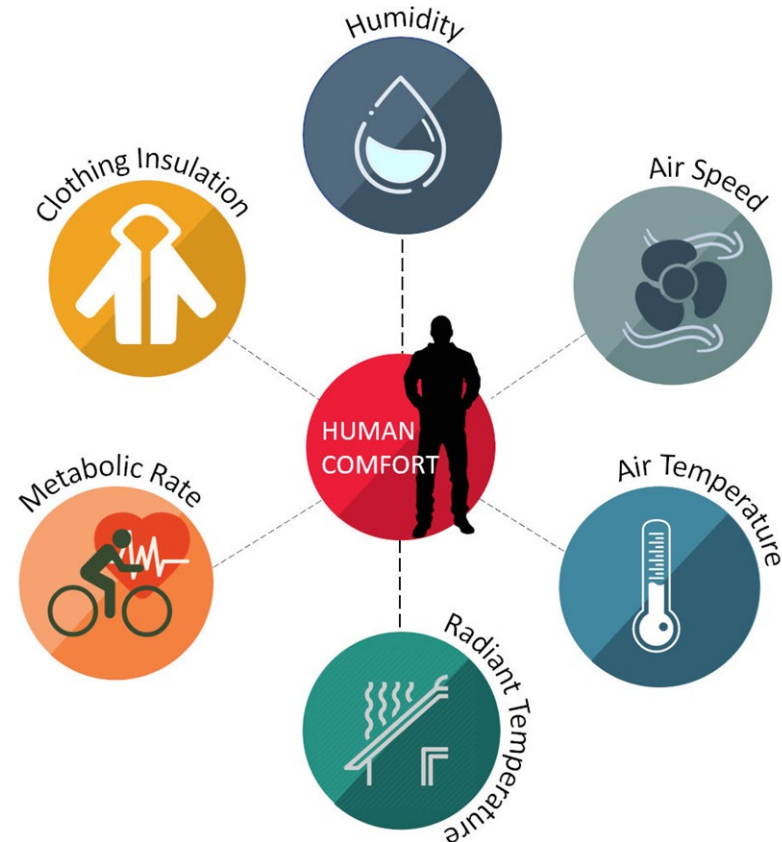
Heat Pumps deliver lower temperature heat than fossil fuel combustion, so cannot compensate for poorly weatherized cold surfaces or keep up with high levels of air infiltration. They also cannot ramp up and down as rapidly.

Heat pumps work very efficiently in properly weatherized buildings, or during mild seasons with fossil fuel backup.

NOTE: this has everything to do with weatherization and not cold outdoor temps. Heat pumps can work efficiently at very cold outdoor temperatures within weatherized homes.

Companion Measure: Weatherization

Thermal comfort isn't just about air temperature



Benefits of weatherization

Reducing building loads reduces the size of the heat pump, which improves cost effectiveness, performance, and capacity. Lower loads means existing ductwork does not need to be upsized.

Pay attention to the thermal boundary

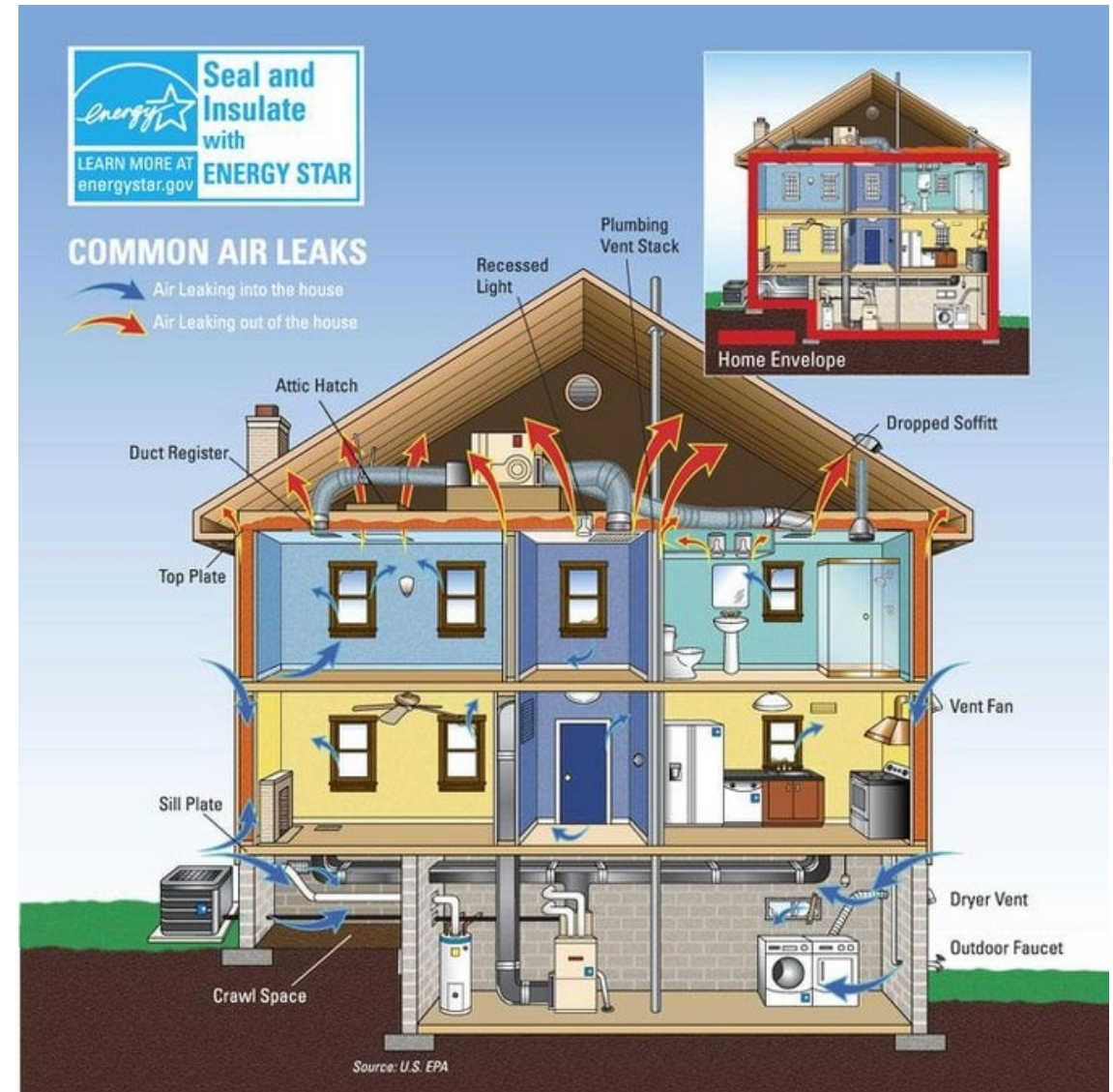
A poorly weatherized building relies on wasteful energy inefficiencies to make up for poor building performance.

Unlike fossil fuel combustion, heat pumps do not generate waste heat, so replacing a furnace with a heat pump in an unconditioned basement can have unintended consequences like frozen pipes.

It is best to put equipment and ductwork inside the conditioned building envelope. If there is plumbing and equipment in the basement or attic, weatherize and condition that space or relocate the equipment.

This includes air-source heat pump water heaters that can have long recovery times, especially if not within the conditioned envelope.

Companion Measure: Weatherization



Companion Measure: Energy Recovery Ventilation

Weatherizing the building envelope requires the addition of mechanical ventilation.

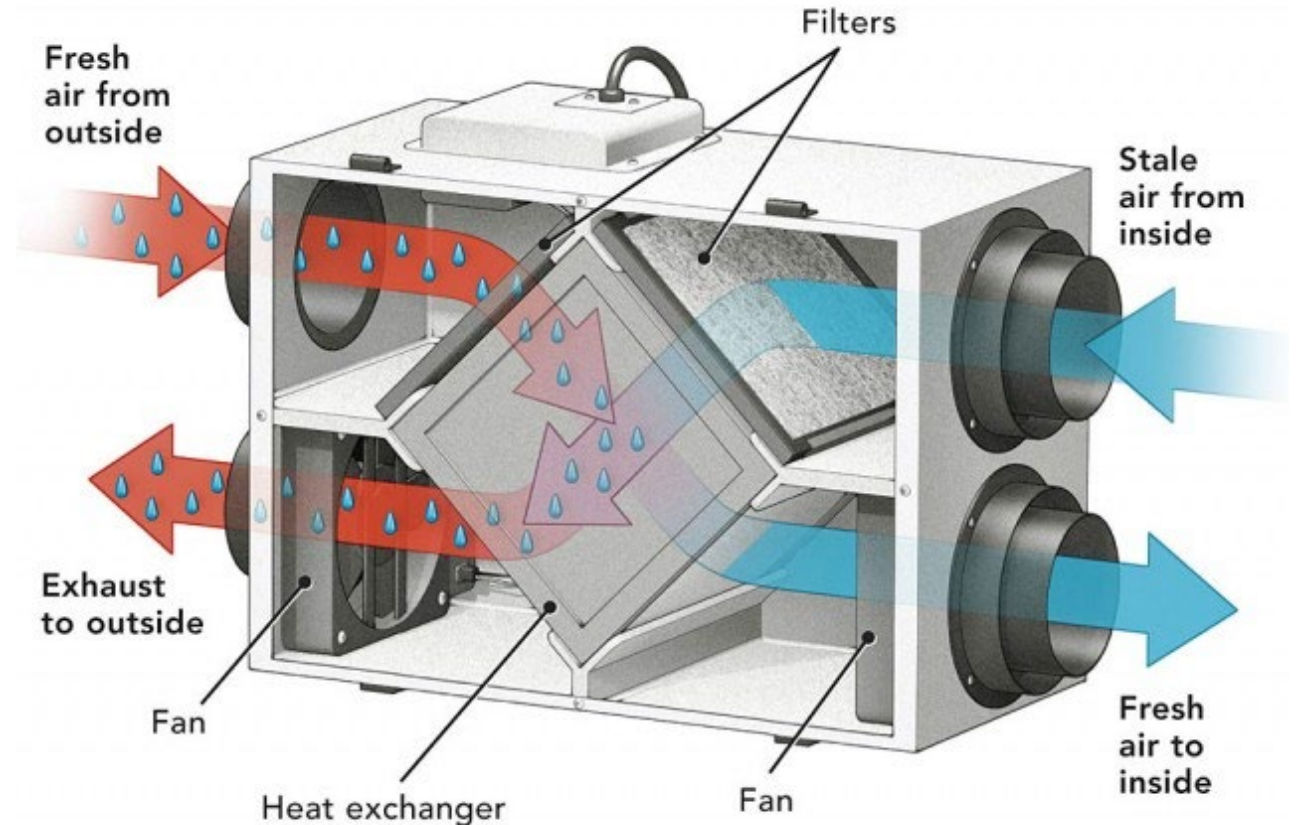
A poorly weatherized building relies on uncontrolled air infiltration through the building envelope to provide fresh air.

Energy Recovery Ventilation is always a good idea for the following reasons:

- Balanced ventilation prevents pressurization or depressurization of the building. Positive and negative pressure forces air and moisture through the building envelope where it can cause damage such as rotting and mold-growth.
- Heat and moisture can be recovered from exhaust air to reduce energy consumption
- Controlled air movement can be passed through a filter to reduce indoor air pollution.

Additional benefits of an ERV as a companion to a heat pump:

- An ERV can help regulate moisture.
- Ventilation needs to incorporate energy recovery because heat pumps have a hard time handling high volumes of fresh outdoor air delivery.



Companion Measure: Renewable Energy

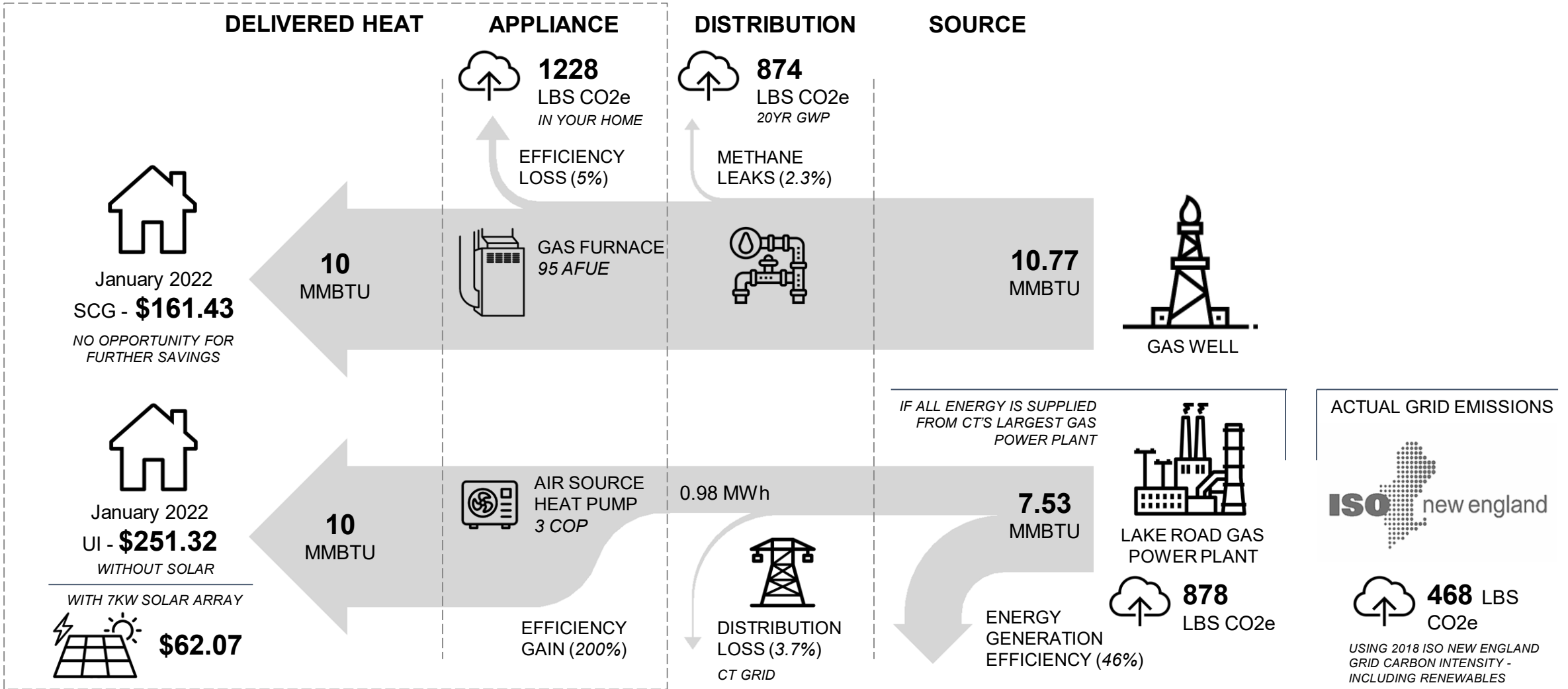


Diagram created by the CT Green Building Council using information from the following sources:

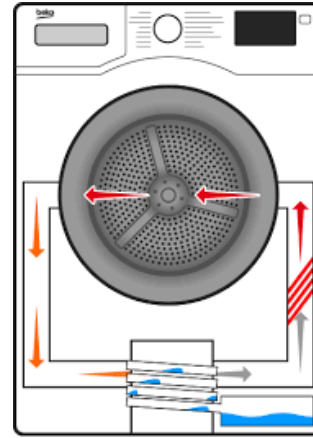
[2018 CT DEEP Greenhouse Gas Inventory](#), [U.S. Energy Information Administration](#), [Assessment of Methane Emission from the US Oil and Gas Supply Chain](#)

Companion Measure: Full Electrification

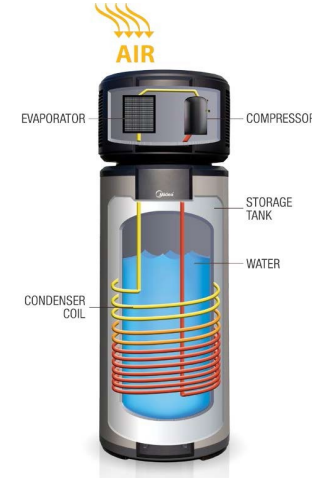
Full electrification provides compounding benefits.

Full electrification eliminates onsite fossil-fuel combustion maximizes the amount of energy usage and cost that can be offset with onsite renewable energy, and eliminates the need to have a gas connection or separate energy bill. *An upgraded electrical service will most likely be required with switching to a heat pump so it is best to upgrade the service to plan for full electrification.*

- **Hybrid Air-Source Water Heaters** are very efficient and economical with current incentives.
- **Induction stoves** are clean, safe, and efficient, and replace gas stoves which are one of the largest sources of air pollution exposure.
- **Heat pump dryers** are more efficient and they eliminate the need for dryer exhaust which eliminates a source of heat loss and another penetration through the building envelope.
- **EV charging** can further improve health by reducing the total amount of exposure to air pollution and gasoline fumes, and reduced total cost of ownership.
- **Battery Storage** can provide resilience in the event of a power outage, and provide demand response benefits to the grid at times of peak load. Newer generations of EVs and charges allow energy flow in both directions to charge the car and provide battery storage to the building and electrical grid.



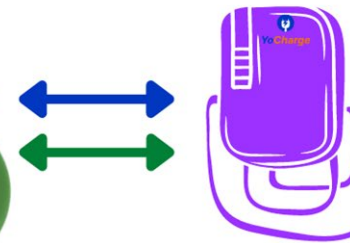
**Heat Pump
Dryer**



**Hybrid Air-Source
Water Heater**



Induction Stove



Information Electricity

Solar & Battery Storage & Bidirectional EV Charging

Recommendations Summary

- Provide more funding to low-income weatherization programs to weatherize the homes of CT residents that have the highest need.
- Incentivize comprehensive electrification to achieve maximum benefits from building decarbonization including all companion technologies.
- Incentivize service upgrades necessary to install comprehensive electrification measures.
- Enable municipalities to adopt electrification stretch codes.
- Provide workforce training to installers and contractors for electrification best practices and the concepts behind why heat pump companion measures are recommended.
- Provide outreach to educate consumers about all the benefits of installing all the companion measures to heat pump installation.
- Provide a predictable demand or buy in bulk to make innovative technologies more available such as high temperature heat pumps.

Acadia Center



Acadia
Center

Advancing the Clean Energy Future

CO-DELIVERY OF HEAT PUMPS WITH OTHER SUPPORTIVE MEASURES

CT CES Technical Session 2B

September 23, 2022

acadiacenter.org • admin@acadiacenter.org • 207.236.6470 ext. 001

Boston, MA • Hartford, CT • New York, NY • Providence, RI • Rockport, ME



WHO IS ACADIA CENTER?



MISSION

Acadia Center's mission is to advance bold, effective, and equitable clean energy solutions for a livable climate and a stronger, more equitable economy.

PROGRAMS

Acadia Center focuses on six areas of climate and clean energy, within which we prioritize consumer benefits, public health, economic growth, and equitable distribution of benefits:

Next Generation Energy Efficiency: Make Our Buildings Healthy, Efficient, and Climate Safe

Beyond Gas: Phasing Out Our Dependence on Fossil Fuels

Utility Innovation: Reform Utilities and Energy Systems

Transportation Climate and Equity Investments

Clean Energy and Climate Pathways

Public Engagement and Communications

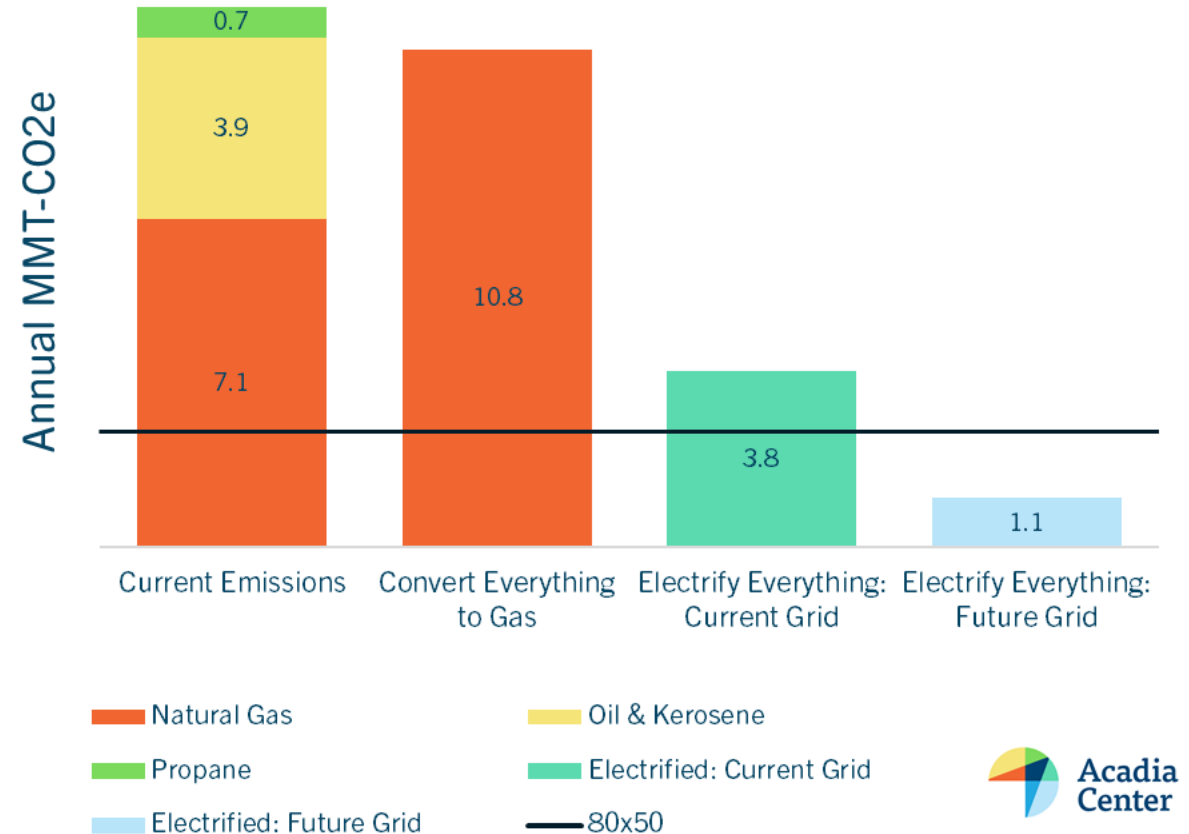
SUPPORT

Acadia Center is funded by foundation grants and individual donations. It does not accept corporate or government funding.

THANK YOU, DEEP!

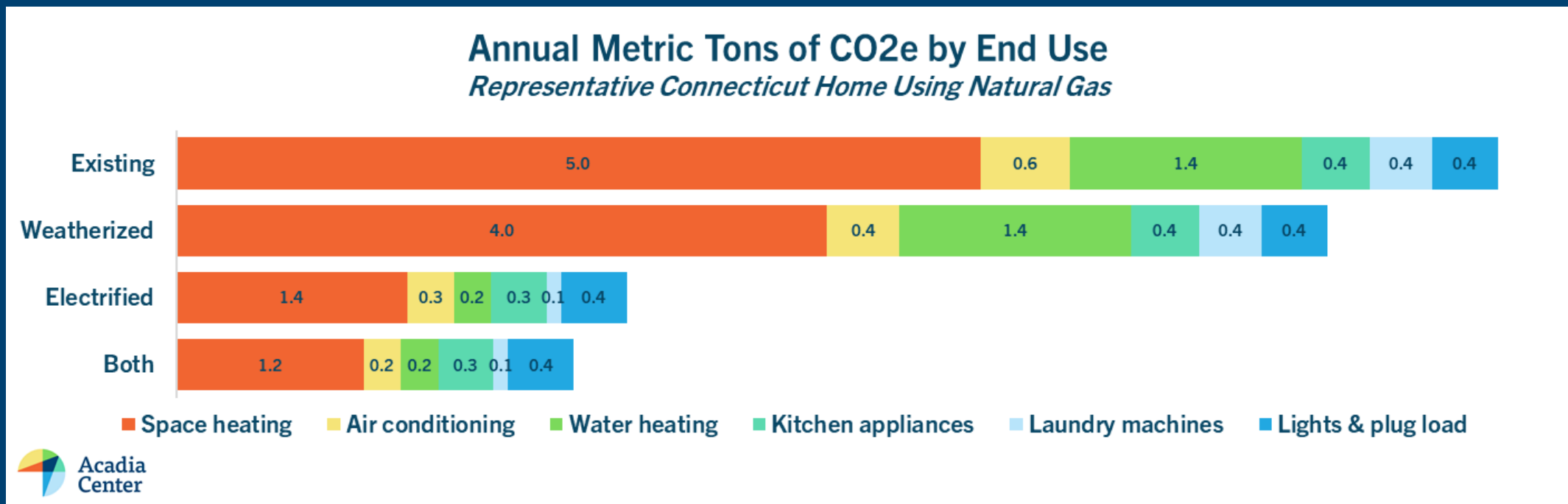
- Electrification of buildings:
 - Necessary to hit state climate goals
 - Health & Safety
- Electrifying only buildings that oil or propane for heat will not enough
- Need to electrify **gas** heated buildings
- Need to stop making more heated buildings

Connecticut Thermal Emissions in Buildings
vs. State Climate Goals



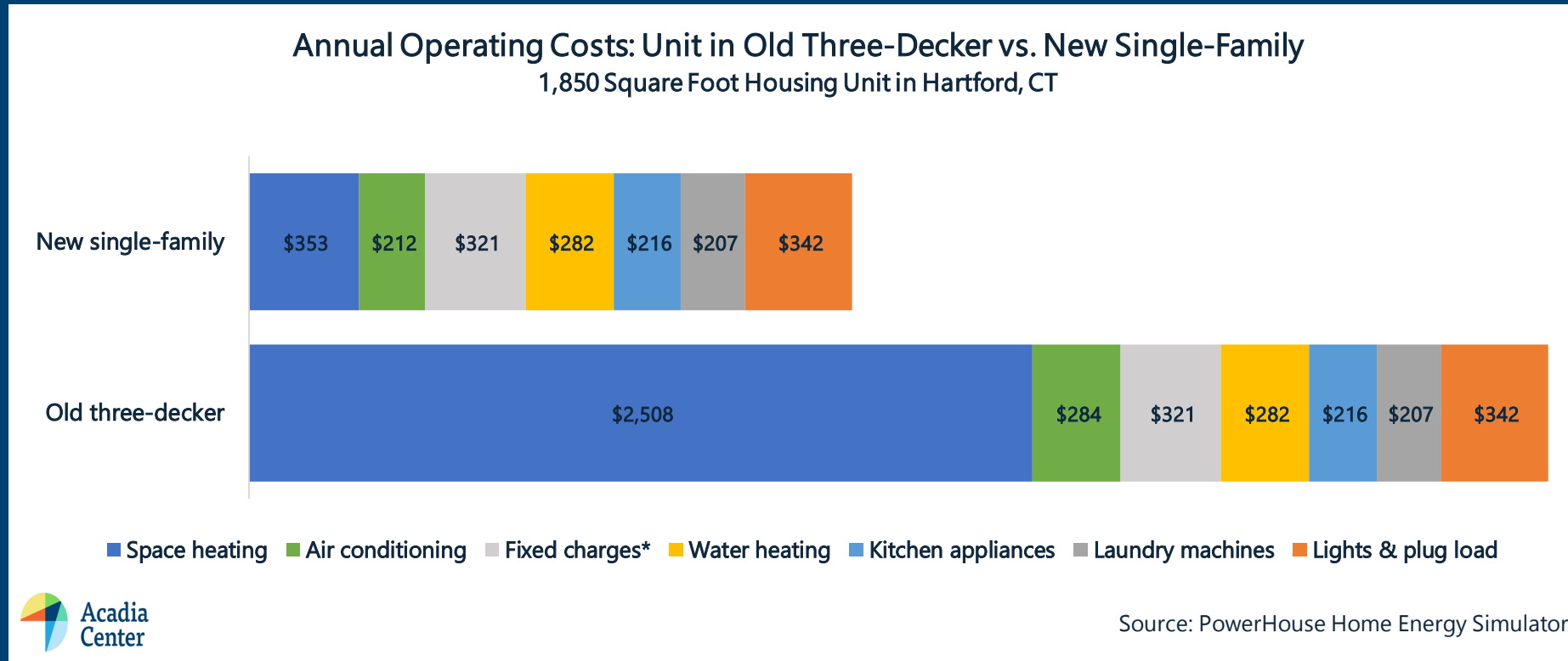
WHOLE-HOME ELECTRIFICATION

- Co-Delivery of HP, HPWH, appliances, EE, Wx and air sealing
- Reduces emissions in gas heated home by 66+% on day one
- Even more as grid gets cleaner



START WITH HIGH-EMITTING, LOW-INCOME HOUSING

25% least efficient: cost 5x more to heat, create 50% of GHG emissions
Tends to be “hard to serve” – renters, lower income, non-English, EJ



FOUR IMPERATIVES, FOUR STRATEGIES

Next Generation Energy Efficiency:

1. Prioritize investment in substandard housing
2. Maximize greenhouse gas mitigation
3. Promote whole-home electrification
4. Sustain high investment levels in efficiency

1. Get the **public** on board with educational materials, incentives, and heat pump-friendly electric rate design
2. Get the **workforce** on board with financial assistance for contractors who enter the heat pump installation business
3. Get serious about enforceable, statewide **targets**
4. Reform energy efficiency programs to more highly value **emissions reduction** and to systematically scale up treatment of the least efficient homes & in **EJ** communities



CT'S MAP TO SUCCESS

- Stop adding more gas
- Structure EE programs for success
 - Change BCRs, create GHG Mandates
 - Remove the budget caps
- Fund EE and electrification programs
- Prioritize High-Emitting, Low-Income Housing
- Whole Home Electrification
- Co-Delivery: Electrification + Weatherization + Controls
- Invest in Workforce!
- Climate and environmental justice are state priorities - **them**



CT'S MAP TO SUCCESS

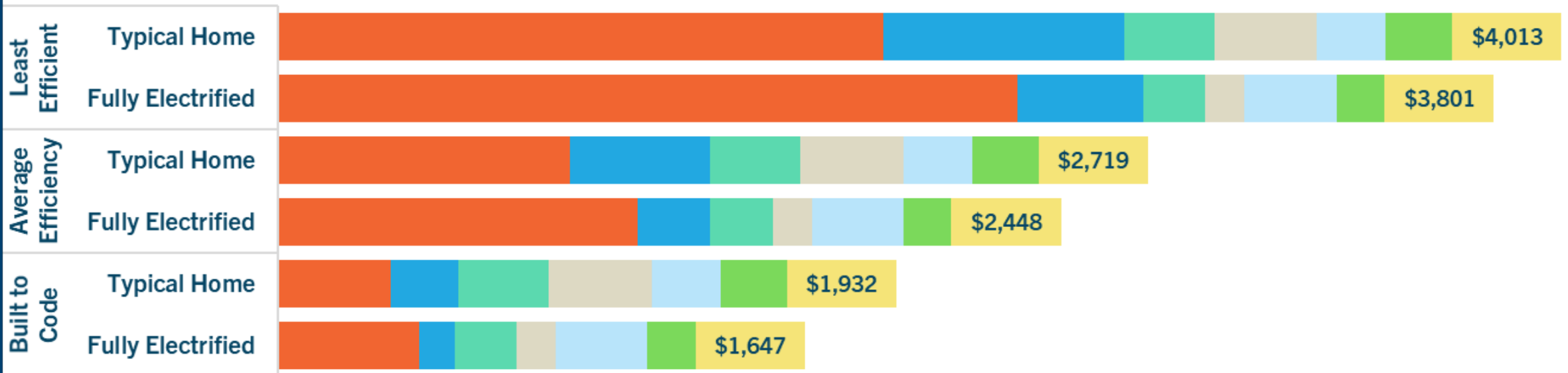
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- Climate and environmental justice are state priorities - **fund them**

START WITH HIGH-EMITTING, LOW-INCOME HOUSING

Electrification reduces bills

Weatherization reduces energy burdens

Annual Operating Costs by Building Shell Efficiency Level
Hartford, CT



■ Space heating
 ■ Air conditioning
 ■ Water heating
 ■ Fixed charges*
 ■ Kitchen appliances
 ■ Laundry machines
 ■ Lighting & plug load

ADDRESS WEATHERIZATION BARRIERS

- Whole-home electrification of LI homes will include addressing health & safety barriers
 - 2018: 23% of audited LI homes deferred from program
 - 2022: \$2M from LIHEAP toward H&S barriers
- Need: seamless, effective path to use funds for low-income household weatherization and H&S barrier mitigation
 - LIHEAP & WAP
 - Federal funding bills (ARPA, IRA)

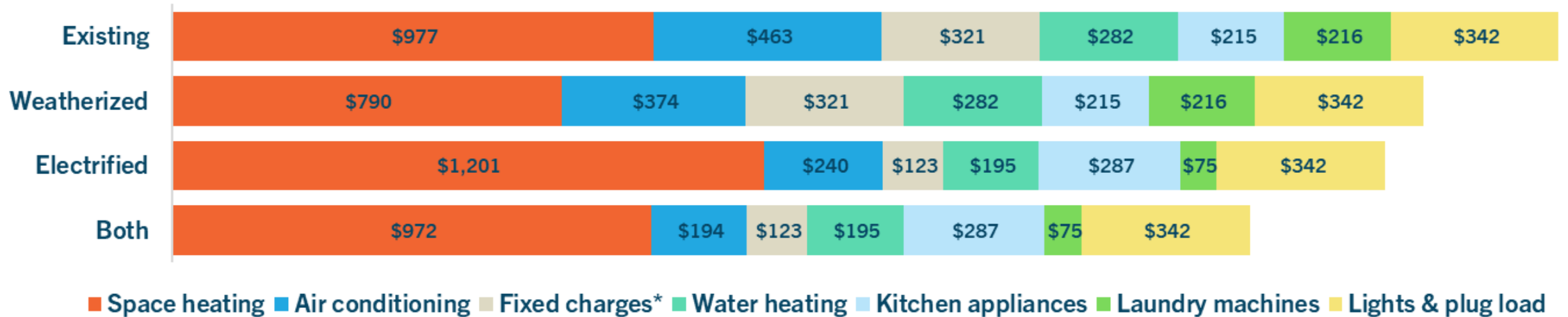


NEED TO ADDRESS RENTALS & UNDERSERVED

- Split incentive problem
- [MA Renter Plan](#): outreach, pre-weatherization, 100% weatherization, community partnerships & grants
- Make policy decision to focus resources in specific places
- Helped in MA: tie portion of PIM to electrification and EJ benefits

HELP CONSUMERS MORE: TREAT THE WHOLE HOUSE

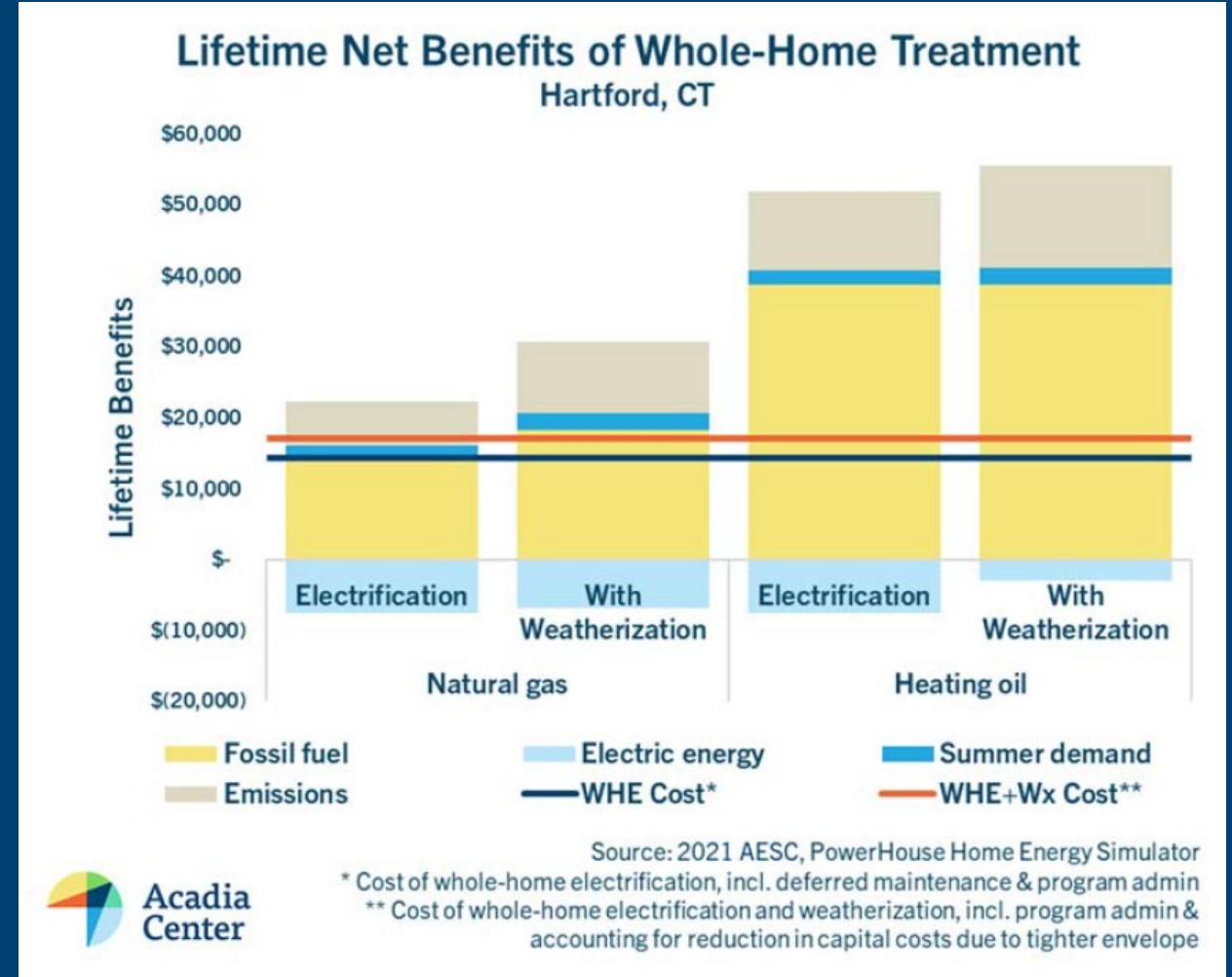
Annual Operating Costs by End Use
Representative Connecticut Home Using Natural Gas



* Electric and natural gas customers pay a fixed monthly charge on their bills. Homes that heat with gas pay both of these charges, while all-electric homes only pay the electric charge.

CO-DELIVERY OF ELECTRIFICATION & WEATHERIZATION

- Weatherize First: right-size heat pump, more savings
- Enhanced incentives in already weatherized bldgs
- Bundled Delivery: one-stop coordinated offering
- Enhanced incentives for HPs with controls (potential DR resource)



BUILD UP THE WORKFORCE

- HPCⁱ biz: rigid & low-margin
 - PAs set compensation
 - Non-program-supported weatherization work is rare
- HPⁱⁱ less common than FFⁱⁱⁱ
- Ways to address:
 - Reward home performance, not measure installations (more customization)
 - Tax breaks, wage subsidies
 - Training! Education! Support!
 - Engage supply houses
 - Better consumer incentives



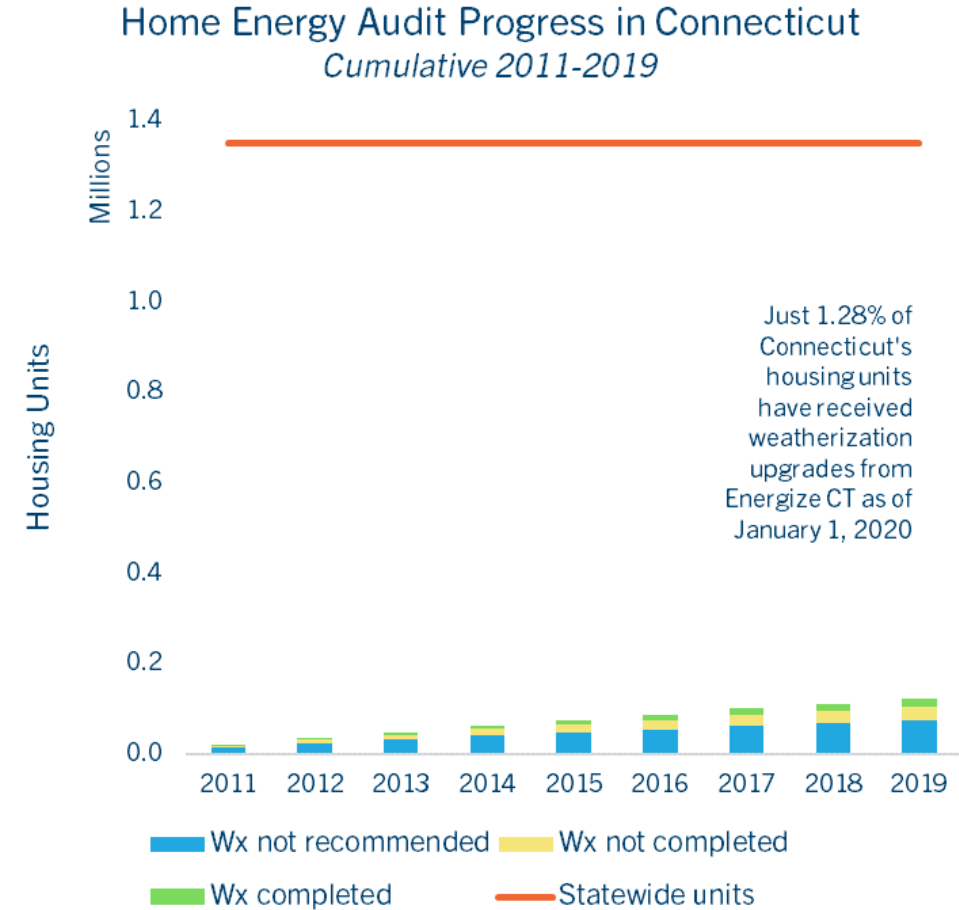
ⁱ Home performance contractor

ⁱⁱ Heat pump equipment

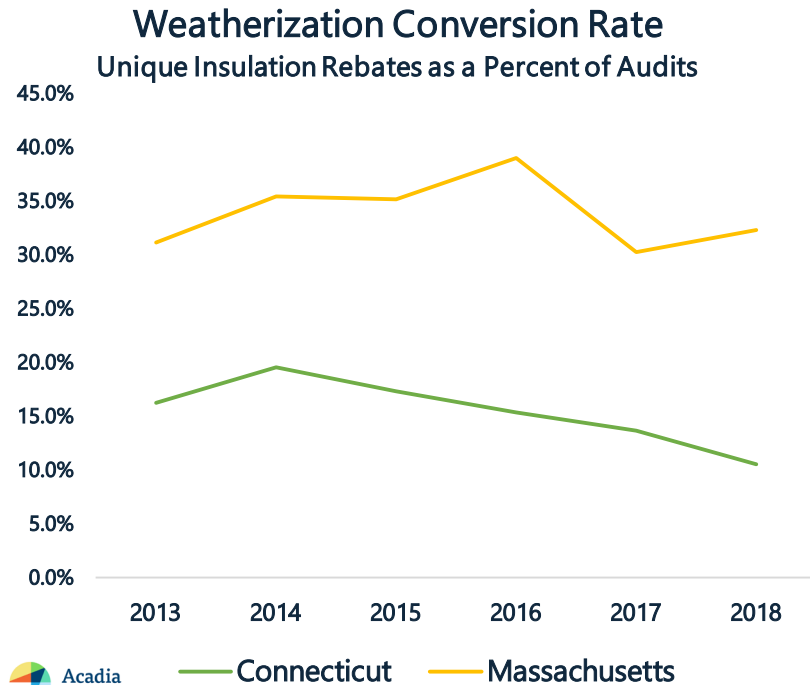
ⁱⁱⁱ Fossil fuel equipment

INCENTIVES @ ENERGY AUDITS WON'T BE ENOUGH

- Moving too slowly
- Go faster, improve closure rate → still need more
- GHG mandates for CL&M Plans
- Design programs to maximize energy/GHG savings per home
- More customizable offerings, integrate HVAC, P4P
- Statewide targets for heat pumps & weatherization, particularly for low-income housing



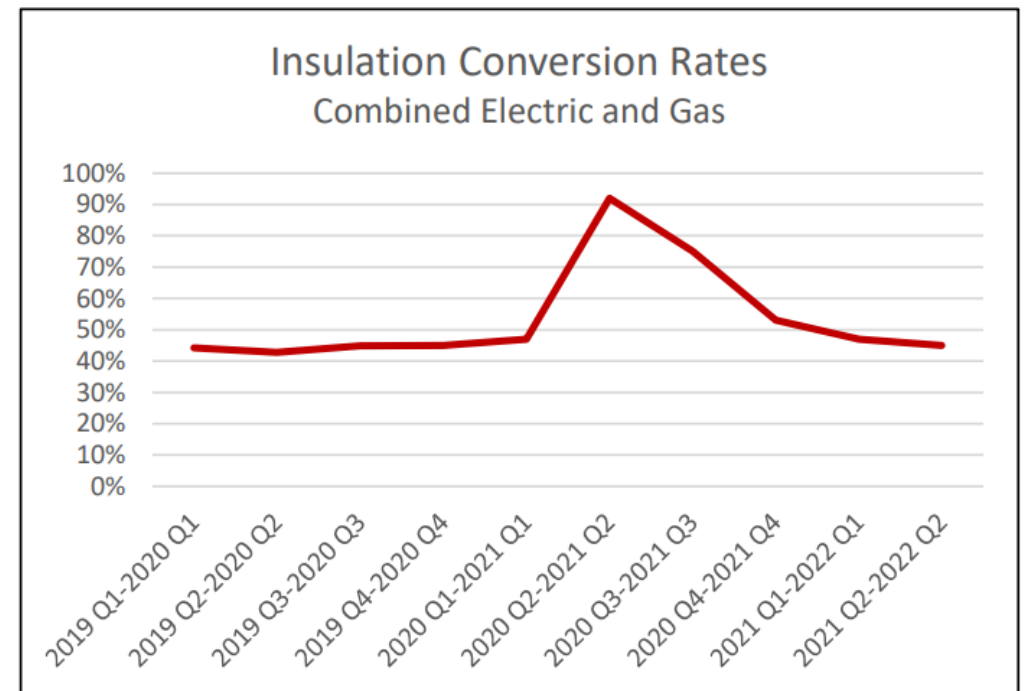
WEATHERIZATION CONVERSION RATES – LOOK TO MA?



— Connecticut — Massachusetts

- MA insulation rebates usually higher than CT
- During pandemic, 100% Wx incentive (normal ~ 75%)

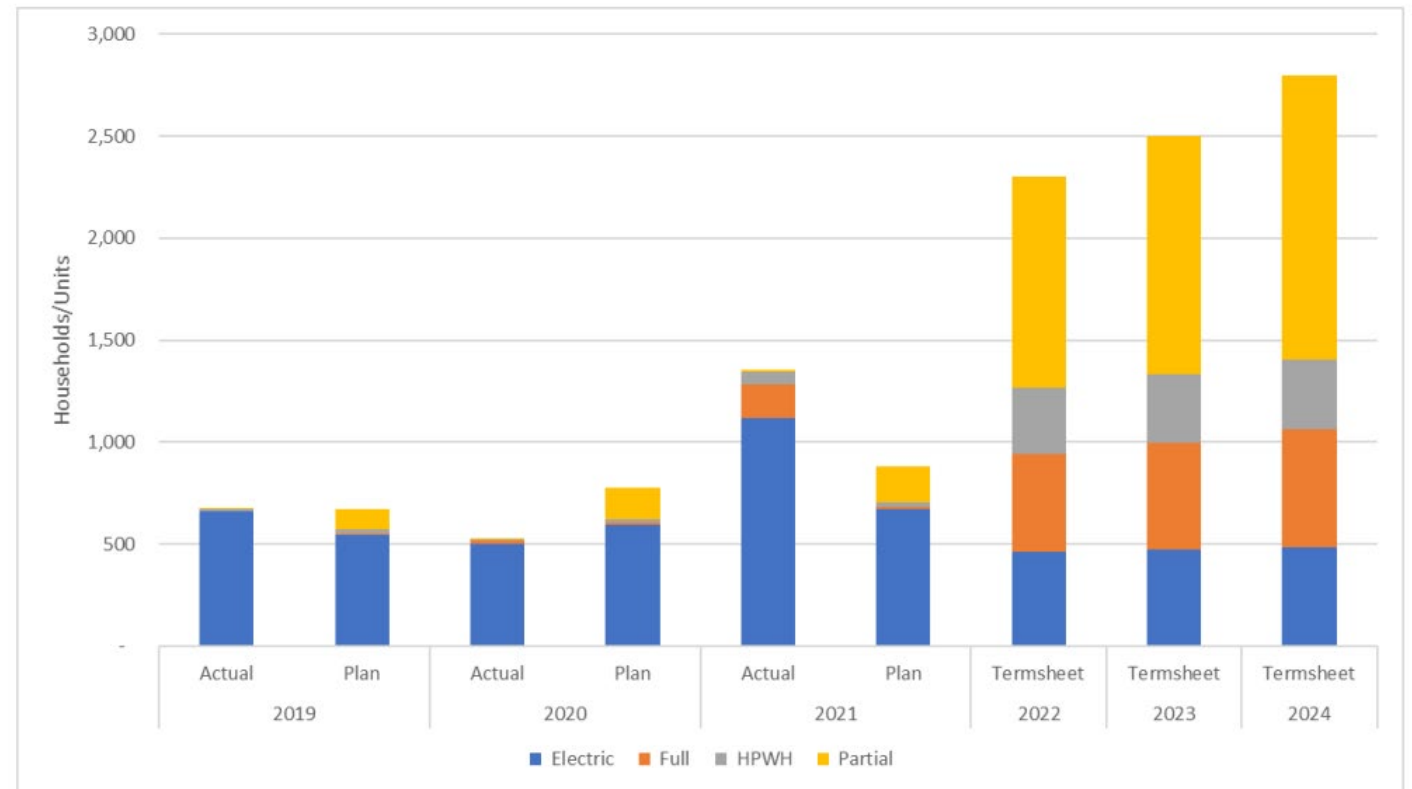
- Fill pipeline for when could get back to insulation work
- Demonstrable impact on closure rate, went away



OTHER LESSONS FROM MA

- Even if the program's not perfect, Start.
- Electric to HPs help build the workforce & market
- Ambitious goals can deliver results
- GHG mandates make all the difference
- This will be difficult. Keep going.

INCOME ELIGIBLE HEAT PUMP INSTALLATIONS





Advancing the Clean Energy Future

FOR MORE INFORMATION:

Amy Boyd
Director of Policy
aboyd@acadiacenter.org
617.742.0054 x102

Sign up: acadiacenter.org/join



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International Center for Appropriate and Sustainable Technology (ICAST)

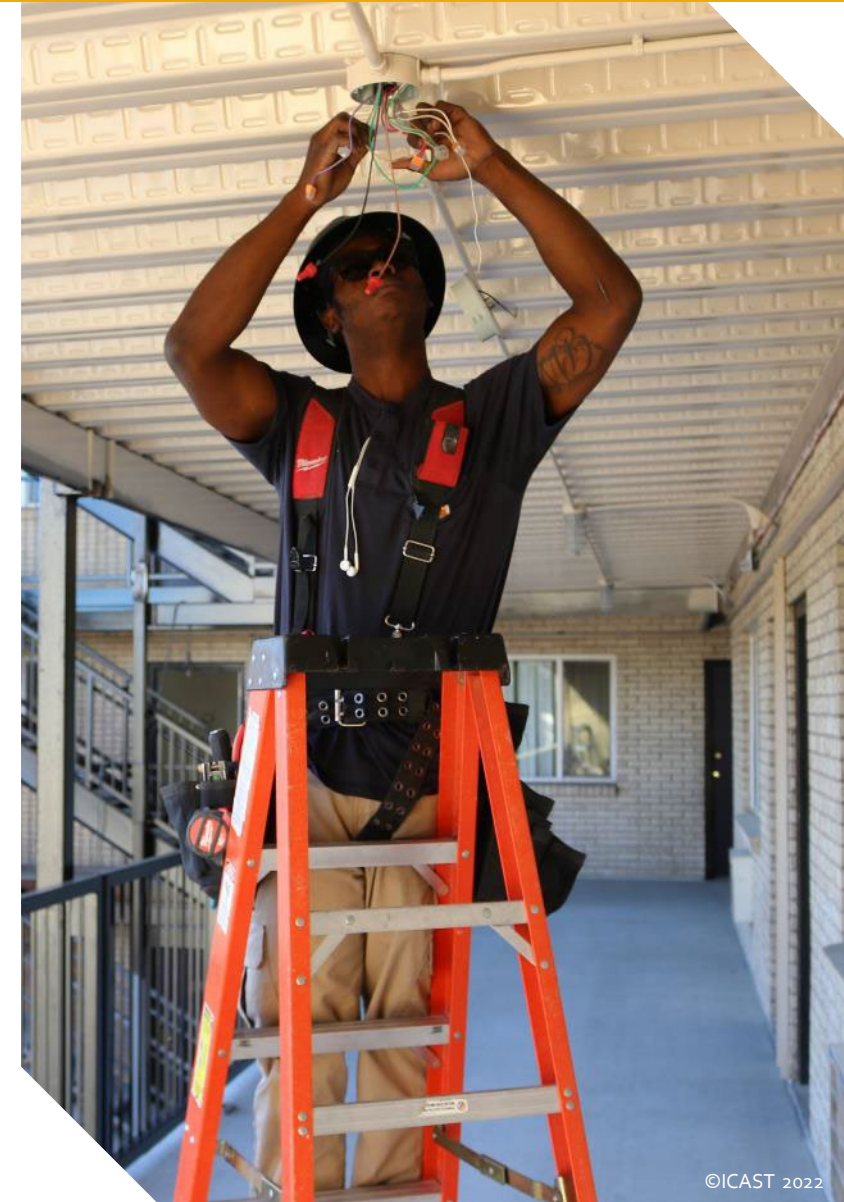
Building Thermal Decarbonization - Heat Pump Barriers and Market Strategies





Who We Are

- 501C3 national nonprofit
- **Population Served:** Low-to-Moderate Income
- **Primary Market Served:** Multifamily Properties
- **Mission:** Provide economic, environmental, and social benefits to LMI communities
- **Motivation:** Affordability of Housing, Climate Change, and Economic Development



What We Do



- **Green retrofits of existing MF properties**
 - ✓ DER solutions (EE, BESS, DR, RE, EV, EMS)
 - ✓ H&S solutions (Barriers, HH, etc.)
- **Design Consulting for New MF Construction**
 - ❖ All-electric, high-performance buildings
- **Utility DSM Programs**
- **WAP and other Local Gov't Programs**
- **Energy Financing (TBL Fund)**
- **Workforce Training (GC2)**

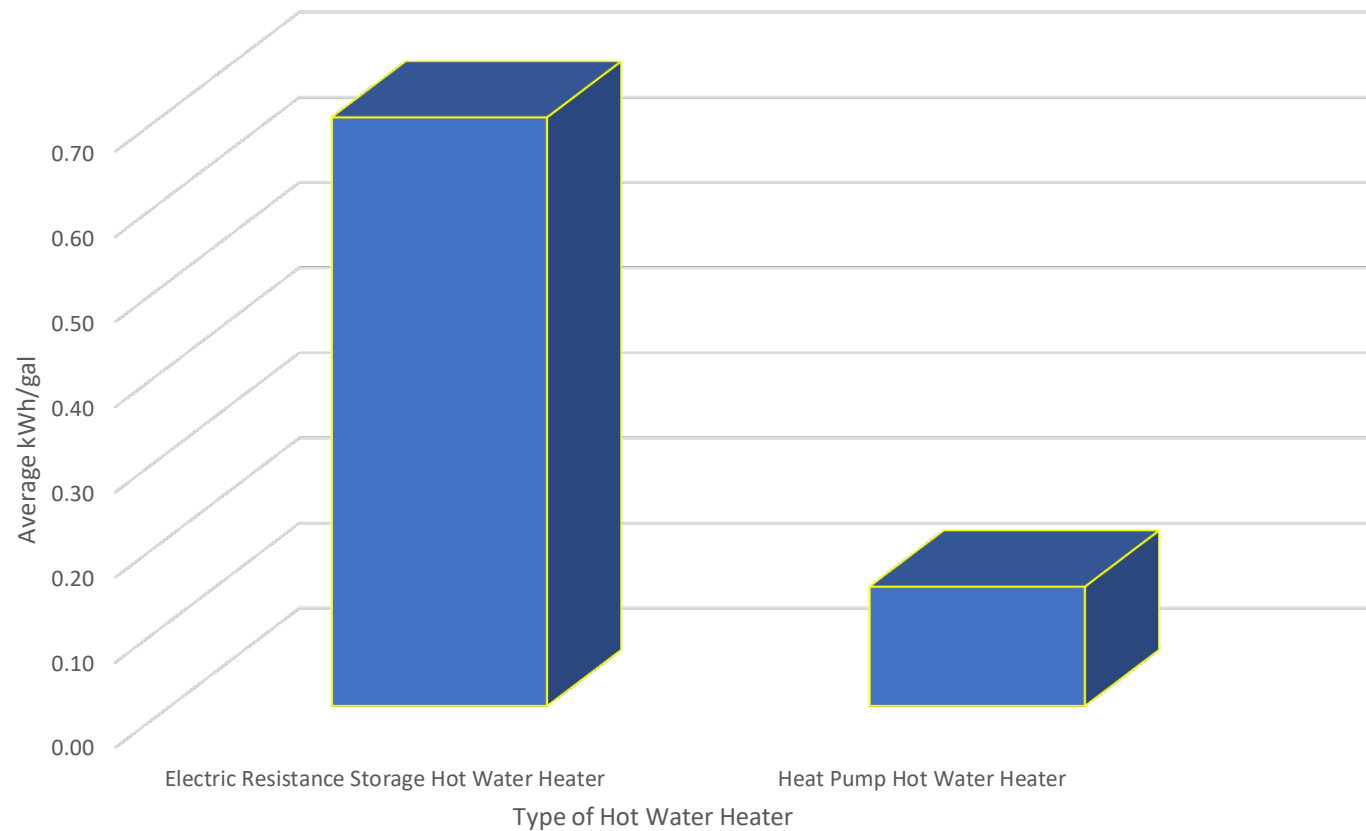
Heat Pump HVAC



- ✓ Heat Pump technology has improved tremendously
- ✓ 2.5 to 5 times efficient
- ✓ Cold Climate designs can operate as low as 17 below zero
- ✓ Dual Fuel - Natural Gas / Heat Pump
- ✓ Cost Parity, w/ and w/o incentives

Heat Pump Water Heaters

Comparing Conventional and Heat Pump Water Heaters





Heat Pump Water Heater

- New 110V models
- Require installation in locations that remain in the 40°–90°F (4.4°–32.2°C) range year-round
- Provide at least 1,000 cubic feet (28.3 cubic meters) of air space around the water heater.
- Lacks cost parity, even with incentives
- Currently commercial scale is the only scalable option





How We Scale



Results



- One-Stop-Shop
- 2023 Goal: 50,000 LMI households served
- 25% energy savings across portfolio
 - 60% of program savings from HVAC
- 12,000 ccASHPs installed
 - ❖ 2023 goal – 5,000 ccASHP installs
- Comprehensive deep retrofit program
 - ❖ Decarbonization ≠ Utility bill savings

Thank You!

Questions?

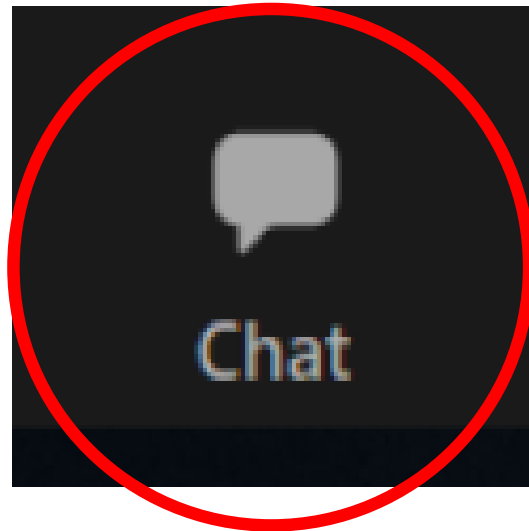
Ravi Malhotra

Founding President, ICAST

720-261-1086 ravim@icastusa.org



Questions



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Incentives & Measure Delivery

Jacob Corvidae – RMI

Natalia Sudyka – Eversource

Doug Presley – Dandelion Energy

Carl Orio – Water Energy Distributors

Click on agenda section heading to
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(speaker order may vary)

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RMI



The Inflation Reduction Act and Building Decarbonization Incentives

For Connecticut Technical
Session: Building Thermal
Decarbonization

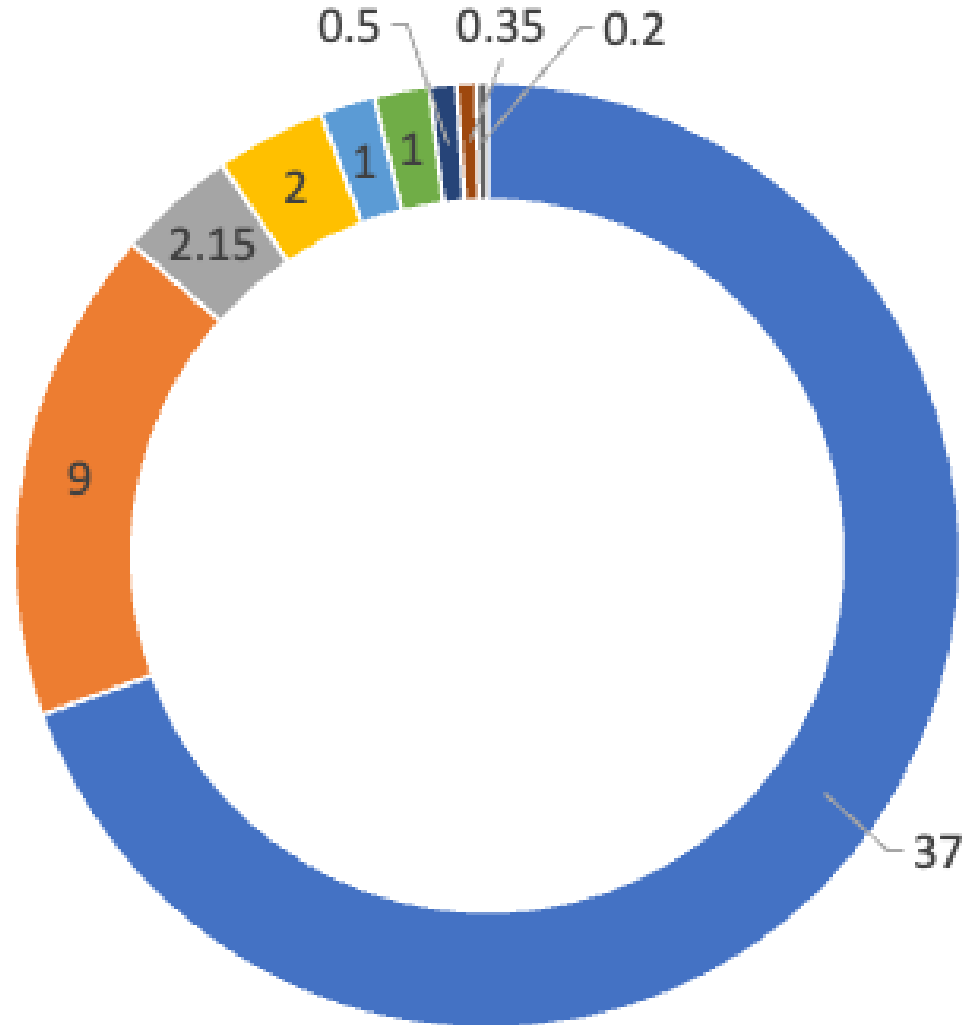
Sept. 23, 2022

Jacob Corvidae, RMI

The IRA is a Game-changer for Buildings

\$50+
Billion

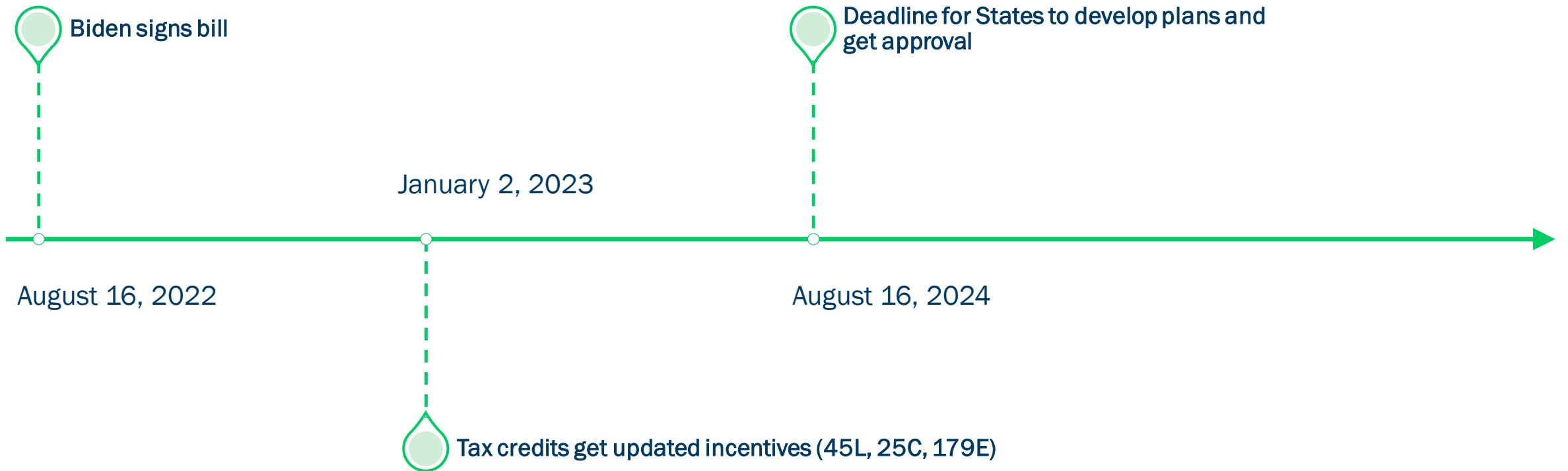
~60
MMtCO₂e
Reductions in 2030



Building Decarbonization Funding in Inflation Reduction Act (Billion \$)

- Tax Credits
- Rebates
- Federal EC Fund
- FHWA EC
- HUD
- Codes
- DPA
- EC Labeling
- Workforce Training

Timeline for IRA to Hit the Streets



Snapshot of Buildings Provisions

Improvements to Existing Tax Credits

(No budget cap*/10 yrs)

New EE Home Tax Credit (45L)
— up to \$5,000/unit including LIHTC

Residential EE Tax Credit (25C)
— \$2,000 for HP

EE Commercial Buildings deduction (179D) — up to \$5/sq ft with prevailing wage requirements

New State Rebates programs

(~\$9B/9 yrs)

High Efficiency Electric Home Rebate (HEEHR): \$4.5B
— Up to \$8K for HP for LMI

Home Energy Performance-Based, Whole Home Rebates (HOMES): \$4.3B
~ up to \$4K/unit (\$8K for LMI)

Additional “Building” Funding

(~\$4.5B/4-8 yrs)

Low carbon materials for federal buildings (\$2.15 B)

State/local building code implementation (\$1B)

HUD housing energy improvements (\$1B)

Contractor training (\$200M)

Low embodied carbon labeling (\$100M)... and much more

“Potential” Funding – not earmarked for buildings

(+\$35B/2-10 yrs)

GHG Reduction Fund (“green banks”) (\$27B)

GHG Reduction Grants for states + local govts (\$5B)

EJ Community Block Grants (\$3B)... and much more

New Energy Efficient Home Credit (45L)

Effective: Jan 1, 2023

Can be stacked with the Low Income Housing Tax Credit Without Reducing Basis.

New AND Major Renovations

Dwelling units acquired after December 31, 2022.

| Energy Performance | Prevailing Wage | Multifamily | Single Family (detached one family, duplex, townhomes, manufactured homes) |
|------------------------------------|-----------------|-----------------------|--|
| EPA's Energy Star New Construction | No | \$500/dwelling unit | \$2,500/dwelling unit |
| DOE's Zero Energy Ready Homes | No | \$1,000/dwelling unit | \$5,000/dwelling unit |
| EPA's Energy Star New Construction | Yes | \$2,500/dwelling unit | \$2,500/dwelling unit |
| DOE's Zero Energy Ready Homes | Yes | \$5,000 dwelling unit | \$5,000/dwelling unit |

Residential Energy Efficiency Tax Credit (25C)

Available through 2031




Updated version launches Jan 1, 2023

Consortium for Energy Efficiency standards

Incentive Levels

- Electric Panel - \$600
- Energy Audit - \$150
- Non-heat pump energy properties - \$600
- Weatherization - \$1,200
- Heat Pump/Heat Pump Water Heater - \$2,000

Commercial Buildings Energy Efficiency Tax Deduction (179D)

| Site EUI Reduction | Without Prevailing Wage | With Prevailing Wage + Apprenticeship |
|--|-------------------------|---------------------------------------|
|  25% Min | \$0.50/SF | \$2.50/SF |
|  +1% | \$0.02/SF | \$0.10/SF |
|  50% Max | \$1.00/SF | \$5.00/SF |

For tax exempt entity, allowed to allocate deduction to person responsible for designing the property in lieu of property owner

Consumer Rebate Programs



High Efficiency Electric Home Rebate Program

- \$4.5B through FY2031
- Income-based incentive structure
- New construction and retrofits
- Contractor incentive up to \$500/project
- DOE is the lead federal agency
- State energy offices and Tribes will develop and administer
- Point of sale rebates for electrification upgrades
 - \$8,000 for heat pump
 - \$4,000 for electric panel upgrade
 - \$1,750 for heat pump water heater
 - \$840 for electric or induction stove
 - \$14,000 total

Home Energy Performance-Based, Whole-House Rebates

- \$4.3B through FY2031
- Savings-based retrofit program
- Increased rebates for low-moderate income households
- Contractor incentive
- Rebates range from \$2,000 - \$8,000 depending on income and energy savings
- DOE is the lead federal agency
- State energy offices and Tribes will develop and administer

Spurring New EE and Electrification Projects Across the Country

Rebates

High-Efficiency Electric Home Rebate Program



~2.4M electrification upgrades

HOMES

Would pay homeowners who make cuts in their home energy use via efficiency retrofits



1.3M whole-home renovations

Tax Credits

25C*

For heat pumps and smaller home improvements



7.3M heat pumps installed

45L*

Energy-efficient home credit



650K new efficient homes

179D*

Commercial building energy-efficiency tax deduction



115M commercial SF retrofitted

Energy-Efficiency, Water-Efficiency, Climate Resilience for Affordable Housing

Administering Agency: U.S. Department of Housing and Urban Affairs

Eligible Recipients: Owners and sponsors of privately-owned, HUD-subsidized properties that agree to an extended period of affordability

\$1B through September 2028:

\$837.5M for grants and direct loans, including to subsidize up to \$4B in direct loans

\$120M for program administration

\$42.5M to benchmark energy and water use for eligible properties

Eligible Uses:

Low-emission technologies, materials, or processes, including zero-emission electricity generation, energy storage or building electrification

Improve energy or water efficiency, indoor air quality or sustainability

Climate resilience

Energy and water benchmarking

Residential Clean Energy Credit (25D)

30% Homeowners Personal Income Tax Credit

Primary residence or second home (with caveats). Not investment property.

Non-refundable. Must have tax liability.

Updated version launches Jan 1, 2023

Qualified Measures

- Solar electric
- Solar hot water heating
- Fuel cell
- Small wind
- Geothermal heat pump
- Biomass fuel property
- Added battery storage (new 2023)

In 2025....

Commercial Investment Tax Credit (ITC) (48)

Solar PV, Solar Water Heat, Solar Heat, Geothermal Electric, Solar Thermal Electric, Solar Thermal Process Heat, Solar Photovoltaics, Wind (All), Geothermal Heat Pumps, Municipal Solid Waste, Combined Heat & Power, Fuel Cells using Non-Renewable Fuels, Tidal, Wind (Small), Geothermal Direct-Use, Fuel Cells using Renewable Fuels, Microturbines, Offshore Wind Biogas, Microgrid, Interconnection Property

Transitions to Clean Electricity Investment Tax Credit (48E)

**Technology neutral - all
generation facilities and
energy storage systems that
have an anticipated
greenhouse gas emissions
rate of zero**

Commercial Investment Tax Credit (ITC) (48) & Clean Electricity Investment Tax (48E)

Utility-Scale,
Commercial, Industrial,
Non-Profit, Government,
Etc. and Third-Party-
Owned Residential

Projects choose the Investment
Tax Credit or Production Tax Credit

Direct Pay - State and tribal
governments, Alaska native
corporations, certain tax-exempt
entities and rural cooperatives

| Projects Under 1MWac* | 2023 -2033 |
|--|------------|
| Base Tax Credit | 30% |
| Domestic Content Bonus | 10% |
| Energy Community Bonus | 10% |
| Low Income Community Bonus | 10% |
| Low Income Residential Building <u>or</u> Low Income Economic Benefit Project | 20% |

* **Projects over 1 MWac** –Tiers of incentives vary depending on
labor requirements.

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GHG Reduction Grants for states + local govts (\$5B)

EJ Community Block Grants (\$3B)... and much more

Impact: Low-income and EJ Communities

\$4.5B dedicated to LMI electrification in the High Efficiency Electric Home Rebates (HEEHR)

\$3B reserved for community-led initiatives via new EJ Community Block Grants

\$1B for affordable housing retrofits via HUD

New compatibility between Low-Income Housing and EE new construction tax credits

OPPORTUNITIES

- State authority over critical financial incentive programs
- Renewed commitment to justice and EJ partnerships

RISKS

- Gas appliances remain eligible for some incentive programs
- Stacking and braiding funds remains a hurdle

Impact: Residential + Commercial Owners

Tax Credits

- Up to **\$2,000** for HPs (“25C”)
- Up to **\$5,000** for new efficient homes (“45L”)
- Up to **\$5/SF** for commercial buildings (“179D”)

Rebates

- **\$2,000 - \$8,000** for whole home EE upgrade incentives ranging from (“HOMES rebate”)
- Up to **\$14,000** via point-of-sale rebates for LMI Electrification! (“HEEHR”)

OPPORTUNITIES

- Consumer education to drive electrification
- State authority to shape rebate programs

RISKS

- Gas appliances allowed in programs
- Complicated processes, delayed roll-out, and state budgeting decisions

Impact: Builders and Contractors

\$200M for additional workforce training

\$500/unit direct incentive to electrification contractors

\$1B for local codes development and adoption

Prevailing wage incentives in new programs

OPPORTUNITIES

- Electrification-specific training
- All-electric and stretch codes
- Diversified and inclusive workforce

RISKS

- Contractor entrenchment on gas appliances
- Codes development that falls short of climate alignment
- Shortfall of workers

Impact: Manufacturers and Industry

Materials Manufacturing & Embodied Carbon

- **\$4.15B** to federal buildings & transportation infrastructure
- **\$250M** for Environmental Product Declarations development by manufacturers
- **\$100M** for low Embodied Carbon labeling

Heat Pump & Insulation Manufacturing

- **\$500M** for Defense Production Act

OPPORTUNITIES

- Transformative public procurement to catalyze product manufacturing

RISKS

- Limited federal capacity or infrastructure to gather data and benchmark performance
- New DPA funding not specifically earmarked for heat pumps

Impact: Local and State Policymakers

\$50B+

to create and implement
countless new building
decarbonization programs

OPPORTUNITIES

- Increased ambition by leading states
- Expansive public education campaigns
- One-stop-shop programs and deep equity focus

RISKS

- Delayed action at both federal and state level
- Continued investment in fossil fuels
- Creation of inaccessible programs



Questions?



Eversource

DEEP Technical Session: Comprehensive Energy Strategy

September 23, 2022

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EVERSOURCE



An AVANGRID Company

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2023 Heat Pump Incentives



Simplify
midstream offer



Expand eligibility
to displace
natural gas



Introduce fuel
optimization
incentives for
businesses



Offer a residential
insulation bonus

2023 Proposed Prescriptive Retrofit Incentives

| Equipment | Equipment Discount | Fuel Optimization Rebates | |
|--|--------------------|---------------------------|-----------------|
| | | Residential | Commercial |
| Air Source Heat Pumps (including Air to Water) | \$250 per ton | \$1,000 per ton | \$2,000 per ton |
| Variable Refrigerant Flow (VRF) | \$250 per ton | \$1,500 per ton | \$3,000 per ton |
| Ground Source Heat Pumps | - | \$2,000 per ton | \$4,000 per ton |
| Heat Pump Water Heater (HPWH) | \$750/\$1,400 | - | - |

2023 Proposed New Construction Incentives

| Equipment | Residential | | Commercial |
|---|----------------|--|-----------------|
| | Single Family | Single Family Attached Multifamily 5+ Units | |
| Air Source Heat Pumps (including Air to Water) | \$250 per ton* | \$125 per ton* | \$640 per ton |
| Variable Refrigerant Flow (VRF) | \$250 per ton* | \$125 per ton* | \$1,000 per ton |
| Ground Source Heat Pumps | \$250 per ton* | \$125 per ton* | \$4,000 per ton |

* Dwelling must meet all-electric home Tier 1 standards. Air-source heat pumps must be CEE Tier 2, and ground-source heat pumps must be ENERGY STAR® certified. Total incentive capped at 4 tons per dwelling unit.

Thank you

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Dandelion Energy



DANDELION

Heat without fire

**Barriers to Geothermal Heat
Pump Market Development**
Technical Session #2
Sep. 22-23, 2022





The Problem

The world is moving to heat pumps, but not fast enough to meet emissions reduction goals

640

k homes heated by fuel oil, propane, or wood

496

k homes heated by natural gas

18%

Share of CT greenhouse gas emissions from residential sector

Barriers to heat pump adoption and measure delivery

- ⊘ **Up-front costs** deter customers, despite long-term savings
- ⊘ Insufficient **licensed workforce**
- ⊘ Limited awareness, split-incentives for landlords/homebuilders/residents

What are Geothermal Heat Pumps?

1

Ground Loop

Absorb heat from earth underground.

Typically 350-500 Feet

2

Heat Pump

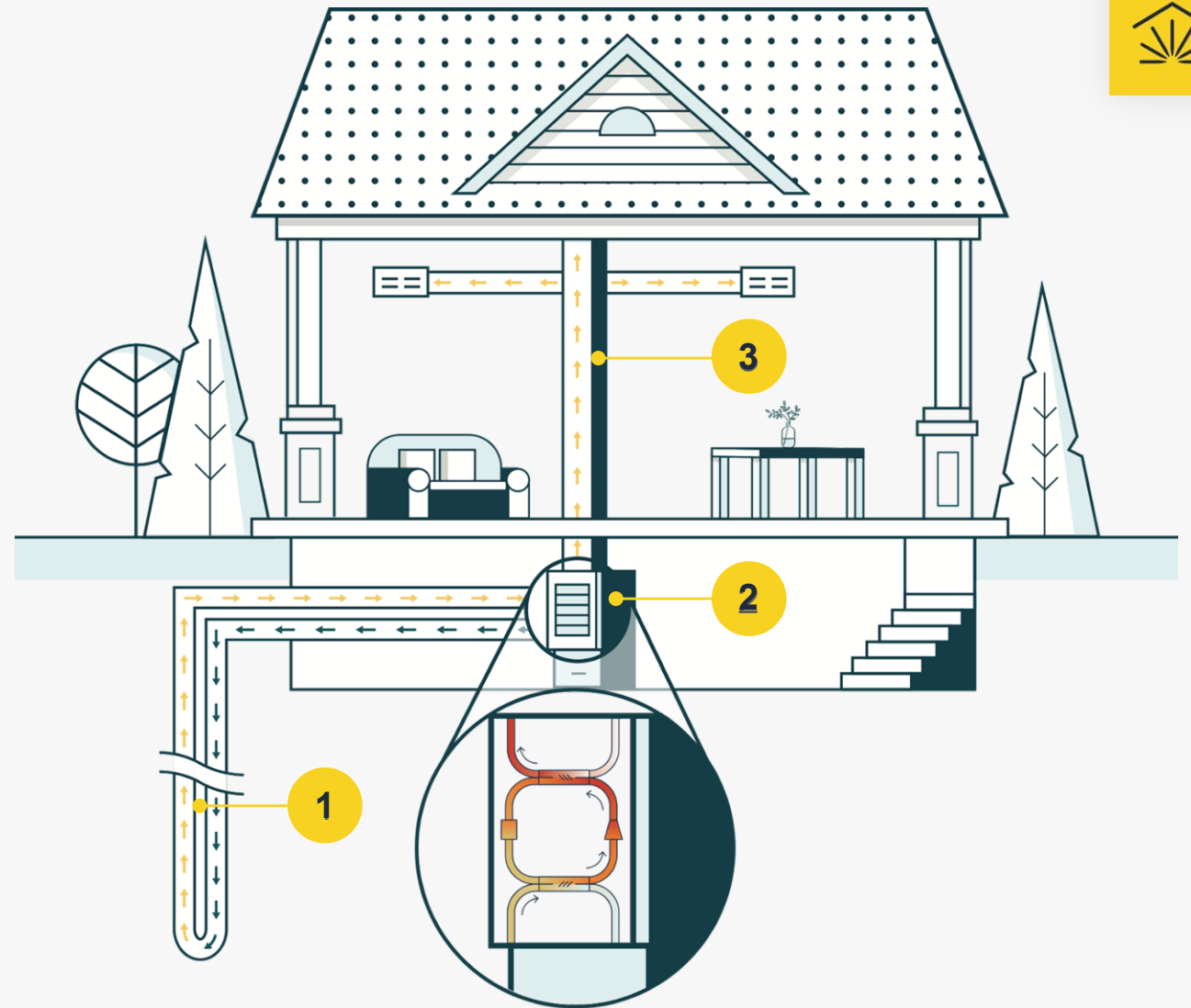
Transfer heat from the ground loop to a refrigerant, which runs through a compressor, boosting the temperature.

3

Distribution System

The hot refrigerant heats air inside the home.

System runs in reverse to cool.



***Highest-efficiency heating and cooling system,
with the lowest operating costs***



Why Geothermal Heat Pumps?

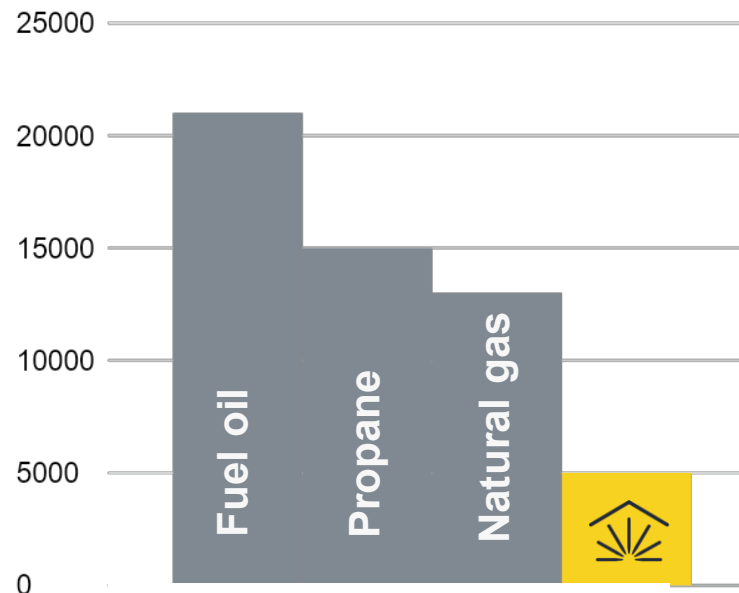
1 Cost Savings



53% reduction in Annual Heating & Cooling Costs with a Dandelion Geothermal System

2 Carbon Savings

CO2 impact of home energy types



As the grid becomes renewable, the emissions from geothermal systems goes to zero

3 Grid Savings

\$7,000

In grid benefits per geothermal heat pump through stable baseload demand¹

\$10 billion

Grid savings potential in NY due to lower peak power levels from geothermal heat pumps vs. air source heat pumps²



Critical Barrier: Up-Front Costs

The Problem

Geothermal heat pumps provide the lowest life-cycle cost, but require up-front investment

The Solutions

1. Innovation

- ✓ Improve design, process, and software

2. Incentives and Rebates

- ✓ 30% federal tax credit, rebates of \$4,000 - \$8,000

- ✓ \$2,000 / ton proposed in 2023

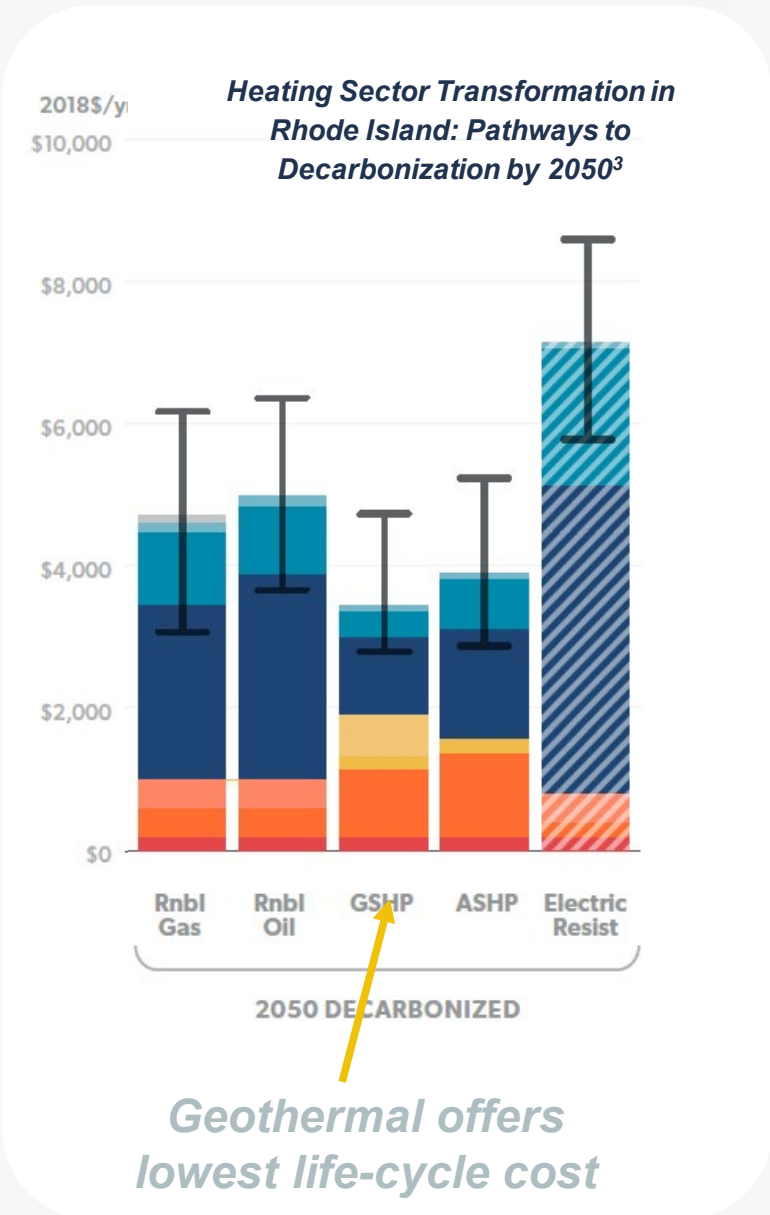
⊘ No enhanced geothermal rebates for LMI households

Based on cooling capacity



- ⊘ \$4,000 / ton new construction adder for C&I in 2023

Not available for residential new construction





Up-Front Costs (cont.)

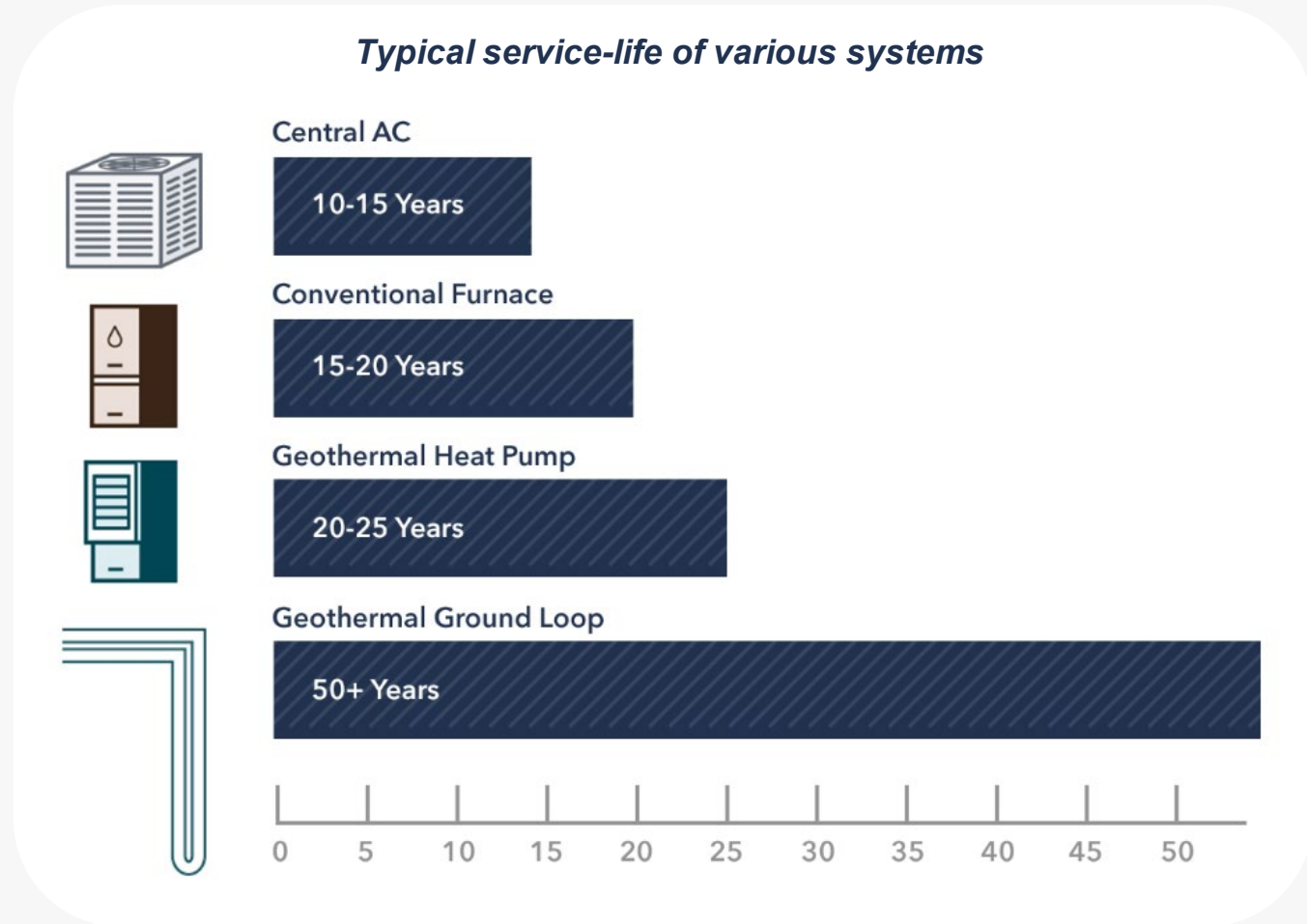
The Solutions (cont.)

3. Low-cost financing

- ✓ Low-interest rate financing through Energize CT and Green Bank
- ✗ Insufficient loan maximum, rate uncertainty, difficult process
- ✗ Financial burden for LMI households

4. Third-party ownership / leasing

- ✓ Emerging heating/cooling as-a-service model to remove up-front financial burden





Critical Barrier: Licensing and Workforce Growth

The Problem

There are not enough trained and licensed workers in CT to meet current customer demand

The Solutions

Workforce training programs

✔ Green STEP, equity opportunities

Geothermal-specific drilling license (W-7 to W-10)

✔ Success – increased workforce availability

Heat Pump-specific license needed

✘ Existing heating/cooling categories all require fossil fuel training



Key Workforce Needs:
Heat Pump Installers
Drillers
Electricians
Plumbers



Critical Barrier: Community Awareness

The Problem

Lack of familiarity with geothermal
heat pumps

The Solutions

- ✔ Community outreach
- ✔ AHJ permitting and approvals
- ✔ Home energy consultant awareness



Thank you

Doug Presley

dpresley@dandelionenergy.com

Sources:

1. **New Efficiency: New York, Analysis of Residential Heat Pump Potential and Economics**, New York State Energy Research and Development Authority, January 2019, pages S-2, S-3, and 58-61
1. **New York Climate Action Council Draft Scoping Plan, Appendix G: Integration Analysis Technical Supplement, December 2021, "Ground Source / District Loop Heat Pump Deployment Sensitivity Analysis,"**
1. **Source: Heating Sector Transformation in Rhode Island: Pathways to Decarbonization by 2050**



Water Energy Distributors

Water Energy Distributors Inc.

Geothermal Designers & Distributors

A Woman Owned Business

Since 1975, Designed & Distributed, Over **22,000** Geo Heat Pumps

Territory: NEW ENGLAND & Nearby NY. Projects in Canada, India & Nigeria

Carl Orio, Chairman, MS, CGD, AI,
Zach Patnaude, GM, MEng, AI



Geothermal Heat Pumps

PROMOTE – Why not moving faster ?

PRO's

- **Lowest Heating & Cooling Operational Cost**
- **Lowest Impact on Environment & Health**

(US EPA-1990)

INCENTIVIZE – Measure & Disseminate

CON's

- **High Installed Cost**
- **HVAC Geothermal Training**
- **Conflicts with Fossil Fuels**

Geo Heat Pump Installation Incentives and Measuring

- **Require - Measure Performance**
- **Require - Reporting**
- **Incentivize – Ease of Ownership**
- **Incentivize - Consistent Design Methods**

Geo Heat Pump Installation Incentives and Measuring

- **Require - Measure Performance**
- Require - Reporting
- Incentivize – Ease of Ownership
- Incentivize - Consistent Design Methods
- Promote- Complete GeoExchange System

Incentivize & Measuring

Monitor Projects for 12 months – Qualitative

Identify Conditioned Spaces

100% Building Heating /Cooling/Dehumidification Loads

Separate Electric Metering for GeoExchange System

Separate Electric Metering for Building System

Required Measurements – Quantitative

Number, types, sizes - of Heat Pumps Installed

Cost of Operation, Yearly

Cost of User Maintenance, Yearly

Cost of Repairs

Comfort and Health – Qualitative and Quantify

Incentives & Measuring

- Require - Measure Performance
- **Require – Reporting – *Geo Evaluator***
- Incentivize – Ease of Ownership
- Incentivize - Consistent Design Methods

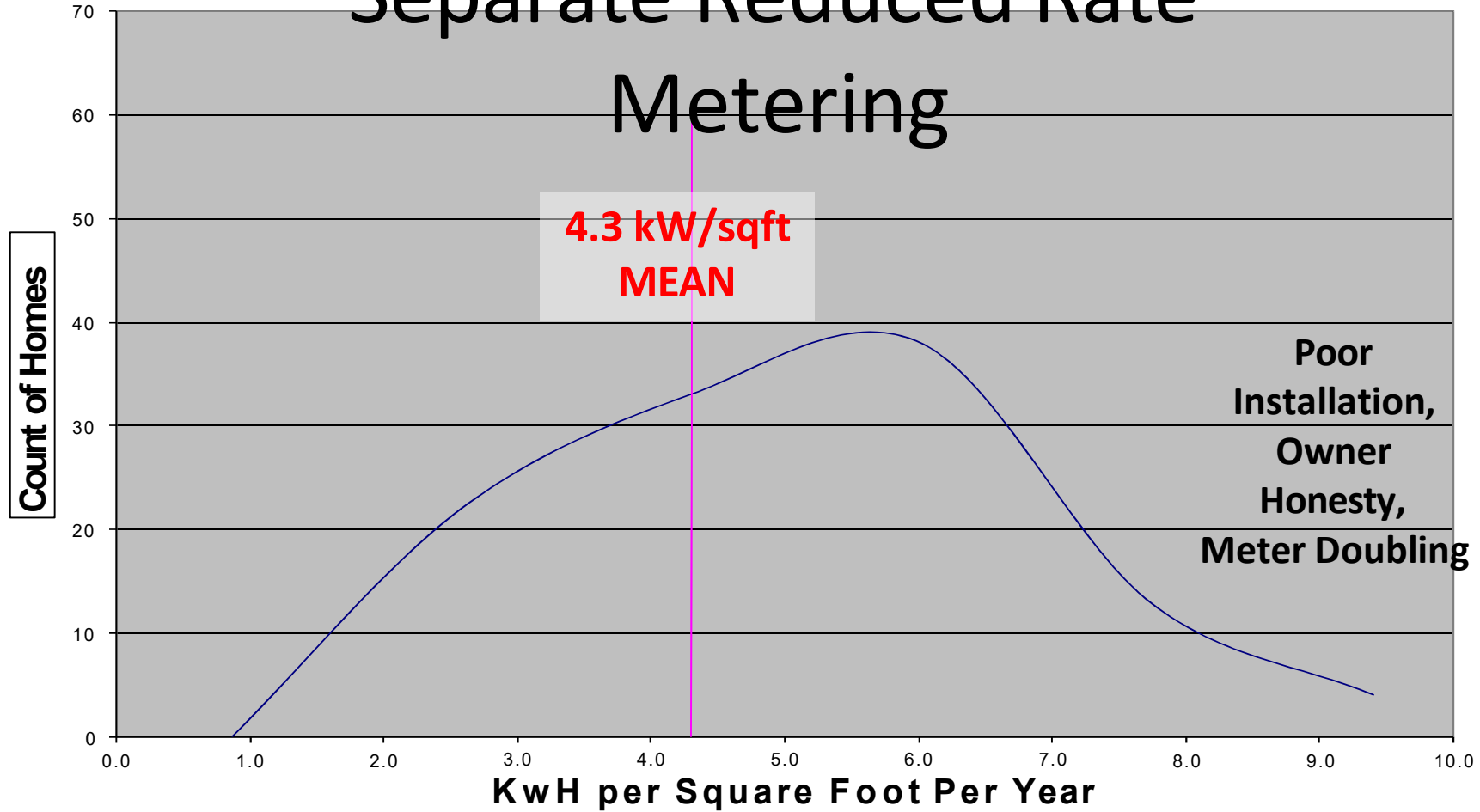
Incentives & Measuring Reporting

not just “Body Count” but Performance

- **12 Month Final Report by “Geo Evaluator”**
 - Financing Summary
 - Operational Costs
 - Maintenance Costs
 - Repair Costs
 - Comfort /Health
 - Societal Benefits

110 Monitored Homes in NH as of 3/24/2006
Last Twelve Months

Separate Reduced Rate Metering



Quantify Health Effects

Effects of Fuel Emissions (CO₂ only) on Community Health :

by R.Tol* aggregated 22 studies, including 88 other estimates on health
related economy impact

Mean Marginalized Health Impact Cost:

\$ 106. per U.S. ton CO₂

N.B. MA CEC at \$130 / ton

*- Carnegie Mellon Institute et al

Homes Avoiding Emissions

- 3,797 ft² = **5,000 # CO₂**
- 2,880 ft² = **3,375 # CO₂**
- 3,126 ft² = **3,175 # CO₂**
- 2,400 ft² = **2,990 # CO₂^p**
- 4,914 ft² = **6,135 # CO₂**
- 2,048 ft² = **4,000 # CO₂**
- 8,066 ft² = **14,275 # CO₂**
- 26,000 ft² = **46,780 # CO₂**

Base on oil (2004/5) at \$ 1.25 per gallon; 1/3 of annual bill is heating



MULTIPLY by 1.55
To
INCLUDE ADDED EMISSIONS
FROM
TRUCKS DELIVERING OIL
OR
PUMPS PRESSURIZING N.GAS

Geo Heat Pump Installation

Incentives and Measuring

- Require - Measure Performance
- Require - Reporting
- **Incentivize – Ease of Ownership**
- Incentivize - Consistent Design Methods

Incentivize – Ease of Ownership

- **Consolidate \$ Incentives** – Federal, State, Utility, Local Financial & Regulatory
- **Simplify Regulatory** -CT Local Regulatory for all Geo Earth Heat Transfer Methods
- **Promote** - Inventory Programs for Distributors and/or installing Contractors
- **Incentivize** – Geo Education for HVAC Technicians and Designers
- **Utility Promotion** – Allow Bill Messages, other advertising

Geo Heat Pump Installation Incentives and Measuring

- Require - Measure Performance
- Require - Reporting
- Incentivize – Ease of Ownership
- **Incentivize - Consistent Design
Methods**

Connecticut Adopt



“Design and Installation of Ground Source Heat Pump Systems for Commercial and Residential Buildings”

CONTENTS 448

- .0 Generic Applications Systems
- .1 Commercial and Institutional Buildings
- .2 Residential and Other Small Buildings
- .3 Vertical Configured Closed Loops
- .4 Horizontal Configured Closed Loops
- .5 Surface Water & Submerged HX
- .6 Open Ground Water Systems
- .7 Standing Column Well Systems
- .8 Direct Expansion Systems
- Technical Appendices

Incentivize Geothermal Training Programs

for



HVAC Managers/Owners



Owners/Drillers



Installers/Maintenance/Operators



Professional Engineers, Designers, Academics, CGD,
Building Owners , Utility Professionals



Utility & Alternative Energy Professionals,



Architects, Building Owners



Thank You

Questions/Comments

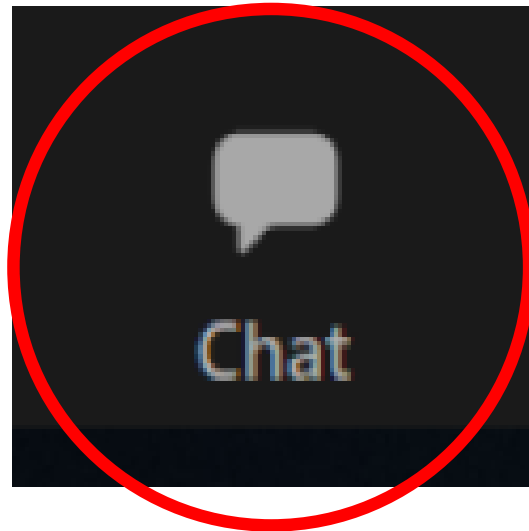


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Questions



At the conclusion of each panel DEEP will hold a brief question and answer period.

If you have a question for a presenter, please drop it into the chat to **Jeff Howard**. DEEP will pose as many questions as time allows to the speakers. Clarifying questions will be prioritized. Leading questions will not be accepted.

WRAP UP

Thanks for joining our technical session today!

Written comments related to this session, or the general Comprehensive Energy Strategy can be submitted to:

1. [this](#) web page – or –
2. Via email to ces@energy.ct.gov

All information on upcoming Comprehensive Energy Strategy technical sessions and written comment opportunities can be found on the [CES website](#)

This slide deck and a recording of this session will be posted on the CES webpage

Written Comments related to this technical session are due
Friday, October 7, 2022, at 5:00 p.m. ET

BUREAU OF ENERGY AND
TECHNOLOGY POLICY



Thank you for joining!

Questions? DEEP.EnergyBureau@ct.gov

BUREAU OF ENERGY AND
TECHNOLOGY POLICY



Lunch Break

We'll start Technical Session 3 at 1:00 p.m. ET

Visit <https://portal.ct.gov/DEEP/Energy/Comprehensive-Energy-Plan/Comprehensive-Energy-Strategy> to register and receive the Technical Session 3 Zoom link

BUREAU OF ENERGY AND
TECHNOLOGY POLICY

