Advancing Equitable Home Upgrades with ENERGY STAR and R2E2

Centering Affordability in Low-Income Home Electrification Programs

Tuesday September 10, 2024 1PM-4PM ET

Residential Retrofits for Energy Equity

EPA United States Environmental Protection Agency

Housekeeping

- We are recording this webinar and will be making it available to all registrants within a few business days.
- Please keep your microphone on mute during the presentation (you can turn on your video).
- To ask a question during the webinar, please submit it via the chat at the bottom of your screen. If you prefer to verbally ask a question, you can raise your hand using the reactions feature also located on the bottom bar. You will be prompted to unmute to ask your question during our Q&A segment.
- You can upvote questions in the chat that you would like us to prioritize.
- Use the chat to engage in respectful and productive discussion with other participants.
- Code of conduct: R2E2 will not tolerate behaviors that cause harm or disrupt the learning environment. Please direct message Carolyn Conant or Stephanie Sosa-Kalter if you feel unsafe in this space. Disruptive participants may be removed from the webinar.

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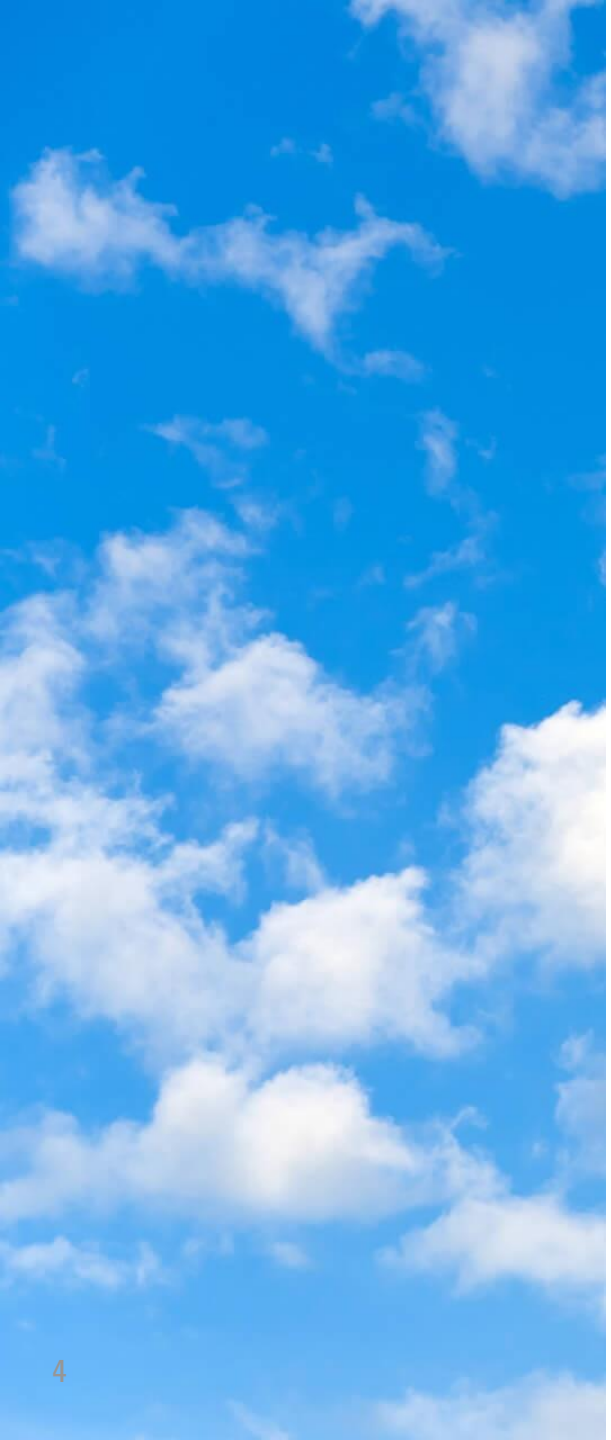

POLL: Where are folks joining from today?

1. Northeast
2. Mid-Atlantic
3. Southeast
4. Midwest
5. Southwest
6. West (incl. NW, CA, AK, and HI)
7. U.S. Territory
8. Outside the U.S.

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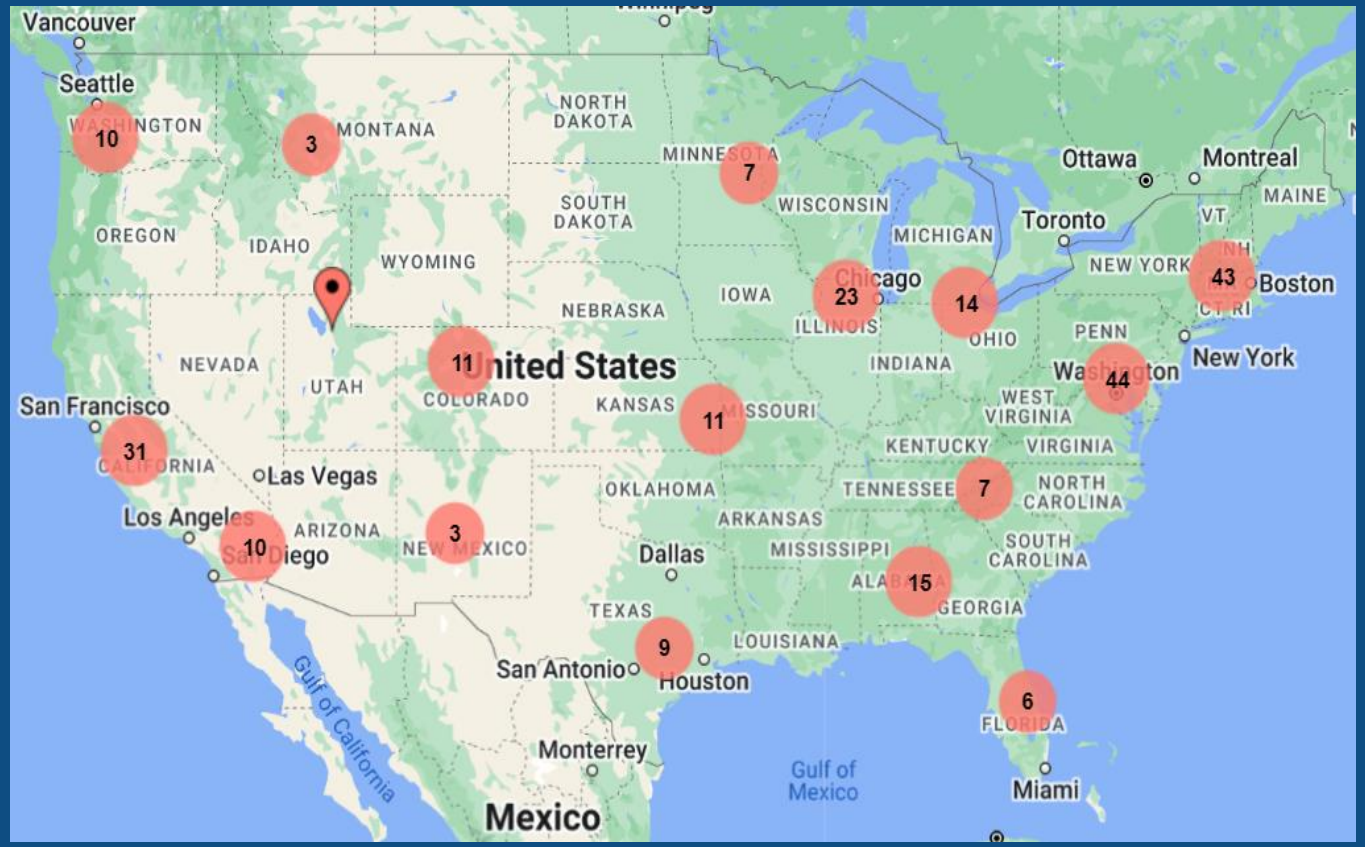
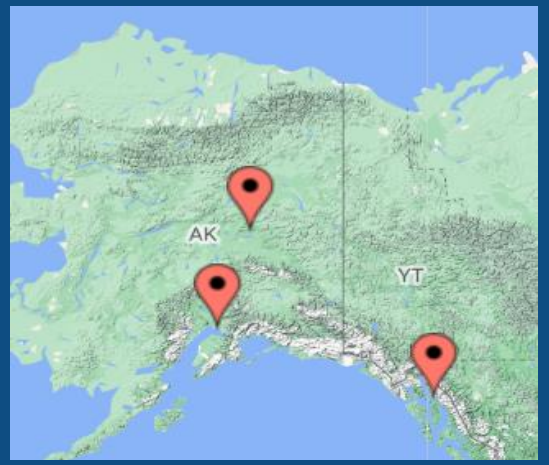
Workshop Attendees





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Residential Retrofits for Energy Equity (R2E2) provides deep technical assistance to state, local, and tribal governments as well as community-based organizations to jumpstart energy upgrades for single family and multifamily affordable housing, especially in frontline communities. These retrofits will lower utility bills, reduce greenhouse gas emissions, improve residents' health, create good-paying local jobs, and help mitigate racial inequity.

ENERGY STAR® is the government-backed symbol for energy efficiency. The blue ENERGY STAR label provides simple, credible, and unbiased information that consumers and businesses rely on to make well-informed decisions.

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About R2E2

R2E2 is a partnership of the American Council for Energy-Efficient Economy (ACEEE), Elevate, Emerald Cities Collaborative, and HR&A Advisors.

Sign up here to receive periodic updates and information about Residential Retrofits for Energy Equity.

Would you like to be considered for free help from R2E2 to plan, launch, implement, or scale your energy upgrade program for low-income housing (not for individual buildings)? If so, please complete our 10-minute survey. As R2E2 secures funding for this work, we will consider and engage those who complete the survey. We particularly encourage those who have completed some level of planning for their upgrade program to complete the survey.

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About ENERGY STAR

ENERGY STAR is administered by the U.S. Environmental Protection Agency. Thousands of organizations—including nearly 40% of the Fortune 500®—partner with ENERGY STAR. Together with EPA, they deliver cost-saving energy efficiency solutions that protect the climate, improve air quality, and protect public health.

Since 1992, ENERGY STAR and its partners have helped American families and businesses:

- Save 5 trillion kilowatt-hours of electricity.
- Avoid more than $500 billion in energy costs.
- Achieve 4 billion metric tons of greenhouse gas reductions, improve air quality, and protect public health.

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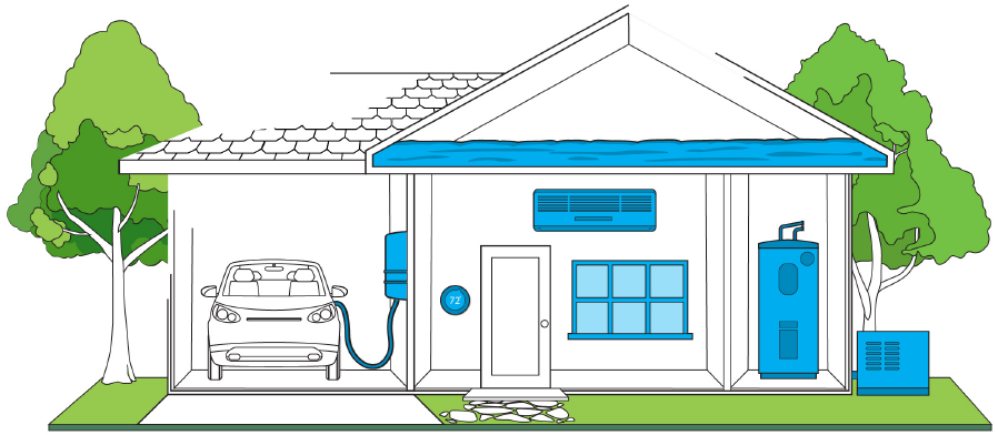
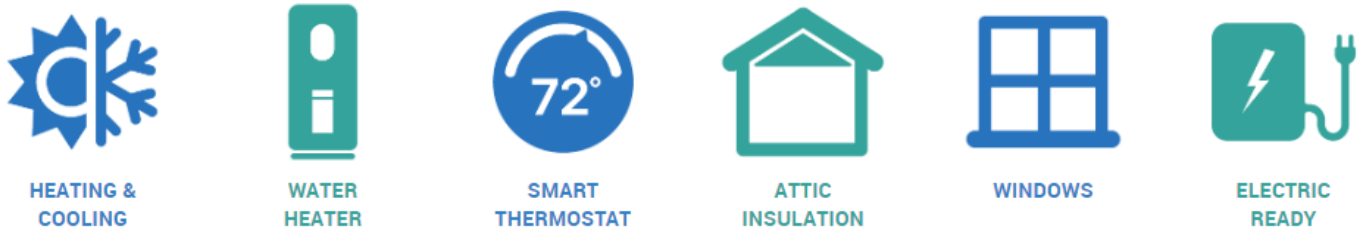
ENERGY STAR Home Upgrade

What is the ENERGY STAR Home Upgrade?

The ENERGY STAR Home Upgrade is a set of six generally applicable, electric energy efficiency improvements that are designed to work together to deliver significant energy and cost savings.

- Upgrades can be made all at once or as equipment is replaced
- Special emphasis on advancing heat pump technology
- ENERGY STAR certified products as applicable





On average, Americans could save approximately $500 a year on utility bills if installing all measures in the ENERGY STAR Home Upgrade

Source: What is the ENERGY STAR Home Upgrade?

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ENERGY STAR Home Upgrade Service Provider Partnership

- The ENERGY STAR Program is partnering with companies and community-based organizations that function as a concierge for energy efficiency home upgrade services to bring the benefits of energy savings and a clean energy future to American households nationwide.
- Together, we will accelerate the adoption of the elements of an **ENERGY STAR Home Upgrade**, which present an opportunity for almost every home in America to lower energy bills while improving home comfort and health.

https://www.energystar.gov/equitableupgrades

About the partnership

Through this partnership, the Environmental Protection Agency (EPA)

Provides a national platform for encouraging Americans to take action on energy efficiency in their home

Facilitates information exchange and connects partners that are implementing and promoting home upgrades through:

a. Webinars
b. 1-1 conversations
c. Stakeholder engagements at events, such as the annual ENERGY STAR Partner Meeting

Leverages the network of existing ENERGY STAR partners to advance productive collaboration

Assists in educating Americans on how to make their homes more energy efficient (e.g. marketing, communications, program design, or other areas)

Supports braiding financial resources best practices designed to make home upgrades more accessible to low-income households

For additional information on the partnership, click here . To view marketing materials available to partners, click here.

https://www.energystar.gov/equitableupgrades

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Advancing Equitable Home Upgrades with ENERGY STAR and R2E2 – Resource Center

- The EPA is committed to supporting community-based organizations, small businesses, and local governments in equitable, efficient electrification home upgrade deployments.

- Working with R2E2 to build and share resources through this 2024 workshop series
  - Visit www.energystar.gov/equitableupgrades

Workshop series schedule

- **May 21: Navigating Organizational Funding for Home Energy Upgrade Programs in Justice 40 Communities**
  - Target Audience: Community-based organizations (CBOs), non-governmental organizations (NGOs), Non-profit Organizations, small businesses, local governments, state governments, Tribes
- **August 20: Well-Designed Equitable Home Energy Upgrades: Best Practices and Strategies**
  - Target Audience: Community-based organizations (CBOs), non-governmental organizations (NGOs), Non-profit Organizations, small businesses, local governments, state governments, Tribes
- **September 10: Centering Affordability in Low-Income Home Electrification Programs**
  - Target Audience: Community-based organizations (CBOs), non-governmental organizations (NGOs), Non-profit Organizations, small businesses, local governments, state governments, Tribes
- **October 30: Incorporating Health and Safety into Home Energy Upgrade Programs**
  - Target Audience: Community-based organizations (CBOs), non-governmental organizations (NGOs), Non-profit Organizations, small businesses, local governments, state governments, Tribes
- **TBD 2025: Maximizing Incentives for Low to No-Cost Home Energy Upgrades: Stacking and Braiding**
  - Target Audience: Program implementers, contractors, etc.

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Presentation

Learning goals

1. What is efficient electrification?
2. What are the reasons to electrify?

Presenters

Annika Brindel
Director of Residential Retrofits for Energy Equity
ACEEE

Jim Young
Associate Director
Guidehouse

Learning goals

You should be able to answer the following questions:

1. What is efficient electrification (focused on heating and cooling)?
2. What are the reasons to electrify?
3. Why is it important not to leave low- and moderate-income (LMI) households behind?
4. How does electrification impact energy bills (and when might it NOT reduce energy bills)?
5. What strategies can be used to reduce post-electrification energy bills for LMI households?

* **Mostly, this will focus on electric heat pumps**

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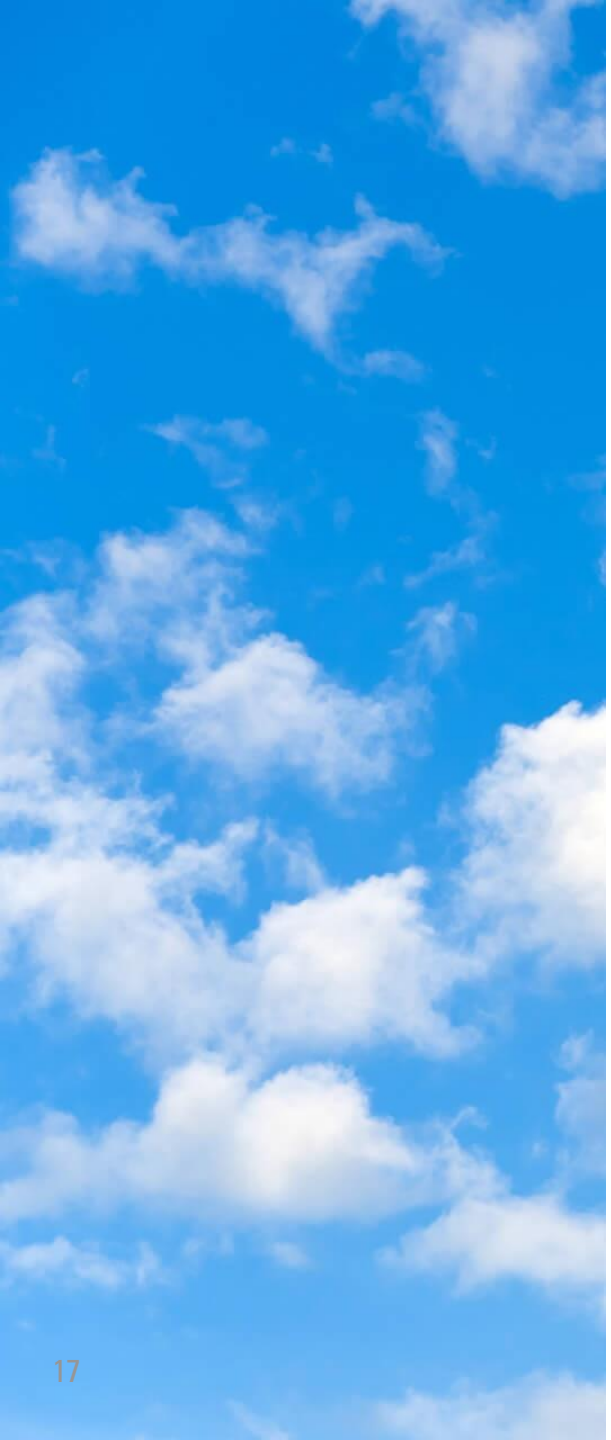

POLL: Which of today's key questions from our learning goals are of most interest to you?

1. What is efficient electrification (focused on heating and cooling)?
2. What are the reasons to electrify?
3. Why is it important not to leave low- and moderate-income (LMI) households behind?
4. How does electrification impact energy bills (and when might it NOT reduce energy bills)?
5. What strategies can be used to reduce post-electrification energy bills for LMI households?

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Workshop Agenda

Part 1 - 1:00-2:15 p.m. ET

- Learning goals
- Presentation and Q&A
  - Why are we here today?
  - #1 What is efficient electrification?
  - #2 What are the reasons to electrify?
- Panel discussion and Q&A
  - Perspectives on equitable electrification

15-minute break – 2:15-2:30 p.m. ET

Part 2 - 2:30-4:00 p.m. ET

- Presentation and Q&A
  - #3 Why is it important not to leave low- and moderate-income (LMI) households behind?
  - #4 How does electrification impact energy bills (and when might it NOT reduce energy bills)?
  - #5 What strategies can be used to reduce post-electrification energy bills for LMI households?
- Breakout discussions

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Why are we here today? A tale of two homes

Owner A and Owner B both install air source heat pumps. Owner A's energy bills decrease and Owner B's energy bills increase.

How can program administrators:

- Predict the impact on energy bills, even before doing any engineering calculations?
- Reduce the risk that efficient electrification will cause energy bills to increase?

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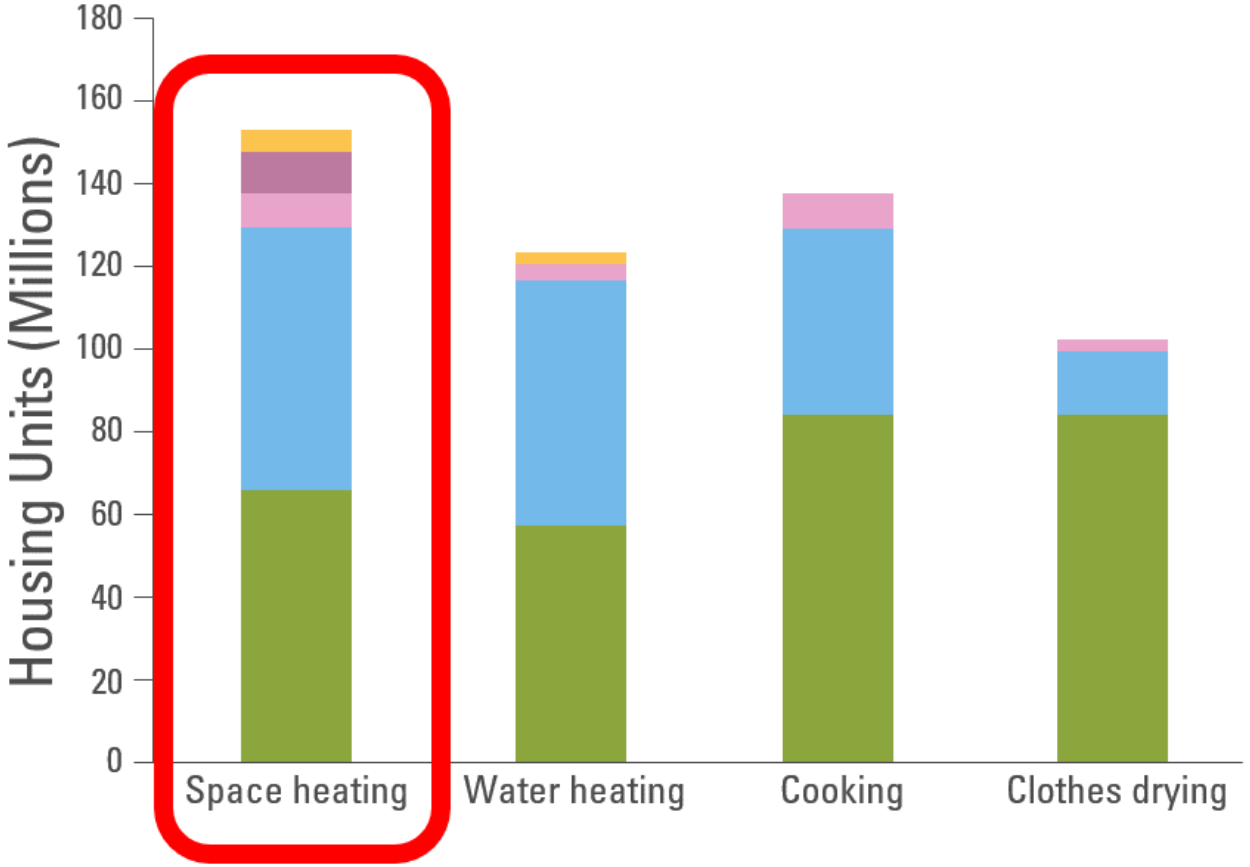
Decarbonizing space heating is key to achieving net zero emissions



Fuels used in U.S. homes by end use

Source: EIA 2024b

- Heating Oil
- Wood
- Propane
- Natural Gas
- Electricity

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Background: Existing primary heating systems

Units in the RECS database for analysis by building type and current primary heating system.

Current primary heating system	Single-family homes	Two- to four- family buildings	Buildings with five or more units	All housing units
Gas furnace or boiler	48%	39%	31%	45%
Propane furnace or boiler	4%	1%	0%	3%
Oil furnace or boiler	4%	3%	3%	4%
Electric heat pump	12%	7%	5%	11%
Electric resistance	16%	32%	41%	21%
Other*	15%	19%	20%	16%

- Of the 5,676 representative housing units analyzed:
- 45% of homes heat with gas
- 21% of homes use inefficient electric resistance systems
- 7% of homes use costly propane or oil systems

Adapted from ACEEE: https://www.aceee.org/research-report/b2205

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Poll

Our North Star: Affordability in Home Electrification

- Strive to reduce upfront costs and ongoing energy bills for LMI households.
- Pair high-efficiency (ENERGY STAR certified) heat pump installation with comprehensive retrofits, including weatherization and/or access to clean energy.
- Link households to existing bill assistance programs and electrification-specific rates.

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Learning goal #1

What is efficient electrification?

Jim Young, Guidehouse

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Definitions

- **Electrification** means shifting any non-electric source of energy to electricity at the point of consumption.
- In a home, typical measures include:
  - Heating and cooling with an electric heat pump…
  - Heating water with an electric heat pump water heater…
  - Cooking with an electric induction stovetop…
  - Drying with an electric clothes dryer…
- …instead of with equipment that uses gas, fuel oil, or propane.
- **Efficient electrification** means choosing efficient technologies when electrifying, e.g. an ENERGY STAR certified air source heat pump rather than electric resistance baseboard heating or electric furnace.
- When the electricity is generated using a clean, renewable energy source such as solar or wind (OR the current grid!), **electrification becomes a strategy for decarbonization**.

Adapted from U.S. DOE: https://www.energy.gov/electricity-insights/stakeholders-guide-electrification

https://www.energystar.gov/equitableupgrades

Example ENERGY STAR certified HVAC heat pumps

*denotes current ENERGY STAR specification

Ducted Air-Source Heat Pumps*

Distribute heating and cooling throughout the home using ducts

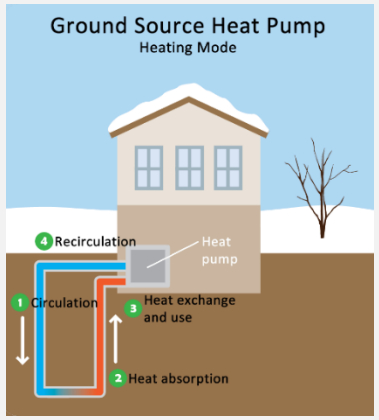
Ductless Air-Source Heat Pumps*

Provide heating and cooling to individual rooms

Air-to-Water Heat Pumps

Generate hot and chilled water for radiators or fan coils

Ground Source Heat Pumps*



Transfer heat with ground loops to reject and absorb heat for the heat pump

Larger Air-to-Water Heat Pumps

Suitable for large multi-family installations with water-based distribution systems

Can "cascade" with floor-by-floor or in-unit water-source heat pumps

Variable Refrigerant Flow Heat Pumps*

Distributes refrigerant to conditioning units in individual zones

Window Heat Pumps* and Packaged Terminal Heat Pumps

Located on exterior walls/windows to provide heating / cooling to individual rooms

Figures: Lennox, Home Depot, AERMEC, Daikin, Rheem, Water Drop

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Example ENERGY STAR certified heat pump water heaters

*denotes current ENERGY STAR specification

240V Heat Pump Water Heater*

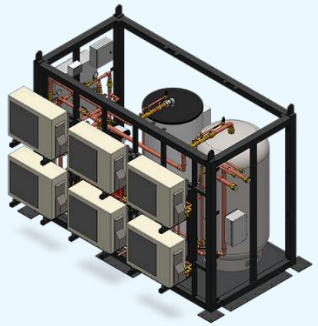
30-80 gallon storage tank, requires 240V connection, which may require new wiring for fossil fuel conversions

120V Heat Pump Water Heater*

Easy replacement for in-unit gas storage water heaters without the need for new electrical wiring if an outlet is available

Larger Multi-family Heat Pump Water Heaters

More options coming to market, including integrated, split, and cascade designs for central building water heating



Figures: Rheem, AO Smith, Water Drop

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Example ENERGY STAR certified electric cooking and clothes drying

*denotes current ENERGY STAR specification

Induction Cooktops and Electric Ovens*

Induction cooktops heat cookware through magnetic coils under the cooking surface.

Models are available as a standalone cooktop or integrated into an electric oven.

Electric Clothes Dryers*

Electric dryers are common today using electric resistance elements.

Next-generation heat pump models are now offered with improved efficiency.

Heat pump dryers can also be installed in small, interior spaces, as they do not require exterior venting.

Figures: Whirlpool, KitchenAid, Channing Street Copper Company

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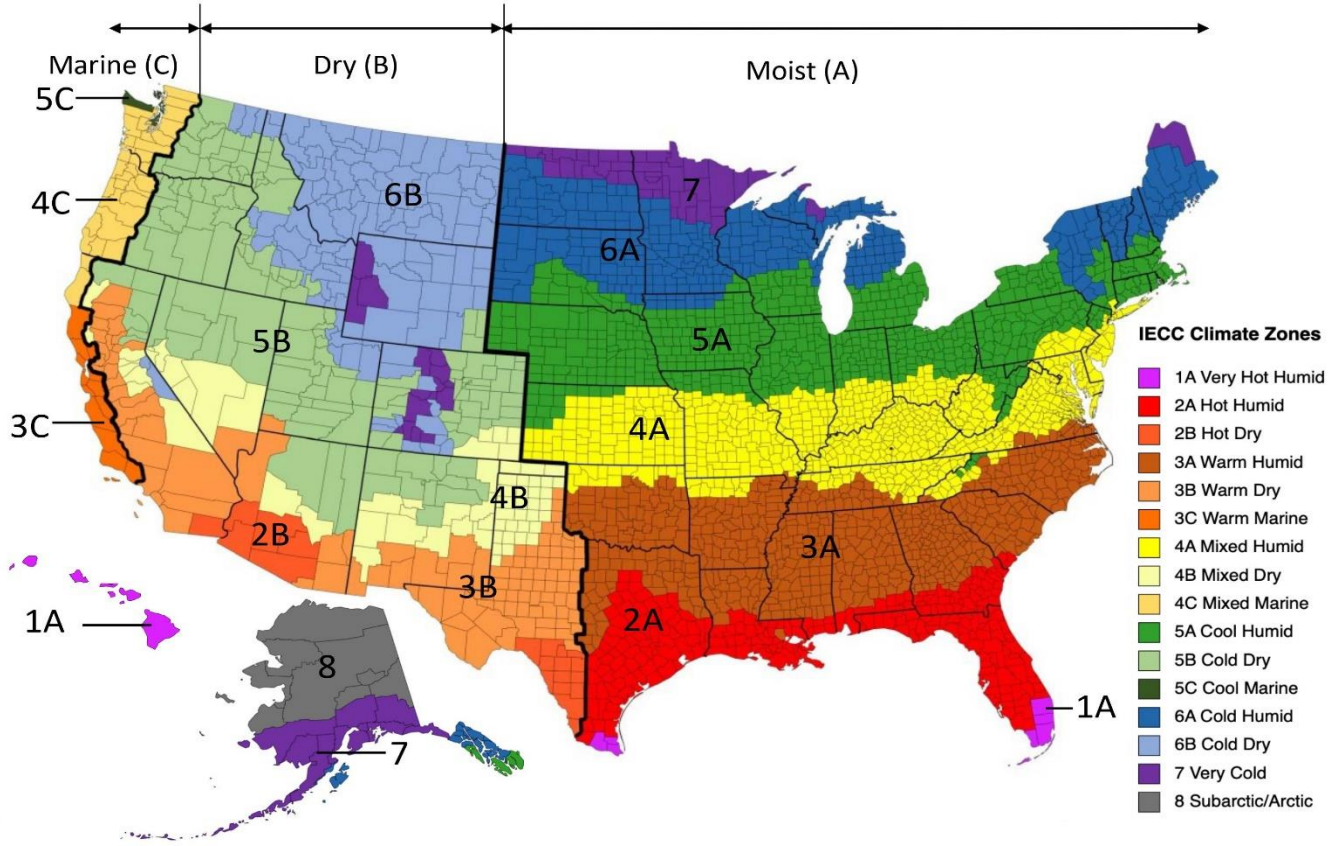
POLL: Where are you working? This can matter a lot!



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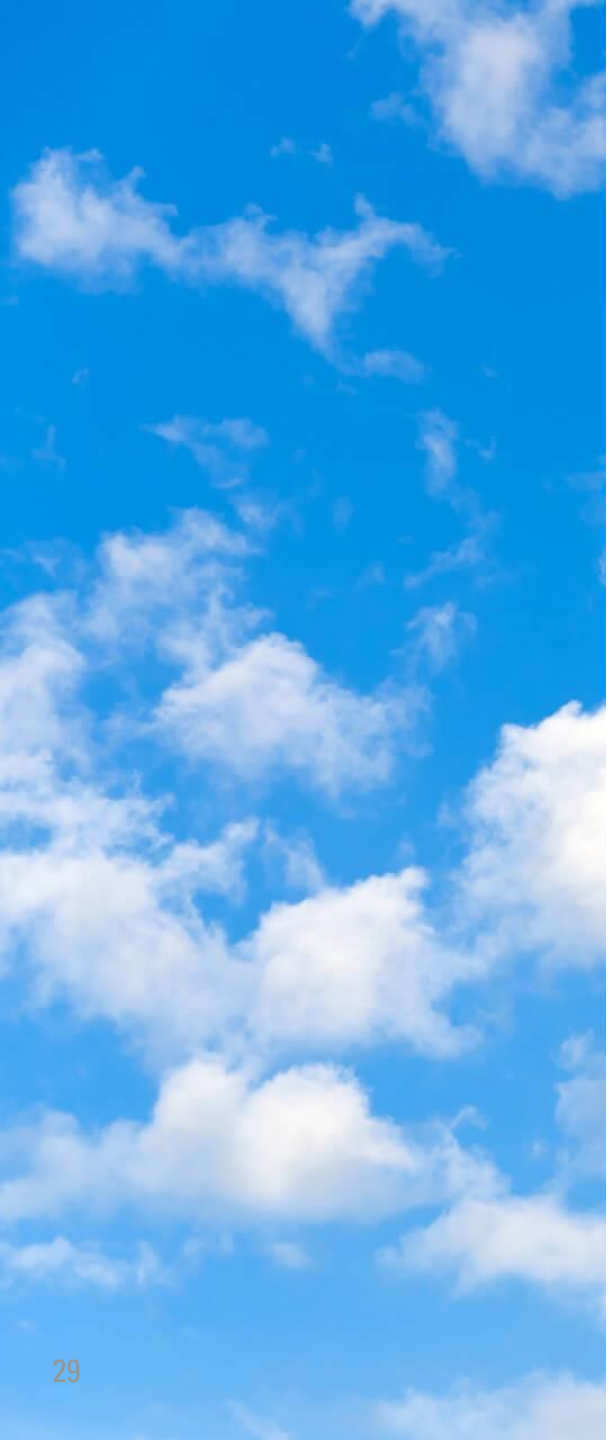

POLL: Are you currently running a program that installs or incentivizes electric heat pumps?

1. Yes: program is operational
2. Soon: actively planning/piloting
3. Not yet: just starting to explore
4. Just here to learn

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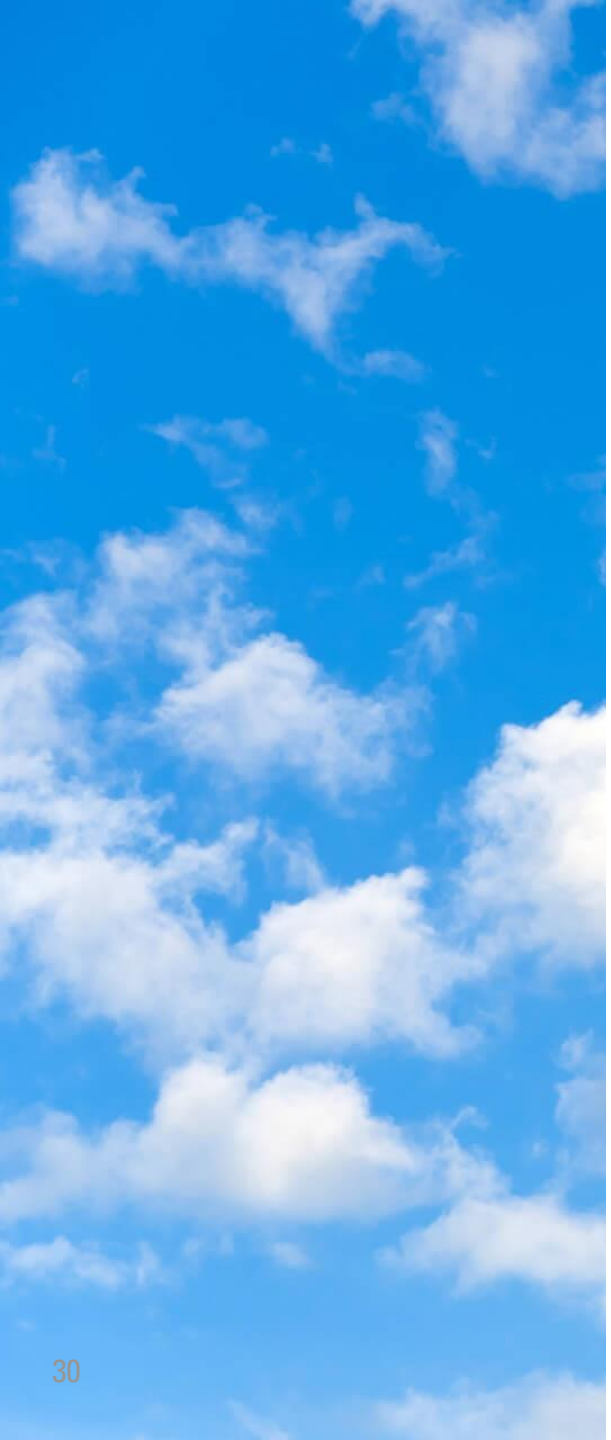

POLL: Do you think that installation of electric heat pumps reduces energy bills in your community?

1. Yes, it generally does
2. It really depends on the circumstances
3. No, it generally doesn't
4. I'm not sure / I have no idea

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Learning goal #2

What are the reasons to electrify?

Annika Brindel, ACEEE/R2E2

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How can building upgrades benefit underserved communities?

Increase climate resilience

- → Reduce greenhouse gas emissions and air pollution
- → Lessen reliance on fossil fuel equipment
- → Enable families to maintain safe indoor temperatures during extreme weather

Improve health, comfort, and safety

- → Reduce exposure to mold, moisture, and lead
- → Improve indoor air quality
- → Lower risk of gas leaks or explosions
- → Reduce ER visits and missed days of work and school related to asthma and other respiratory diseases
- → Improve mental health

Increase affordability

- → Reduce energy bills for people with low and moderate incomes
- → Improve long-term housing affordability and stability
- → Free up household budgets for essential needs such as food and medicine

Strengthen the local economy

- → Promote equity via women- and minority-owned business development and inclusive procurement
- → Create local jobs through job training

Promote racial equity

- → Ensure retrofits benefit BIPOC communities that have been excluded from past policies
- → Address frontline community priorities
- → Center community leadership, especially voices from BIPOC, renter, and marginalized communities

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How can building upgrades benefit underserved communities?

Prevent long-term stranding on the fossil gas system

Increase climate resilience

- → Reduce greenhouse gas emissions and air pollution
- → Lessen reliance on fossil fuel equipment
- → Enable families to maintain safe indoor temperatures during extreme weather

Improve health, comfort, and safety

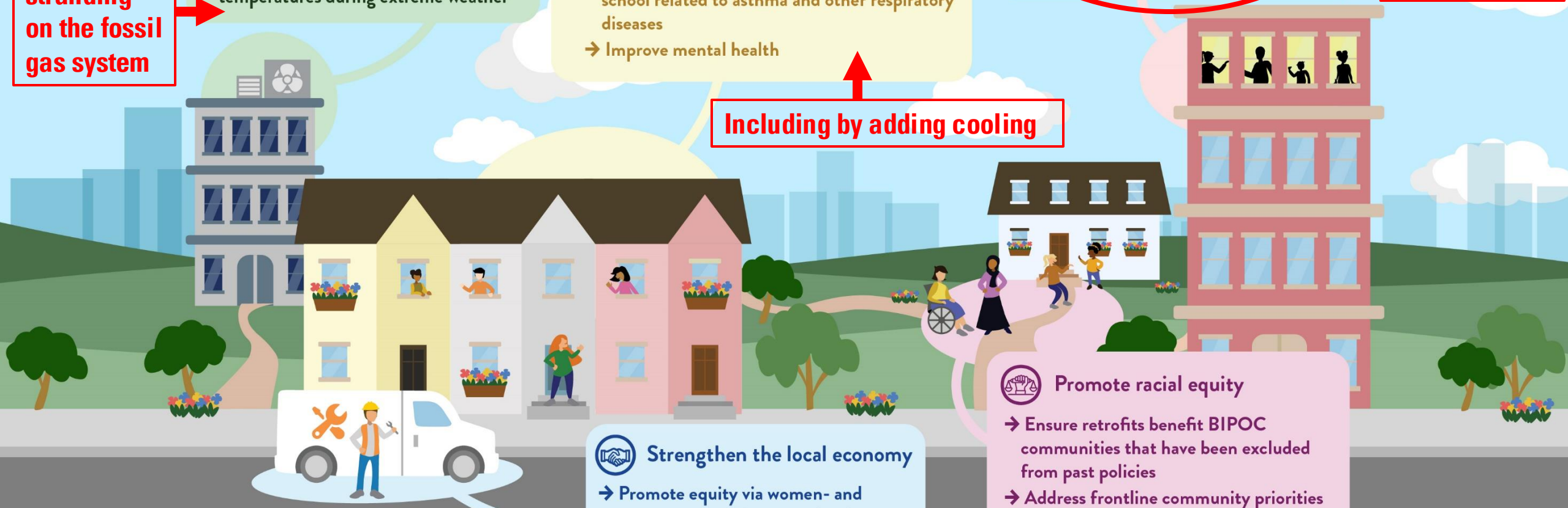
- → Reduce exposure to mold, moisture, and lead
- → Improve indoor air quality
- → Lower risk of gas leaks or explosions
- → Reduce ER visits and missed days of work and school related to asthma and other respiratory diseases
- → Improve mental health

Including by adding cooling

Increase affordability

- → Reduce energy bills for people with low and moderate incomes
- → Improve long-term housing affordability and stability
- → Free up household budgets for essential needs such as food and medicine

This is not guaranteed, which is why we are here today!



Strengthen the local economy

- → Promote equity via women- and minority-owned business development and inclusive procurement
- → Create local jobs through job training

Promote racial equity

- → Ensure retrofits benefit BIPOC communities that have been excluded from past policies
- → Address frontline community priorities
- → Center community leadership, especially voices from BIPOC, renter, and marginalized communities

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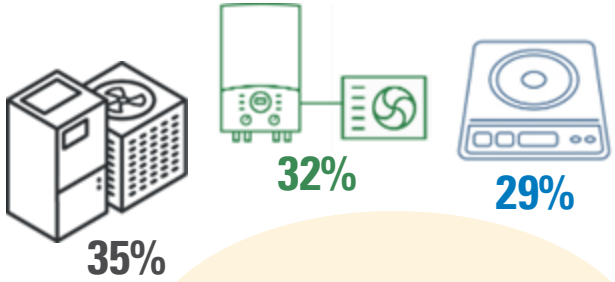
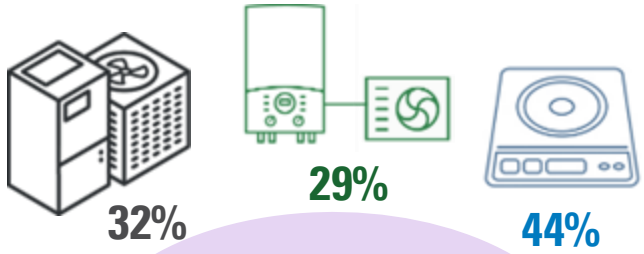
Survey results: Why go electric?



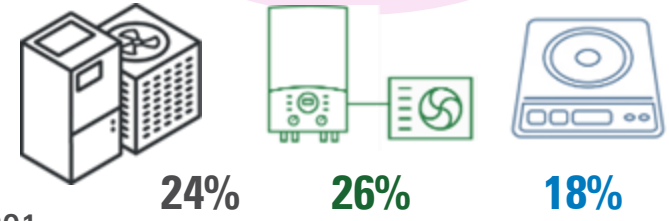
Electricity is a safer option for my home



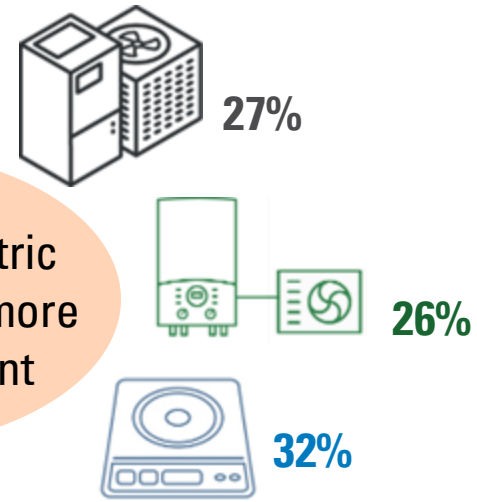
Electricity is cleanest/best for the environment

Electric stoves are easier to clean

Electricity is a more reliable option for my home



Electricity/electric appliances are more energy efficient



Source: Nationally representative sample of 1,801 Americans surveyed by ACEEE in 2024 (link)

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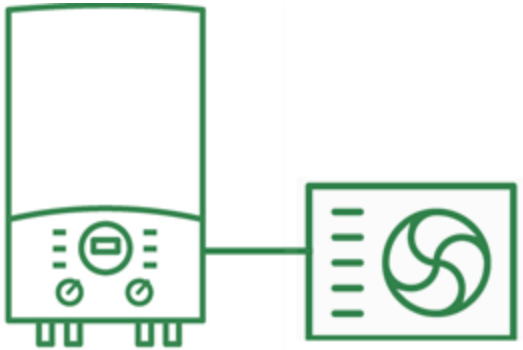
Barriers

Heat

- "Electricity Costs Too Much" (36%)
- "Electricity is not the most efficient option" (9%)



Hot Water

- "Electricity Costs Too Much" (34%)
- "Electricity is not the most efficient option" (17%)

Cooking

- "Gas offers a better cooking experience" or "gas has better heat distribution" (38%)
- "Electricity Costs Too Much" (10%)

Source: Nationally representative sample of 1,801 Americans surveyed by ACEEE in 2024 (link)

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Busting Electrification Myths

Myth: Electrification will overtax the electric grid.

REALITY: Electrification generally reduces loads in summer and increases loads in winter, when many regions already have much less load.

In some regions, grid planners and other entities will need to plan for increased winter loads sooner than in others. These regions are already working to better match demand to clean energy supply by building demand flexibility into program planning and design.

Myth: Electric heat pumps don't work in cold climates

REALITY: Cold-climate heat pumps are available that deliver full heating capacity at outdoor temperatures down to 15°F and continue operating at even colder temperatures, usually assisted by backup heating systems. Modern cold climate heat pumps keep your home as warm as gas.

Myth: Electric heat is inefficient.

REALITY: Today's heat pumps are much more efficient than electric resistance heating AND more efficient than older heat pump technologies.

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Q&A

Panel Discussion

Panelists

JahAsia Jacobs

Qualitative Research Analyst
Rewiring America

Katharine Kaplan

Chief Strategy Advisor, Office of the Deputy Assistant Secretary for Buildings and Industry, Energy Efficiency and Renewable Energy
U.S. Department of Energy

Andreanecia M. Morris

Executive Director
HousingNOLA

Rebecca Olson

Sr. Director of Residential and Community Energy
Center for Energy and Environment

REWIRING AMERICA

Equitable Electrification For LMI Households

Energy burden

→ Low-and moderate-income (LMI) households experience high energy burdens (% of gross HH income spent on energy costs)

→ As wealthier households electrify, LMI residents are left paying to maintain an aging gas system

→ Home electrification can reduce energy burden and (in some cases) generate cash flow for LMI residents depending on the amount of bill savings they see after switching.

Home health & comfort

→ The combustion of fossil fuels produces hazardous pollutants within and outside of the home. LMI households disproportionately experience the negative health effects of these pollutants including premature mortality, heart attacks, asthma, and other morbidities.

→ Electrification can improve the air quality within and outside of the home while its efficiency can make the home more comfortable.

Upfront costs

→ Upfront costs are the largest barrier to home electrification for LMI households. Despite robust incentives made available through the Inflation Reduction Act, households without sufficient tax liability, cash, or savings, are unable to pay for energy-efficient upgrades out-of-pocket.

→ Low-cost financing is emerging as a vital resource to facilitate LMI electrification

→ Rewiring America, as part of the Power Forward Communities coalition, will deploy GGRF funds for financing, financial assistance. & technical assistance for SFH electrification, focused mostly on LMI HHs.

GGRF Research on LMI Lending Preferences

Figures

LOAN AMOUNT

Should not exceed $10,000

INTEREST RATE*

Should not exceed 8%

PAYBACK PERIOD (TERM)

Should not exceed 7 years
(5-year term is ideal)

MONTHLY PAYMENT*

Should not exceed $150/mo

**most important figures*

General

- Demand/interest in loans is split 50/50 across both surveys and lit review shows EE financing programs struggle with low participation rates. Most respondents who say no to a loan are **debt-averse or say it's not "worth"** going into debt for an EE heating/cooling upgrade.
- Demand/interest in loans is **highest among moderate-income** households
- Low-income respondents would sooner **avoid replacing** their heating/cooling system altogether than take out a personal loan to finance a replacement
- Across all income groups, **monthly payment and interest rate** matter most while net bill savings are not a high priority. However, respondents feel strongly about at least **breaking even** and should not owe more than they save monthly.

U.S. DEPARTMENT OF ENERGY

Office of
ENERGY EFFICIENCY & RENEWABLE ENERGY

Decarbonizing the U.S. Economy by 2050: A National Blueprint for the Buildings Sector

bit.ly/building

A National Blueprint for the Buildings Sector:

Key Levers for Federal and State Government

To Deliver Peopled Centered Outcomes:

Economic Growth

High Quality Jobs

Climate Resilience

Improved Health

Decreased Energy Burden

Maximize technology performance and affordability

Develop markets and enable deployment

Provide direct funding and financing

Lock in cost effective performance gains

Ingredients of responsible electrification

- ✓ Weatherization improvements (Electrify Everything: Weatherization, DOE WAP)
- ✓ If current system is not all electric, consider dual fuel systems
- ✓ Explore onsite solar or community solar subscriptions
- ✓ Knowledgeable contractors (MN ASHP Collab: Tips for choosing a contractor)
  - ✓ Proper sizing, installation, commissioning, & switchover temps (Switchover Guide, Cost of Heat Comparison)
- ✓ Rebates, tax credits, and other incentives that reduce install costs
- ✓ Electric space heat rates (Developing Electric Rates For Hybrid Air Source Heat Pumps In The Midwest | (mncee.org))
- ✓ Workforce development (Workforce Development (mncee.org))

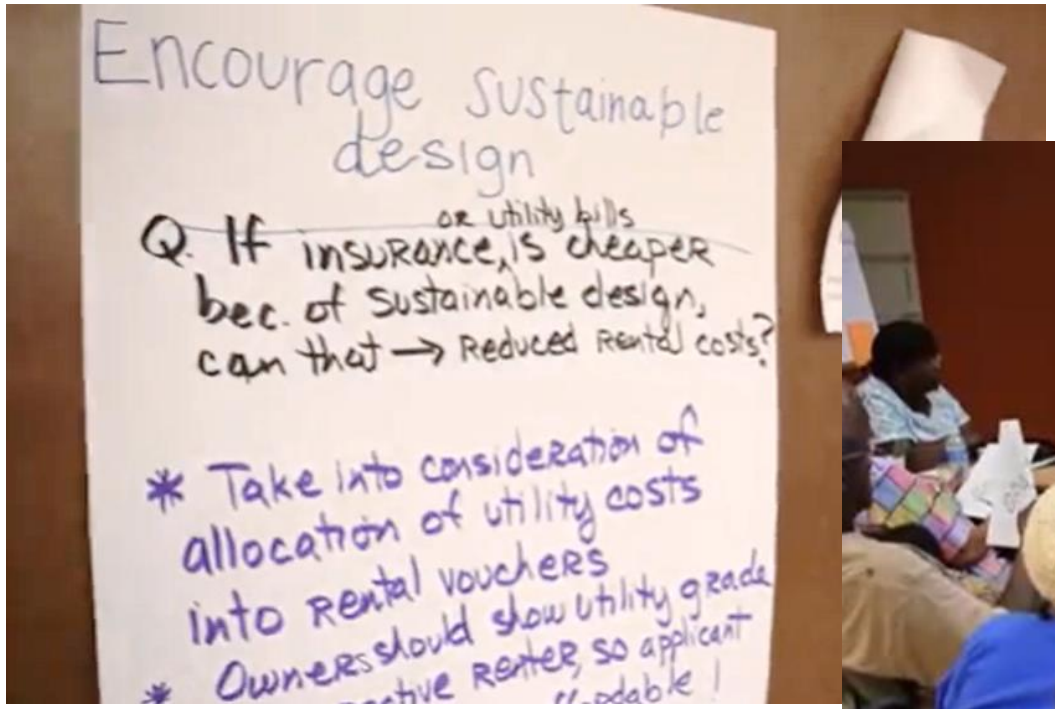
Case Studies Air Source Heat Pump Collaborative (mnashp.org)

rolson@mncee.org

ETA™ MN ASHP Air Source Heat Pump Collaborative MIDWEST ASHP COLLABORATIVE cee Center for Energy and Environment

Electrification in the Southeast

HousingNOLA



Q&A

THIS WORKSHOP IS BEING RECORDED

15 Minute Break

R2E2

Residential Retrofits for Energy Equity

EPA United States Environmental Protection Agency

Presentation, continued

Learning goals

3. Why is it important not to leave low- and moderate-income (LMI) households behind?
4. How does electrification impact energy bills (and when might it NOT reduce energy bills)?
5. What strategies can be used to reduce post-electrification energy bills for LMI households?

Presenters

Annika Brindel
Director of Residential Retrofits for Energy Equity
ACEEE

Jim Young
Associate Director
Guidehouse

Dan Lawlor
Environmental Policy Analyst, ENERGY STAR Products Labeling
U.S. Environmental Protection Agency

Learning goal #3

Why is it important not to leave low- and moderate-income (LMI) households behind?

Annika Brindel, ACEEE/R2E2

https://www.energystar.gov/equitableupgrades

Who is in danger of being left behind?

- **Policies that intentionally institutionalized racist practices** in housing, lending, and zoning have led to low-income households and communities of color being concentrated in areas with **poorer quality housing, greater pollution, and fewer high-quality jobs**.
- The legacy of this disinvestment endures today, such that **homes in disadvantaged communities are in worse condition** and **households are less able to invest** in electrification and other home upgrades.

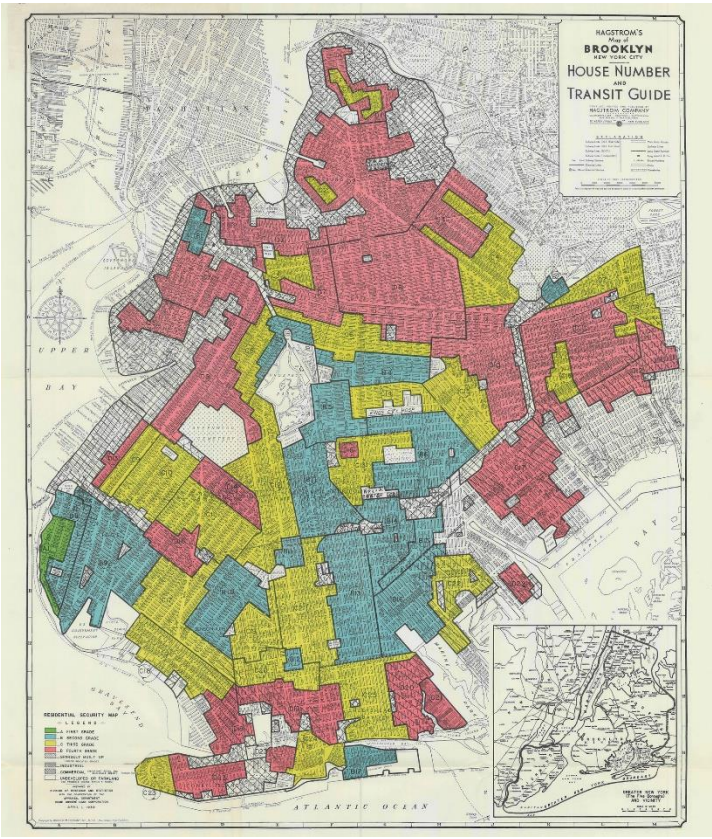


Image source: New York Times (link)

https://www.energystar.gov/equitableupgrades

R2E2

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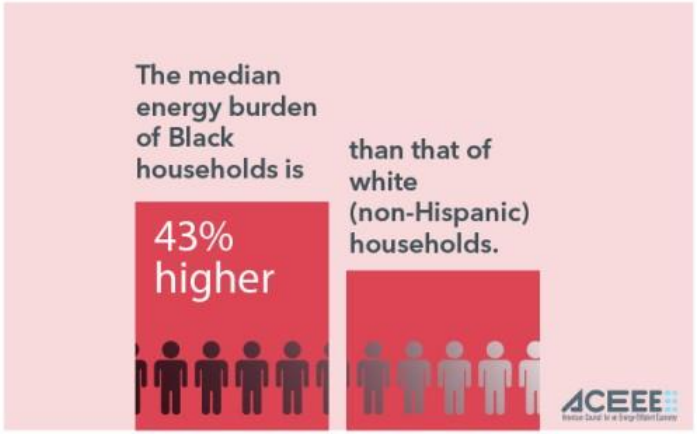
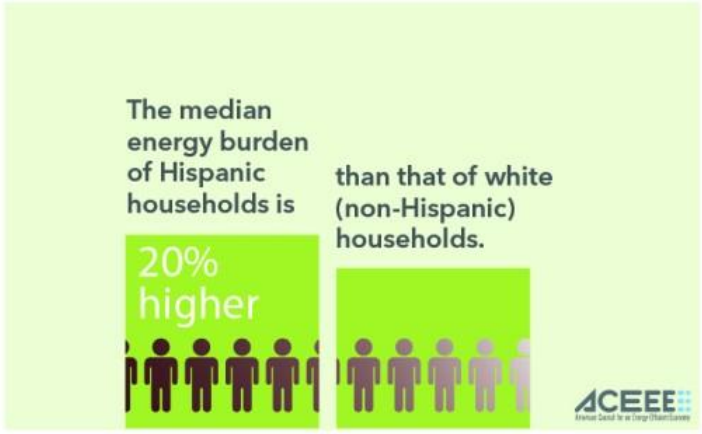
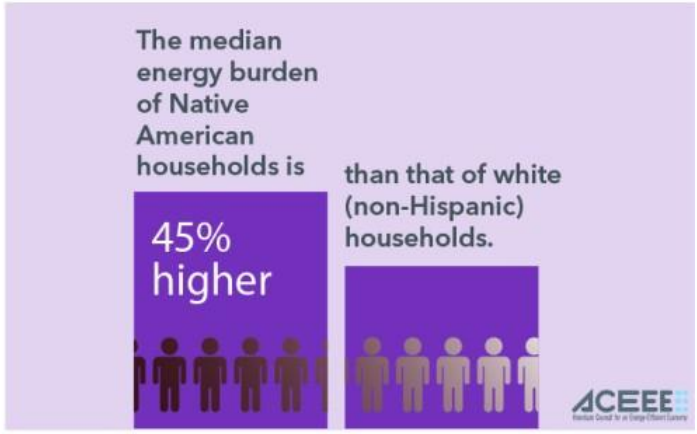
Energy burdens are not spread equitably

- High energy burdens (paying more than 6% of income for home energy bills) are correlated with greater risk for respiratory diseases, increased stress and economic hardship, and difficulty in moving out of poverty.
- 67% percent of households with low incomes face a high energy burden.
- Low-income, Black, Hispanic, Native American, and older adult households have disproportionally higher energy burdens than the average household.







ACEEE research: https://www.aceee.org/energy-burden

https://www.energystar.gov/equitableupgrades

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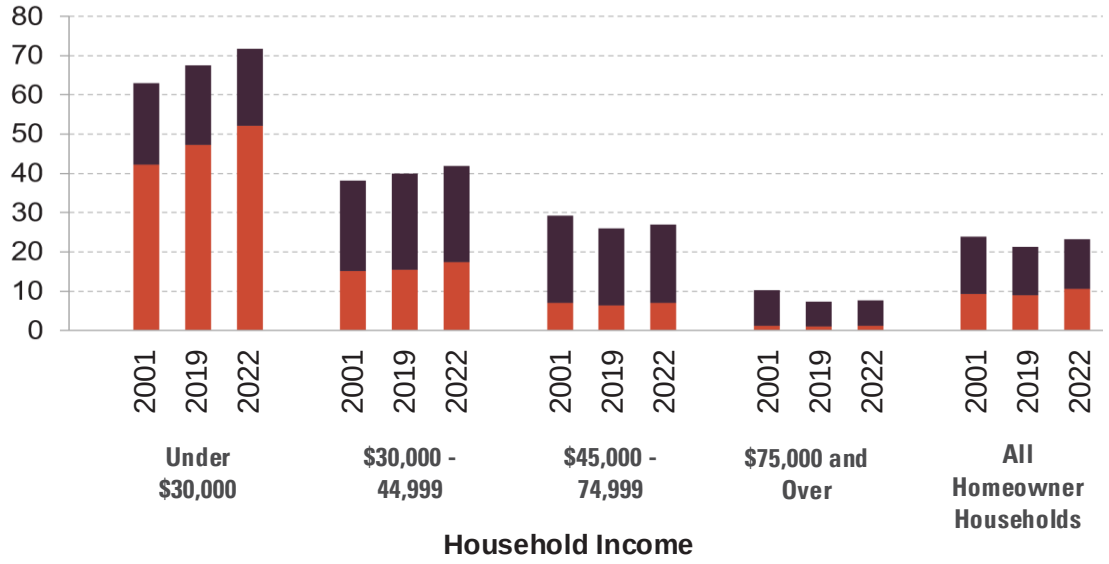
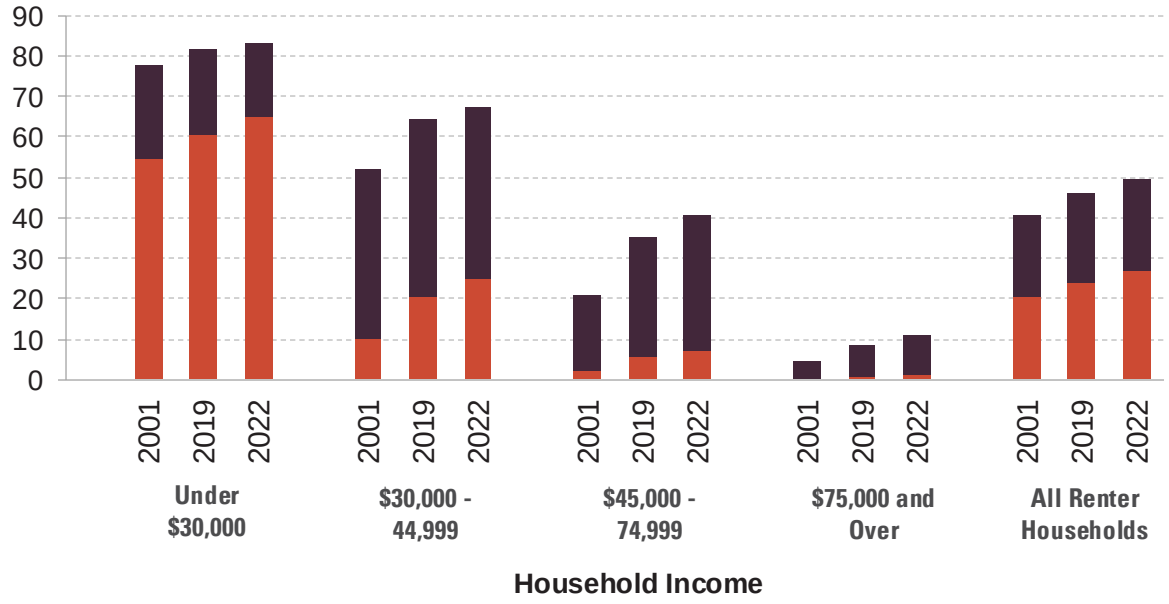
Most low-income households are housing cost burdened

In 2022, 72% of homeowners and 83% of renters with incomes of less than $30,000 were housing cost-burdened, paying more than 30% of their income for housing and home energy bills. There has been an increase in cost burden across renter households of all income levels since 2019.

Share of Homeowner Households with Cost Burdens (Percent) by Income



Share of Renter Households with Cost Burdens (Percent) by Income



Source: Joint Center for Housing Studies of Harvard University/U.S. Census: https://www.jchs.harvard.edu/state-nations-housing-2024

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Why is it important to center affordability in electrification?

- Too many low- and moderate-income households have not reaped the benefits of past energy efficiency efforts, contributing to high energy bills, housing unaffordability, and poor home conditions.
  - For example, 27.5% of all U.S. households have low incomes, but only 13% of overall spending from utility efficiency programs go to these households.
- If electrification efforts do not center affordability, low-income households will not be able to participate or participating in programs may make them worse off.

Source: Morales, D., and Nadel, S. Meeting the Challenge: A Review of Energy Efficiency Program Offerings for Low-Income Households

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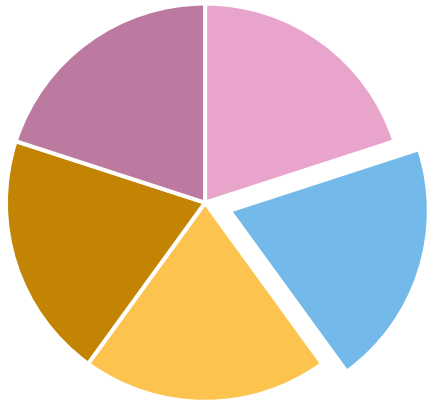
What happens if low-income households are left behind?

In the long run, if low-income households forgo switching from gas to electric equipment because it is unaffordable, they are likely to experience ballooning bills as other users leave the gas system and the cost of its upkeep is spread among fewer and fewer users.

Gas System Costs – Many Users

Gas System Costs – Few Users



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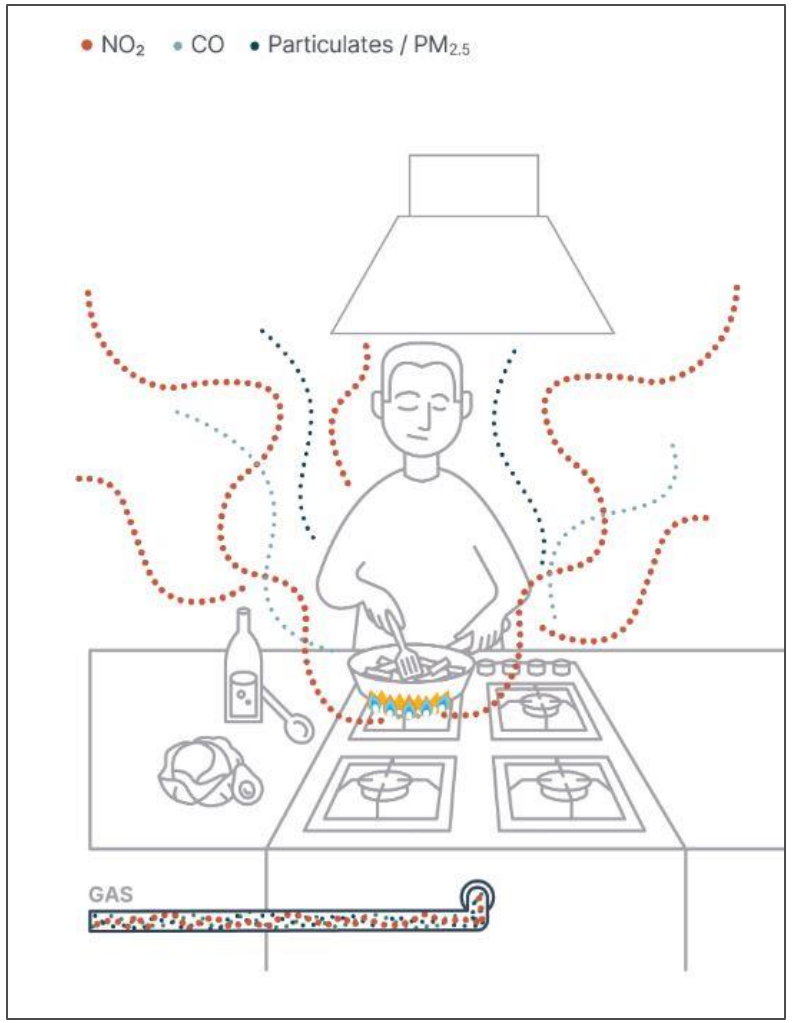
What are the health impacts of continuing to use gas in the home?

- Exposure to nitrogen oxide (NO_2), carbon monoxide, and particulate matter (PM2.5)
- Increased risk of childhood asthma and other respiratory illnesses
- "12.7% of current childhood asthma nationwide is attributed to gas stove use, which is similar to the childhood asthma burden attributed to secondhand smoke exposure." - Gruenwald et al. 2022

"Cooking with gas frequently leads to levels of indoor air pollution that would be illegal outdoors."
- Nicole Kearney, CLASP (Kearney (2023))



Learning goal #4

How does electrification impact energy bills (and when might it NOT reduce energy bills)?

Annika Brindel, ACEEE/R2E2

Jim Young, Guidehouse

https://www.energystar.gov/equitableupgrades

Why does electrification sometimes increase energy bills?

1. Existing heating system technology and fuel source
2. Electric rates
3. Gas rates
4. Geography/climate
5. Building envelope
6. Addition of cooling for the first time
7. Change in responsibility for bill payment

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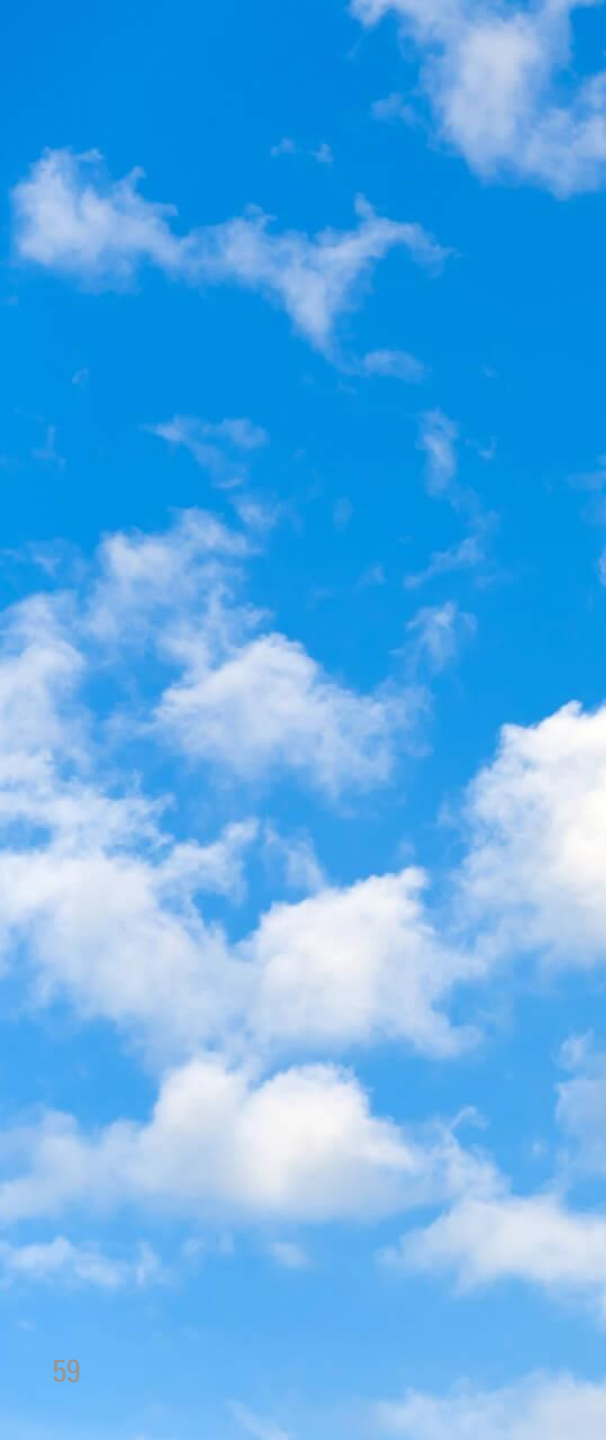

POLL: Which of these factors exert upward pressure on post-electrification energy bills in your community?

1. Existing heating system technology and fuel source
2. Geography/climate
3. Electric rates
4. Gas rates
5. Building envelope
6. Addition of cooling for the first time
7. Change in responsibility for bill payment
8. I'm not sure / I have no idea

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Existing heating system technology and fuel, electric rates, and gas rates

Switching from _____ to EFFICIENT ELECTRIC HEAT PUMP	Bill Pressure
Electric resistance/baseboard heat to heat pump	↓
Fuel oil to heat pump	↓
Propane to heat pump	↓
Natural/fossil gas to heat pump	
----------When electric rates are high	↑
----------When electric rates are low	↓
----------When natural gas rates are high	↓
----------When natural gas rates are low	↑

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Existing heating system technology and fuel

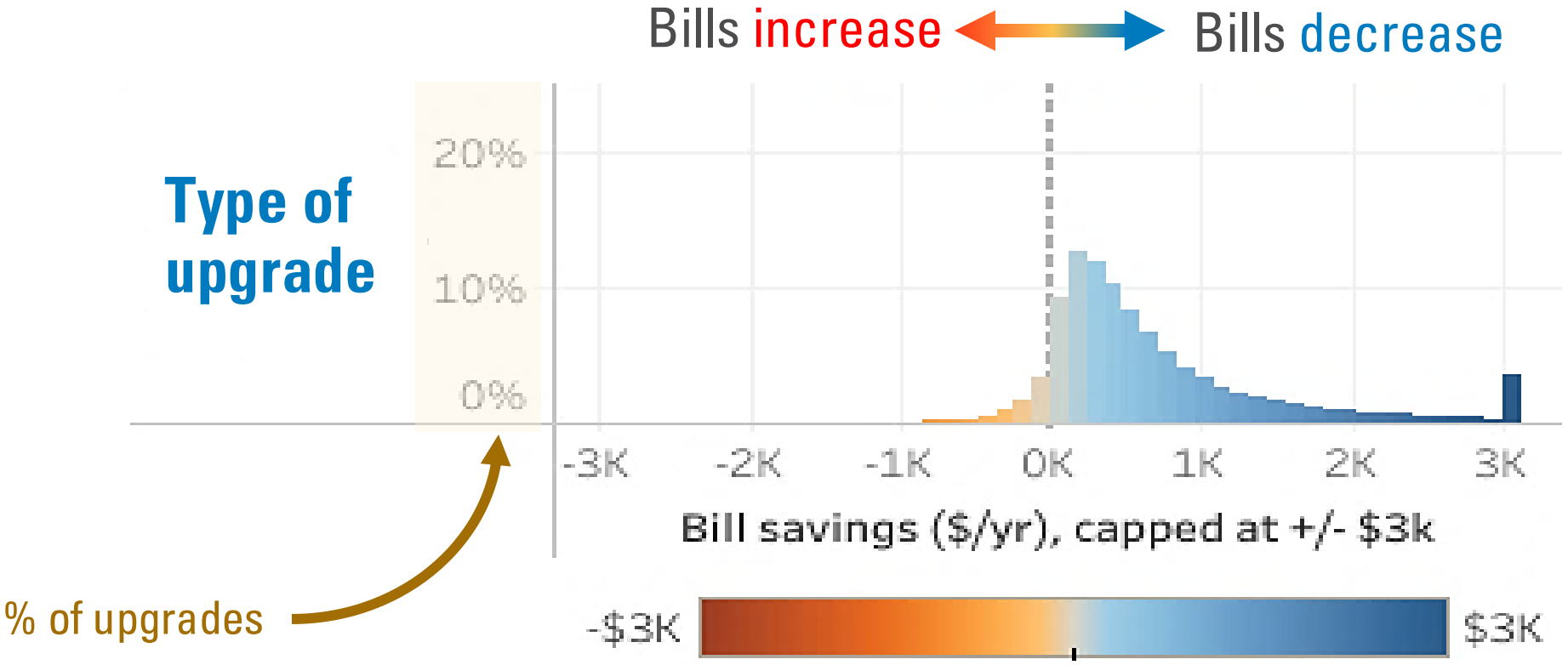
- NREL published visualizations of ResStock data, explored next.
- Takeaway 1: Homes with propane and fuel oil (and electric heating, though not shown on the next slides) almost always see utility bill savings with electric heat pumps—regardless of the geography or climate zone.
- Takeaway 2: Homes with gas are less likely to see utility bill savings with baseline heat pumps, but a greater share see savings with higher efficiency heat pumps, especially with envelope upgrades.

Wilson, Munankarmi, Less, Reyna, Rothgeb. 2024. Heat Pumps for All? Distributors of the Costs and Benefits of Residential Air-Source Heat Pumps in the United States. Link

https://www.energystar.gov/equitableupgrades

Existing heating system technology and fuel

How to read these figures:



Wilson, Munankarmi, Less, Reyna, Rothgeb. 2024. Heat Pumps for All? Distributors of the Costs and Benefits of Residential Air-Source Heat Pumps in the United States. Link

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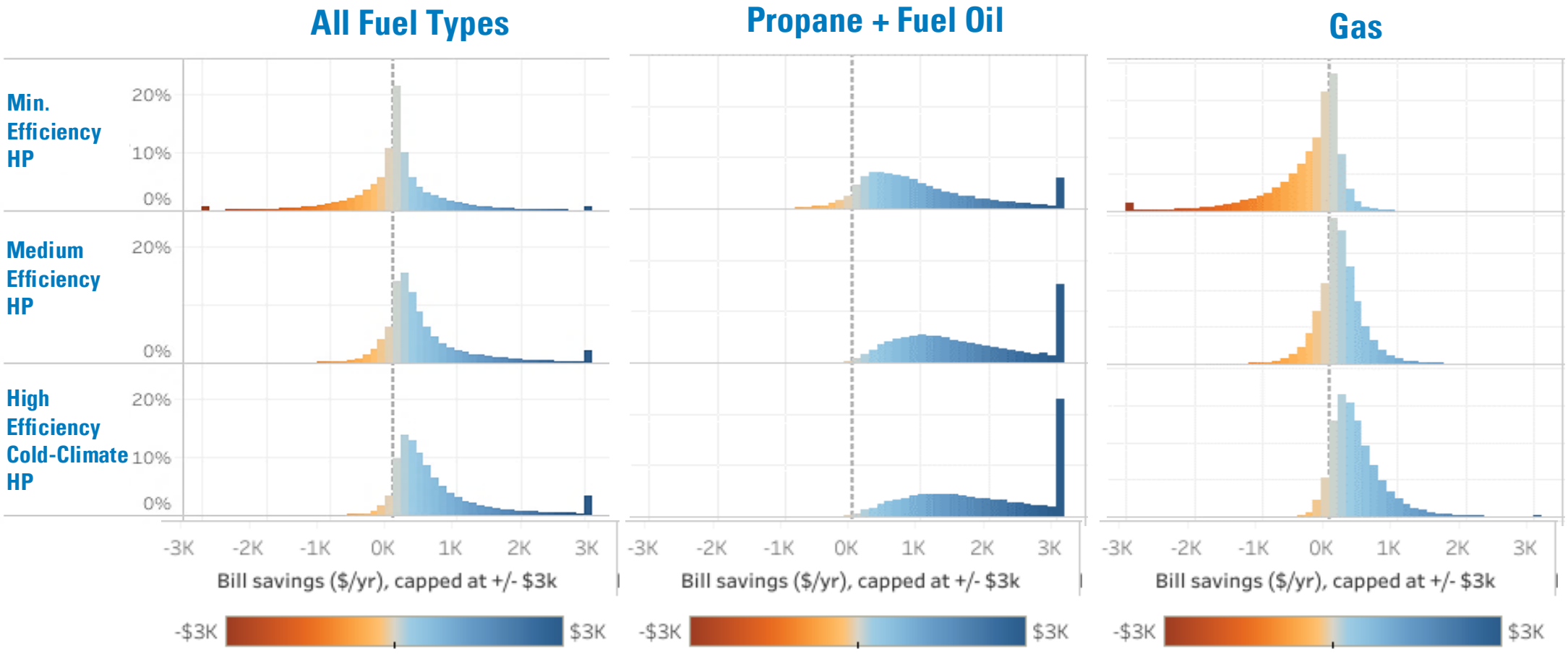
Existing heating system technology and fuel



Wilson, Munankarmi, Less, Reyna, Rothgeb. 2024. Heat Pumps for All? Distributors of the Costs and Benefits of Residential Air-Source Heat Pumps in the United States. Link

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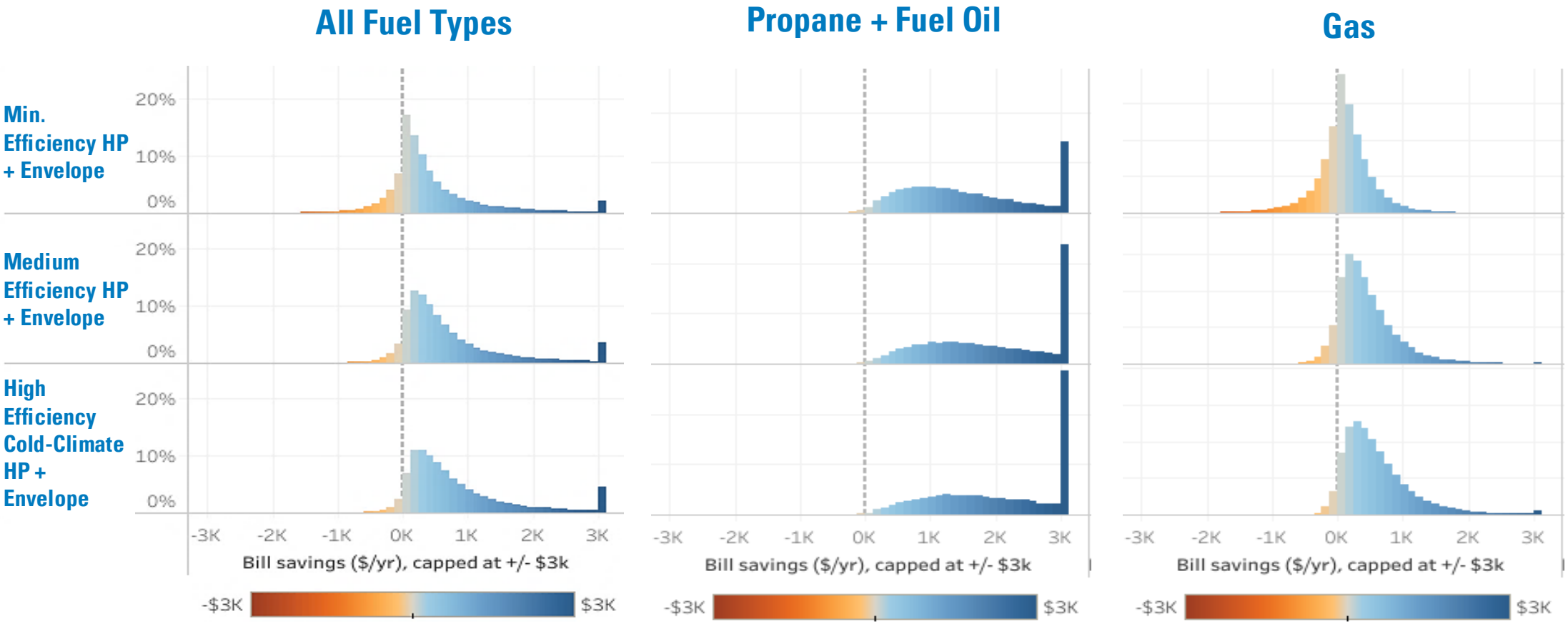
Building envelope



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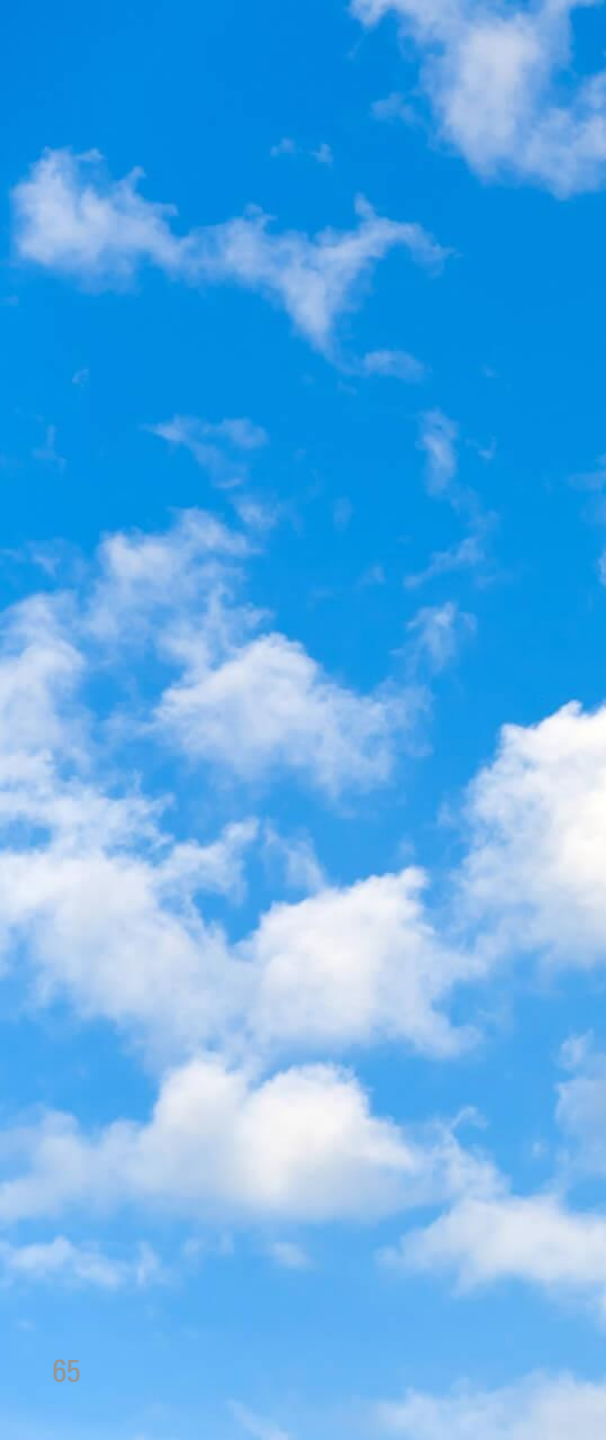

POLL: Which of the following are true statements?

1. Virtually all households that heat with propane or fuel oil will see energy bill savings from switching to a heat pump, even before envelope upgrades.
2. Households that heat with natural gas are more likely to see bill increases (not bill savings) when installing a minimum efficiency heat pump vs. a high efficiency cold-climate heat pump.
3. The vast majority of households that heat with natural gas will see bill savings when installing a high efficiency cold climate heat pump paired with envelope upgrades.
4. Households that have electric resistance heat are already using an efficient electric technology and will not see bill savings from switching to a heat pump technology.

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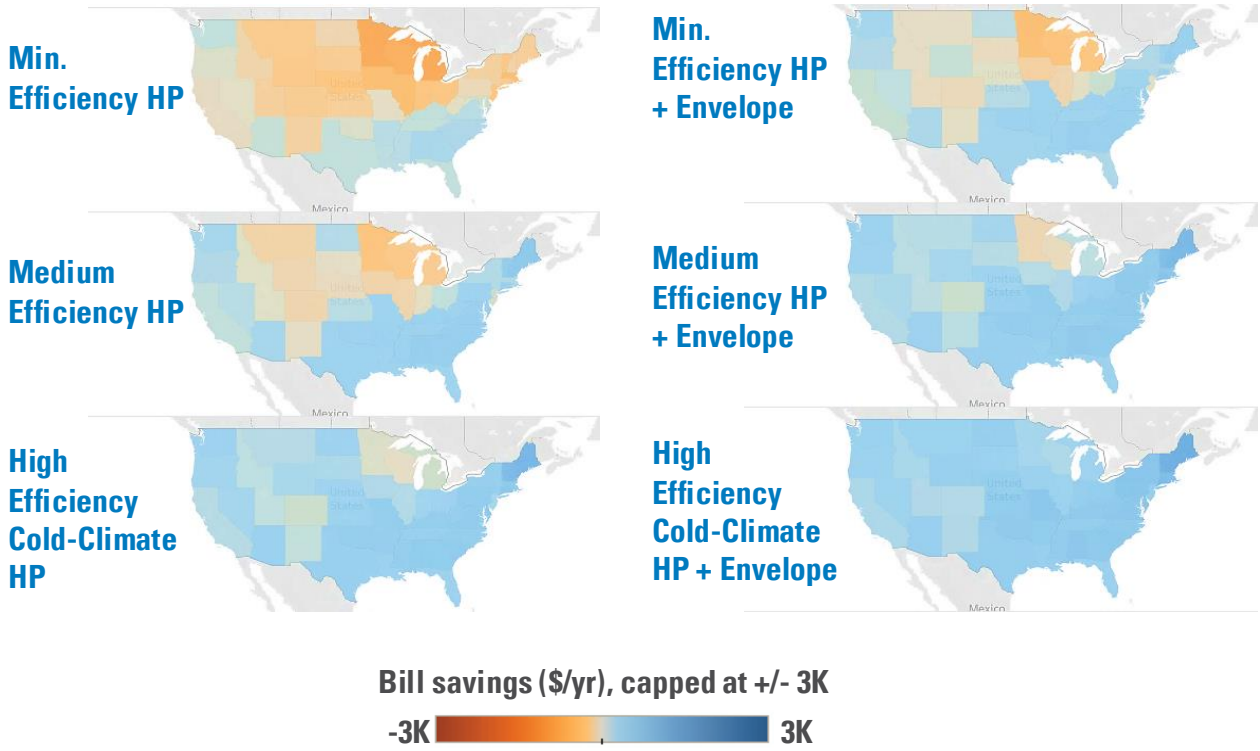
Geography/climate and building envelope

- Homes in East Coast, Southeast, and West Coast states see annual utility bill savings with medium efficiency HPs or minimum efficiency HPs + envelope upgrades.
- Homes in colder climates, such as the Upper Midwest and Mountain states see annual utility bill savings with high efficiency cold-climate HPs.
- In all cases, pairing envelope upgrades with electrification can support greater annual bill savings for residents, as well as improved comfort and other benefits.

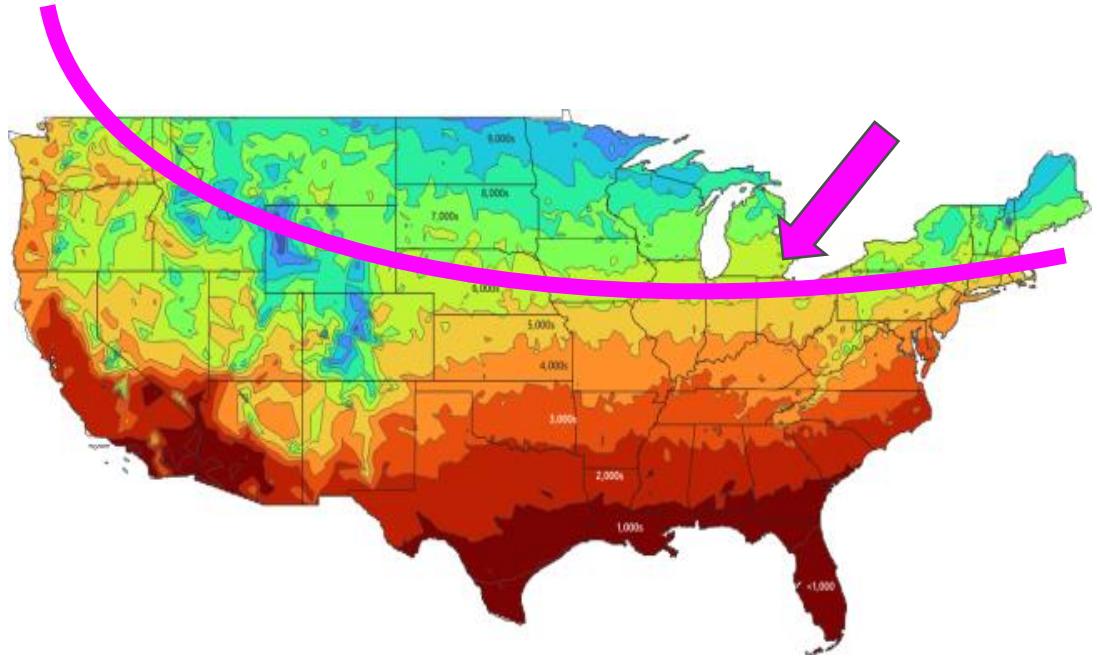


Wilson, Munankarmi, Less, Reyna, Rothgeb. 2024. Heat Pumps for All? Distributors of the Costs and Benefits of Residential Air-Source Heat Pumps in the United States. Link

https://www.energystar.gov/equitableupgrades

Geography/climate (2040 future impacts)

- Looking at predicted gas and electric prices in 2040 with decarbonized gas, electric heat pumps generally minimize operating costs for heating and cooling in places that are warmer than Detroit.
- These places have fewer than 6,000 heating degree days (HDD)—a measure of how much seasonal temperatures fall below 65°F.
- In colder climates, electric heat pumps combined with use of a backup fuel during frigid periods (below 5°F) generally minimize these costs.
- For water heating, electric heat pumps minimize costs in all climates.



ACEEE: https://www.aceee.org/research-report/b2205

https://www.energystar.gov/equitableupgrades

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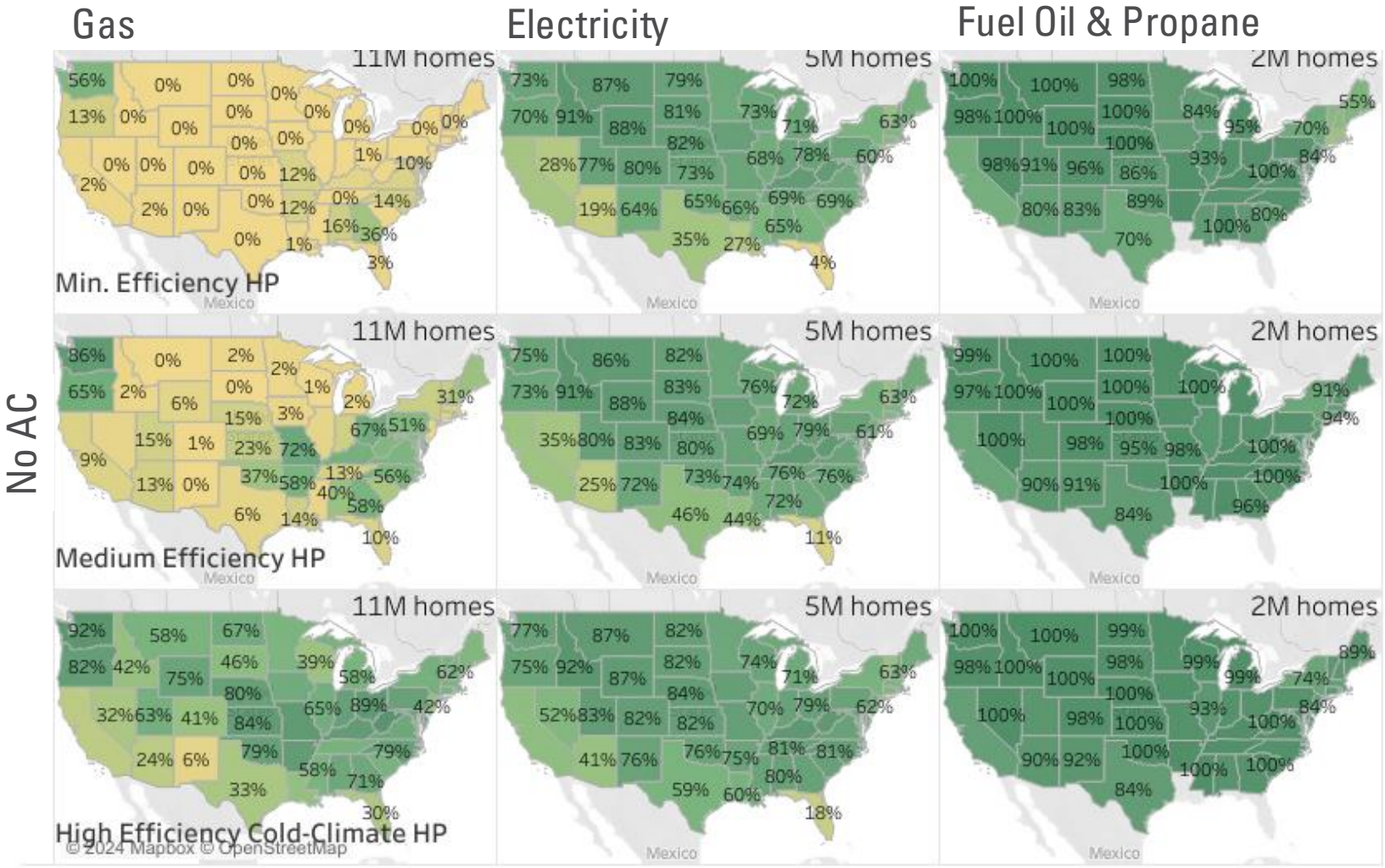
Addition of cooling for the first time



Expected Utility Bill Impacts for Different Scenarios (Total US)

Percent positive bill savings (21-22)

0% 100%

Wilson, Munankarmi, Less, Reyna, Rothgeb. 2024. Heat Pumps for All? Distributors of the Costs and Benefits of Residential Air-Source Heat Pumps in the United States. Link

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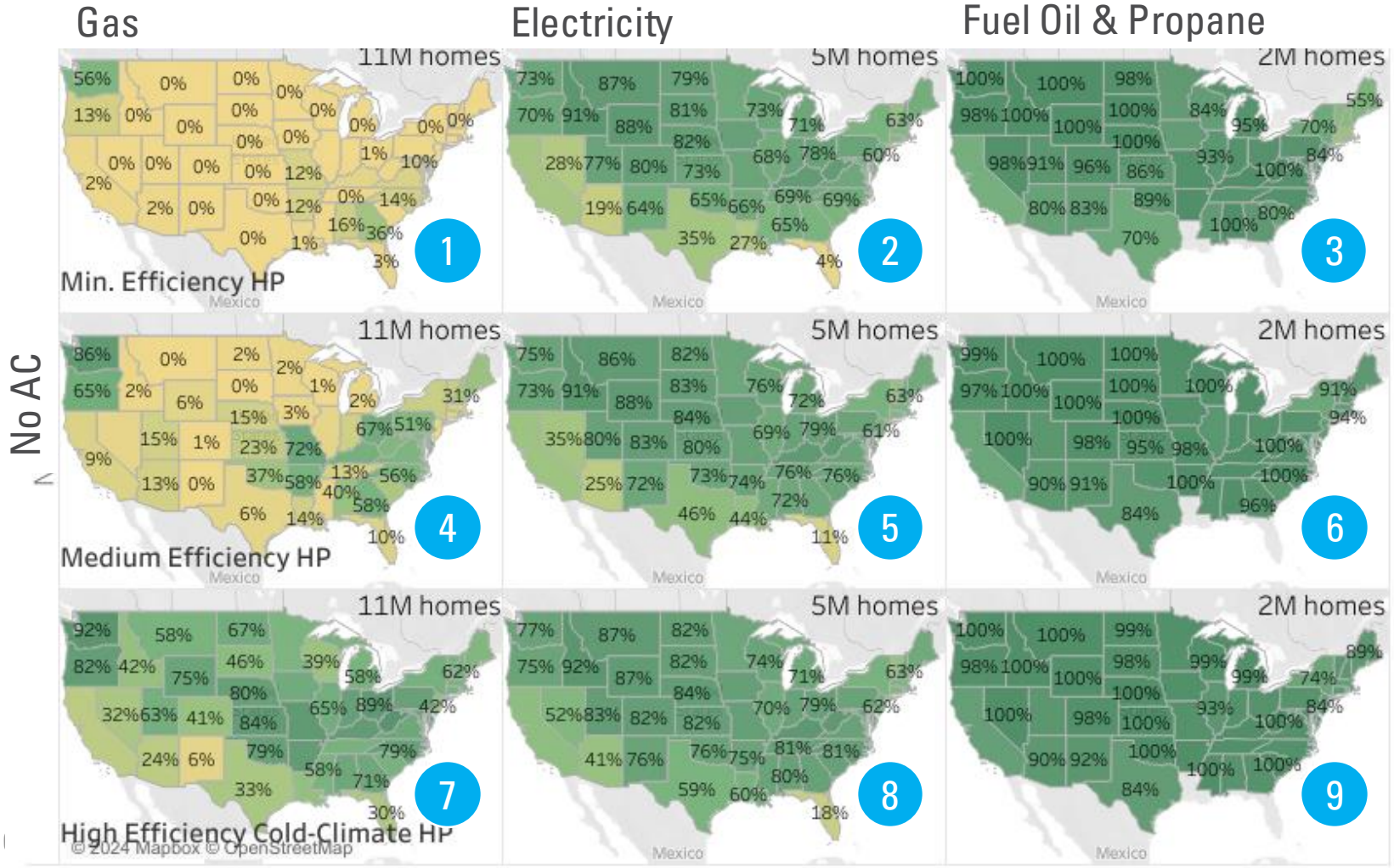
CHAT RESPONSE: Addition of cooling for the first time Why do you think…

1. All the states are green in maps #3, #6, and #9?
2. Florida is yellow in map #2?
3. Minnesota is green in map #7, but not in maps #1 and #4?
4. Washington is green in map #1?

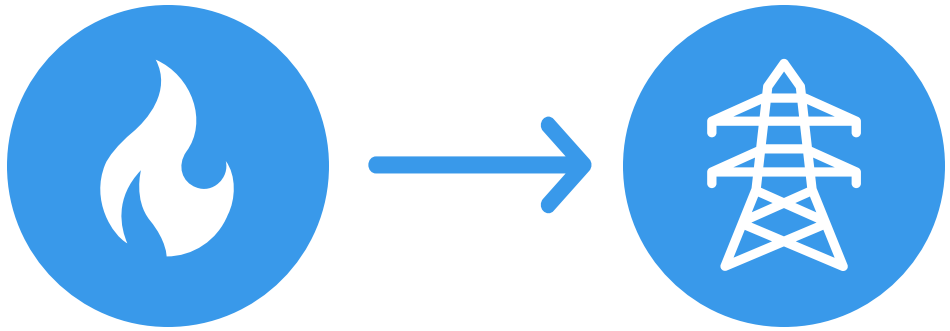


Percent positive bill savings (21-22)

0% 100%

Change in responsibility for bill payment

- Electrification of a gas-heated property will shift costs from the gas bill to the electric bill.
  - If a rental property owner pays the gas bill and a renter pays the electric bill, then costs previously covered by the rental property owner will shift to the renter.
  - This could be mitigated by transferring the electric bill to the rental property owner OR by reducing the renter's monthly rent, but these are not common practices.



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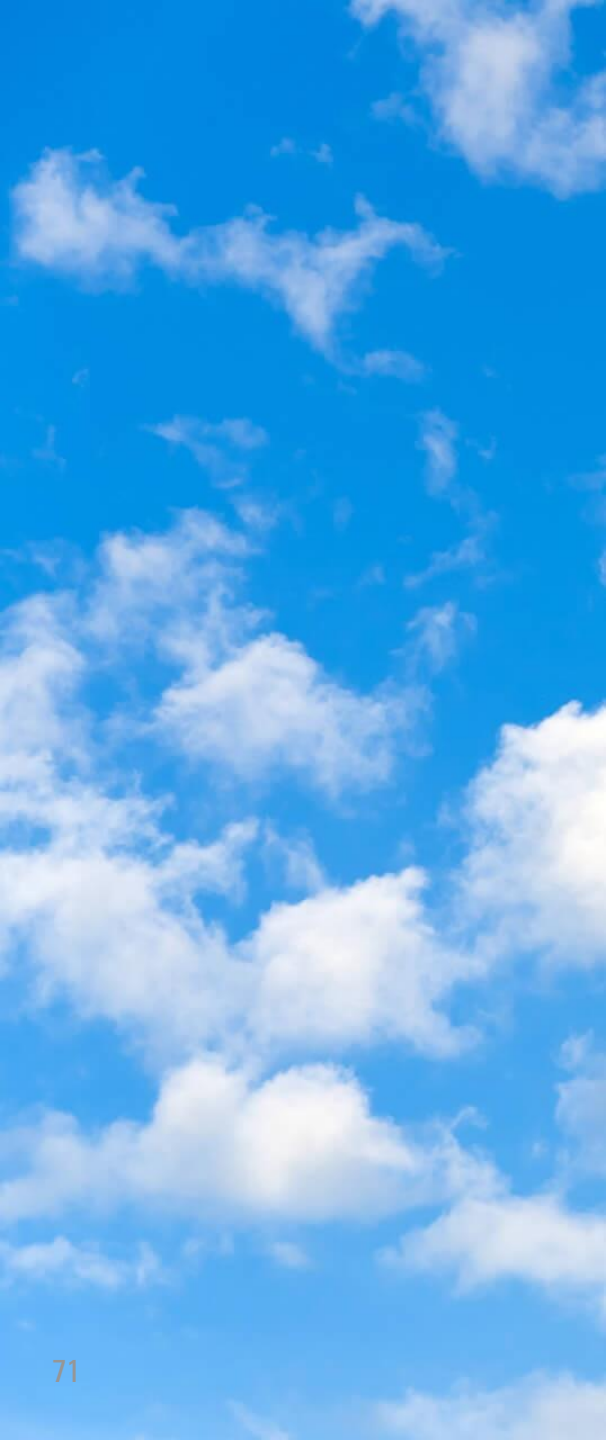

POLL: What is the primary heating system in the homes you are seeking to electrify?

- Gas furnace or boiler
- Propane furnace or boiler
- Oil furnace or boiler
- Electric heat pump
- Electric resistance
- Other
- None
- Not sure
- Just here to learn

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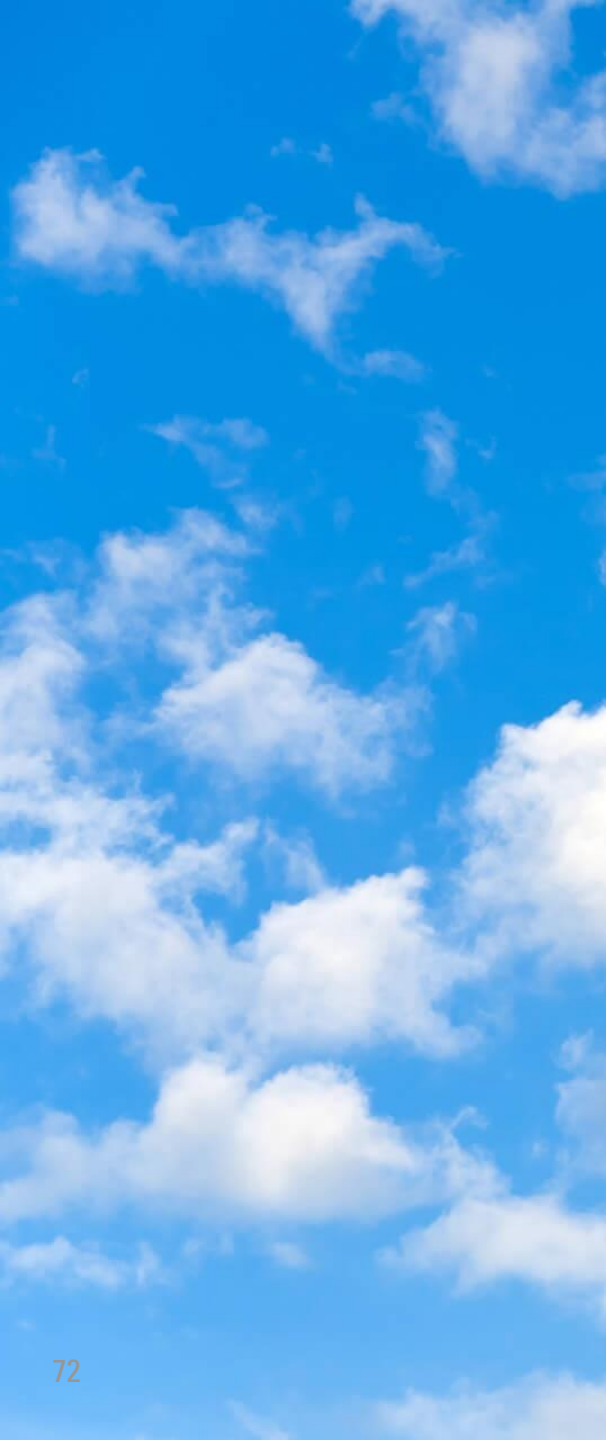


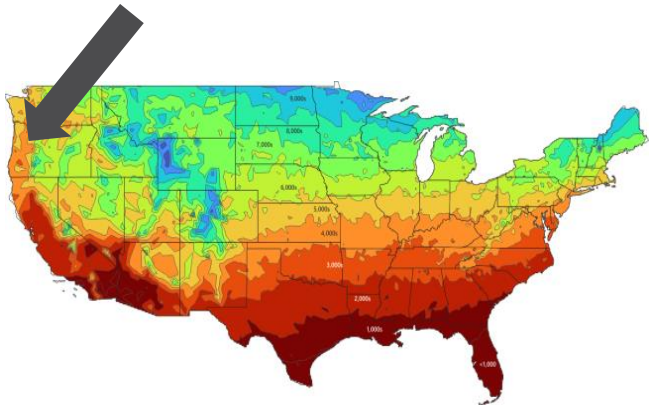
POLL: Which type of building stock are you seeking to electrify?

1. Single-family homes
2. Two- to four-family buildings
3. Buildings with five or more units
4. Manufactured housing
5. Other
6. Just here to learn

https://www.energystar.gov/equitableupgrades

Example 1: 1970s single-family home in Pacific Northwest region with gas

- **Existing system**: Gas furnace, no A/C system, good envelope
- **Electrification Upgrade**: Ductless mini-split (single zone) or multi-split (several zones) heat pumps
- **Impacts**: Annual utility cost likely decrease or remain the same in winter months and increase in summer months. Home now has space cooling for extreme heat events.



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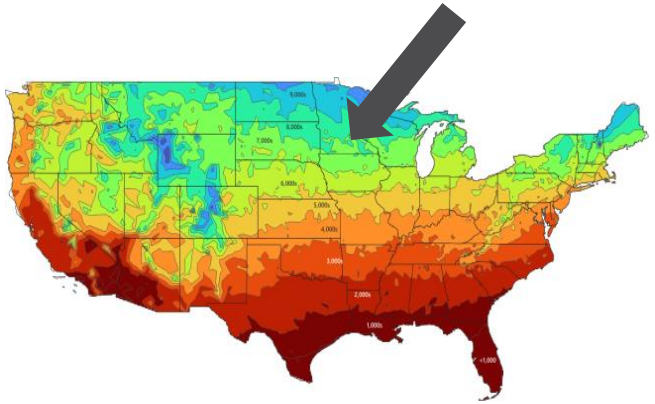
Example 2: 1950s single-family home in Upper Midwest region with propane

- **Existing system**: Propane gas furnace + central AC system, leaky envelope
- **Electrification Upgrade**: Central cold-climate heat pump with propane backup plus upgraded attic insulation and air sealing
- **Impacts**: Annual utility costs decrease by leveraging CCHP during moderate-to-cold conditions and the propane backup in extreme conditions with reduced thermal loads from the weatherization upgrade



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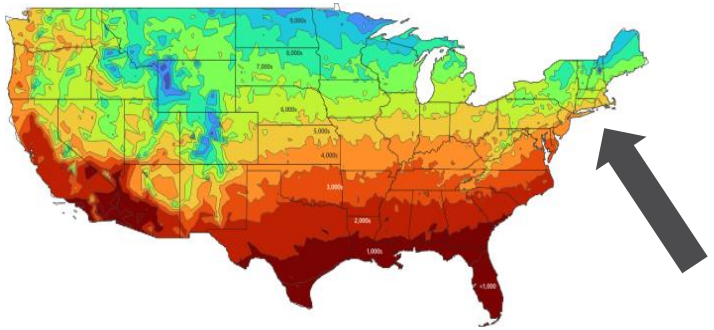
Example 3: 1960s rental property in Northeast region with fuel oil

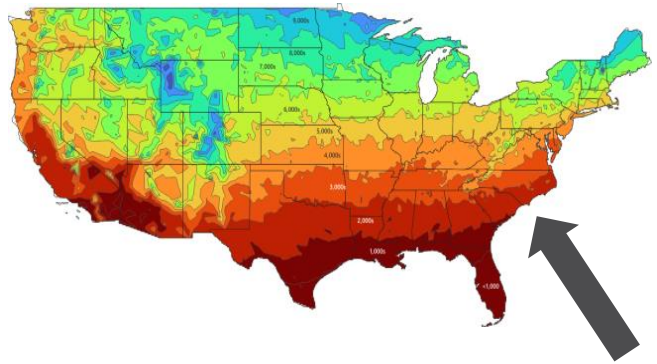
- **Existing system**: 6-story, 80-unit building with central fuel oil boiler serving steam radiators in each apartment unit, packaged terminal air conditioners (PTACs) and/or window A/Cs
- **Electrification Upgrade**: Cold-climate packaged terminal heat pumps (PTHPs) and window heat pumps in each apartment, decommission steam system
- **Impacts**:
  - Annual utility cost decrease for the entire building.
  - Heating utility costs may shift from building owner to resident if the new electric systems are wired to resident meters. If applicable, rent should decrease to recognize this bill payment shift to residents.



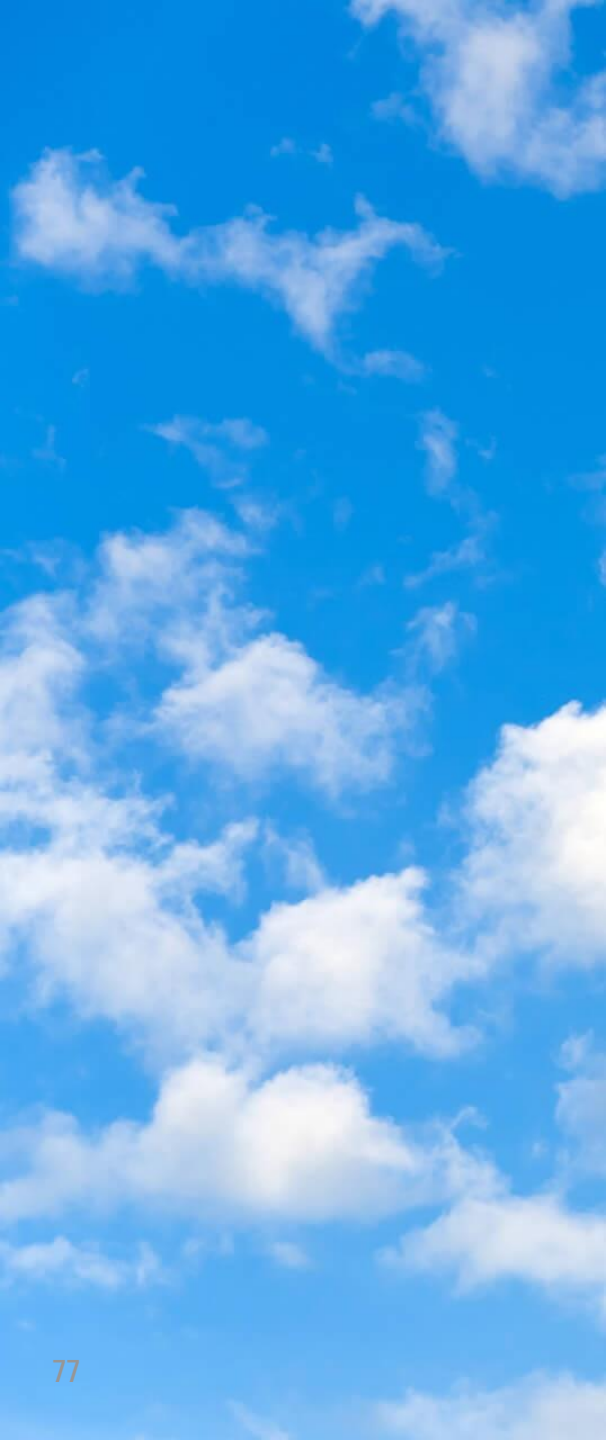
https://www.energystar.gov/equitableupgrades

Example 4: 1950s single-family rental property in Southeast region w/ electric resistance

- **Existing system**: Electric resistance baseboard heating in each room, no A/C systems
- **Electrification Upgrade**: Ductless mini-split (single zone) or multi-split (several zones) heat pumps plus upgraded attic insulation and air sealing
- **Impacts**:
  - Heating utility costs decrease significantly
  - Summer utility costs increase as the residents have space cooling for the first time
  - Annual utility cost impacts will vary by climate and user preferences



https://www.energystar.gov/equitableupgrades



REPEAT POLL: Do you think that installation of electric heat pumps reduces energy bills in your community?

1. Yes, it generally does
2. It really depends on the circumstances
3. No, it generally doesn't
4. I'm not sure / I have no idea

https://www.energystar.gov/equitableupgrades

Learning goal #5

What strategies can be used to reduce ongoing energy bills for LMI households?

Annika Brindel, ACEEE/R2E2

https://www.energystar.gov/equitableupgrades

Overview of strategies

1. Reducing upfront costs
2. Targeting and/or sequencing
3. Comprehensive retrofits
4. Quality control
5. Access to clean energy
6. Linking to bill assistance and rates
7. Protecting housing affordability

https://www.energystar.gov/equitableupgrades

Strategy 1: Reducing upfront costs

- It is important to reduce upfront costs, but this is not the focus of this discussion. Strategies to reduce upfront costs include:
  - Stacking and braiding multiple funding sources
  - Grants/rebates that cover at least 75-80% of project costs if not 100%
  - Tax credits (limited applicability for LMI households)
  - Bundling projects for bulk discounts
  - Neighborhood-scale approach + gas-decommissioning (emerging approach)

- Reducing upfront costs also affects ongoing affordability if there will be ongoing payments
  - Considering inclusive utility investments/PAYS (leverage grants/rebates first)
  - Keeping loan amounts small (leverage grants/rebates first)
  - Offering low- or no-interest loans (interest rate buy-downs)

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Strategy 1: Reducing upfront costs

Examples

- Stacking and braiding multiple funding sources
  - Philadelphia's Built to Last Program partnership with the Philadelphia Energy Authority and Philadelphia Green Capital Corp to identify and close funding gaps through layering and streamlining existing fundings sources and services.
- Neighborhood-scale approach + gas-decommissioning
  - Pacific Gas & Electric completed 88 targeted electrification projects, including decommissioning 22 miles of transmission pipe and converting 105 customers from gas in California—in clusters of <5 customers at a time.
- Offering low- or no-interest loans
  - The City of Minneapolis uses its utility franchise fee from Xcel Energy to offer grants and 0% interest 10-year loans of up to $20,000 for qualified efficiency and electrification projects. Grant size based on cost, income, and neighborhood.

Strategy 2: Targeting and/or sequencing

- By existing heating system technology
  - E.g., electric resistance heat
- By fuel source
  - E.g., oil or propane
- Homes with certain predetermined characteristics
  - E.g., single family, already weatherized
- By metering structure
  - E.g., where renter pays both gas and electric
  - E.g., where rental property owner pays both gas and electric
- Geographically
  - E.g., prioritizing certain climate zones where multiple zones are present

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Strategy 2: Targeting and/or sequencing

Examples

- Targeting by fuel source
  - For several years, NYS Clean Heat prioritized the highest-cost propane/oil customers for access to efficient cold-climate heat pumps. The program provides higher incentives for full vs. partial electrification of homes and enhanced incentives for disadvantaged communities.
  - "Maine, Massachusetts, and Rhode Island all specifically exclude households using gas for heating from their low-income heat pump rebate programs (though in Massachusetts National Grid allows exceptions if a household acknowledges its energy burden might increase)." (Read more about the drawbacks of this approach on the ACEEE blog.)

NEW YORK STATE | NYS Clean Heat

Logo from NYS Clean Heat website
Screenshot from ACEEE blog post

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Strategy 3: Comprehensive retrofits

- Weatherization, including insulation, air sealing, and duct sealing (as applicable)
- Timing weatherization first or simultaneously to allow right-sizing of equipment
- Other energy efficiency measures

Screenshot from ACEEE blog post

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Strategy 3: Comprehensive retrofits

Examples

- Timing Weatherization First
  - Mass Save Residential Electrification Program helps households prepare for new electric heat pumps by first increasing the home's efficiency through weatherization, followed by installation of the heat pump technology.
  - Mass Save currently offers residents:
    - Home energy assessments and decarbonization consultations
    - Incentives and 0% interest financing
    - Income-based assistance

mass save®
Savings through energy efficiency

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Strategy 4: Quality control

- Contractor education and engagement
  - Installation quality
  - Specifying the correct/correct size of equipment
  - Specifying a backup system in cold climates that is compatible with the household's price sensitivity
- Post-retrofit commissioning
  - E.g., set correct crossover temperature for backup heat
- Clear standards and inspection for weatherization quality
- Post-retrofit operations and maintenance training

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Strategy 4: Quality control

- State and local jurisdictions usually have licensing, training, and certification requirements for HVAC, electrical, plumbing, weatherization, inspectors, and other building professionals.
  - Consult with state and local code officials and their websites for relevant requirements in your region.
- Utility and government incentive programs often have their own quality control requirements, including training, post-install inspections, and documentation submittals, and often maintain qualified contractor lists.
  - Review program materials and/or reach out to the program leads in your area.
- The DOE Energy Skilled™ recognition designates high-quality programs that equip contractors to evaluate buildings and conduct installations: the available job families are heat pumps, HPWHs, and energy assessment.

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Strategy 4: Quality control

Examples

- Contractor education/installation quality
  - Staff in the **Minnesota ASHP Collaborative** Preferred Contractor Network listings are sales staff who help customers select and size equipment.
- To be listed, they must:
  - Complete required training from ASHP Collaborative (Online in about 2 hours or at a qualified in-person event)
  - Demonstrate quality installation of a centrally ducted ASHP with a one-time virtual site verification
  - Maintain responsiveness and complete a renewal site verification every other year
- Funded by several of the state's investor-owned and consumer-owned utilities
- Administered by the state energy office and implemented by Center for Energy and Environment

ASHP Air Source Heat Pump Collaborative

Source: https://www.mnashp.org/

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Strategy 5: Access to clean energy

- Rooftop solar
- Community solar
- Other renewables

Zero-energy modular homes on McKnight Lane in Waltham, Vermont. Source: VHCB 2020b.

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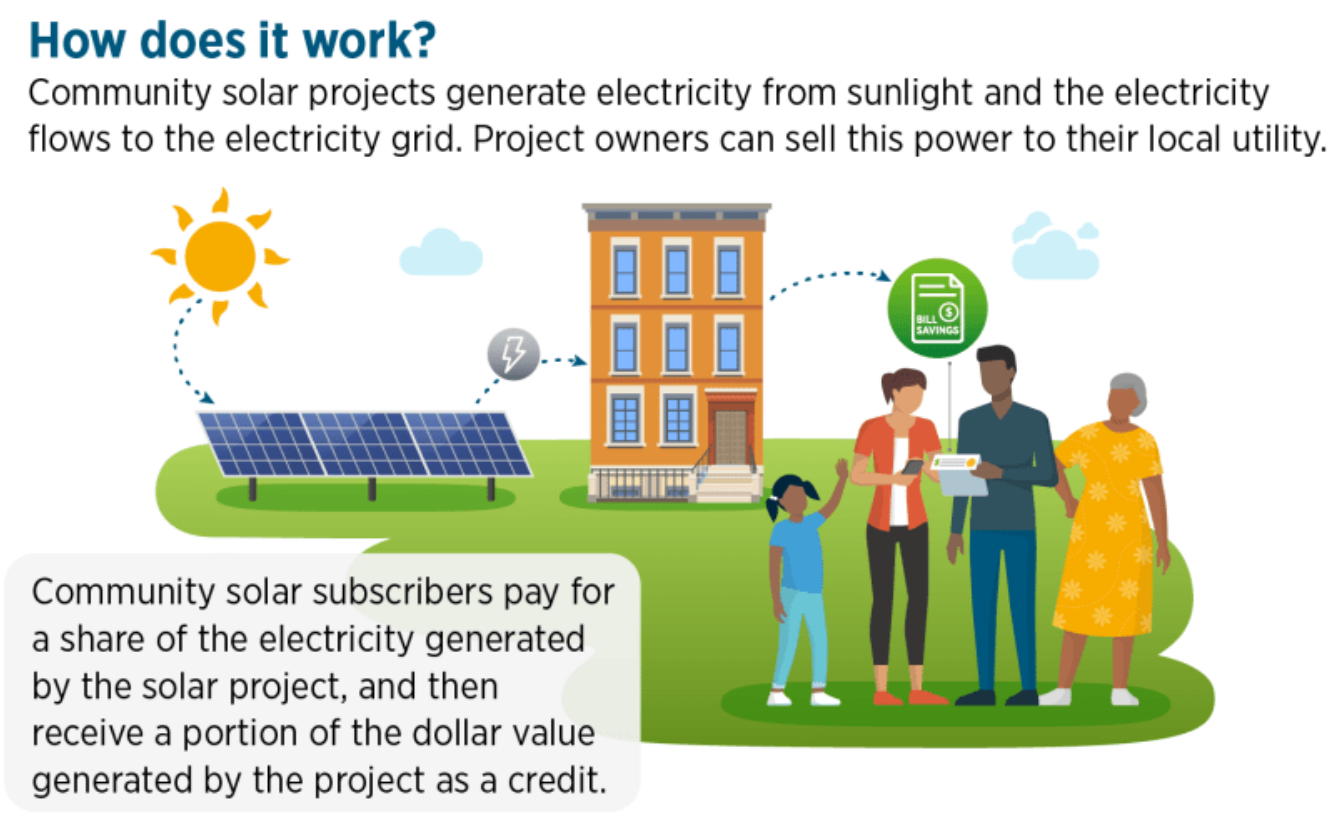
Strategy 5: Access to clean energy

Rooftop solar

- New research from Lawrence Berkeley National Laboratory found:
  - "Rooftop solar reduced median energy burden for low-income households from 7.7% to 6.2% (a median savings of $660 annually)"
  - "[T]he median energy burden fell from 4.1% to 3.3% ($674) for moderate-income households."

Community solar



Sources: Berkeley Lab study and U.S. Department of Energy infographic

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Strategy 5: Access to clean energy

Examples

- Rooftop and Community Solar
  - **DC Sustainable Energy Utility Affordable Home Electrification Program** offers no-cost electrification retrofits for qualifying low-income owner-occupied and renter-occupied homes.
    - To offset any potential utility bill increases, all households participating in the program must also participate in DCSEU's Solar for All Community Solar or Single-Family Rooftop Solar program.

DC SUSTAINABLE ENERGY UTILITY

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Strategy 6: Linking to bill assistance and rates

- Link to bill assistance and arrearage management programs
- Link to income-based or low-income rates
- Link to electrification-specific rates

Source: Illinois Commerce Commission tweet promoting LIHEAP and Percentage of Income Payment Plans, May 2024

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Strategy 6: Linking to bill assistance and rates

Federally Sponsored Programs

Assistance Paying Bills

Low Income Home Energy Assistance Program (LIHEAP). Assists eligible low-income households with their heating and cooling energy costs, bill payment assistance, energy crisis assistance, weatherization and energy-related home repairs.

Local Programs

Local Bill Assistance

Certain states and utilities have their own bill assistance programs for LMI households.

Low-Income Rates

Certain utilities offer special rates for low-income households, such as percentage of income payment plans.

Net Billing & Net Metering

Certain states and utilities offer net metering or net billing, an offset or buyback of electricity for solar customers.

Electrification Rates

Many utilities have historically offered electric heating rates, and utilities are also beginning to design electrification-specific rates to minimize cost impacts for heat pumps, electric cooking, electric vehicles, etc.

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Strategy 6: Linking to bill assistance and rates

Examples

Income-based or low-income rates

- **Colorado Percentage of Income Payment Program**: In 2012, all investor-owned electric and gas utilities in Colorado started offering a Percentage of Income Payment Plan to income-eligible households. The state caps electricity costs at 6% of income for homes that are heated only with electricity. If the heating source is gas, then costs are capped at 3% each for gas and electricity bills. This ensures that bills are always capped at 6% of income for households regardless of the heating source.

Bill assistance

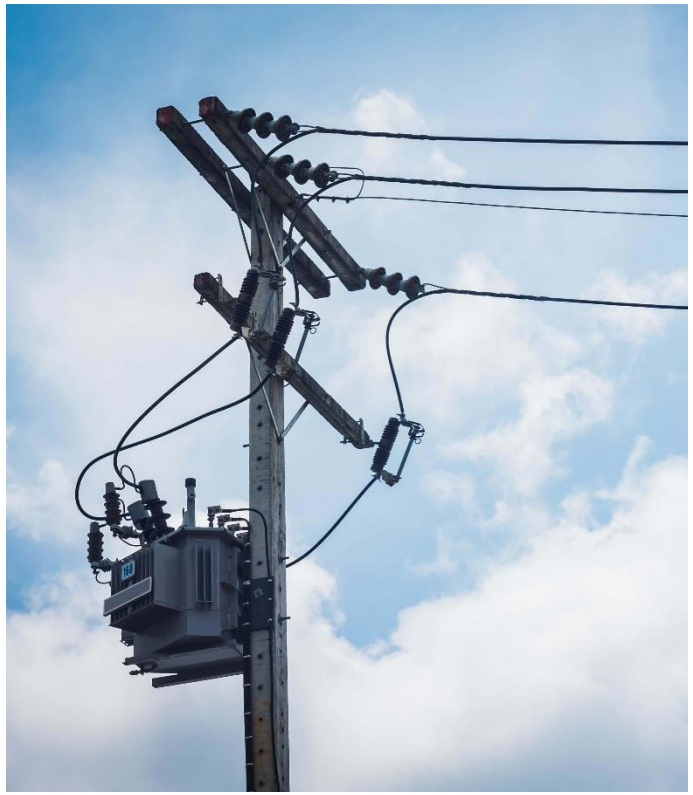
- **Nevada Fund for Energy Assistance**: This fund provides qualified low-income households with an annual credit to their utility account. The amount varies by household size, income, and energy usage, but is based on lowering energy burden to the median energy burden for all households statewide, which is typically less than 3% (e.g. 2.29% in 2022). Households may receive assistance with arrearages when funding is available.

Strategy 6: Linking to bill assistance and rates

Examples

Electrification-specific rates

- **Central Maine Power** gives customers with air source heat pumps access to a seasonal heat pump rate. The rate has a lower per kWh rate in the winter and a higher per kWh rate in the summer. Customers are expected to enroll for at least 12 months and these rates can reduce a household's annual electric bills by 10-20%.
- **Pacific Gas and Electric** offers an Electric Home (E-ELEC) rate plan, a time-of-use rate available to customers with electric vehicle charging, battery storage, heat pump water heating, or an electric heat pump for HVAC. It includes a $15 fixed charge, which lowers the per kWh charge compared to other rate plans. Customers can also save on their electricity bills when their usage shifts from periods of high electricity to low electricity prices.



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Strategy 7: Protecting housing affordability

- Deed restrictions and affordability covenants
  - A formal agreement to maintain or extend the affordability of a property for a set period of time. Typically made between a building owner and a local public regulatory authority, but affordability covenants can be arranged between a building owner and an energy upgrade program as well.
- Loan forgiveness if rents do not increase/increase beyond a certain amount
- Require rental property owner commitments not to let gas heating costs borne by the owner convert to electric heating costs borne by the renter, e.g., require owner to lower rent by a commensurate amount

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Strategy 7: Protecting housing affordability

Examples

Deed restrictions and affordability covenants

- **U.S. Department of Energy HOME Energy Rebates Program** *(select and paraphrased requirements):* For at least two years following the receipt of the rebate the owner agrees…
  - To rent the dwelling unit to a low-income tenant.
  - Not to evict a tenant to obtain higher rent tenants.
  - Not to increase rent as a result of the energy improvements with the exception of increases to recover actual increases in property taxes and/or specified operating expenses and maintenance costs.
  - If the property is sold within two years, the conditions apply to the new owner and must be part of the purchase agreement.
  - If the owner does not comply, the owner must refund the rebate.

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Strategy 7: Protecting housing affordability

Examples

Affordability covenant and loan forgiveness

- **Tacoma Power** offers 5-year forgivable loans with $0 payments to owners of 1-4-unit rental properties that serve income-qualified tenants (80% AMI) and heat primarily with electric heat. Properties may receive insulation, duct sealing, heat pumps, or heat pump water heaters, among other options. Then, owners must keep annual rent increases below 6% during the 5-year loan term and report rent amounts annually. A prorated amount of the loan is due upon sale of the property.
- Philadelphia Housing Development Corporation's **Rental Improvement Fund** is targeted at small landlords to make a range of improvements to their properties, including weatherization. Loans can be $10,000-$24,999 per property and are repaid over 10 years but are forgiven 20% annually beginning in year 6 so long as rents in each impacted unit remain affordable at 60% AMI.

$0 PAYMENTS!
5 YEAR
FORGIVABLE
LOAN

RENTAL
Improvement Fund

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Tools and Resources

Annika Brindel, ACEEE/R2E2

Dan Lawlor, EPA/ENERGY STAR

https://www.energystar.gov/equitableupgrades

Modeling

- Examples of tools:
  - NREL's BEopt™ (Building Energy Optimization Tool Link) allows users to easily evaluate residential building designs and identify cost-optimal efficiency packages at various levels of whole-house energy savings along the path to zero net energy.
  - NREL's ResStock (Link) and ComStock (Link) analysis tools provide detailed information on current building stock characteristics at the state and local level, as well as the energy, economic, and emissions impacts of different energy efficiency and electrification upgrade packages.
- Contractors, engineering firms, and other building professionals often have their own tools to support energy audits, system designs, economic assessments, and other analyses.

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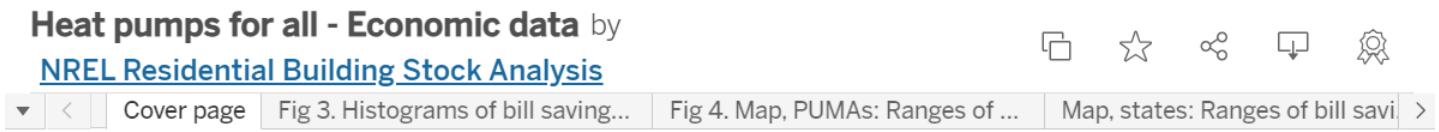
Resource: National Renewable Energy Laboratory research

- NREL "Heat Pumps for All" study
- NREL Tableau visualization of electric heat pump costs



NREL

Heat pumps for all - Economic dashboard

ResStock

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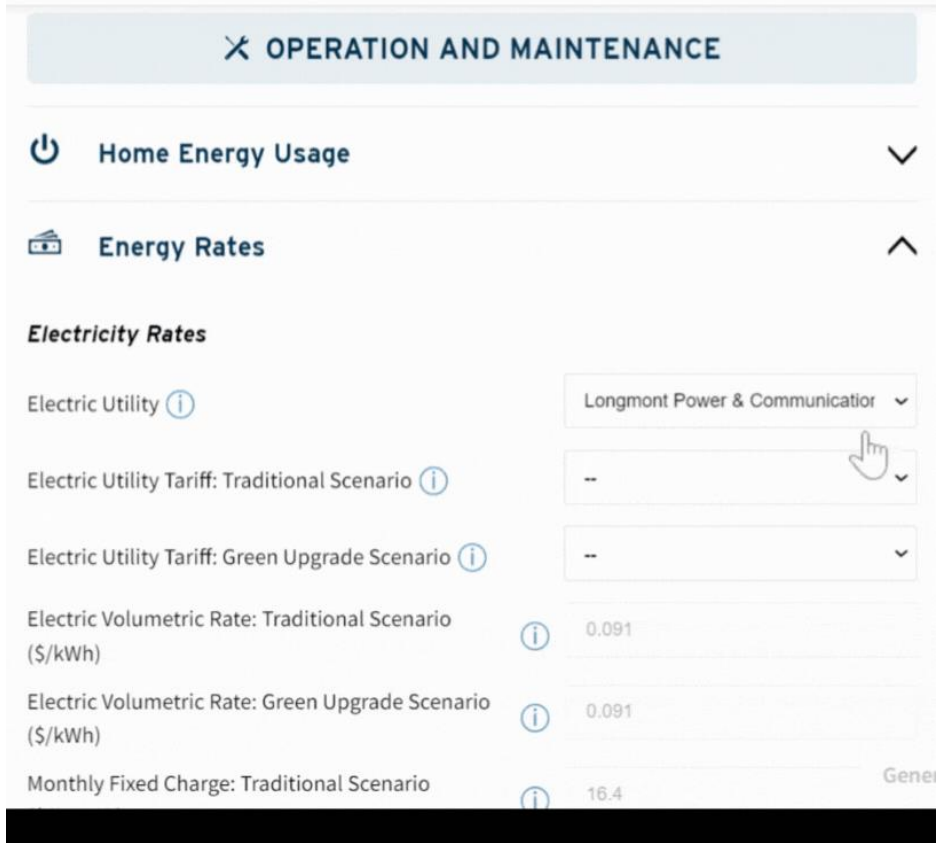
Tool: RMI Green Upgrade Calculator

- Developed with seven partners, including Pacific Northwest National Laboratory.
- For: home contractors, home energy advisors, residential decarbonization analysts.
- Enables economic modeling to assess how potential upgrades will impact utility bills, including comparison of alternatives.



Source: https://rmi.org/at-last-a-residential-modeling-tool-for-energy-professionals/

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Combining ENERGY STAR's Brand Recognition with ResStock Modeling to Create a Go-To Heat Pump Savings Estimator

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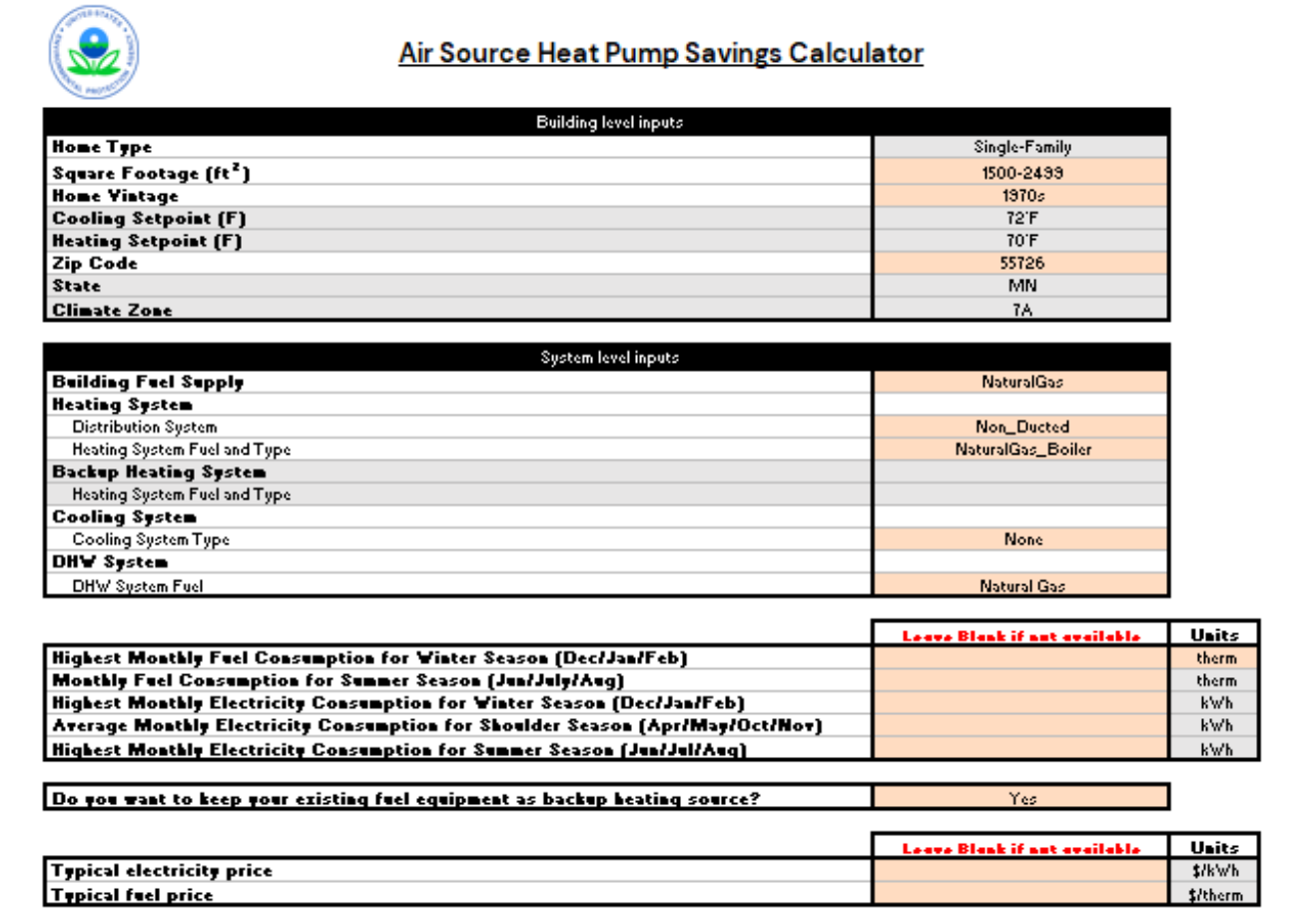
Daniel Lawlor, EPA

Residential Retrofits for Energy Equity

EPA United States Environmental Protection Agency

Goals for Savings Estimator



Air Source Heat Pump Savings Calculator

Building level inputs	
Home Type	Single-Family
Square Footage (ft^2)	1500-2499
Home Vintage	1970s
Cooling Setpoint (F)	72°F
Heating Setpoint (F)	70°F
Zip Code	55726
State	MN
Climate Zone	7A

System level inputs	
Building Fuel Supply	NaturalGas
Heating System	
Distribution System	Non_Ducted
Heating System Fuel and Type	NaturalGas_Boiler
Backup Heating System	
Heating System Fuel and Type	
Cooling System	
Cooling System Type	None
DHW System	
DHW System Fuel	Natural Gas

	Leave Blank if not available	Units
Highest Monthly Fuel Consumption for Winter Season (Dec/Jan/Feb)		therm
Monthly Fuel Consumption for Summer Season (Jun/July/Aug)		therm
Highest Monthly Electricity Consumption for Winter Season (Dec/Jan/Feb)		kWh
Average Monthly Electricity Consumption for Shoulder Season (Apr/May/Oct/Nov)		kWh
Highest Monthly Electricity Consumption for Summer Season (Jun/Jul/Aug)		kWh

Do you want to keep your existing fuel equipment as backup heating source?	Yes

	Leave Blank if not available	Units
Typical electricity price		$/kWh
Typical fuel price		$/therm

- Consumer friendly, holistic tool
- Applicable to all areas of the country
- Leverages ENERGY STAR brand recognition
- Easy to use interface
- Balance simplicity with accuracy

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Methodology

- User Inputs:
  - 8 building specific inputs for parameters (e.g., vintage, sq ft. of home)
  - Additional inputs available to tailor the model
- Home models
  - Created by utilizing NREL's ResStock framework
  - User inputs are mapped to database of energy modeling simulation results of archetype building models
  - Maps out all possible 35,640 building models representing 15 climate zones
- Platform:
  - Current: Microsoft Excel accompanied with a user guide and a README in the workbook
  - Future: HTML based version

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Tool Setup

Air Source Heat Pump Savings Calculator

Building level inputs	
Home Type	Single-Family
Square Footage (ft²)	1500-2499
Home Vintage	1970s
Cooling Setpoint (F)	72°F
Heating Setpoint (F)	70°F
Zip Code	54813
State	WI
Climate Zone	6A

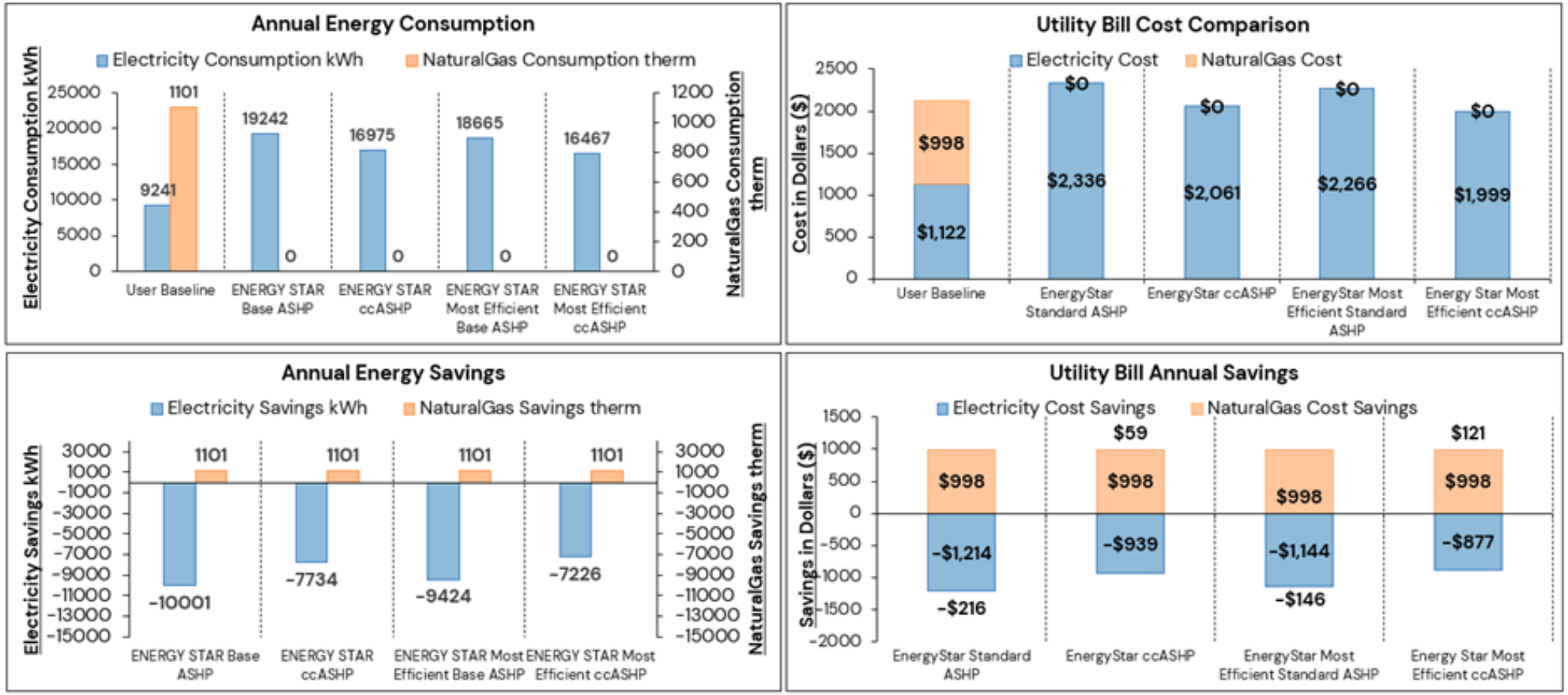
System level inputs	
Building Fuel Supply	NaturalGas
Heating System	
Distribution System	Ducted
Heating System Fuel and Type	NaturalGas_Furnace
Backup Heating System	
Heating System Fuel and Type	
Cooling System	
Cooling System Type	Central AC
DHW System	
DHW System Fuel	Electricity

	Leave Blank if not available	Units
Highest Monthly Fuel Consumption for Winter Season (Dec/Jan/Feb)		therm
Monthly Fuel Consumption for Summer Season (Jun/July/Aug)		therm
Highest Monthly Electricity Consumption for Winter Season (Dec/Jan/Feb)		kWh
Average Monthly Electricity Consumption for Shoulder Season (Apr/May/Oct/Nov)		kWh
Highest Monthly Electricity Consumption for Summer Season (Jun/Jul/Aug)		kWh

Do you want to keep your existing fuel equipment as backup heating source?	Yes

	Leave Blank if not available	Units
Typical electricity price		$/kWh
Typical fuel price		$/therm

Results – Electric Backup



Energy and utility bill impacts for a sample home in Minneapolis, Minnesota (CZ6) from installing an ENERGY STAR heat pump with electric backup

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Utility Rates & Bill Calibration

- Additional utility bill and rate inputs can help normalize the consumption and savings to the user's home
- Ensured any erroneous utility bill data does not propagate through the calculations

	Leave Blank if not available	Units
Highest Monthly Fuel Consumption for Winter Season (Dec/Jan/Feb)		therm
Monthly Fuel Consumption for Summer Season (Jun/July/Aug)		therm
Highest Monthly Electricity Consumption for Winter Season (Dec/Jan/Feb)		kWh
Average Monthly Electricity Consumption for Shoulder Season (Apr/May/Oct/Nov)		kWh
Highest Monthly Electricity Consumption for Summer Season (Jun/Jul/Aug)		kWh

Do you want to keep your existing fuel equipment as backup heating source?	Yes

	Leave Blank if not available	Units
Typical electricity price		$/kWh
Typical fuel price		$/therm

Conclusion

- Aim to become the go-to resource for reliable, accurate estimates of energy and utility cost impacts from installing an air-source heat pump
- With low user input requirement, offers a balance of accuracy and usability
- The framework is scalable to eventually encompass all residential building types

Future Work

- Addition of GHG emissions savings as part of the results
- Multi-family homes to be included in the following versions
- Potentially add complimentary measures to heat pumps
  - Envelope
  - Heat pump water heater

Q&A

Breakout discussions

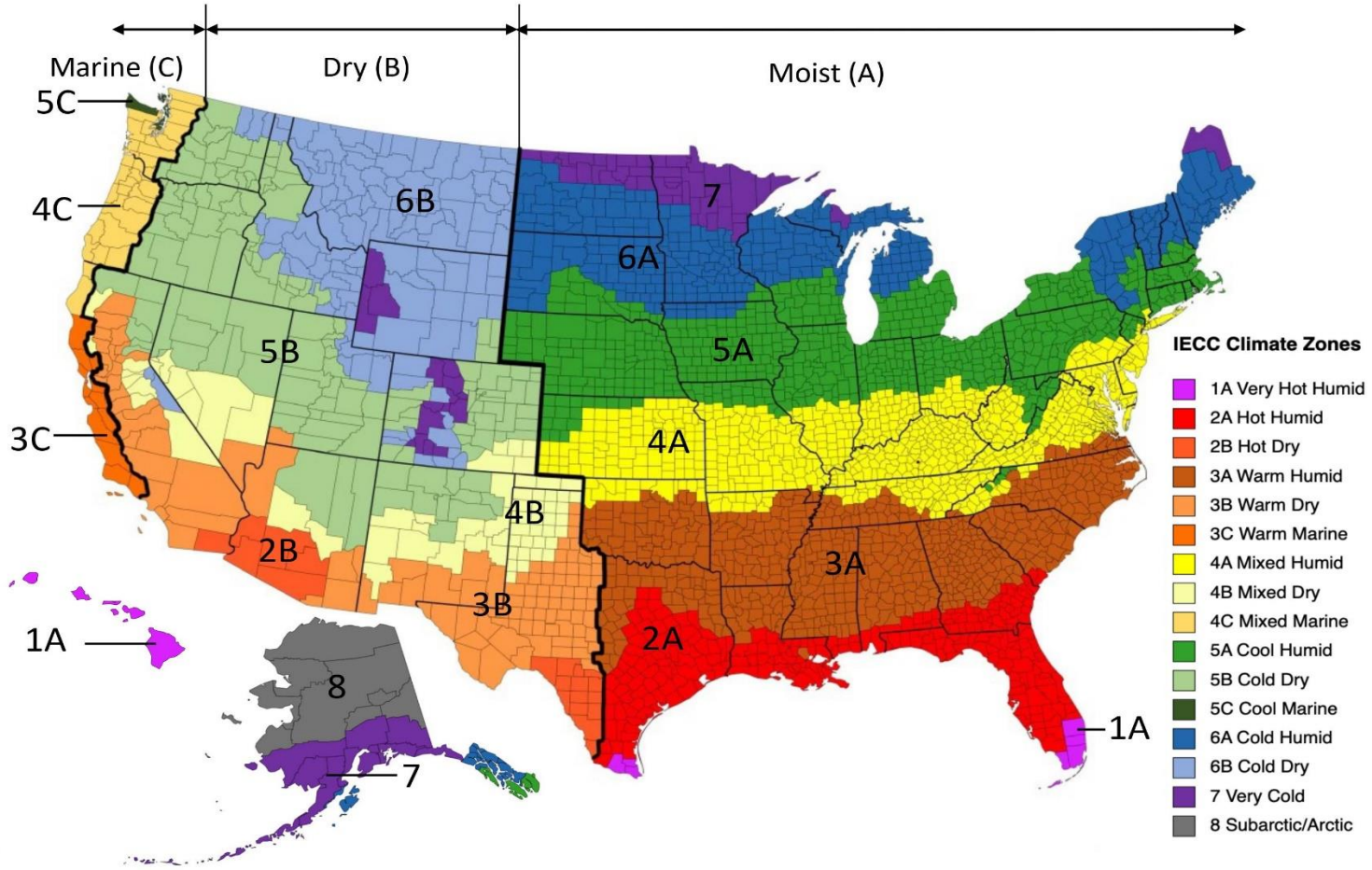
- Name, pronouns, organization, location
- What are you struggling with related to energy bills and electrification?
- Based on today's presentation, do you have any new ideas for strategies to mitigate potential post-electrification energy bill increases in your community?

Choose your breakout by climate zone

Breakouts 1 & 2: Very Hot/Hot
- 1A Very Hot Humid
- 2A Hot Humid
- 2B Hot Dry

Breakouts 3 & 4: Warm/Mixed
- 3A Warm Humid
- 3B Warm Dry
- 3C Warm Marine
- 4A Mixed Humid
- 4B Mixed Dry
- 4C Mixed Marine

Breakouts 5 & 6: Cool/Cold/Very Cold
- 5A Cool Humid
- 5B Cool Dry
- 5C Cool Marine
- 6A Cold Humid
- 6B Cold Dry
- 7 Very Cold
- 8 Subarctic/Arctic



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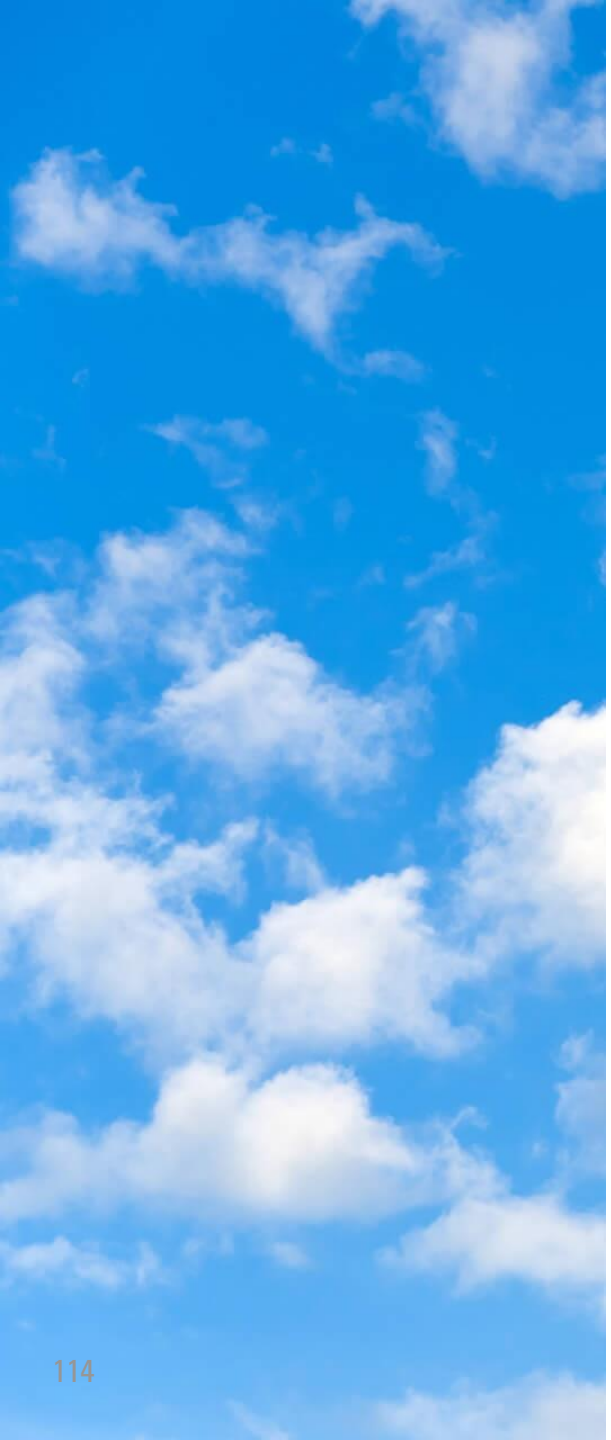

POLL: Based on today's presentation, do you have any new ideas for strategies to mitigate potential post-electrification energy bill increases in your community?

1. Yes, and I will share information with others who may find it useful!
2. Yes!
3. Maybe: there are some ideas I'd like to explore!
4. No, I already knew all the information covered today.
5. No: but I will share information with others who may find it useful.

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Workshop series schedule

- **May 21: Navigating Organizational Funding for Home Energy Upgrade Programs in Justice 40 Communities**
  - Target Audience: Community-based organizations (CBOs), non-governmental organizations (NGOs), Non-profit Organizations, small businesses, local governments, state governments, Tribes
- **August 20: Well-Designed Equitable Home Energy Upgrades: Best Practices and Strategies**
  - Target Audience: Community-based organizations (CBOs), non-governmental organizations (NGOs), Non-profit Organizations, small businesses, local governments, state governments, Tribes
- **September 10: Centering Affordability in Low-Income Home Electrification Programs**
  - Target Audience: Community-based organizations (CBOs), non-governmental organizations (NGOs), Non-profit Organizations, small businesses, local governments, state governments, Tribes
- **October 30: Incorporating Health and Safety into Home Energy Upgrade Programs**
  - Target Audience: Community-based organizations (CBOs), non-governmental organizations (NGOs), Non-profit Organizations, small businesses, local governments, state governments, Tribes
- **TBD 2025: Maximizing Incentives for Low to No-Cost Home Energy Upgrades: Stacking and Braiding**
  - Target Audience: Program implementers, contractors, etc.

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Thank you!