MULTISTATE ACTION PLAN:

ACCELERATING THE TRANSITION TO ZERO-EMISSION RESIDENTIAL BUILDINGS

FALL 2025

This Action Plan was developed by the following jurisdictions through NESCAUM's multistate Building Electrification Initiative Task Force

California
Colorado
District of Columbia
Maine
Maryland
Massachusetts
New Jersey
New York
Oregon
Rhode Island
Washington

Northeast States for Coordinated Air Use Management (NESCAUM) facilitated Action Plan development

NESCAUM

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RMI

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Buildings are a significant source of greenhouse gas (GHG) and air pollutant emissions that exacerbate climate change and harm human health. Direct emissions from the buildings sector account for 13% of all U.S. GHG emissions and release more than 542,000 tons of nitrogen oxides (NO_x) per year into the air we breathe.[1,2] Because space and water heating drive most of these emissions,[3,4] transitioning these end uses to zero-emission equipment represents the highest-impact opportunity to reduce air pollution from buildings.

To address emissions from residential buildings, nine states – California, Colorado, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, and Rhode Island – and the District of Columbia signed a Multistate Memorandum of Understanding (MOU): Accelerating the Transition to Zero-Emission Residential Buildings in 2024. Washington subsequently joined the MOU in 2025. Organized by Northeast States for Coordinated Air Use Management (NESCAUM), the MOU aims to improve air quality and public health by accelerating the transition to zero-emission residential buildings, with a focus on technologies like heat pumps for residential space and water heating. It establishes a collective target across signatory states for heat pumps to make up 65% of residential heating, air conditioning, and water heating equipment sales by 2030, and 90% by 2040.

Zero-emission refers to equipment that produces during operation zero onsite emissions of GHGs (specifically carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O)) and U.S. Environmental Protection Agency (EPA)-defined criteria and hazardous air pollutants. Hydrofluorocarbons (HFCs) and other refrigerants are excluded from this definition because the global warming impact of refrigerants is being phased down by international, national, and state laws and refrigerant leaks can be minimized through lifecycle refrigerant management. This Action Plan identifies a range of actions to address refrigerant GHG emissions.

Residential buildings include single-family, multifamily, and mobile/manufactured homes.

MOU states also committed to develop the present *Multistate Action Plan: Accelerating the Transition to Zero-Emission Residential Buildings* ("Action Plan"). The Action Plan reviews the market for zero-emission equipment, the need for an equitable transition to zero-emission residential buildings, and key barriers to the transition. It then details more than 50 recommendations for state action to accelerate the transition to zero-emission single-family homes and multifamily buildings, with a focus on space and water heating. States that implement these recommendations will help their residents access state-of-the-art zero-emission technologies and enjoy the benefits of clean heat, affordable energy bills, and improved air quality, health, and comfort.

States have many options to make progress: not every state is expected to pursue every recommendation, and a state's participation in the MOU should not be interpreted as an endorsement of any or all the recommendations in this Action Plan. States will make their own assessments of how various building-sector policies interact and can best drive progress.

Recommendations for state action are organized into four categories – equity and workforce, carbon reduction obligations, codes and standards, and utility planning and regulation – using a framework introduced in a 2024 policy brief, Decarbonizing Buildings: How States Can Set the Table for Success. Because the context for building decarbonization is unique to each state, with each state at a different point in the process, recommendations are not organized in priority order. Instead, the Action Plan offers a menu of options for states to consider according to their specific situations. Table 1 summarizes all recommendations in the Action Plan.

Methane gas refers to natural gas (also known as "pipeline gas" and "fossil gas"). For purposes of this Action Plan, methane gas does not necessarily refer to pure methane or CH_4, but rather to a gaseous mixture of hydrocarbon compounds primarily composed of methane with sufficient energy content and sufficiently low impurities to be transported through commercial gas pipelines and sold to end users.

TABLE 1: RECOMMENDATONS FOR STATE ACTION

GENERAL	Policy Coordination & Accountability	• Establish an office charged with coordinating a whole-of-government, cross-agency approach to statewide climate and energy transformation efforts • Create regular touchpoints between state energy, public utility, environmental, and housing offices to coordinate buildings policies • Clarify local authority and empower local governments • Provide resources and funding to ensure that policies and regulations can be appropriately implemented and enforced
EQUITY & WORKFORCE INVESTMENTS	Stakeholder Engagement & Inclusive Process	• Establish community and stakeholder advisory boards to co-design and co-implement decarbonization policy with government agencies • Partner with individuals and organizations embedded in local communities on policy design • Make it easier for community-based organizations and residents to participate in policy processes by providing compensation and support services
	Ensuring that Underserved Households Benefit	• Set, meet, and increase targets for low- and moderate-income (LMI) household and disadvantaged community (DAC) spending or impact in building decarbonization programs • Work with state housing finance and local housing agencies to include tenant protections as a requirement for building owner participation in incentive programs
	Equitable Program Design & Implementation	• Create and expand whole-home programs serving LMI households • Coordinate between agencies to consolidate and streamline incentive and financing programs to the extent possible • Streamline income verification for LMI and DAC programs • Provide technical and financial assistance to multifamily and affordable housing owners and public housing authorities • Offer targeted incentive programs for the systems and technologies unique to multifamily buildings • Work with lenders to expand financing options to enable affordable multifamily buildings to upgrade to zero-emission equipment • Reduce risk for LMI customers by offering affordability guarantees when zero-emission measures are installed
	Education, Awareness, & Access	• Deliver consumer campaigns that increase awareness of zero-emission technologies and combat misinformation • Create "one-stop-shop" hubs and clearinghouses where homeowners, other building owners, and contractors can find comprehensive information on building programs and financing • Partner with community-based organizations (CBOs) and other trusted local messengers on outreach and marketing to ensure that communities that might otherwise be underserved have full access to programs and incentives • Partner with manufacturers, distributors, and retailers to promote technology education • Help customers plan ahead for zero-emission upgrades like heat pumps and avoid emergency replacement scenarios
	Workforce Development & Economic Empowerment	• Form workforce advisory committees to guide state agencies on workforce needs, career pathways, labor standards, and training opportunities for building decarbonization workers • Support small businesses focused on energy efficiency and zero-emission upgrades • Encourage aggregation of work across multiple buildings or households within a neighborhood to allow for higher labor standards • Equitably grow the workforce and enhance job quality by expanding apprenticeship and training programs, supporting access for new entrants to the workforce, and encouraging high-quality compensation • Create contractor networks within building decarbonization programs to support qualified contractors and make it easier for customers to find them

TABLE 1: RECOMMENDATONS FOR STATE ACTION

CARBON REDUCTION OBLIGATIONS	Climate Goal-Setting & Progress Tracking	• Establish and track progress towards measurable and enforceable targets for decarbonization and equity • Make data related to state decarbonization, health, and equity targets publicly available in a timely manner
	Clean Heat & Cap-and-Invest Policies	• Establish reporting requirements for fuel suppliers • Enact clean heat standards and/or cap-and-invest policies covering the thermal sector
	Refrigerant Policies & Programs	• Update state definitions of zero-emission buildings to account for refrigerants • Improve lifecycle refrigerant management including leak management, recovery, reuse, and destruction • Adopt state-level legislation or regulations to support full implementation of the AIM Act and facilitate a full market transition towards low-global warming potential (GWP) refrigerants • Support safety testing, research, demonstration, and deployment efforts for heat pump technologies that safely use ultra-low GWP A3 refrigerants • Remove barriers to low-GWP refrigerants by enacting legislation to allow the use of refrigerants such as A3s in equipment that meets safety standards • Invest in workforce training on refrigerant management, reclamation, and disposal
CODES & STANDARDS	Building Codes	• Update building energy codes to incorporate high standards for energy efficiency and emissions • Develop model stretch codes for local jurisdictions to adopt • Update electrical codes to enable power efficient design strategies that reduce the need for electrical upgrades
	Building Energy Performance Standards & Disclosure	• Require energy benchmarking and disclosure for large buildings • Adopt statewide building energy performance standards (BEPS) for existing large buildings • Offer technical and financial assistance to help building owners comply with BEPS and other applicable building and equipment standards • Require residential homeowners to provide energy performance disclosures at point of sale or lease signing • Require residential homes, rental housing, or other buildings not covered by BEPS to meet energy performance criteria at time of sale or lease
	Equipment Emissions Standards	• Set zero-emission heating equipment standards for space and water heating
	AC-to-Heat Pump Policies	• Enact AC-to-heat pump policies to shift purchases from central ACs to heat pumps

TABLE 1: RECOMMENDATONS FOR STATE ACTION

UTILITY PLANNING & REGULATION	Access to Utility Data	• Pass legislation requiring utilities to make energy consumption data available to authorized recipients
	Rate Reform	• Direct electric utilities to adopt rates that encourage zero-emission heating while adhering to cost causation principles • Direct electric and methane gas utilities to incorporate equity & affordability elements in rate design • Establish an interagency rates working group to conduct research and make recommendations for short- and long-term rate design • Require that utilities increase enrollment in rates that reduce customer energy bills
	Consumer-Facing Programs & Incentives	• Expand and redirect energy efficiency program funding toward zero-emission technologies and weatherization • Update energy efficiency program rules to allow fuel switching to zero-emission equipment • Target zero-emission equipment programs to customers using expensive fuels and technologies like oil, propane, and electric resistance • Design incentives and rebates to reduce or eliminate the need for large out-of-pocket expenses for zero-emission projects, with a focus on LMI customers • Bundle information and incentives for zero-emission equipment and weatherization with distributed energy resources and other measures
	Midstream & Upstream Incentives & Programs	• Design and implement midstream and upstream incentive programs for zero-emission technologies • Pilot innovative incentive and procurement strategies that engage market actors in new ways
	Inclusive & Accessible Financing	• Design financing programs to work for unplanned equipment replacements • Work with utilities to offer on-bill financing that enables customers to pay for energy efficiency and zero-emission measures through their utility bills • Work with financing providers to offer zero- or low-interest loans to homeowners to defray the upfront costs of zero-emission equipment and associated building upgrades • Incorporate energy efficiency and emissions requirements in the lending programs administered by housing finance agencies
	Utility Business Models & Performance Requirements	• Reform electric utility business models to link compensation to performance requirements for decarbonization, load flexibility, and equity • Direct utilities to invest in zero-emission technology, load flexibility, distribution system planning, and electrification readiness programs • Enact policies that change the business model for methane gas utilities and protect remaining gas customers from rising costs • Account for non-energy benefits in cost-benefit analyses of utility programs and investments
	Utility System Planning	• Pursue integrated electric and gas system planning • Target electrification upgrades to locations with aging gas equipment and infrastructure and require gas utilities to share data to support infrastructure planning • Require electric utilities to assess the age and capacity of existing electric infrastructure at premise and service transformer level • Eliminate subsidies for methane gas line extensions • Require gas utilities to assess non-pipeline alternatives when considering upgrades to methane gas distribution infrastructure • Promote thermal energy networks (TENs) as an emerging option for community-wide building decarbonization that offers a viable business model for methane gas utilities and workers

SECTION 1

INTRODUCTION

Background

Buildings are a significant source of greenhouse gas (GHG) and air pollutant emissions that exacerbate climate change and harm human health. Across the country, 75 million homes and businesses use equipment that produces onsite air pollution (also referred to as "emitting equipment"), mostly for space and water heating.[5] Emitting equipment used in homes vents exhaust gases directly outdoors, releasing harmful pollutants like nitrogen oxides (NO_x) and fine particulate matter ($PM_{2.5}$) into surrounding communities.[6]

As states have reduced air pollution from the transportation and power sectors, buildings represent a growing share of GHG and other air pollutant emissions.[7] For example, buildings now generate more NO_x emissions in the U.S. than gas-fired power plants.[8] As such, many states have identified building decarbonization as a key pathway to reach a zero-emission economy, mitigate climate change, and reduce emissions of harmful pollutants like NO_x and $PM_{2.5}$.[9]

Nationally, the vast majority of direct energy use and emissions from residential buildings comes from space and water heating, making this equipment a prime target for emissions reductions.[10] While a variety of technologies can reduce building pollution, upgrading to zero-emission heating and cooling equipment can eliminate onsite air pollution while leveraging an increasingly clean electric grid. Although different types of buildings face different challenges in achieving emissions reductions, zero-emission electric heat pumps have emerged as a leading option for clean, all-in-one space heating and cooling, as well as water heating. Modern heat pumps are highly energy-efficient, widely accessible in the market, available for most residential applications, and perform well in cold climates.[11]

Multistate MOU and Action Plan

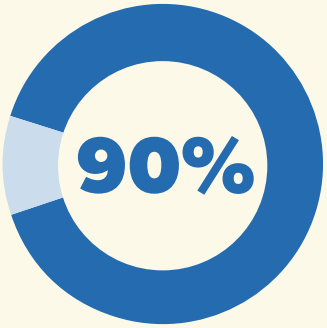
In 2024, nine states – **California, Colorado, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon**, and **Rhode Island** – and the **District of Columbia** signed a Multistate Memorandum of Understanding (MOU): Accelerating the Transition to Zero-Emission Residential Buildings. **Washington** joined the MOU in 2025.

Organized by Northeast States for Coordinated Air Use Management (NESCAUM), the MOU aims to promote public health and mitigate climate change by accelerating the transition to zero-emission heat pumps for residential space and water heating. It establishes a collective goal across signatory states for heat pumps to make up 65% of residential heating, air conditioning, and water heating equipment sales by 2030, and 90% by 2040.[12] Together, MOU signatories represent one third of U.S. residential fossil fuel consumption.[13]

For simplicity, this Action Plan refers to participating jurisdictions, including the District of Columbia, as "states."

Heat pump market share targets across MOU states

HEAT PUMP PERCENTAGE OF RESIDENTIAL HEATING, AIR CONDITIONING, AND WATER HEATING SALES BY **2030**



HEAT PUMP PERCENTAGE OF RESIDENTIAL HEATING, AIR CONDITIONING, AND WATER HEATING SALES BY **2040**

10 States and D.C

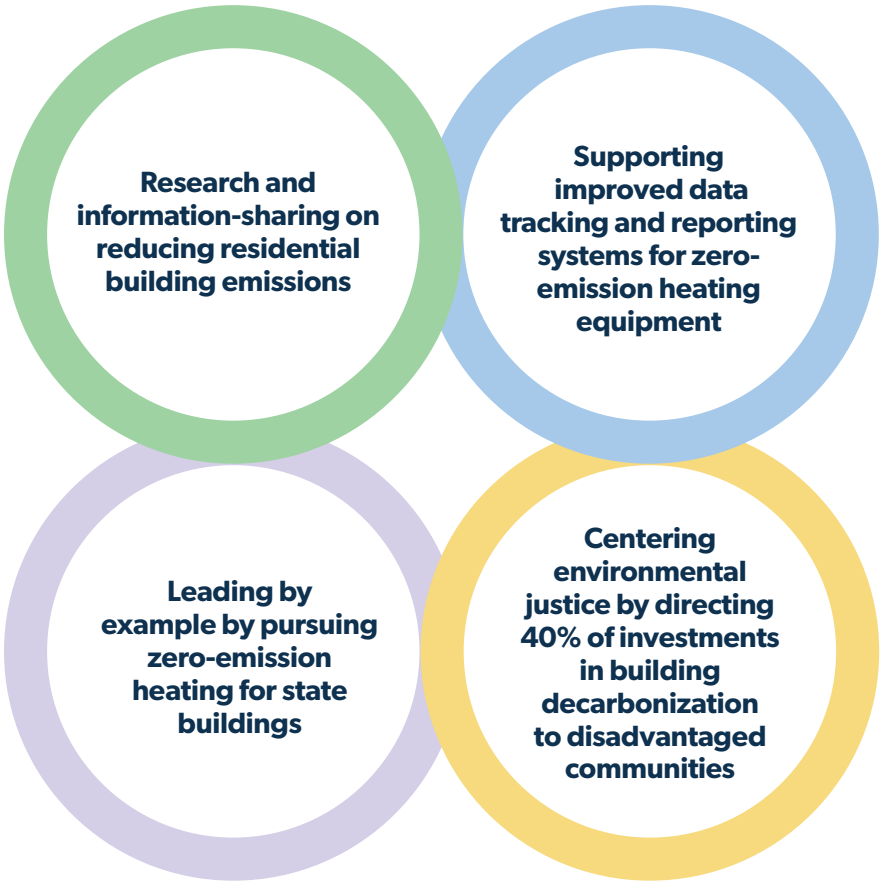
Working together towards zero-emission residential buildings

California	Colorado	D.C.	Maine	Maryland	Massachusetts
CALIFORNIA AIR RESOURCES BOARD	COLORADO Energy Office	DEPARTMENT OF ENERGY & ENVIRONMENT	DEPARTMENT OF ENVIRONMENTAL PROTECTION STATE OF MAINE	Maryland Department of the Environment	MassDEP
New Jersey	**New York**	**Oregon**	**Rhode Island**	**Washington**	
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION	NEW YORK STATE Department of Environmental Conservation	State of Oregon Department of Environmental Quality DEQ	DEM RHODE ISLAND	Washington State Department of Commerce	

The MOU builds on a long history of environmental leadership among signatory states, such as a prior commitment by U.S. Climate Alliance states to collectively quadruple heat pump installations and install 20 million heat pumps by 2030.[14] The MOU also leverages in-state efforts to coordinate between environment, energy, housing, labor, and other agencies to reduce building-related emissions.

To support accountability, MOU signatory states will work with NESCAUM and Northeast Energy Efficiency Partnerships (NEEP) to produce an annual report on zero-emission space and water heater sales that assesses each state's progress toward the 2030 and 2040 targets, the status of the residential heating and cooling equipment market, key barriers, and high-priority opportunities to accelerate the market transition.

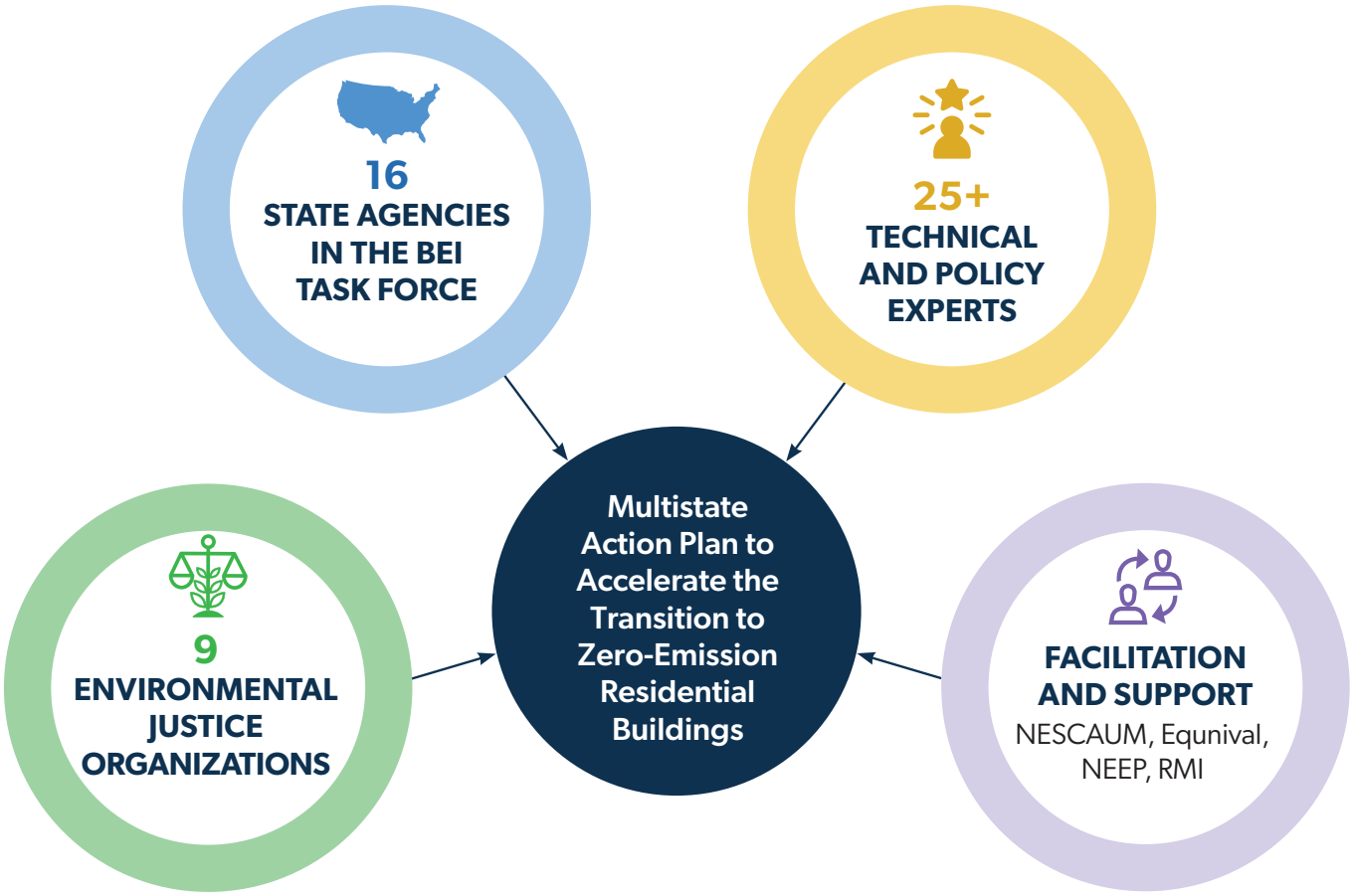
MOU states also agreed to collaborate in other areas



Signatory states also agreed to work with NESCAUM to develop the present *Action Plan to Accelerate the Transition to Zero-Emission Residential Buildings* ("Action Plan"). This Action Plan identifies high-priority opportunities and compiles policy and program strategies that states can use to advance decarbonization of both single-family homes and multifamily buildings, with a focus on space and water heating. Signatory states are not required to endorse or enact every recommendation in the Action Plan, but can use the plan as a roadmap to achieve equitable decarbonization and air quality goals.

Focus on space and water heating: Given the large opportunity for emissions reductions from residential space and water heating, this Action Plan focuses on high-impact strategies to accelerate the adoption of heat pumps for space and water heating. Other building equipment typically powered by fossil fuels – such as stoves, clothes dryers, lawn-care equipment, outdoor grills, etc. – are not covered extensively in the Action Plan. Similarly, other opportunities to facilitate building decarbonization – including through reductions in embodied carbon in building materials, electric vehicle (EV) charging, on-site generation of electricity via solar and battery storage, and purchases of zero-carbon electricity – are not covered extensively.

To develop the Action Plan, NESCAUM convened a Building Electrification Initiative (BEI) Task Force of state agency staff to develop recommendations and best practices to accelerate the transition to zero-emission residential buildings. NESCAUM also created an Environmental Justice Advisory Group (EJAG) of nine environmental justice organizations and a Stakeholder Advisory Group (SAG) of technical and policy experts to guide recommendations and ensure Action Plan strategies lead to equitable outcomes.



Participants in the BEI Task Force include MOU states (CA, CO, DC, MA, MD, ME, NJ, NY, OR, RI, WA) as well as non-MOU states interested in building decarbonization.

Participants in the EJAG include Alternatives for Community & Environment, CASA, Connecticut Coalition for Environmental Justice, Emerald Cities Collaborative, Green & Healthy Homes Initiative, Maine People's Alliance, National Housing Trust, New Jersey Environmental Justice Alliance, and WE ACT for Environmental Justice.

Participants in the SAG include American Council for an Energy-Efficient Economy; Biome Studio; Building Decarbonization Coalition; Center for Energy & Environment; Climate Jobs RI; Community Preservation Corporation; Conservation Law Foundation; Ceres; Evergreen Action; Greenhouse Institute; Guarini Center on Environmental, Energy, and Land Use Law; Harvard Environmental & Energy Law Program; Lawrence Berkeley National Lab; Maine Labor Climate Council; Natural Resources Defense Council; New Buildings Institute; Northeast Energy Efficiency Partnerships; Public Health Law Center; Regulatory Assistance Project; Rewiring America; RMI; Sierra Club; Stewards of Affordable Housing for the Future; Urban Green Council; U.S. Climate Alliance Secretariat; and U.S. Green Building Council.

The rest of the Action Plan is organized as follows

SECTION 2

The Case for Action

Reviews the state of the market for zero-emission technologies and the need for a just transition to zero-emission residential buildings, highlighting health, housing, equity, and economic benefits. This section also contains a set of equity principles to guide states as they develop decarbonization policies.

SECTION 3

Barriers to Progress

Describes key barriers in the transition to zero-emission residential buildings.

SECTION 4

Recommendations for State Action

Identifies state actions to accelerate the transition to zero-emission residential buildings. Recommendations are organized into four categories: equity and workforce, carbon reduction obligations, codes and standards, and utility planning and regulation.

SECTION 2

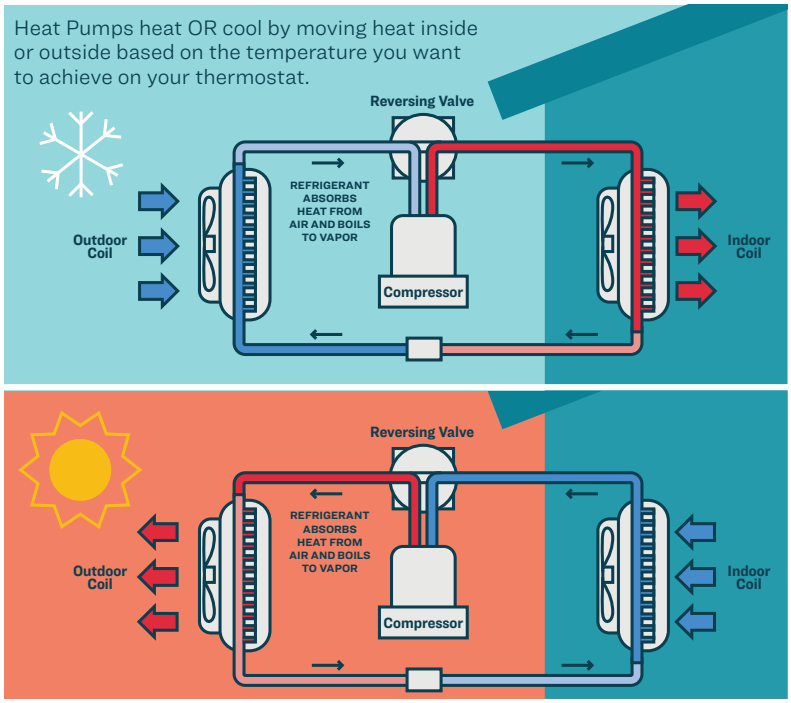
THE CASE FOR ACTION

This section reviews the case for action, explaining why it is both important and timely for states to act now to accelerate the transition to zero-emission residential buildings.

Collectively, **signatory states need to double heat pump market share** over the next five years to achieve the MOU goal of making heat pumps 65% of the heating, air conditioning, and water heating market by 2030.

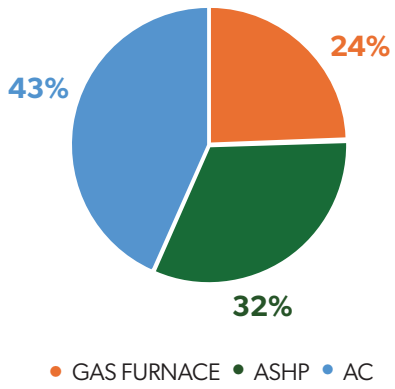
Technological Readiness and Innovation

Zero-emission space and water heating technologies for residential buildings are now widely available. **Heat pumps are a leading zero-emission option because they use electricity to move heat rather than create heat**, enabling efficiencies that are 2.2–4.5 times those of emitting furnaces and water heaters without producing onsite emissions.[15] Air- and ground-source heat pumps can provide heating, cooling, and dehumidification in a single system, sometimes eliminating the need for separate types of heating, ventilation, and air conditioning (HVAC) equipment;[16] they can also be used for water heating. Heat pumps have been successfully deployed in cold regions from Maine to Norway and provide a viable decarbonization solution for most residential applications.[17] Appendix 2 provides an overview of heat pump technologies for space and water heating, including air-source heat pumps (ASHPs), ground-source heat pumps (GSHPs), and heat pump water heaters (HPWHs).



Current State Of The Market For Zero-Emission Technologies

FIGURE 1. National HVAC shipments, 2024: ASHPs represent 32% of the U.S. HVAC market*



*Shipments of oil furnaces represent less than 0.05% of the HVAC market and are not visible in the chart. Excludes shipments of hydronic heating systems and less common fuels like propane and wood, which are not included in AHRI estimates.

FIGURE 2. Household heating fuel in MOU States, 2019-2023: Over one quarter of MOU households already use zero-emission heating

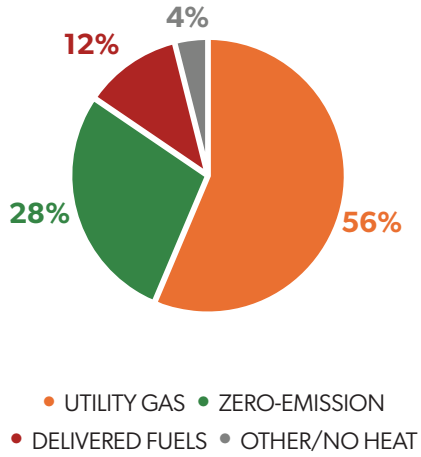


FIGURE 3. National ASHP and gas furnace sales: ASHPs have outsold gas furnaces since 2022

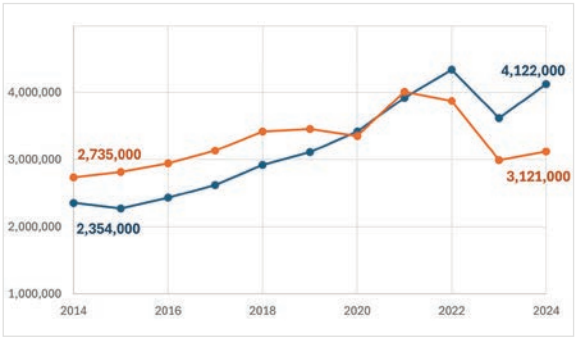
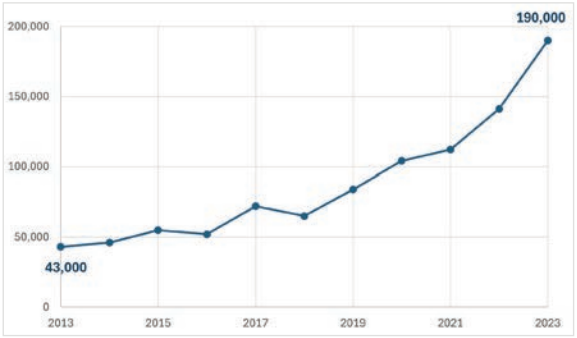


FIGURE 4. National sales of HPWHs have quadrupled over the past decade



Despite this growth, HPWH market penetration remains low at only 2.1% of all water heater and 3.9% of electric water heater sales in 2023. Federal efficiency standards scheduled to take effect in 2029 would dramatically shift the water heating market to more efficient HPWHs.

SOURCES

Figure 1: *Air-Conditioning, Heating, & Refrigeration Institute (AHRI), AHRI Releases December 2024 U.S. Heating and Cooling Equipment Shipment Data, February 14, 2025.*

Figure 2: *U.S. Census Bureau, Table B25040: House Heating Fuel, ACS 2023 5-Year Estimates. Note: Delivered Fuels includes bottled or tank gas, fuel oil, kerosene, and coal; Zero-emission includes electricity and solar; Other includes wood, "other," and no heating fuel.*

Figure 3: *AHRI, Historical Data: Twenty Year Graphs, accessed May 5, 2025.*

Figure 4: *Advanced Water Heating Initiative, 2024 State of the Heat Pump Water Heater: Market Report, New Buildings Institute, 2025; RMI, Tracking the Heat Pump & Water Heater Market in the United States, last updated December 2024; Northwest Energy Efficiency Alliance (NEEA), Department of Energy Residential Water Heater Final Rule, August 2024.*

Heat pump technologies are also rapidly improving in performance and efficiency, with new options now available in the market to accommodate nearly every residential application.

120-volt HPWHs, an emerging alternative to 240-volt HPWHs, can plug into a standard outlet and avoid the need for electrical upgrades that can add time and cost to HPWH retrofit projects.

Window heat pumps connect indoor and outdoor units across a windowsill, and can be installed in dense multifamily housing in place of window air conditioning (AC) units,[18] while single-unit heat pumps with no outdoor unit can connect directly to the outside air through a wall.[19]

Split HPWHs with two separate units can fit into smaller spaces than typical HPWHs,[20] making them a potential solution for manufactured homes.

Cold-climate heat pumps maintain heat and comfort at very low temperatures. While there are currently over 19,000 cold-climate heat pump models available,[21] state-of-the-art models coming to market can operate even more efficiently than existing models at even colder temperatures (down to -15°F), and are equipped for grid interactivity.[22] While some recent innovations come with higher price points, increasing contractor experience with heat pump technology and economies of scale may lower costs as these technologies are more widely adopted.

Refrigerants used in HVAC equipment are also changing in response to international agreements and federal law. Today, the most common refrigerants in AC systems and heat pumps are hydrofluorocarbons (HFCs), a group of synthetic chemicals that have global warming potentials (GWPs) as high as hundreds to thousands of times more potent than carbon dioxide.[23] HFC use is currently being phased down – internationally, under the Kigali Amendment to the Montreal Protocol, and domestically, under the 2020 American Innovation and Manufacturing (AIM) Act. The evolving refrigerant landscape requires updated HVAC technology, and there is growing interest in heat pump designs that use refrigerants with an ultra-low GWP of less than 10. For example, monobloc air-to-water heat pumps (AWHPs), which contain all components in a single outdoor unit and do not need to run refrigerant lines indoors, can use ultra-low-GWP R-290 refrigerant. R-290 refrigerant is commonly used in Europe but has not yet been approved for wide use in the U.S. market.[24,25,26]

Health Benefits

AIR QUALITY

Building emissions produce a variety of air pollutants known to harm human health, including nitrogen oxides (NO_x)[27,28] which are linked to airway inflammation, coughing and wheezing, reduced lung function, and higher risk of asthma attacks.[29] NO_x also react in the atmosphere with volatile organic compounds (VOCs) in the presence of sunlight to form ozone (smog), which is linked to acute respiratory symptoms and serious health effects including nervous system impairment, reproductive issues, and cancer.[30]

Emitting equipment in buildings can also produce indoor air pollution from unvented equipment like stoves and improperly vented space and water heaters, creating chronic health harms and acute risks.[31,32]

WITHIN MOU STATES

96

COUNTIES DESIGNATED under the Clean Air Act as being in "non-attainment" with National Ambient Air Quality Standards (NAAQS) for pollutants like ozone and particulate matter[33]

1,900

ANNUAL DEATHS could be prevented nationally by transitioning residential buildings in MOU states to zero-emission space and water heating[34]

106,000

TONS OF NO_x produced by residential buildings each year, which is:

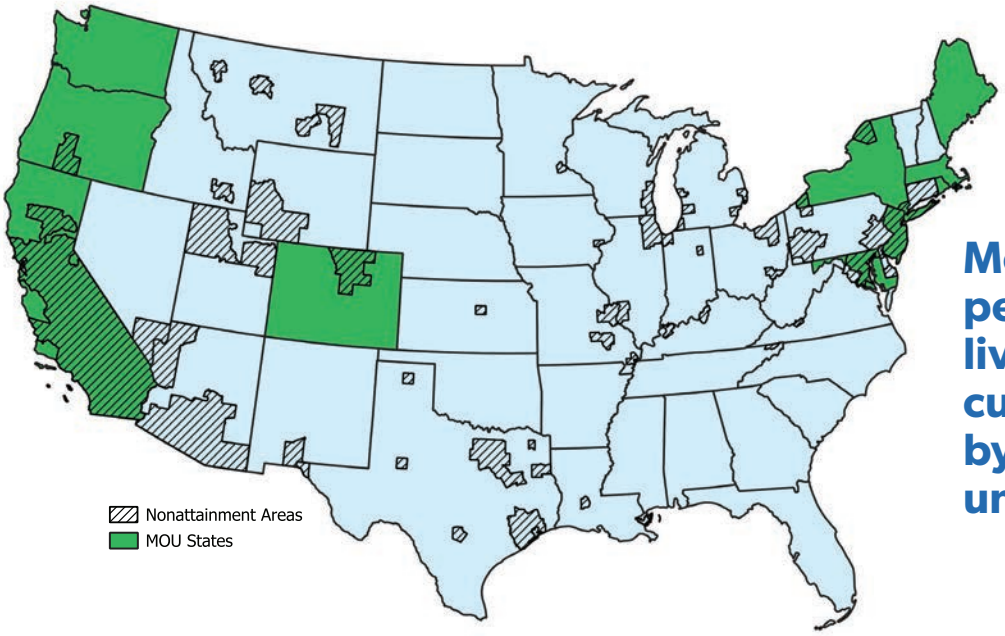
2x

NO_x PRODUCED by power plants

56%

MORE NO_x than commercial buildings[35]

Because pollutants from emitting equipment in buildings are vented at or near to ground level, **they can pose a more localized health threat than industrial or power plant emissions released from tall smokestacks**.[36] These emissions particularly harm people of color, who are disproportionately exposed to $PM_{2.5}$ pollution from residential gas combustion.[37]



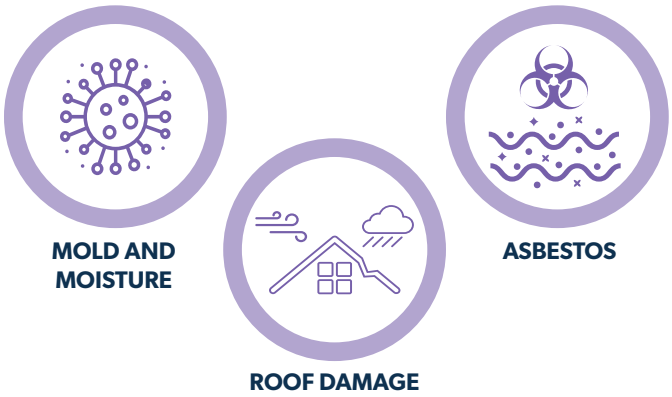
More than 62 million people in MOU states live in a county that is currently designated by EPA as having unhealthy air.[38]

HOUSING QUALITY

Zero-emission heating equipment can be installed in existing buildings as part of a suite of building upgrades that improve housing quality and resident comfort and health. Many heat pump incentive programs encourage homeowners to adopt weatherization measures they might otherwise overlook to enhance heat pump performance and reduce operating costs.[39] These measures can include envelope upgrades like air sealing, insulation, and door or window improvements that improve energy efficiency and thermal comfort, and reduce exposure to extreme heat.[40,41] In older or poorly maintained homes, weatherization may require that safety and structural barriers, such as mold, asbestos, and roof damage, are addressed before energy efficiency or zero-emission upgrades can be undertaken.[42]

Whole-home retrofit programs that comprehensively address all stages of the building decarbonization process, from structural repairs to heat pump installation, can lower energy bills while generating health benefits such as improved resilience to extreme temperatures and reduced exposure to mold and pests.[43,44] Given that people of color and low-income residents are significantly more likely to live in poor-quality housing due to historical disinvestment and segregation,[45,46] whole-home retrofit programs paired with renter protections can be an important tool to reduce housing and health disparities.[47,48]

PRE-WEATHERIZATION ISSUES

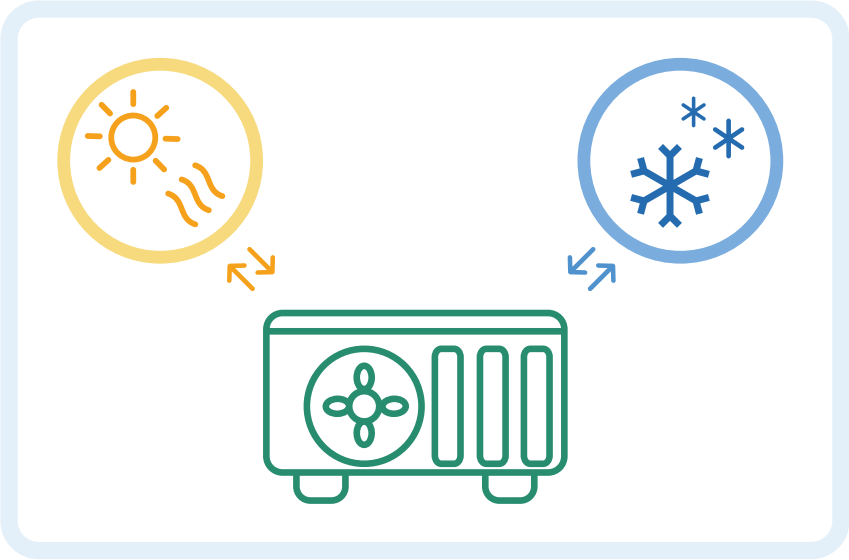


WEATHERIZATION MEASURES

ACCESS TO COOLING

Heat pumps provide the benefit of using a single piece of equipment to deliver both heating and cooling.

As climate change causes more frequent extreme heat events, access to AC becomes increasingly important to human health.[49] People of color, low-income communities, renters, and people without health insurance are among the most vulnerable to heat impacts due to their higher exposure to adverse risk factors such as housing quality, neighborhood characteristics, and access to medical care.[50,51,52] Young children and the elderly are also vulnerable due to lower physiological capacity for heat response.[53,54]



Two-way heat pumps can provide highly efficient cooling and energy bill reductions compared to one-way ACs, especially when installed in homes without central AC that previously relied on inefficient window units.[55,56] Because many communities that have not historically used AC technology may be reluctant to adopt new cooling equipment due to cost concerns, installing heat pumps for space heating can also provide life-saving cooling during heat waves for households that have not installed stand-alone ACs.[57] Completing weatherization as part of the heat pump upgrade process can further reduce energy bills and increase resilience during power outages. In areas that rely on natural ventilation for cooling, these measures can keep temperatures comfortable at times when other air pollution events (such as wildfires) mean that windows should be closed.[58]

29%

HIGHER EFFICIENCY when using heat pumps rather than window ACs for cooling[59]

Justice and Equity

Beyond improved health and housing quality, the transition to zero-emission residential buildings can advance equity in other ways. Policy design creates an opportunity to include communities as partners in policy processes – a vital step for developing programs that achieve intended goals and benefit all stakeholders. Additionally, higher demand for heat pump installation and maintenance services, paired with workforce protections and guidance, can generate training, workforce development, and entrepreneurship opportunities in disadvantaged communities.[60]

Improving equity through building decarbonization requires intentional policy choices to prevent increases in housing costs and ensure that all communities can afford and benefit from the transition. NESCAUM convened an Environmental Justice Advisory Group (EJAG) to develop the recommendations outlined in this Action Plan and provide states with guiding principles for equitable buildings policies.

ENVIRONMENTAL JUSTICE ADVISORY GROUP

- **Formed in 2023**
- **Nine environmental justice & housing organizations**
- **Provided input on building decarbonization priorities and concerns to inform Action Plan recommendations**
- **Advised on Action Plan drafts throughout development**

Through a series of meetings, the EJAG developed the following definition of equity in state-level building decarbonization policy:

Equity is a function of access – access for all communities to participate in and influence the decision-making structures that shape buildings policy as it impacts our everyday lives, as well as access to the resources, benefits, and opportunities that result from building decarbonization policy. By incorporating equity into building decarbonization policy, states can help address historical injustices that have prevented segments of society from accessing decision-making power and associated resources. We see just and equitable building decarbonization policy as creating standards and programs that make the benefits of zero-emission buildings accessible to all members of society.

Specifically, buildings policy should:

- *Ensure that residents have robust access to the resources, benefits, and opportunities that accrue from these policies (distributional equity).*
- *Address disparities that prevent historically marginalized and underserved communities from accessing system benefits (structural equity).*
- *Create inclusive, transparent, and accessible processes where community members have authentic leadership roles that define, drive, and hold accountable clean energy policy and program decisions and outcomes (procedural equity).*

With this understanding, the EJAG identified principles that reflect the group's thinking on the best policies and practices to guide the transition to zero-emission residential buildings. States should incorporate these principles as they design and implement building decarbonization policies.

Access

Affordable zero-emission options must be accessible to all residents, particularly low- and moderate-income (LMI) residents. This means expanding program offerings to ensure that all kinds of residents, including renters and occupants/owners in multifamily buildings, have access to programs and incentives supporting comprehensive retrofits. Policies should be structured to ensure renters are not adversely affected or displaced when buildings are upgraded. Policies should also ensure that existing programs are effectively communicated and that participation processes are easy to navigate.

Affordability

Installation and operating costs for zero-emission equipment can be high, creating affordability challenges in low-income communities. Policies to address these challenges, such as pairing zero-emission equipment with weatherization and revising utility rate structures, are needed to reduce costs and barriers to entry for LMI households. Policies should encourage and enable renters and homeowners to make decisions about upgrading to zero-emission heating.

Air Quality and Human Health

Policies should reduce emissions in a manner that improves indoor and outdoor air quality and delivers public health benefits. Reductions in criteria air pollutant emissions from building electrification and associated changes in emissions from fossil fuel-based electricity generation should be measured to assess the impacts of decarbonization policies.

Education and Awareness

Policy development should include broad-scale education and awareness activities, particularly in historically underserved communities where awareness and knowledge about zero-emission technology, its applications, and available financial resources may be limited. In addition, culturally appropriate education and awareness campaigns are needed to communicate effectively and meet people where they are.

Employment and Entrepreneurship

Decarbonization policies should include workforce and entrepreneurial development programs that are targeted toward historically marginalized and underserved communities, to ensure that the jobs associated with clean energy and zero-emission equipment benefit all communities. Inclusive workforce pathways, including education and pre-apprenticeship programs, should be expanded and supported while also upholding fair labor standards that ensure clean energy and energy efficiency jobs are accessible, well-compensated, and provide meaningful benefits to local communities. These efforts should prioritize community-based workers and businesses, alongside established workforce development programs, to maximize opportunities for economic participation.

Enforceability

Policies should be designed to ensure compliance with established standards while also tracking progress toward successful program implementation.

Governance and Decision-Making

Policies should be designed to help communities partner with other decision-makers to generate the most effective solutions and implementation strategies. This requires expanded support for community leaders as they engage in the decision-making process.

Legacy Issues

Decarbonization efforts should prioritize the needs of low-income households and communities that have historically faced "legacy challenges," including poor housing conditions, toxic environments, in-home health issues, climate vulnerability, and old and energy-inefficient housing. To address these interconnected issues, holistic policies that target energy and housing concerns in tandem are recommended.

Resilience and Reliability

Power outages can have severe consequences, particularly for vulnerable households that do not have access to alternative energy sources or backup systems. Identifying and implementing alternative energy sources or backup systems such as off-grid generators and renewables, and ensuring that homes are properly weatherized, can enhance resilience and reliability. This can also mitigate the impacts of grid outages on heating and cooling, since outages affect most equipment types regardless of fuel used, including furnaces, ACs, and heat pumps, and ensure that communities are not disproportionately affected during emergencies.

Economic Opportunity

Construction of new zero-emission residential buildings can cost significantly less than construction of emitting buildings by streamlining equipment and infrastructural needs. For example, a conventional emitting building would typically include an AC unit, furnace, water heater, electrical infrastructure, as well as methane gas piping and connections to support heating and cooling needs. A zero-emission building would only require electrical infrastructure, a heat pump for heating and cooling, and a heat pump water heater to provide the same functions. This streamlining can create cost savings for zero-emission new construction.[61,62]

At present, zero-emission technologies like heat pumps often have higher upfront costs than emitting alternatives when installed as retrofits in existing buildings. However, residents in MOU states have access to a wide range of utility, state, and local incentives, tax credits, and financing to make zero-emission options cost-competitive. Installation costs are expected to decline as contractors grow more familiar with these technologies.

Building decarbonization efforts drive job creation, entrepreneurship, and economic development.

75,000

ENERGY EFFICIENCY JOBS ADDED to the US economy in 2023[63]

2.3M

ENERGY EFFICIENCY WORKERS EMPLOYED across the country[65]

3M

NEW JOBS due to the transition to zero-emission residential buildings, estimated by 2035[64]

2x

THE NUMBER OF WORKERS employed in energy efficiency compared to the fossil fuel industry[66]

Pairing building decarbonization programs with high-quality workforce development and strong labor standards can create jobs that provide quality wages and career advancement opportunities.[67]

Most customers who use delivered fuels or electric resistance heating will realize utility bill savings by upgrading to efficient heat pumps, and delivered fuel customers will also reduce their exposure to volatile fossil fuel pricing.[68,69]

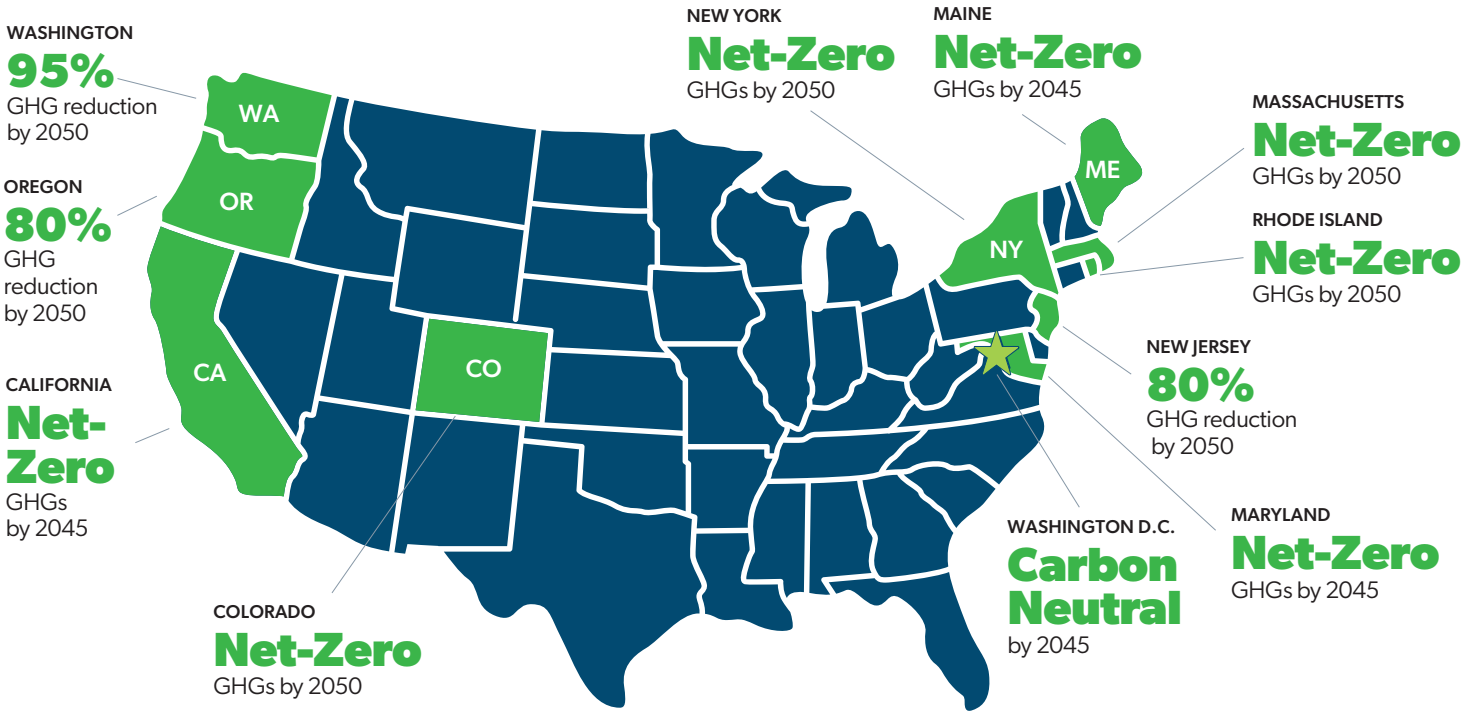
Bill impacts for residents who switch from methane gas can be more variable depending on the relative price of gas versus electricity. However, as changing consumer preferences and decarbonization policies reduce the total number of methane gas customers and overall gas use, and as significant upgrades are needed for aging gas infrastructure, gas utility bills are expected to rise, improving the value proposition for heat pumps.[70,71]

Energy efficiency jobs include those related to the manufacturing of energy-efficient equipment, installation of energy-efficient products and weatherization measures, and energy-efficient building design.

Climate Progress

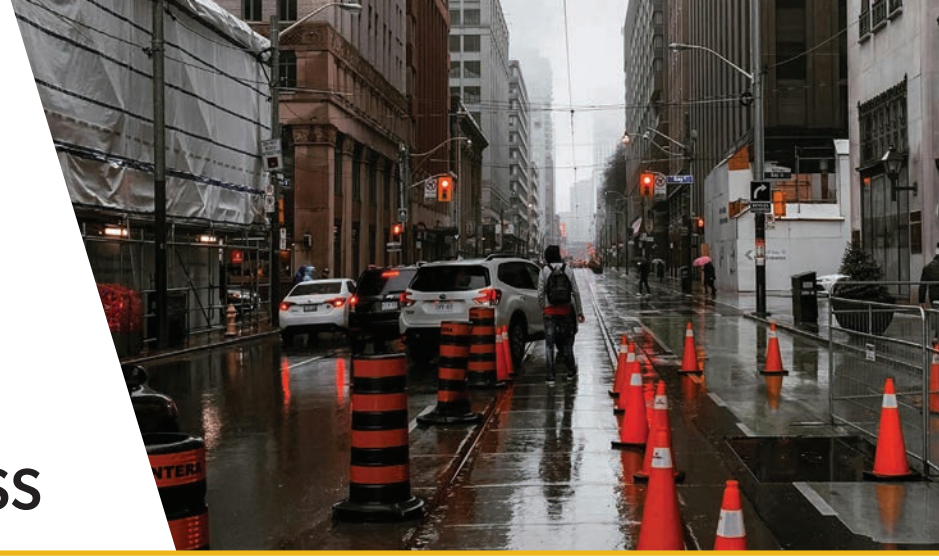
Zero-emission buildings are key to achieving state climate goals. The buildings sector accounts for a larger share of GHG emissions in MOU states compared to the national average, with direct emissions from residential buildings alone contributing over 10% of MOU states' GHG emissions, compared to 6% nationally.[72] Typical replacement intervals for residential heating equipment range from 10–15 years for water heaters and 15–20 years for space heaters, meaning that polluting technology is generally locked in for at least a decade after it is installed.[73] Many MOU states have adopted the goal of achieving net-zero economy-wide GHG emissions by 2050.[74] In these states, any emitting space or water heater installed between 2030 and 2040 is likely to continue polluting beyond the net-zero target date. **Decarbonizing buildings now is essential to achieve immediate emissions benefits and help states reach longer-term climate targets.**

STATEWIDE CLIMATE TARGETS[75]



STATEWIDE BUILDING DECARBONIZATION TARGETS[76]

California	6 million heat pumps installed and 40% GHG reductions from residential and commercial buildings by 2030
Colorado	20% GHG emissions reductions from large buildings by 2030 (compared to 2021 levels)
D.C.	Energy use reductions from large buildings in line with the District-wide goal of reducing GHG emissions and energy consumption 50% by 2032
Maine	175,000 new heat pumps installed between 2023 and 2027
Maryland	Net-zero direct GHG emissions for large buildings by 2040
Massachusetts	500,000 new households using heat pumps as primary heating between 2020 and 2030
New Jersey	400,000 electrified homes between 2023 and 2030
New York	2 million climate-friendly (electrified or electrification-ready) homes by 2030
Oregon	500,000 new heat pumps installed between 2023 and 2030
Rhode Island	40% GHG emissions reductions from state-owned buildings by 2030 (compared to 2014 levels)
Washington	14% reduction in GHG emissions from gas in buildings by 2030



SECTION 3

BARRIERS TO PROGRESS

Understanding barriers to the adoption of zero-emission technologies like heat pumps is crucial for developing policy and program interventions to overcome them. This section briefly reviews the major obstacles.

Cost and Accessibility

High cost is one of the most important barriers to the adoption of zero-emission equipment. Cost is driven by several factors.

INSTALLATION COST AND COMPLEXITY

Heat pumps often cost more to install than an emitting furnace or central AC system, although they can be cost-competitive for customers replacing both systems at once. Installing most heat pumps for space heating requires more work than the simple "box swap" involved in replacing an old furnace with a new one. Installation complexities can increase labor prices, deter residents from making the switch, and discourage contractors from recommending it. Common challenges include:

Space Constraints. Some single-family homes, manufactured/mobile homes, and multifamily buildings do not have readily available space for zero-emission technology such as HPWHs, which require a larger area than emitting water heaters to support heat exchange. To ensure sufficient space, zero-emission equipment may need to be placed in areas (such as balconies) that interfere with resident use; alternatively, installation may require building modifications that increase project cost.[77] Split HPWH systems, which are currently being brought to market to address this issue, are one potential solution.[78]

Retrofit Complexity. Some buildings may need pre-electrification upgrades to address issues with the building envelope, physical space needed for zero-emission equipment, electrical requirements, or duct airflow constraints before a heat pump can be installed. This increases project time and cost, and creates a higher administrative burden for home and building owners who need to coordinate with multiple contractors to address each upgrade.[79] Retrofit complexity is particularly salient for multifamily buildings, which have more complicated heating systems than single-family homes and bear higher expenses for service upgrades; and for buildings in low-income communities, which more frequently require weatherization and pre-weatherization upgrades to enable heat pump installation.

Limited Electrical Capacity. Existing buildings have finite electrical capacity on their utility service (i.e., the connection to the utility grid), electrical panels, and other electrical circuits. Consequently, adding electrical equipment such as heat pumps and EV chargers can require upgrading to higher-capacity panels and/or utility service and related electrical infrastructure. Buildings with limited electrical capacity can experience significant costs and delays associated with installing higher-capacity service lines, upgrading electrical equipment, and addressing other construction and structural challenges.[80,81]

Emergency Replacements. Many HVAC and water heater replacements are prompted by equipment failures.[82,83] Under emergency conditions, homeowners and contractors are more likely to default to "like-for-like" replacements that minimize time without heat, hot water, or air conditioning. Heat pumps may not be stocked and available from wholesale distributors on short notice,[84] and time pressure can increase installation fees and make it difficult to adhere to best practices such as proper sizing.[85]

Poor Equipment Selection. In some cases, contractors and customers may default to less expensive heat pump models that do not work well in cold climates and frequently run in inefficient electric resistance mode, increasing operating costs.

RELATIVE COST OF ENERGY

Heat pumps offer significant operating cost savings compared to oil, propane, and electric resistance heating.[86] However, if electricity rates are substantially higher than methane gas rates, users who switch from methane gas to heat pumps could incur higher bills.[87,88] The higher this "spark gap" (the ratio of electricity costs to fossil fuel costs), the less likely it is that the homeowner will see operating cost savings.[89]

UNDERDEVELOPED WORKFORCE

A lack of consistent training and licensing requirements for qualified workers, along with low wages and poor job quality in the residential sector, hinder the growth of a skilled workforce. Many areas are also experiencing a shortage of HVAC installers, electricians, and plumbers, which can increase installation costs as heat pump demand outstrips available contractors.[90] Lack of experience with heat pumps can also cause contractors to price perceived risk into installation prices,[91] oversize heat pumps,[92] or make other installation errors that require repairs or result in higher energy bills.[93,94]

LACK OF ACCESS TO INCENTIVES

While incentives and financing options can reduce upfront costs, they may be insufficient, uncoordinated, and/or difficult to access. Complicated application processes, delays in receiving rebate payments or tax credits, inconsistent requirements for incentive-eligible measures across programs, and long payback times can discourage building owners and contractors from pursuing incentives for their projects.[95] One analysis found that some consumers have to submit up to six different applications to take advantage of the federal, state, and local funding available to them.[96] This administrative burden particularly hinders participation among residents in LMI and disadvantaged communities who often face additional barriers (e.g., language, time).[97]

OWNER-RESIDENT DYNAMICS

In rental housing, owner–resident dynamics can complicate decision-making around zero-emission upgrades. Split incentives can reduce owners' willingness to pay higher upfront costs for measures that primarily deliver bill savings to residents.[98] In multifamily properties where methane gas is not metered to residents or the property is served by central systems, switching to an electric or in-unit system may change who pays for certain end uses. These issues can result in renters not having access to zero-emission technology or experiencing higher energy bills after electrification.[99]

Education and Awareness

Another significant barrier is a general lack of awareness of zero-emission technologies – particularly in colder climates. Even for consumers who know about the benefits of heat pumps, difficulty in accessing the information needed to choose equipment, find an installer, and navigate incentives can prevent them from moving forward.[100] Contractors often discourage customers from choosing heat pumps because they lack awareness of the latest technologies, are concerned about negative customer feedback, or hold outdated perceptions of heat pump performance.[101] Because **contractors are a primary source of information for consumers who are replacing old equipment**, their recommendations for (or against) heat pumps can significantly influence consumer decisions.[102]

Common heat pump misconceptions held by consumers and contractors:

Heat pumps are unreliable and do not work in cold climates.

Properly installed heat pumps already provide reliable, comfortable heat in cold-climate locations such as Maine, Alaska, and Norway. The technology also continues to improve in performance and efficiency.

Fossil fuel heating systems can provide heat in a power outage and are the better option for consumers with concerns about electric grid reliability.

Gas furnaces and other emitting heating systems require electricity for start-up and air circulation and generally do not work in a power outage.[103] Only homes with a small backup generator that can start a fossil fuel-based heater but cannot run a heat pump would offer a reliability advantage compared to staying on a fossil fuel heating system.

Additional expenses and steps such as weatherization or electrical panel upgrades are always required prior to heat pump installation.

Many homes can support heat pumps today without additional steps or associated costs, and options exist to manage electricity demand within electric panel capacity.

Heat pumps are noisy.

In general, modern heat pumps produce sound at or below 60 decibels (on the quiet end of normal conversation),[104] with newer models reaching as low as 43 to 45 decibels (comparable to a suburban area at night).[105] Homes with existing window or central AC systems are usually as loud, or louder than, a modern heat pump.

Utility and Grid Constraints

Many current electric rate structures and utility business models do not encourage residents to use zero-emission technologies. Nationally, electric rates are usually set volumetrically based on the quantity of electricity a customer uses. Volumetric rates encourage conservation but can discourage heat pump use if electricity prices are high.[106] Due to cooling needs, many grids experience peak electricity demand during the summer months, leading to electricity distribution systems built to meet that demand. This means that the summer peak creates costs for the system that are often recovered in the form of a flat, year-round volumetric rate. However, since heat pumps draw the most energy during winter – which in most regions is currently an off-peak time for the electric system – heat pump users pay the same flat volumetric rates as summer AC users. As such, **current electric rates often overcharge heat pump users relative to their actual costs to the grid.**[107,108]

Households with heat pumps will continue to be overcharged for their winter heating bills until enough people upgrade to heat pumps to cause winter peak electricity demand to exceed the summer peak – a switch not expected to occur until the mid-2030s in most MOU states.[109,110] **Unaffordable rates particularly harm lower-income households**, who already experience high energy burdens and cannot upgrade to heat pumps if doing so would increase their bills.

Load growth on the grid also presents a barrier to building decarbonization. Winter peaking due to heating electrification may necessitate grid system upgrades and will require utilities to incorporate load flexibility strategies into their planning processes. States, utilities, and grid operators are working to improve grid reliability, resilience, and flexibility in tandem with promoting zero-emission technologies.

SECTION 4

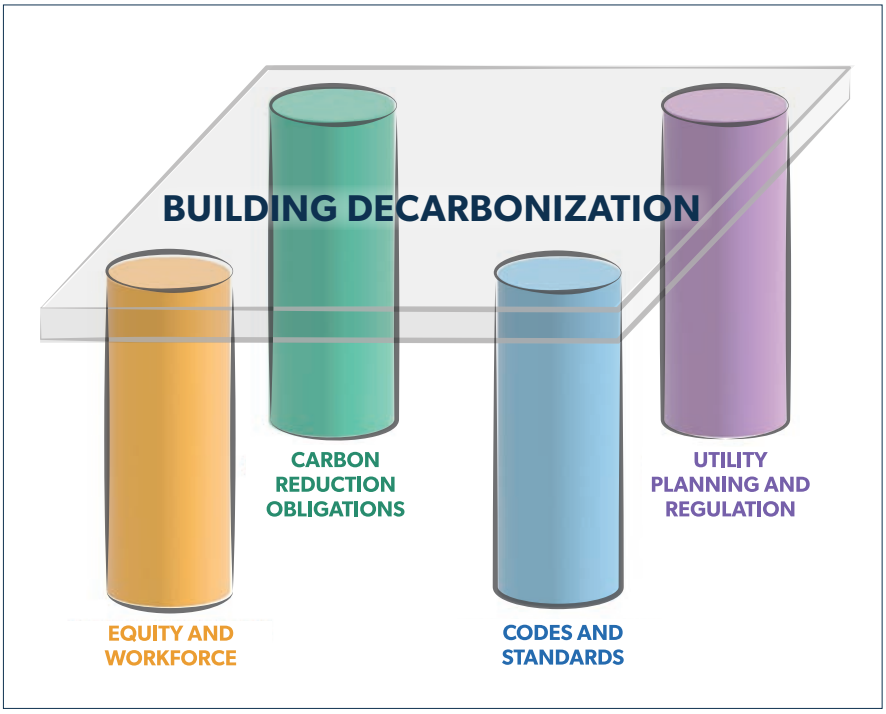
RECOMMENDATIONS FOR STATE ACTION

With a focus on near-term strategies, this section includes more than 50 recommendations for state policymakers to support the rapid, equitable, and widespread transition to zero-emission residential buildings. The large number of recommendations reflects the many options states have to make progress, not an expectation that every state will pursue every recommendation.

A state's participation in the MOU should not be interpreted as an endorsement of any or all the recommendations included in this Action Plan. There is considerable diversity in the economic base, population density, climate, governance structure, and other characteristics that shape individual states' policy needs and opportunities. As such, these recommendations are not intended to prescribe a uniform path for states to follow, but rather to help states develop their own plans – informed by robust engagement with stakeholders and residents – for an equitable transition to zero-emission residential buildings.

This section begins with **Policy Coordination and Accountability** recommendations for establishing a whole-of-government approach to building decarbonization that streamlines and improves interagency coordination.

The specific recommendations for state action that follow are organized using a framework first presented in a policy brief authored by NEEP, NESCAUM, and the Regulatory Assistance Project (RAP), Decarbonizing Buildings: How States Can Set the Table for Success.[111] That brief describes four key policy areas, which can be thought of as legs of a table for effectively supporting building decarbonization.[112]



Each state presents a unique context for building decarbonization and is at a different stage in the decarbonization process, which will inform its priorities for action. The listing of these four policy areas does not represent a priority order, nor are specific recommendations within each area organized by priority. To the extent that some ordering occurs within policy areas, it is primarily limited to cases where sequence matters (e.g., one recommendation must be completed to enable another).

EQUITY AND WORKFORCE

Actions to address housing and workforce inequities and ensure that the transition to zero-emission buildings is inclusive and just.

CODES AND STANDARDS

Regulations that establish a clear timeline for building emissions reductions and spur a market transition to zero-emission buildings.

CARBON REDUCTION OBLIGATIONS

Performance requirements for obligated parties to reduce carbon emissions or install zero-emission heating systems.

UTILITY PLANNING AND REGULATION

Actions to ensure that utility investments, rates, and programs align with building decarbonization goals.

Policy Coordination and Accountability

Transforming residential buildings involves a whole-of-government approach. Cross-agency collaboration is essential to:

- Develop policies that meet states' overarching goals for decarbonization, air quality, and equity.
- Coordinate and sequence policy implementation.
- Streamline programs for consumers and market actors. In situations where policies cannot be implemented at the state level, states can encourage local governments to act.

Each state will have different priorities for interagency collaboration and coordination and will face different political, economic, and legal constraints. In some states, relevant agencies may not have the authority to implement certain recommendations. Legislative changes, additional staffing, new and sustainable sources of funding, and strong partnerships may be needed.

States can use the following recommendations to jumpstart cross-agency coordination and planning processes and ensure that policies and programs deliver on their goals.

While NESCAUM primarily works with state air and environmental agencies, the Action Plan provides recommendations across all the entities listed below. Each is essential to advancing an equitable, affordable, and durable transition to zero-emission residential buildings.

Icons representing different entities are used throughout the recommendations in this Action Plan to indicate which agencies are likely to be responsible for each action. The icons are intended to provide a general indication of which state agency is best positioned to enact each action and may not apply to every individual state's unique organizational structure and agency composition.

KEY POLICY ACTORS

ALL **All** represents when many or all state agencies are likely to be involved in implementing an action.

SL **State legislatures** are responsible for passing clean energy and building decarbonization laws. Legislatures can set binding climate targets, enable and require state agencies to initiate new policies and programs, and revise governing frameworks for regulators and utilities.

GO **Governor's offices** can provide leadership, coordination, and vision regarding building decarbonization policies. Governors can also issue executive orders that direct state agencies to take certain actions.

EA **State environmental agencies** often include air quality and climate divisions. Air quality agencies have authority to regulate air pollution, while climate offices typically coordinate state-level climate planning, lead rule development for GHG mitigation, and manage state GHG inventories. Building decarbonization actions led by state environmental agencies have the goal of reducing air emissions and/or climate impacts. In some states, local air agencies may have independent authority to adopt strategies for reducing emissions.

EO **State energy offices** develop and implement policies that promote energy efficiency, reliability, and sustainability. This can include energy planning, designing and implementing state-level efficiency incentives, educating consumers, and offering training programs related to energy efficiency and building decarbonization. In some states, energy offices also implement building energy codes, while in others building commissions or administrative agencies are responsible for building code updates and enforcement.

PUC **State public utility commissions (PUCs)** – or, in some states, public service commissions (PSCs) – regulate electricity and methane gas utilities. PUCs are responsible for setting just and reasonable electric and gas rates and overseeing utility planning processes and budgets (including investments related to grid reliability, resilience, flexibility, and decarbonization). They often oversee utility-administered programs relevant to energy efficiency, demand response, electrification, and renewable energy. State PUCs are also instrumental in shaping the regulatory framework for utility-owned and operated thermal energy networks (TENs), as well as other neighborhood-scale decarbonization strategies.

HFA **State housing finance agencies** provide housing support primarily to LMI residents through rental assistance programs, preservation and rehabilitation of affordable housing, new housing construction, and affordable housing policy. Their role in the transition to zero-emission residential buildings involves funding and implementing high-performance new construction and retrofits of existing buildings.

DOL **State departments of labor** oversee registered apprenticeship programs, maintain lists of qualified contractors, enforce labor standards, and assess workforce needs and gaps to ensure that a well-trained and adequately supported workforce is available to implement the transition to zero-emission residential buildings.

EDA **State economic development agencies** are responsible for promoting business, entrepreneurship, and community development in their states, including by providing financial assistance, real estate investments, and programming to encourage local business growth.

SL GO

Establish an office charged with coordinating a whole-of-government, cross-agency approach to statewide climate and energy transformation efforts.

Massachusetts established an Office of Climate Innovation and Resilience by executive order to advance the state's climate innovation, mitigation, adaptation, and resilience policies.[113] In addition to creating a new, cabinet-level Climate Chief, the executive order required each cabinet secretary to appoint a Climate Officer to implement climate-related efforts within their agency. Recognizing the need for additional coordination on grid and utility issues, the governor's office also created the Office of Energy Transformation (OET) in 2024. Areas under OET's purview include planning for increased demand on the electric grid, facilitating integrated planning and investment between gas and electric utilities, protecting methane gas customers from rising prices as consumers exit the gas system, ensuring a just transition for gas industry workers, and maximizing high-quality job creation.[114]

GO ALL

Create regular touchpoints between state energy, PUC, environmental, and housing offices to coordinate buildings policies and improve alignment within and between different levels of government.

New Jersey launched a Clean Buildings Working Group, which is a collaboration between the governor's Office of Climate Action and the Green Economy, state agencies such as the Board of Public Utilities, Department of Environmental Protection, Department of Community Affairs, Economic Development Authority, and Department of the Treasury, as well as other stakeholders and industry experts, in 2022.[115] The Clean Buildings Working Group also helped to inform New Jersey's Strategic Buildings Roadmap for reaching state building decarbonization and clean energy goals.

GO EO

Clarify local authority and empower local governments to adopt measures that may not be feasible statewide. This may include issuing an attorney general's opinion that interprets existing law on local authority for building decarbonization, defining the scope of local authority on building decarbonization through legislation, or granting local governments new authorities. As an example, states may be able to grant local jurisdictions the authority to pass excise taxes based on climate pollution (e.g., from methane gas equipment in new construction)[116] or adopt more stringent building energy codes than those required by the state. This type of authority can reduce legal risk for local governments and support local action.

Some municipalities have already passed ordinances taxing the air pollution from equipment installed in new homes based on equipment type, quantity of emissions, and equipment service life.

ALL

Provide resources and funding to ensure that policies and regulations can be appropriately implemented and enforced. For example, even if a regulation is passed with strong equity provisions – such as tenant or labor protections – those provisions may not be effective without enforcement. At the same time, budget and staffing limitations may mean that state agencies need to allocate additional resources to enforcement, redesign policies to make them easier to enforce, promote accountability and enforcement at the local or municipal level, coordinate with neighboring states to make policies easier to monitor across state lines, and/or increase data collection on target metrics so that the public can track policy outcomes directly.

Equity and Workforce Investments

The following equity and workforce investment recommendations highlight processes and practices that states should consider early in policy and program design and throughout implementation. These actions can help states engage stakeholders in building decarbonization, allow all households and communities to participate in the transition to zero-emission residential buildings, and expand access to the economic opportunities and jobs created by investments in zero-emission upgrades.

STAKEHOLDER ENGAGEMENT AND INCLUSIVE PROCESSES

The recommendations in this section can help states gather insights from a diverse range of constituents, begin the long-term process of building trust with communities, and improve policy success.

TYPES OF EXTERNAL ENGAGEMENT

Community engagement means bringing all groups – including historically marginalized low-income residents and communities of color – into decision-making processes that will affect them.[117] It requires partnering with communities at every stage of policy development,[118] in contrast with the common practice of soliciting public comments only after a program or regulation is close to finalized.

Stakeholder engagement involves consulting with a broad and representative group of interested parties during policy development, which could include industry experts, manufacturers, utilities, policymakers, community representatives, nonprofit organizations, and advocates.

EO HFA DOL EA EDA

Establish community and stakeholder advisory boards to co-design and co-implement decarbonization policy with government agencies. In some cases, it can be helpful to define the structure of these boards in statute. When establishing community advisory boards, states should plan for capacity building, including having trained facilitators, working with community partners to develop an appropriate scope and recruitment plan for the advisory board, and committing the necessary time during board meetings to develop a shared understanding of policy issues and community concerns.

The Rhode Island Energy Efficiency Council (EEC) advises on, monitors, and evaluates ratepayer-funded energy efficiency programs in the state. It is composed of 15 members representing businesses, municipalities, environmental organizations, homeowners, and renters. EEC meetings are open to public attendance and comment.[119]

EO HFA DOL EA EDA

Partner with individuals and organizations embedded in local communities, or "public experts," such as community-based organizations (CBOs), housing groups, contractors, and tenant associations, on policy design. Tenants, who often have the least access to and control over home energy upgrades, should also be engaged, along with LMI households, disadvantaged communities, and the contractors who work in these communities.

The Washington, D.C. Department of Energy and Environment (DOEE) conducted two kinds of outreach to engage stakeholders in building decarbonization programs. For the development of its Building Energy Performance Standards (BEPS), DOEE established a stakeholder Task Force to meet biweekly to discuss recommendations for designing the BEPS rule. The BEPS Task Force consisted of stakeholders from a variety of backgrounds, imcluding commercial and rent-controlled apartment buildings, affordable housing, energy utilities, and energy efficiency nonprofits.[120] To inform its clean energy plan, DOEE partnered with affordable housing nonprofit National Housing Trust (NHT) to solicit community input from residents of two affordable multifamily housing buildings. DOEE and NHT partnered with local CBOs to 1) advertise and host neighborhood block parties to create a positive community experience and recruit participants interested in discussing zero-emission building upgrades, and 2) hold small group discussions facilitated by the CBOs for residents to voice concerns, discuss the benefits of zero-emission equipment, and share recommendations for the clean energy plan.[121]

EA EO HFA PUC DOL EDA

Make it easier for CBOs and residents to participate in policy processes by providing compensation and support services, such as:

- Providing compensation and convening at times (including after work hours) convenient for CBOs or residents who participate in advisory boards, focus groups, or other forums that assist with the regulatory process.

The New York State Energy Research and Development Authority (NYSERDA) established a Disadvantaged Community (DAC) Honorarium to reimburse CBOs and individuals who provide input on NYSERDA programs. The reimbursement process includes criteria for determining whether groups or individuals are eligible to receive payment, a voucher issued by the NYSERDA program team requesting community expertise, and a rate structure for payment including $300 for up to 2.5 hours of engagement and $800 for 5.5 hours and more.[122]

- Creating plain-language explanations of policy proposals and regulations and providing outreach in multiple formats to maximize engagement.
- Performing language translation for all workshops, community meetings, and documents.
- Providing additional services such as transportation, childcare, and meals to remove logistical barriers to resident participation.

ENSURING THAT UNDERSERVED COMMUNITIES BENEFIT

Building decarbonization policies should be thoughtfully designed to enhance equity by improving affordability, housing quality, and health, while also avoiding unintended, inequitable consequences, such as gentrification and displacement.

EA EO HFA PUC

Set, meet, and increase targets for LMI household and disadvantaged community spending or impact in building decarbonization programs to ensure that equity is prioritized during program design and implementation. Examples include requiring a certain number of homes to be upgraded in disadvantaged communities or targeting a certain percentage of energy efficiency program spending toward LMI households. Targets can also be set for holistic retrofits that address pre-weatherization, weatherization, and heat pump installation, to ensure that people living in housing that needs these upgrades also benefit. The Multistate MOU sets a target for states to direct at least 40% of new investments in energy efficiency and zero-emission upgrades to low-income and disadvantaged communities.

The Oregon Department of Energy's heat pump program includes specific allocations for LMI households. Established in 2022 to increase access to cooling after an extreme heat event killed around 100 people, the state's Rental Home Heat Pump Program allocates a minimum of 25% of funding for LMI renter households, and another 25% of funding for affordable housing providers. The program also includes dedicated funding for heat pump installations in rental housing occupied by members of Oregon's seven federally recognized tribes.[123]

EO HFA

Work with state housing finance and local housing agencies to include tenant protections as a requirement for building owner participation in the incentive programs these entities manage or oversee. Protections should remain in place for the term of the agreement, even if the landlord sells the property. Building owners who fail to comply with tenant protections should be required to repay any subsidies received, and to cover the cost of any enforcement actions.

The California Energy Commission's Equitable Building Decarbonization Direct Install Program includes tenant protections in a program that provides no-cost energy efficiency and zero-emission upgrades to low-income households in single, multifamily, and manufactured homes in under-resourced communities. Building owners who participate in the program must limit annual rent increases to 3% for 5–10 years after project completion, and cannot evict their tenants before, during, or after the building upgrade without just cause. In addition, program administrators are required to provide landlords and tenants with project information, planned upgrades, project impacts and benefits, landlord responsibilities, and tenant rights associated with program participation, in the predominant language spoken in the community.[124]

PROTECTING RENTERS

Strategies to protect renters from displacement and other harms include:[125,126]

- Limiting building owners' ability to increase rents to recover the cost of state-subsidized energy efficiency or zero-emission upgrades.
- Capping rent increases for 5–10 years after a subsidized upgrade has been completed, even if the tenant changes.
- Restricting evictions to cases of nonpayment and violations of law only for 5–10 years after a subsidized upgrade has been completed.
- Adjusting rent to reflect the landlord's heating-related cost savings to maintain affordability for renters in cases where a centralized heating system with operating costs paid by the landlord is replaced by in-unit zero-emission heating units (such as minisplit heat pumps) with operating costs paid by tenants.
- Incorporating anti-harassment provisions that prevent landlords from using construction work to make living conditions so uncomfortable that they drive tenants out.
- Requiring that landlords provide temporary accommodation for tenants who must be relocated during building upgrades, along with the right to return to the original rental home at the pre-retrofit rent price after upgrades are complete.
- Ensuring that tenant protections are adequately enforced by increasing public enforcement activity, giving tenants the ability to enforce their rights in private actions, ensuring that tenants are aware of their rights, and adequately resourcing private enforcement options through attorneys' fee provisions and right-to-counsel programs.[127]
- Monitoring tenant outcomes after upgrades are performed to ensure that protections and enforcement programs are sufficient.

EQUITABLE PROGRAM DESIGN AND IMPLEMENTATION

Well-intentioned programs fail if people cannot access them. The following recommendations for equity-centered program design and implementation can help states improve, expand, and increase access to programs for households and communities that have often been underserved by existing energy efficiency programs.

EO HFA PUC

Create and expand whole-home programs serving LMI households. Whole-home programs typically offer no-cost direct installation of an array of retrofits, including weatherization, heat pumps, and any needed pre-electrification and health and safety improvements, ideally through a concierge model that delivers multiple upgrades through one consolidated service. Bundling zero-emission equipment with weatherization and, where feasible, installation of solar panels or enrollment in community solar programs can improve health and housing quality while mitigating the risk that customers who switch from methane gas to zero-emission electric equipment see an increase in their energy costs. Pre-electrification measures include:

- Health and safety improvements, such as moisture, mold, lead, and asbestos remediation, that should be implemented to ensure that weatherization measures can be installed safely. Without appropriate support for these improvements, low-income and disadvantaged residents (who are more likely to live in poor-quality housing) will be unable to access energy and zero-emission upgrades.[128]
- Incidental repairs, including roof, door, and window upgrades that are needed to ensure that standard weatherization measures are effective (e.g., air sealing may not work properly if a damaged window does not permit caulking or weatherstripping).[129]
- Electrical upgrades and "power efficient design" for homes that do not have sufficient capacity to support electric heating.

New York offers funding for electrical panel and wiring upgrades when paired with home energy improvements such as installing a heat pump clothes dryer, heat pump space heater, or HPWH.[130]

- Ductwork improvements to homes that are being retrofitted with central heat pumps.

The New Jersey Board of Public Utilities (NJBPU) launched a "holistic housing intervention" pilot program targeting lower-income households in Trenton, NJ. NJBPU worked with major electric and gas utilities in the state to combine health and safety repairs with energy efficiency measures in older homes that cannot participate in conventional energy efficiency programs. Residents can qualify for the program in several ways, including by showing proof of federal assistance programs or by living in a low-income census tract, and each resident works with a program coordinator throughout the application and upgrade process.[131]

POTENTIAL SOURCES OF FUNDING FOR PRE-ELECTRIFICATION MEASURES[132]

Federal: Subject to continued funding and appropriation, federal funding sources may include the Low-Income Home Energy Assistance Program (LIHEAP), American Rescue Plan Act (ARPA) grants, the U.S. Department of Energy (DOE) Weatherization Assistance Program (WAP), and the U.S. Department of Agriculture (USDA) Housing Repair Program

State: Appropriations, fuel fees, carbon market revenues

Utility: Ratepayer-funded efficiency and electrification programs

Regional: Northeast states may have access to revenues from the Regional Greenhouse Gas Initiative (RGGI) and ISO New England Forward Capacity Market (FCM)

ALL

Coordinate between agencies to consolidate and streamline incentive and financing programs to the extent possible. Examples include:

- Allowing customers to apply for multiple programs or incentives through a single application.

The Philadelphia Energy Authority's "Built to Last" program provides a comprehensive service for low-income homeowners, allowing them to access a range of home repairs, energy efficiency upgrades, and healthy home improvements through a single application. The program coordinates with partner organizations and state agencies to layer funding and implement necessary repairs and installations, including health and safety fixes, energy upgrades, and even rooftop solar.[133]

- Improving coordination between regulatory and incentive programs, referring customers subject to regulatory requirements, like building energy performance standards and zero-emission heating equipment standards, to available incentive and technical assistance programs.
- Aligning eligibility requirements such as income qualifications or equipment specifications across incentive programs.
- Layering incentives and financing from multiple sources (including state energy and housing agencies, regional and local governments, and utilities) to support different types of upgrades needed for whole-home electrification.

New York State Homes and Community Renewal (NY HCR) and NYSERDA partnered to create the Clean Energy Initiative, which provides incentives and technical support for zero-emission affordable housing.[134] Electrification retrofits are managed by NY HCR, and benefit from NYSERDA funding without the need to submit a separate NYSERDA application.

ALL

Streamline income verification for LMI and DAC programs, such as by:

- Using geographic areas to define eligibility, such as if a census tract meets a certain threshold, rather than determining eligibility at the level of individual households or buildings.

The Massachusetts statewide energy efficiency program, Mass Save, designates 21 equity communities in its most recent plan that have access to enhanced incentives and services.[135]

- Establishing categorical eligibility and allowing data matching with non-energy programs such as the Supplemental Nutrition Assistance Program or Medicaid, so that individuals who qualify for those benefits are automatically eligible for, or enrolled in, income-eligible home energy programs.

New York allows data sharing between the Office of Temporary Disability and Assistance (OTDA) and utilities. In 2024, the New York legislature passed a law that allows OTDA to share data on OTDA program participants (with participant consent) so that investor-owned electric and gas utilities can automatically enroll income-eligible customers in utility energy affordability programs.[136]

EO HFA

Provide technical and financial assistance to multifamily and affordable housing owners and public housing authorities. Such assistance can take a variety of forms:

- "How-to" guides with step-by-step information on phasing zero-emission retrofits into large buildings and incorporating zero-emission upgrades into the scope of other building projects.
- Case studies with technical and cost information.
- Guidance on planning upgrades to complete during tenant turnover to minimize tenant disruption.
- Guidance on how to implement "power-efficient design" strategies[137] to reduce peak building electricity demand and enable zero-emission upgrades without triggering electrical panel and service upsizing, which is often costly and can hamper heat pump installation.
- Guidance on calculating utility allowances in subsidized multifamily housing to more accurately account for efficient heat pumps (rather than electric resistance technology that costs more to operate), to make upgrading to heat pumps more financially attractive to property owners.[138]
- Opportunities to "pilot" upgrades in one unit to assess implementation issues and get resident, onsite staff, and property owner feedback before expanding upgrades to the whole building.
- Connections to project managers or external organizations who can assist with creating a plan and communicating with tenants about the benefits, operation, and maintenance of zero-emission equipment.
- Technical assistance and funding for ongoing operation and maintenance of zero-emission equipment in multifamily buildings.

NYSERDA developed a Retrofit Playbook for Large Buildings[139] that provides step-by-step instructions and resources to help large buildings decarbonize. NYSERDA also offers a separate FlexTech Program that provides cost sharing and project support for building owners to conduct site-specific studies to identify zero-emission opportunities, reduce energy bills, and create long-term energy plans.[140]

EO HFA PUC EDA

Offer targeted incentive programs for the systems and technologies unique to multifamily buildings. Improving the value proposition of zero-emission measures is particularly important for affordable housing developers, who operate on low margins and often cannot afford complex upgrades. Program administrators can offer incentives for a variety of upgrades in multifamily buildings, in addition to commonly installed in-unit HPWHs and ASHPs:

- Building management systems that enable facility managers to monitor and improve energy efficiency.
- Window heat pumps that can replace window AC units, with the caveat that landlords who transition their buildings from a central heating system to heating for individual units deduct the previously covered heating costs from tenants' rent.[141]
- Central HPWH equipment instead of in-unit HPWHs to make installation and maintenance more convenient and avoid in-unit space and noise issues – particularly in buildings with preexisting central water heating systems.[142] Central HPWHs are relatively new and would likely require pilot funding and ongoing technical support.

Maryland's Multifamily Energy Efficiency and Housing Affordability Program offers funding for affordable multifamily buildings under two income-based programs: the EmPOWER program, which focuses on reducing gas and electricity consumption, and the Greenhouse Gas Reduction Program, which provides funding for the installation of zero-emission equipment in multifamily buildings to reduce GHG emissions.[143]

- Submetering infrastructure (to encourage residents to reduce electricity use while maintaining lower costs from utility-managed master metering).[144] Any addition of submetering to a master-metered building should be carefully managed to ensure that tenants who will be paying utility bills for the first time are aware of the change, understand how to achieve savings, and enroll in any opt-in programs that may reduce their utility bills or provide other direct customer benefits. Additionally, there should be careful enforcement to ensure that submetered customers are aware of their utility billing rights.

EO HFA PUC EDA

Work with lenders to expand financing options to enable affordable multifamily buildings to upgrade to zero-emission equipment, including predevelopment capital to assist building owners with early-stage work such as scoping, permitting, auditing, and engineering. Owners of small-to-midsized buildings may not be able to front predevelopment costs, even if they can secure loans to fund the rest of the project. Because predevelopment loans are smaller, short-term, and generally riskier, they are good candidates for green bank funding.[145]

EO HFA PUC

Reduce risk for LMI customers by offering affordability guarantees when zero-emission measures are installed.

The New York EmPower Plus Guarantee pilot program ensures that participants who fully electrify their homes pay no more than 6% of their income for post-retrofit electricity use. The guarantee can also apply to rental properties, and can be transferred to new tenants if the original participant moves, provided the new tenant meets the same income eligibility requirements.[146]

EDUCATION, AWARENESS, AND ACCESS

The recommendations in this section are aimed at increasing consumer awareness of zero-emission heating equipment and improving access to program offerings.

GO EA EO

Deliver consumer campaigns that increase awareness of zero-emission technologies and combat misinformation about heat pump costs, viability in cold weather, sizing, and other topics. Strategies can include:

- Collaborating with utilities, program administrators, and other partners on statewide or regional campaigns that provide consistent and compelling messaging about the health, comfort, and affordability benefits of clean heat.
- Addressing misinformation through online and social media engagement and by working with trusted organizations to disseminate information through earned media, op-eds, and customer testimonials.
- Developing and implementing "train the trainer" programs that equip contractors and residents to coach others on the benefits and process of upgrading to high-efficiency heat pump equipment.

GO EA EO

Create "one-stop-shop" hubs and clearinghouses where homeowners, other building owners (including multifamily and affordable housing owners), and contractors can find comprehensive information on building programs and financing. Hubs can provide:

- Educational information about building improvement measures, zero-emission technologies, and associated air pollution, health, and energy bill benefits.
- Links to schedule an energy assessment.
- Cost estimates and case studies, including tools to help building owners compare the cost of immediate versus deferred upgrades.
- A searchable database of incentive and financing programs that can compile a comprehensive list of stackable incentives depending on customer-specific inputs. States should increase awareness of these resources by promoting them to renters, landlords, property owners, and other stakeholders.
- Links to connect with approved contractors, such as contractors who participate in a trade ally network.
- Information on project costs, to improve transparency for customers and create downward pressure on contractor pricing.

The Switch Is On provides a one-stop resource for California consumers. As the comprehensive marketing partner for the California Public Utility Commission's TECH Clean California program, a statewide initiative to accelerate the adoption of clean water and space heating technology, The Switch is On provides a single source for information on zero-emission space and water heating, clothes drying, cooking, transportation, and more. Consumers can see the full range of incentives available to them by inputting details such as zip code, equipment of interest, and building type; they can also connect with contractors. In addition, The Switch Is On website provides information for contractors looking to find incentives or join a contractor network.[147] This resource is also available in Washington state.

EA EO PUC

Partner with CBOs and other trusted local messengers on outreach and marketing to ensure that communities that might otherwise be underserved have full access to programs and incentives, for example by offering language translation.

The Massachusetts Clean Energy Center (MassCEC) Home Modernization Navigator offers technical support and help navigating incentives and financing for owners and occupants of one- to four-unit residential buildings. The program, which is currently offered in two towns, focuses on outreach and support for renters, LMI residents, and environmental justice communities.[148]

EO DOL

Partner with manufacturers, distributors, and retailers to promote technology education. These market actors tend to have strong relationships with contractors and can provide a more trusted avenue to educate contractors on zero-emission technologies. States can work with upstream market actors to:

- Educate contractors on zero-emission technologies and common myths and misconceptions regarding reliability, cost, and cold-climate performance.
- Connect contractors with contractors in other states (such as Maine) who are successfully installing heat pumps in cold climates.
- Collaborate on sales and marketing strategies to educate consumers on the benefits of state-of-the-art zero-emission technologies.

California's Heat Pump Partnership brings together public agencies, utilities, and heat pump manufacturers, distributors, and retailers, to accelerate the state's heat pump market. In 2025, the Heat Pump Partnership published a blueprint to help California address barriers and take advantage of opportunities to increase statewide heat pump adoption.[149]

EO PUC

Help customers plan ahead for zero-emission upgrades like heat pumps and avoid emergency replacement scenarios. Specific strategies to encourage upgrading HVAC and water heating equipment before failure include:

- Designing programs to provide incentives for pre-electrification and zero-emission upgrades in homes where the existing heating system is over ten years old.
- Using LIHEAP flexibility to develop state programs that support HVAC repair, replacement, and upkeep, including consumer education about energy efficiency options, heater age checks, and electrification plans for homes with older heaters.[150]
- Partnering with local governments to use permit databases to target marketing and outreach toward owners of buildings that have not been issued an HVAC or water heater permit within the past ten years. States may also be able to obtain this information through emerging software that aggregates permit and property assessment data.[151]
- Offering loaner programs that temporarily install "plug and play" equipment such as gas water heaters or window heat pumps, to create a buffer period in an emergency replacement scenario so that residents can take the time they need to assess heat pump feasibility and implement any upgrades necessary for heat pump installation without losing access to heating, cooling, and hot water.

TECH Clean California funded a pilot project that offered customers in emergency replacement situations a no-cost methane gas water heater for temporary use. The plumbing company that implemented the pilot aimed to give customers extended time to undertake a larger HPWH upgrade. Among this company's customers, the program increased the proportion of HPWH upgrades from less than 1% to more than 17%.[152]

WORKFORCE DEVELOPMENT AND ECONOMIC EMPOWERMENT

The recommendations in this section identify actions states can take to engage contractors and other workers; create well-paid, high-quality jobs in residential building decarbonization; and meet growing demand for zero-emission equipment installations.

GO EO DOL

Form workforce advisory committees to guide state agencies on workforce needs, career pathways, labor standards, and training opportunities for building decarbonization workers, including HVAC, building envelope, electrical, and plumbing contractors. Committees should include representatives from contractors, apprenticeship and pre-apprenticeship programs affiliated with labor organizations, and labor organizations with knowledge of home electrification or weatherization workforce needs.

The New Jersey Business and Industry Leadership Team (BILT) convenes key stakeholders in the energy efficiency industry. Led by NJBPU and the NJ Department of Labor Workforce Development (NJDOL), BILT brings employers, contractors, technical training providers, labor unions, community-based organizations, and academic institutions together to assess the needs of the energy efficiency industry, align skill sets with training programs, and promote wraparound support networks aimed at creating long-term career pathways.[153]

EO PUC EDA

Support small businesses focused on energy efficiency and zero-emission upgrades by:

- Setting aside a portion of program funding for small businesses and for businesses and organizations based in disadvantaged communities.
- Creating programs that connect small businesses to community development or other financial institutions that can provide credit lines, loans, and other sources of funding to help contractors carry the cost of building upgrades until they can access available incentives.
- Supporting training on basic business skills, access to working capital, and business system development as part of the curriculum for energy education programs.
- Promoting joint ventures or mentoring programs between new and established businesses by providing preferential contracts, requiring vendors to include small business purchasing plans in state procurement opportunities, or other mechanisms.

The Massachusetts Equity Workforce Program helps minority and women-owned businesses successfully bid on clean energy projects through a network of support programs established throughout the state.[154]

EO PUC

Encourage aggregation of work across multiple buildings or households within a neighborhood to allow for higher labor standards. For example, incentives could be offered for contracts that aggregate multiple smaller jobs into a single bid (e.g., installing heat pumps across the whole portfolio of buildings owned by a public housing authority or private landlord). Aggregation can help achieve the scale needed to incorporate project-specific labor agreements between construction unions and employers, take advantage of apprenticeships, accelerate workforce training and development, and incentivize high-quality contractors to pursue work in the residential sector. Similar labor standards should be incorporated into programs that already support large-scale projects, such as large multifamily building retrofits.

California's Equitable Building Decarbonization Direct Install Program requires program administrators to group projects for economies of scale and to encourage local contractor participation. It also includes minimum training and experience requirements for contractors to ensure high-quality installations and to support the creation of local, high quality jobs.[155]

GO EO DOL EDA

Equitably grow the workforce and enhance job quality by expanding apprenticeship and training programs, supporting access for new entrants to the workforce, and encouraging high-quality compensation (e.g., competitive wages, benefits, advancement opportunities, and work culture). These efforts should focus on people from historically underrepresented backgrounds, including women, communities of color, and low-income individuals. States can support equitable workforce expansion and development by:

- Increasing funding for apprenticeship programs and other high-quality workforce development opportunities.

The Maine Governor's Energy Office Clean Energy Partnership has disbursed more than $2 million for clean energy workforce development since 2022 using funding from the Maine Jobs and Recovery Plan (leveraging ARPA money). The state plans to allocate portions of the technical assistance allowance within other federal grants to sustain this work.[156]

- Maximizing career impacts for graduates of pre-apprenticeship and apprenticeship programs by fostering strong connections between training programs and contractors who participate in these markets. In some states, there is currently more interest in apprenticeship programs than there are contractors able to take on apprentices. State agencies can play an important role in connecting building decarbonization contractors with apprenticeship graduates, creating durable, easily navigated pathways from training programs to high-quality careers.
- Partnering with CBOs, labor organizations, state departments of labor, community colleges, trade schools, and high schools to disseminate information about energy efficiency trainings and career opportunities, while also expanding workforce development infrastructure, such as registered apprenticeship and pre-apprenticeship programs.

The Union Construction Academy of Maine (UCA)[157] is working with electrical and plumber unions to develop a training partnership with the state's four federally recognized tribes. The aim of this partnership is to offer training on heat pump installation and service, expand access to on-the-job learning opportunities in tribal communities, and help tribal members enter the unions' registered apprenticeship programs.

- Attaching prevailing wage standards to public funding for incentive programs, particularly those serving large buildings and neighborhood-scale projects, to support the creation of high-quality decarbonization jobs. Such jobs should pay family-sustaining wages commensurate with the wages available to previous generations of workers in the building trades.
- Funding wraparound services for training program participants, such as case management, childcare, transportation support, living wage stipends, and job placement, in addition to traditional certifications.[158]

Building Futures RI offers a pre-apprenticeship program that helps prepare individuals (particularly those from historically disinvested communities) to enter apprenticeship programs.[159] Graduates earn several relevant certifications and receive wraparound services such as case management, transportation support, and living wage stipends.

EO PUC

Create contractor networks within building decarbonization programs to support qualified contractors and make it easier for customers to find them.[160] States and program administrators can expand and improve the quality of contractor networks by:

- Drawing on joint labor/management apprenticeship training programs, existing manufacturer and distributor contractor channels, and community colleges to identify qualified contractors.
- Expanding training opportunities by offering trainings on topics such as heat pump sizing, refrigerant handling, power efficient design, and available incentives;[161] helping contractors be more successful in selling heat pumps through business and sales training (including broaching conversations with customers about proactively replacing aging equipment); and partnering with manufacturers and distributors to provide trainings and disseminate best practices.
- Coordinating with other states on contractor network requirements such as HVAC licensing requirements and training and certification programs to improve regional consistency in installation quality – particularly since many contractors work across state lines.

California offers reciprocal contractor license agreements with Arizona, Louisiana, and Nevada for many classifications, including general engineers, electricians, general residential and commercial contractors, plumbers, HVAC contractors, and more.[162]

- Ensuring that contractors in the contractor network, or on a related "preferred contractor" list, fulfill requirements such as carrying liability and workers compensation insurance, paying the state prevailing wage, committing to local hiring practices, working with registered apprenticeship programs, having a clean record regarding worker classification and wage practices, and having never been debarred or had any credentials revoked by a government agency. Additional support and flexibility for small businesses (such as assistance with proper bonding and insurance) can ensure that small contractors can still participate in these programs.

California's Equitable Building Decarbonization Direct Install Program mandates that program administrators provide retrofit "workforce plans" that meet at least three of the following criteria: comply with "skilled and trained workforce" standards per the Public Contracts Code; are based in the community or county; are small business or women, minority, disabled veteran, or LGBT business enterprises; participate in relevant state-approved apprenticeship programs; are party to a multi-craft community workforce and training agreement; or employ hiring strategies to create jobs for residents of under-resourced, tribal, or low-income communities, or individuals with barriers to employment. In addition, the program requires that at least a third of all workers on a project meet minimum training and experience requirements.[163]

- Creating a forum for contractors, labor organizations, and training centers to inform program design, share knowledge with each other, provide feedback to state agencies on real-world challenges, and access relevant educational materials and training opportunities.

Efficiency Vermont's "Efficiency Excellence Network" (EEN) provides a training and communications forum for over 600 contractors, distributors, and suppliers.[164] Through the EEN, a team of relationship managers works to increase contractor participation in new technology trainings, support high-quality heat pump installations, address distrust of zero-emission technologies, and keep contractors updated on programs, rebates, and other resources.

Carbon Reduction Obligations

This section focuses on recommendations related to carbon reduction obligations, including climate goals and clean heat standards, as well as GHG emission caps and phase-down requirements. These types of policies set clear decarbonization targets and require regulated entities that serve the building sector, such as fuel suppliers, gas utilities, and entities handling refrigerants, to reduce GHG emissions or provide clean heat services.

With the right safeguards to promote equitable implementation, these policies can ensure that building sector GHG emissions decrease over time in line with targets, make fuel suppliers that contribute to pollution pay for building retrofits that reduce pollution, encourage market actors to change their business models, generate health co-benefits from reduced air pollution, and create sustained, long-term incentives that unlock resources for the transition to zero-emission buildings.

SETTING GOALS AND TRACKING PROGRESS

Setting clear goals and benchmarks to measure program success and making progress towards those benchmarks visible to the public can help states meet climate goals. States can utilize the following recommendations to measure progress and build public trust.

SL EA EO PUC

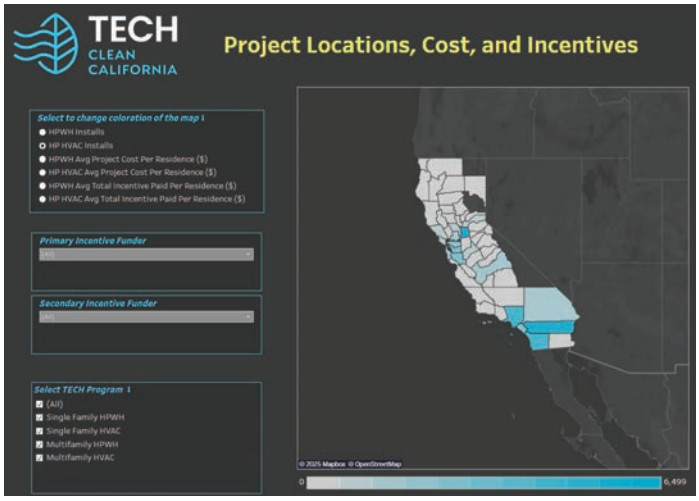
Establish and track progress towards measurable and enforceable targets for decarbonization and equity. Progress should be tracked on a statewide basis and within individual state and utility programs.

- Decarbonization goals should be set and measured in meaningful units, ideally in terms of GHG emissions reductions. This may involve updating targets in regulated energy efficiency programs so that they are fuel-neutral (e.g., measured in GHG reductions or total British Thermal Units (BTUs) of energy saved), rather than in fuel-specific terms (such as kilowatt-hours (kWh) in the case of electricity, or therms in the case of methane gas).
- Equity goals can be set in terms of program outcomes (e.g., heat pumps installed, households served, energy burdens reduced, or health hazards eliminated) in LMI households and targeted communities (where targeted communities could include designated environmental justice communities, renters, people living in mobile and manufactured housing, etc.). While it is better to measure equity impact on the basis of outcomes, at a minimum, a set level of program spending can be dedicated to serve these households and communities.

GO EA EO PUC

Make data related to state decarbonization, health, and equity targets publicly available in a timely manner. Information transparency enables the public to track progress toward state goals and observe follow-through on commitments. Data can also inform decision-making, for both consumers and policy makers, by shedding light on the real-world costs and savings associated with heat pump installations.

TECH Clean California publishes data on heat pumps for space and water heating throughout the state for public use. Information available to the public includes number of heat pump space and water heaters installed by county, average project cost per residence, and average incentive amount received per residence. In addition, the database shows allocated and utilized spending through state incentive and grant programs, with additional transparency regarding funding reserved for and paid to support equity-related projects.[165]



CLEAN HEAT AND CAP-AND-INVEST STANDARDS

Market-based policies like clean heat standards (CHS) and cap-and-invest programs are typically designed to achieve emission reductions within a set timeframe while also generating funding for decarbonization initiatives. Implementation of these policies often starts with reporting requirements to establish an emissions baseline; the state can then develop sector-specific or economy-wide emission reduction programs, depending on its priorities. States can consider a variety of policy approaches to impose binding performance obligations on heating fuel suppliers, whether in terms of delivering GHG reductions or providing clean heat services, at a pace that aligns with the state's decarbonization targets for the residential sector.

SL EA EO PUC

Establish reporting requirements for fuel suppliers. These requirements apply to methane gas utilities and/or suppliers of delivered fuel (e.g., heating oil, propane) and lay the groundwork for future implementation of carbon reduction obligations like CHS or cap-and-invest policies. Many states lack data on fuel use in the building sector and associated emissions, particularly with respect to the consumption of delivered fuels, because these suppliers are not regulated by PUCs. States can require fossil fuel suppliers to report fuel quantities and/or associated GHG emissions for all fuels sold, transferred, or delivered to end users in a state.

To enable GHG emissions tracking, Massachusetts requires heating fuel suppliers to report emissions data to the state's Department of Environmental Protection on a quarterly basis; operators of heating fuel storage facilities must report fuel shipment data on a monthly basis.[166]

SL EA EO PUC

Enact clean heat standards and/or cap-and-invest policies covering the thermal sector. Such policies can be designed to phase down heating emissions at a pace that aligns with state decarbonization and air quality targets and timelines.

- CHS policies require fuel suppliers to deliver clean heat options to customers; under these policies, progress is often measured by the quantity of emission reductions achieved through various clean heat measures.[167] CHS policies can be designed to offer flexibility for fuel suppliers by recognizing a variety of options for meeting clean heat targets, such as installing heat pumps, completing energy efficiency or weatherization projects, and building thermal energy networks. They can also be implemented with or without credit trading (without trading, each heating fuel supplier is responsible for achieving the requirement; with trading, suppliers who exceed the requirement can sell credits to other suppliers). Finally, CHS policies can be designed to incorporate equity requirements.[168]

In 2021, the Colorado legislature passed a bill that requires methane gas utilities to file clean heat plans with the state PUC that reduce GHG emissions 4% below 2015 levels by 2025 and 22% by 2030, without increasing utility bills above 2.5%.[169] In 2024, the Colorado PUC approved a proposal by the state's largest utility to meet GHG reduction targets primarily through electrification and energy efficiency, with 20% of the utility's investment to take the form of rebates for low-income households.[170]

- Economy-wide cap-and-invest policies establish a limit ("cap") on statewide GHG emissions and require polluters to reduce their own emissions accordingly or purchase GHG allowances. Cap-and-invest policies can be designed to cover heating fuel suppliers and generate funds for building decarbonization programs. Among MOU states, California and Oregon have implemented economy-wide cap-and-invest policies, and New York is currently developing one. Under these policies, proceeds from GHG allowance sales are used to fund decarbonization projects, including energy efficiency and weatherization.[171] Additionally, 11 states in the Northeast belong to the Regional Greenhouse Gas Initiative (RGGI), a cap-and-invest program focused on power plant emissions. Many RGGI states have used funding generated through allowance auctions to fund building decarbonization programs.

Credit trading policies and equity

While CHS and cap-and-invest programs with credit trading may meet less resistance from fuel suppliers because of the additional flexibility they provide, credit trading mechanisms can create significant equity issues if not thoughtfully designed. NESCAUM's EJAG has recommended that any policies that include trading or offset provisions, such as CHS or cap-and-invest, should be structured to ensure that benefits to environmental justice and disadvantaged communities are proportionate to the benefits realized by other communities. This can be achieved by, for example, requiring a minimum number of credits to be earned through zero-emission equipment installations and energy efficiency improvements in environmental justice and disadvantaged communities.

Without guardrails, credit trading systems can exclude disadvantaged communities because it is often more costly to implement building improvements in these communities. This may lead fuel suppliers to purchase credits rather than complete upgrades,[172] thereby creating or exacerbating "sacrifice zones" – that is, zones where air pollution remains high even as surrounding communities benefit from pollution reductions.[173] By contrast, properly designed programs, including CHS with credit trading and equity carve-outs, can generate emission reductions and energy savings in communities with some of the lowest-quality, highest-emitting building stock, and ensure that all residents benefit from air pollution reductions.[174]

ADDRESSING REFRIGERANTS

Air conditioners and heat pumps use refrigerants to transfer heat. Synthetic hydrofluorocarbons (HFCs) are widely used as refrigerants in today's heat pumps because they are chemically stable, non-ozone-depleting, difficult to combust, and enable designs that perform well over a wide temperature range. However, most HFCs also have high global warming potentials (GWPs) – in some cases, hundreds to thousands times the potency of carbon dioxide.[175] While the GHG emissions from refrigerants in heat pumps are lower than the GHG emissions from emitting heating equipment,[176] management of existing HFC equipment and a careful transition away from high-GWP refrigerants and toward climate-friendly alternatives is important to mitigate potential climate harm and maximize the benefits of heat pumps.

HFCs are currently being phased down, internationally and domestically. EPA has promulgated several regulations under the AIM Act, including the Technology Transitions (TT) Rule,[177] which limits the GWP of refrigerants in new residential and light commercial ACs and heat pumps to 700 (reducing their warming impact by almost 70%), and the Emissions Reduction & Reclamation Rule, which requires HFC leak management and recovery. While this is significant progress, more work is needed to ensure that buildings meet state emission targets, particularly since refrigerant emissions are expected to rise as demand for heat pumps increases.

Until 2025, R-410A was the most common refrigerant in heat pumps and ACs; under the TT Rule, the residential HVAC market is shifting to mid-GWP refrigerants such as R-32. R-410A has a 100-year GWP of 2,088 while R-32 has a GWP of 675 based on the IPCC's Fourth Assessment Report (AR4). AR4 GWP values are used under the AIM Act and under the Montreal Protocol.

The recommendations in this section identify steps that states can take to accelerate the transition to lower GWP refrigerants (including refrigerants with GWPs under 10) while also improving the management of existing refrigerants by limiting leaks and promoting responsible HFC recovery, reuse, and disposal.

<4%

OF REFRIGERANTS are reported as reclaimed nationwide[178]

27%

OF ALL U.S. FLUORINATED GAS EMISSIONS are produced by the residential sector[179]

15.8M

METRIC TONS OF $CO2_e$ EMISSIONS are produced by residential-sector HFC emissions in MOU states each year[180]

SL GO EA EO

Update state definitions of zero-emission buildings (ZEBs) to account for refrigerants. As direct and indirect building emissions decline in response to zero-emission equipment upgrades and clean energy improvements, refrigerants may become the largest remaining source of emissions. Including refrigerant emissions in ZEB definitions will encourage developers, owners, operators, and other stakeholders to select equipment that uses refrigerants with the lowest GWP possible. States should also explore opportunities for multistate coordination to promote consistency in the definitions of terms like "ultra-low-GWP" and "zero-emission building."

SL GO EA EO

Improve lifecycle refrigerant management including leak management, recovery, and reuse, as well as destruction when the refrigerant becomes obsolete.[181] Despite federal laws to prevent the intentional venting of HFCs during equipment servicing or disposal,[182] enforcement is lax in the residential sector and HVAC contractors often have little incentive to properly recover refrigerant.[183] Key actions to improve refrigerant management, reclamation, and reuse include:

- Adopting laws and regulations that promote the reuse of reclaimed HFCs. For example, the use of virgin or newly produced HFCs could be restricted and equipment in state-owned buildings could be required to use reclaimed HFCs.

California's Senate Bill (SB) 1206 restricts the use of virgin or newly produced HFCs on a prescribed schedule with earlier restrictions for high-GWP HFCs, while allowing the use of reclaimed HFCs in all equipment. SB 1206 also requires that the California state government lead by example by requiring that all HFCs with a GWP greater than 750 used in equipment in state-owned buildings must be reclaimed.[184]

- Improving training for service technicians on proper refrigerant installation, leak detection, and reclamation techniques.
- Offering incentives and technical assistance to help HVAC service technicians, consumers, and municipalities track and document refrigerant recovery and disposal for decommissioned ACs, heat pumps, and dehumidifiers. Contractors and community groups have described a lack of financial incentives or adequate recycling equipment as causes of illegal refrigerant venting.[185] States can fund these initiatives by setting up extended producer responsibility (EPR) programs that require refrigerant and equipment manufacturers to pay into a fund or organization that in turn incentivizes service technicians to return refrigerants for reuse.
- Requiring annual reporting and recordkeeping for entities in the refrigerant supply chain – e.g., distributors, wholesalers, reclaimers, service contractors, and technicians – to collect accurate data on refrigerant purchases, sales, recovery, recycling, reclamation, and destruction. This may involve requiring that refrigerant materials are traceable through the supply chain so that they can be tracked and sales can be attributed to specific supply chain entities.

SL EA

Adopt state-level legislation or regulations to support full implementation of the AIM Act and facilitate a full market transition towards low-GWP refrigerants. Key elements of this approach include:

- Adopting state laws and regulations that align with the HFC phasedown timeline specified in the AIM Act to provide regulatory certainty should rollbacks occur at the federal level. To date, more than 15 states have adopted regulations or legislation to codify some portion of the initial HFC phasedown.[186]

The New York State Department of Environmental Conservation updated an HFC regulation to lower the GWP limit for refrigerants used in air conditioning and heat pumps to 700 starting in 2025. The GWP limit will fall to 10–20 starting in 2027, meaning that near-zero refrigerants will be required within the next few years. The rule was developed as an implementation measure under the New York State Climate Leadership and Community Protection Act.[187]

Refrigerants are rated on a flammability scale from A1 to A3. Under the TT rule, the HVAC market is transitioning to lower-GWP, mildly flammable A2L refrigerants (e.g., R-32 and R-454B). Most ultra-low GWP refrigerants, such as R-290 (propane) are rated as higher flammability A3 refrigerants. R-290 refrigerants are already widely and safely used in heat pumps in Europe. To be used in the U.S., heat pumps with A3 refrigerants need to go through safety testing with American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and Underwriters Laboratories (UL).

- Establishing dates by which the industry must shift to ultra-low-GWP refrigerants, which are already commonly used in Europe and other parts of the world for heat pump space and water heating,[188] and setting GWP limits for refrigerants used in water heating equipment.

California's Senate Bill (SB) 1206 establishes 2035 as the year by which the state should transition off high-GWP refrigerants. It directs the California Air Resources Board to assess how to transition the state's economy away from HFCs and toward ultra-low-GWP or no-GWP alternatives no later than 2035, and to initiate a rulemaking to that effect where practicable. SB 1206 also places prohibitions on the sale of newly produced refrigerants above certain GWP thresholds on a phased schedule, with a more stringent timeline for state-owned equipment.[189]

EA EO

Support safety testing, research, demonstration, and deployment efforts for heat pump technologies that safely use ultra-low GWP A3 refrigerants. States can support efforts to advance UL listing and ASHRAE 15 updates for heat pumps with ultra-low GWP A3 refrigerant by:

- Funding and supporting, potentially through multistate collaborative efforts, safety testing, demonstration projects, and risk assessment research on A3 refrigerant use in common types of heat pump equipment. The initial focus should be on technologies that can safely use A3 refrigerants, such as residential monobloc air-to-water heat pumps (self-contained outdoor units that keep all refrigerants outside the occupied space) and direct small-charge systems in window heat pumps and HPWHs that use very small amounts of refrigerant.

The California Air Resources Board matched funds with industry groups to jointly fund an Air-Conditioning, Heating, & Refrigeration Institute (AHRI) research project to evaluate safety needs for A3 refrigerants for commercial refrigeration equipment.[190]

- Harmonizing state safety standards with international safety standards, such as the International Electrotechnical Commission's standard 60335-2-40, which allows up to one kilogram of R-290 in air-source heat pumps and five kilograms in air-to-water heat pumps where the refrigerant is located outdoors.[191,192]
- Working with local code officials to allow demonstration projects within their jurisdictions.

SL EO

Remove barriers to low-GWP refrigerants by enacting legislation to allow the use of refrigerants such as A3s in equipment that meets safety standards under UL 60335-2-40 and ASHRAE 15, as well as applicable environmental standards. Specifically, states can take the following steps:

- Passing legislation to specify that no provision of the building code, or other local code, may prohibit or otherwise limit the use of AC or heat pump equipment allowed under nationally recognized safety standards. Many states have already made similar updates to building codes to allow the use of mildly flammable A2L refrigerants.[193]

Currently, the EPA Significant New Alternatives Policy Program (SNAP) reviews ASHRAE and UL changes and approves them as acceptable, at the federal level, for refrigerants used in refrigeration and AC equipment. Allowing the use of refrigerants that have a UL listing and meet ASHRAE 15 could streamline the refrigerant approval process and enable states to continue using more efficient and lower-GWP refrigerants, even if the SNAP program is discontinued.

Prevailing charge limits in the U.S. prohibit manufacturers from selling residential equipment using A3 refrigerants (despite common indoor propane combustion for cooking and heating), even if all the refrigerant is contained in an outdoor unit that presents little flammability risk.[194]

- Updating mechanical codes to allow ultra-low GWP refrigerants for heat pumps in alignment with safety standard harmonization efforts.[195]
- Publishing technical guidance for local code officials and offering training to ensure that these officials are up to date on refrigerant safety standards once standards are updated.

EA EO

Invest in workforce training on refrigerant management, reclamation, and disposal. States should invest in training technicians on how to manage leakage, high pressure, flammability risks, and other specific characteristics of new refrigerants, and to maximize emission benefits. States can also institute training requirements for HVAC contractors to ensure they are following the best refrigerant handling practices and complying with the law. States and program administrators who support heat pump contractor networks should ensure that education on refrigerant management and reclamation is included in training curricula for participating contractors.

Codes and Standards

Establishing firm timelines for bringing improvements to market will provide clear regulatory signals that spur change in technologies and building practices. Mandatory policies such as building codes, building performance standards, and equipment emissions standards each set requirements for different intervention points in the lifecycle of a building, and require building owners, builders, and equipment manufacturers to meet a certain level of building or technology performance.

Codes typically set standards for new construction or major retrofits, while building performance standards apply to existing buildings and require owners of buildings that are not in compliance to make energy upgrades by a certain date. Emissions standards apply to space and water heating equipment that is sold or installed after a certain date, ensuring that when a polluting piece of equipment reaches the end of its lifetime, it is replaced with a new product that meets stricter emissions requirements.

BUILDING CODES

The recommendations in this section identify ways for states to promote energy efficiency and decarbonization in new construction and retrofits, while maintaining housing affordability. Frameworks for state and local authority to set energy codes differ from state to state, so these recommendations should be adapted to each state's unique context.

EO

Update building energy codes to incorporate high standards for energy efficiency and emissions. Different agencies, including departments of state, labor, and safety, are in charge of developing and updating building, energy, and mechanical codes in different states. In most states, energy offices can collaborate with code-setting agencies to improve the energy performance of new buildings and major renovations by:

- Adopting the latest energy codes for residential buildings, based on the most up-to-date International Energy Conservation Code (IECC) and/or ASHRAE 90.1 model codes, to ensure maximum energy efficiency in new construction and renovation. States should also ensure that energy codes are regularly updated in accordance with IECC code updates.
- Updating statewide building energy codes to encourage building decarbonization by adopting electric-ready and/or zero-fuel-bias codes. Electric-ready energy codes require that buildings have the electrical infrastructure, wiring, and capacity to support zero-emission heating and other uses (e.g., EV charging, cooking, and clothes drying), thus significantly reducing structural and cost barriers to future zero-emission technology installation.[196] Zero-fuel-bias codes support zero-emission new construction by requiring all buildings to reach the same efficiency objectives regardless of the fuels they use. This addresses the historical practice of allowing buildings with emitting equipment to use far more energy than zero-emission buildings.[197]
- Updating building and mechanical codes to allow the use of A3 refrigerants in heat pump equipment that meets ASHRAE and UL safety standard requirements.

The *California Restaurant Association v. City of Berkeley* decision in the U.S.Ninth Circuit held that the Energy Policy and Conservation Act (EPCA) preempts a municipal building code that effectively precludes energy use of covered appliances, where that energy is otherwise readily available at the point of use. However, federal district courts in New York recently declined to follow the *Berkeley* decision, and held in *Association of Contracting Plumbers of City of New York v. City of New York*, that EPCA does not preempt a local law barring use of fossil fuels in newly constructed residential buildings and, in *Mulhern Gas Co. v. Mosley*, that EPCA does not preempt a state law requiring the issuance of codes that prohibit the use of fossil fuel equipment in new buildings. See case updates from the Public Health Law Center Litigation Tracker.

EO PUC

Develop model stretch codes for local jurisdictions to adopt. Model stretch codes can be designed to achieve specific buildings goals, such as zero-emission, high-efficiency, low-carbon, or all-electric. All-electric codes can deliver cost savings for builders and homeowners by reducing the quantity of equipment that must be purchased and installed (e.g., when a gas furnace and central AC can be replaced by a single heat pump), while also eliminating costs associated with gas piping and new gas connections.[198] Such codes also prevent future expenses for electric retrofits. States can support municipalities in adopting codes that encourage zero-emission new construction by:

- Developing model stretch codes for new construction.

> **Colorado requires any jurisdiction updating its building code to also adopt model electric-ready, solar-ready, and (upcoming) low-carbon codes** at the same time.[199] While this approach is less stringent than adopting an all-electric energy code, it ensures that all new buildings can easily transition to all-electric systems while reducing legal risk.

- Reviewing and amending home rule to allow municipalities to adopt stretch codes. Some states may need to update home rule provisions to allow local jurisdictions to adopt codes that go beyond the statewide base code.
- Working with utilities, energy efficiency program administrators, and PUCs to offer efficiency programs that support energy code adoption, training, and compliance, such as by allowing utilities to attribute savings to activities in support of code updates and enforcement.[200]

> States can develop model stretch codes as a tool for municipalities that want to go beyond the base code; stretch codes are optional for municipalities to adopt but, once adopted, any new buildings or major renovations in the jurisdiction must meet the stretch code requirements.

EO

Update electrical codes to enable power efficient design strategies that reduce the need for electrical upgrades. Power efficient design can avoid unnecessary and expensive electrical upgrades by keeping a home's instantaneous electrical use within panel and service constraints. States can update electrical codes to enable power efficient design by:

- Adopting the latest model electrical code (including expeditious adoption of the 2026 model National Fire Protection Association (NFPA) 70, National Electrical Code)[201] to better enable deployment of energy management systems that can control electrical end uses.
- Revising state energy and electrical codes to reduce overestimates of electrical service and feeder loads, such as by utilizing nameplate ratings for large appliance loads rather than default values, calibrating demand factors to real-world energy consumption data, and clarifying the effects of energy management systems and circuit controllers on energy load.[202]
- Ensuring that electrical safety authorities who oversee compliance with electrical codes have streamlined processes to approve the use of key power efficient design technologies (such as power control systems).

> **Power efficient design** refers to strategies that reduce a building's instantaneous electricity use, including energy efficiency measures, proper equipment sizing, and energy use management.

BUILDING ENERGY PERFORMANCE STANDARDS

Energy or emissions performance standards, along with associated requirements for benchmarking and disclosure of energy performance, are a tool for advancing decarbonization in existing buildings. They can also encourage innovation and investment in clean technologies in the real estate sector.

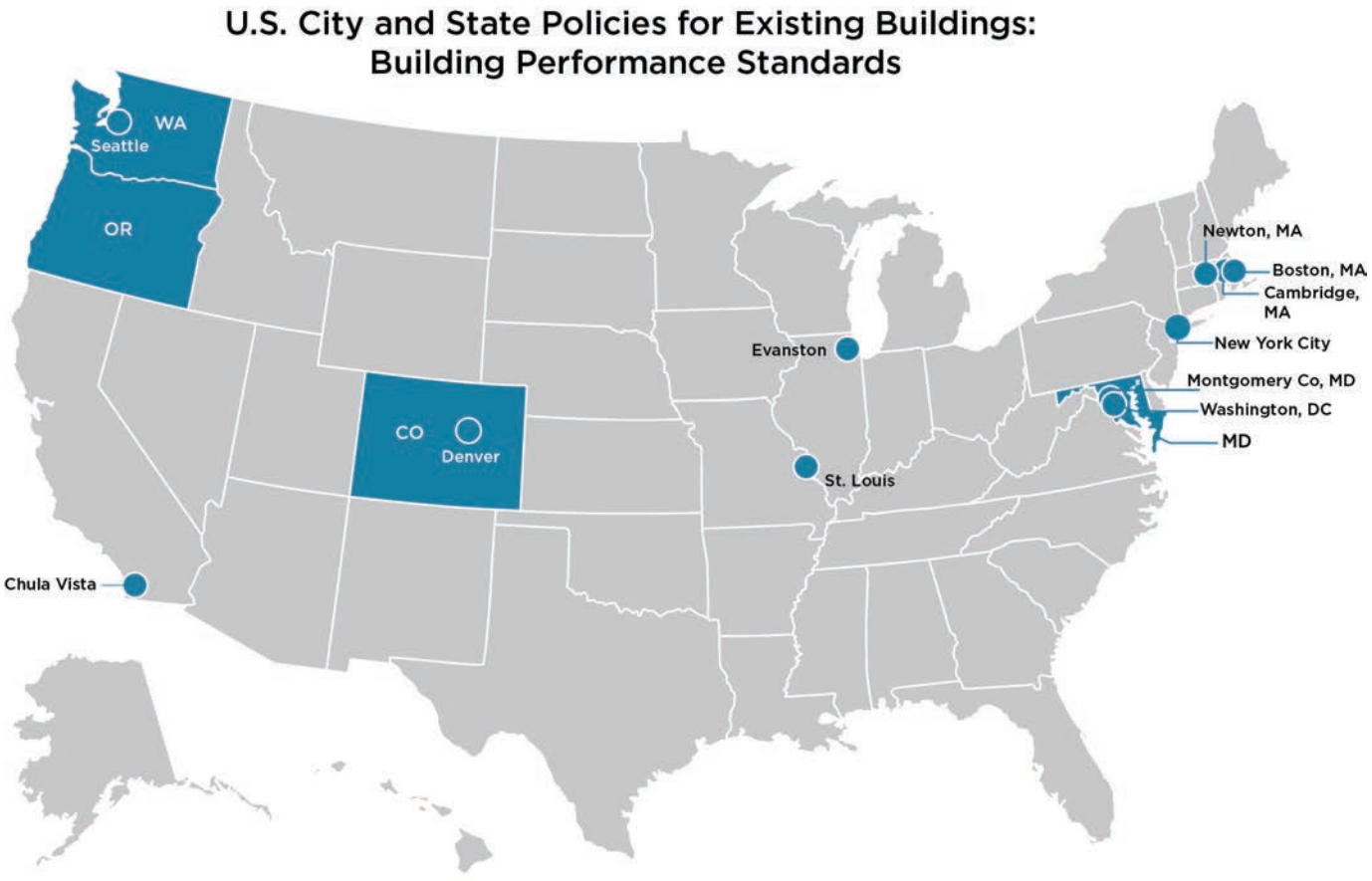
EA EO

Require energy benchmarking and disclosure for large buildings (e.g., 25,000 square feet or larger), including multifamily buildings, on a statewide basis. Benchmarking can be a good starting point for states that are considering whether to adopt building energy performance standards because it requires building owners to calculate and monitor their energy use, setting a baseline and highlighting opportunities for improvement. Benchmarking data can be made publicly available and can be used to target policies, programs, and funding toward a state's most energy-inefficient large buildings. Furthermore, benchmarking has been shown to improve building performance simply by drawing building owners' attention to how their buildings perform compared to others, using metrics like energy use intensity.[203]

GO EA EO

Adopt statewide building energy performance standards (BEPS), also known as building performance standards (BPS), for existing large buildings. These policies often start with benchmarking but add requirements – for example, to reduce direct building emissions and/or energy use intensity – that increase in stringency over time.[204] BEPS give building owners the flexibility to gradually reduce emissions via measures that work best for their property, rather than requiring them to follow a specific path.

The Maryland Department of the Environment has begun implementing a statewide BEPS. It requires benchmarking and reporting for large buildings beginning in 2025, with limits on direct emissions taking effect in 2030. By 2040, nearly all large buildings will be required to meet zero-emission limits or be subject to an alternative compliance fee for their excess GHG emissions.[205]



GO EA EO HFA

Offer technical and financial assistance to help building owners comply with BEPS and other applicable building and equipment standards. States can support BEPS compliance by working with program administrators to coordinate incentives and technical assistance for energy upgrades[206] and by developing new programs to help owners of multifamily buildings, and owners or operators of affordable housing in particular.

> **The Washington, D.C. Affordable Housing Retrofit Accelerator provides technical and financial assistance to help owners of affordable multifamily buildings** make a plan to come into compliance with the city's BEPS and access resources for building upgrades. The Retrofit Accelerator is a partnership between the D.C. Sustainable Energy Utility, the D.C. Department of Energy & Environment, and D.C. Green Bank.[207]

GO EO HFA

Require residential homeowners to provide energy performance disclosures at at time of sale or lease. Energy performance can be measured using established metrics such as the U.S. Department of Energy's Home Energy Score[208] or Home Energy Rating System (HERS) Index Score.[209] Disclosures may include historic utility bills, a description of the home's energy efficiency characteristics, and/or completion and disclosure of a home energy assessment.[210] This policy can create market pressure for home sellers and landlords to improve energy efficiency and protect home buyers and tenants from unexpected utility costs.

GO EO HFA

Require residential homes, rental housing, or other buildings not covered by BEPS to meet energy performance criteria at time of sale or lease. Time of sale is a key intervention point because energy upgrades can be more easily installed when the home is unoccupied. Exemptions for buildings that already have at least one type of zero-emission equipment, such as a heat pump, HPWH, or electric car charger, can help incentivize owners to make these upgrades prior to home sale.

> **Boulder, CO, requires rental housing to meet a basic energy efficiency standard** to earn a rental license. Compliance can be determined either by having a certified inspector survey the property, or by achieving a Home Energy Rating System (HERS) score of 120 or less.[211]

EQUIPMENT EMISSIONS STANDARDS

Emissions standards for equipment sold and installed by manufacturers, distributors, retailers, and contractors in a state or region are another important policy tool. They rely on longstanding state and regional air district authority to regulate air pollution within the framework of the federal Clean Air Act and state environmental statutes. Standards provide a direct signal to market actors about the pace of transition to zero-emission heating equipment.

EA

Set zero-emission heating equipment standards (ZEHES) for space and water heating. Under this policy, only space and water heating equipment with zero onsite GHG or air pollutant (e.g., NO_x) emissions can be sold and installed after a certain date. These standards usually do not require early replacement of functioning equipment

> Local authority to set ZEHES has been the subject of litigation, but a federal district court in California recently held in *Rinnai America Corp. v. South Coast Air Quality Management District (AQMD)* that the *Berkeley* decision does not apply to, and EPCA does not preempt, zero-NO_x standards adopted by South Coast because the standards regulate appliances' air emissions in order to meet federal air pollution standards, not limit appliances' energy use. See case updates from the Public Health Law Center Litigation Tracker.

in buildings; rather they ensure that polluting equipment is replaced with zero-emission alternatives, such as high-efficiency heat pumps, at the end of its useful life.[212] ZEHES, also known as healthy air standards, are a particularly important regulatory tool for states that have binding net-zero GHG targets or that have areas in nonattainment with NAAQS for ozone or $PM_{2.5}$. Setting the ZEHES compliance date at least 15 years before the state's net-zero target year can help states stay on track by preventing the installation of equipment that will lock in pollution for one to two decades after installation. By adopting ZEHES well in advance of their net-zero target date, states also send a clear signal to market actors and help prepare them for the transition to zero-emission equipment. NESCAUM has developed a model rule to support consistency across states in the design of ZEHES regulations.[213]

The Bay Area Air District amended existing NO_x regulations to include zero-NO_x emissions standards for residential-scale methane gas space and water heating equipment that take effect starting in 2027.[214] The amendments were designed to reduce NO_x emissions and secondary ozone and $PM_{2.5}$ formation in the San Francisco Bay Area. They also established an Implementation Working Group (IWG) composed of more than 40 stakeholders to provide guidance on implementation challenges. Bay Area Air District staff are required to compile IWG recommendations and provide a status update on overcoming implementation challenges every two years prior to a compliance date.[215]

AC TO HEAT PUMP POLICIES

While many building decarbonization policies focus on replacing emitting heating systems with heat pumps, AC installation and replacement also presents a critical opportunity for intervention – particularly because demand for cooling equipment is growing due to rising temperatures. While annual ASHP shipments exceeded furnace shipments in the U.S. in 2024, more central ACs were shipped than either ASHPs or furnaces.[216] The main difference between ACs and ASHPs is that "one-way" central ACs only provide cooling, while "two-way" heat pumps can provide heat as well as cooling. This section identifies several "AC-to-HP" policy options for requiring or encouraging customers to purchase two-way heat pumps instead of one-way AC systems.

SL EA EO

Enact AC-to-heat pump policies to shift purchases from central ACs to heat pumps. Encouraging a customer to purchase a two-way heat pump instead of a one-way AC when they are in the market for a new AC system presents a crucial opportunity for decarbonization, since that customer can also use the ASHP for zero-emission heating.[217] Policy options include:

- Removing efficiency rebates for central ACs and redirecting funds to heat pump incentives when possible.
- Passing legislation or adopting regulations to reduce emissions by encouraging new space cooling equipment manufactured, distributed, sold, or installed in existing and new homes to be two-way heat pumps. To achieve emissions and cost reductions, this policy should also include design requirements to ensure that the heat pump displaces the use of emitting heating equipment, for example by requiring controls that set the heat pump as the primary heating source and any other heating equipment as a supplemental heating source.

States should adopt AC-to-heat pump policies for the purpose of achieving air quality and climate benefits and ensure that these policies are carefully designed to avoid regulating the energy efficiency of the equipment covered, to avoid preemption under EPCA.

Vancouver, British Columbia has implemented an AC-to-HP policy that requires all new air conditioning systems to provide both heating and cooling through zero-emission heat pumps.[218]

- Updating building energy codes or developing model stretch codes that strongly encourage homeowners to install two-way heat pumps rather than one-way ACs in new construction and additions, and to replace central one-way ACs with two-way heat pumps during major renovations or end-of-life equipment replacement. Codes can be designed to specify that heat pumps are sized to cover a home's heating as well as cooling loads.[219] They can also set performance standards that encourage heat pump installation by requiring customers that choose to install ACs to complete additional upgrades to improve energy performance, such as air sealing and duct insulation.

The City of Denver has directed that its building code be amended to require the installation of heat pumps instead of unitary ACs in commercial and multifamily buildings when AC equipment is proposed to be replaced.[220]

Utility Planning and Regulation

Affordability is a top concern for states and for all stakeholders interested in accelerating the transition to zero-emission residential buildings. The recommendations in this section encompass a range of policy options within the utility regulatory space, many of which are crucial for affordability – and for unlocking funding for building decarbonization. Most of the policies in this section require action by PUCs; in some cases, action by state legislatures may also be needed to change regulatory and utility frameworks.

DATA ACCESS

Access to utility data is a key enabler of policy development and program implementation on several fronts. States and local governments need data on electricity and gas consumption, for example, to target energy efficiency and electrification efforts to specific communities and distribution grid feeders. Even more urgently, in many states and utility service territories, building owners' lack of access to data on tenants' energy consumption prevents them from being able to accurately benchmark the energy performance of their own buildings, assess peak electricity load and power efficient design options, and plan for retrofits. This is an issue for nearly all multi-tenant buildings, including multifamily and mixed-use buildings. Privacy concerns can be addressed by aggregating data so that no individual can be identified.

SL

Pass legislation requiring utilities to make energy consumption data available to authorized recipients.[221] This would allow owners of multi-tenant buildings to access aggregated whole-building energy use and peak demand data, while protecting customer privacy by aggregating this data at a reasonable threshold, based on the number of unique tenants within a building. Such legislation can also provide homeowners and other utility account holders with improved access to their own energy consumption data and make it easier for them to share their data with authorized third parties, such as energy service providers. Utilities can take advantage of data tools and standards like Green Button to provide data in consistent, easier-to-use formats.[222]

RATE REFORM

Rate reform is a critical action that states and PUCs can take to improve heat pump economics and accelerate the transition to zero-emission residential buildings. As electricity gets cleaner, the societal cost of using electricity declines relative to the societal cost of using methane gas.[223] In many states and utility service territories, however, current rate structures create a "spark gap" that sends the opposite price signal to customers. Rate design is particularly important for the Northeast states and California, where some of the highest electricity rates in the country prevent many households from realizing energy bill savings when they electrify, despite the high efficiency of heat pumps.[224] This section outlines rate reforms that states can advance to support zero-emission equipment and affordability.

GO EO PUC

Direct electric utilities to adopt rates that encourage zero-emission heating while adhering to cost-causation principles. In many states and utility service territories, heat pump customers pay disproportionately higher amounts toward fixed grid costs through their electricity bills over the course of a calendar year because they require more electricity in the winter for heating than non-heat pump customers who heat their homes with methane gas or other fuels. In most areas, the summer season is currently when grid costs to supply electricity are highest because of demand peaks caused primarily by air conditioning load. Because most utilities charge the same price for electricity year-round, standard electricity rates are generally designed to meet the needs of non-heat pump customers by offering artificially lower prices in summer and artificially higher prices in winter compared to the cost of serving load during each season. Those deviations from cost of service balance over the course of a full year to meet utilities' revenue requirements. As a result, customers with electrified heating are effectively overcharged in winter relative to their impact on the electric grid. PUCs can direct electric utilities to adopt rate designs that encourage the installation and use of zero-emission equipment by more equitably accounting for the electricity needs of heat pump customers over the course of a full year.

California offers qualifying IOU customers a special allowance to help offset increased electricity consumption resulting from electrification. Customers who rely on electric space heating or who take no methane gas service are entitled to the special allowance, which reduces electricity bills and is both seasonally adjusted and tailored to the electricity demand of specific climate zones.[225]

- **Seasonal rates** can be offered to all customers, or only to customers using a specific technology, such as heat pumps. Under seasonal rates, electricity prices would reflect the differing cost of providing electricity in the winter versus the summer. This incentivizes heat pump use for heating while maintaining a cost signal to reduce energy consumption during peak periods. There is significant precedent for setting seasonal electric heating rates – 88 utilities currently offer them.[226] PUCs can consider expanding on these offerings and/or targeting them specifically to heat pump customers, as opposed to customers using inefficient electric resistance heating. It is important to note that well-designed electrified heating rates will not increase costs or rates for non-electrified customers; in fact, heat pump customers use more electricity and bring in more revenue to pay for grid infrastructure, while enabling better utilization of the existing grid.[227] The demand assumptions underlying seasonal rate structures can be updated in each rate case to incorporate any changes to seasonal demand as more customers electrify their heating loads. In New England, for example, ISO New England projects that the system could shift to winter peaking by 2033, depending on weather, though winter peak growth can be mitigated and pushed further into the future through load management strategies.[228]

Central Maine Power launched a seasonal heat pump pilot rate with winter volumetric rates set at less than 9% of the base rate and summer volumetric rates set at twice the base rate. To afford the significantly lower winter rate, the utility also raised the year-round fixed charge for heat pump customers by around 50%.[229]

- **Lower volumetric charges**. Electric rates typically include two components: a volumetric charge based on the quantity of electricity consumed, and a fixed charge to cover base service to the customer. Many utilities recover most utility costs through volumetric charges.[230] While volumetric charges promote electricity conservation, they can discourage electrification. Decreasing volumetric charges and increasing fixed charges can better align rates with actual costs to the system, while resulting in lower winter heating costs for heat pump users.[231] This strategy represents a large shift in thinking about optimal rate design from common practice over the past decades and can give rise to equity concerns if lower-volume users experience increased energy costs. States can consider layering higher fixed charges with technology-specific and equity-focused strategies (discussed below) to mitigate unintended bill impacts.

California's new income-graduated fixed charge rate structure pairs fixed charges that change based on customers' incomes with lower volumetric rates. Fixed charges for market-rate customers increased to $24.15/month, while customers on existing energy assistance programs pay lower fixed charges (either $6 or $12 for customers on two different assistance programs). In conjunction, volumetric rates were lowered by 5–7 cents per kWh for all residential customers. This proposal seeks to deliver savings for lower-income ratepayers while still sending price signals for energy conservation.[232]

- **Time-of-use (TOU) rates** charge customers more for electricity during "on-peak" hours, when demand is high, and less during "off-peak" hours. Customers on TOU rates can lower their energy bills by shifting electricity-intensive activities such as water heating and EV charging to off-peak times, reducing peak demand and grid transmission and distribution costs.[233] TOU rates are more complicated for end uses like space heating, which are harder to shift to off-peak times of day. While much of the energy use for space heating occurs during current off-peak periods (e.g., night and early morning), it may not be practical to completely avoid space heating during peak periods – especially for people living in older, poorly insulated buildings. The timing of peak periods may also shift to include winter mornings as more customers electrify. While TOU rates can play a key role in mitigating peak demand and reducing grid stress, they can also be difficult for ratepayers to understand and/or they may rely on advanced metering infrastructure that not all utilities have installed. As a result, consumer education and potentially significant utility investments in grid modernization may be needed to realize full cost and grid benefits.

In Fort Collins, Colorado, technology-specific, seasonal, and TOU elements are combined in electric rate design for electricity service. Standard customers see several different rates throughout the year: summer on-peak, non-summer on-peak, off-peak, and an additional charge per kWh for consumption over 700 kWh per month. Customers with electric heating can opt into an electric heating rate, which offers slightly higher volumetric seasonal and on/off-peak rates but removes the tiered charge for consumption above 700 kWh. The city also provides financial assistance to customers who are unable to pay their energy bills and provides ample marketing and informational materials to explain the differences in rate classes to residents.[234]

SL PUC

Direct electric and methane gas utilities to incorporate equity and affordability elements in rate design. PUCs can direct utilities to adopt, or increase participation in, rate options including those listed below. PUCs may also need to consider the extent to which any of these options may cause under-collections that will materially affect the rates of other ratepayers.

- **Discounted utility rates for low-income households.**

> **The California Alternate Rates for Energy (CARE) program offers low-income customers up to 35% off their electricity bills.**[235]

- **Percentage of income payment plans (PIPPs)** that cap consumer energy bills at a set percent of the consumer's income. To streamline the application process, states can automatically enroll customers who qualify for LIHEAP, or other state assistance programs, in a PIPP.[236]

> **The Nevada Energy Assistance Program provides a fixed annual credit for income-eligible customers that is paid directly to the utility.** The credit reduces the percentage of household income spent on utility bills to the median percent of household income spent on utilities within the state as a whole.[237] In 2023, this meant energy bills were capped at 2.29% of household income.[238]

- **Progressive fixed charges** to ensure that low-income households don't pay a higher percentage of their income in fixed utility charges compared with high-income households. Instead of a single fixed charge for all customers, income-qualified households would pay a lower fixed charge.[239] The California income-graduated fixed charge discussed above is an example of this approach.

- **Bill protection guarantees** that protect customers – particularly low-income customers – against exposure to higher bills if they participate in alternative rate designs. Customers who pay more after switching to a different electricity rate can receive bill credits from the utility for the difference between their original and new energy costs for a period of time.

> **Silicon Valley Clean Energy offers bill protection for up to 12 months** to all customers who switch to time-of-use rates. Customers that pay more in energy bills in the first year after switching receive a bill credit making up the difference with the old rate and can switch back to the old rate if desired.[240]

- **Rates specific to multifamily buildings** reflect the fact that multifamily buildings tend to be easier than single-family homes for electric utilities to serve.[241] PUCs can require utilities to reduce rates or fixed charges for multifamily households to better reflect this smaller burden on the grid and deliver cost savings for residents in multifamily buildings that electrify. Utilities should also confirm that multifamily buildings are not being mistakenly enrolled in more expensive commercial rates, which can include costly demand charges that are not typically applied to residential customers.

> Multifamily buildings typically have less costly distribution infrastructure on a per-customer basis and less fluctuation in energy consumption due to weather (a multifamily unit only loses heat through a few walls whereas a single-family unit loses heat through all walls and the roof).

In Nevada, NV Energy offers a rate that is specific to residents of multifamily buildings who have separate meters within a multi-unit complex.[242] These rates are provided to individual ratepayers within multifamily buildings rather than building owners, ensuring that the financial benefit goes to households rather than landlords.

GO EO PUC

Establish an interagency working group to conduct research and make recommendations for short- and long-term rate design. Each state has a unique context for rate design based on existing electric and methane gas rates, utility infrastructure needs, peak demand periods, regulatory framework, and other factors. An interagency working group can bring key agencies and stakeholders together to determine the optimal mix of rate design elements to meet each state's emissions and affordability goals. While the PUC will ultimately need to approve rates for each regulated utility, a working group can also align stakeholder interests and identify best practices in advance, allowing for a more inclusive and proactive process and a more consistent approach to rate-setting across utilities than would be possible through individual utility rate cases. An interagency working group could also be charged with reviewing add-on charges on electricity bills (e.g., system benefit charges associated with renewable energy or nuclear power deployment) to ensure that each charge is reasonable and still needed.

The Massachusetts Interagency Rates Working Group is composed of members from four different state offices and agencies. It is responsible for developing and conducting stakeholder outreach covering current electric rates, near-term rate strategies, and long-term rate strategies.[243] In line with Working Group recommendations, the Massachusetts Department of Public Utilities (DPU) has developed plans for lower winter heat pump electric utility rates, one of which became available to ratepayers on March 1, 2025.[244,245]

SL EO PUC

Require that utilities increase enrollment in rates that reduce customer energy bills. For example, utilities can automatically enroll customers in electric heating rates if doing so reduces their energy bills, or utilities can note the amounts a customer would have paid under different rate structures on each bill. This can be accomplished through performance incentive mechanisms, such as Massachusetts' 2025–2027 statewide energy efficiency plan, which offers an equity performance incentive mechanism based in part on increasing enrollment in discount service rates.[246] These types of efforts can increase consumer awareness and uptake of beneficial rate structures.

CONSUMER PROGRAMS

Many zero-emission heating and hot water technologies currently have higher upfront costs than emitting alternatives. The recommendations below can assist states in designing or enhancing incentive programs to reduce cost barriers. They can also help states better align existing energy efficiency programs with emissions goals and ensure that incentive dollars are being effectively deployed.

EO PUC

Expand and redirect energy efficiency program funding toward zero-emission technologies and weatherization. Specifically, program administrators should phase out incentives for emitting heating equipment and one-way ACs, and expand incentives for zero-emission measures, including heat pumps and weatherization. Some states and regions might also consider increasing incentives for higher-efficiency heat pumps, such as variable-speed ASHPs and cold-climate ASHPs that are designed to work well at low temperatures.

In 2024, Mass Save eliminated rebates and 0% loans for methane gas, oil, and propane heating equipment, consistent with new legislation.[247]

EO PUC

Update energy efficiency program rules to allow fuel switching and substitution to zero-emission equipment. Where feasible, programs should:

- Provide incentives for customers to shift from equipment that operates on fossil fuel – including methane gas and unregulated fuels (e.g., oil, propane) – to zero-emission equipment that runs on electricity, such as high-efficiency heat pumps.[248] Historically, some efficiency program rules have prohibited fuel switching outright or restricted program administrators' ability to count energy savings associated with fuel switching. Regulators should update these rules to enable programs to better serve households that want to install zero-emission alternatives.
- Set energy efficiency savings targets in fuel-neutral terms (e.g., GHG reductions or total Million British Thermal Unit (MMBtu) savings), which as previously discussed, can also remove a barrier to fuel switching.

EO PUC

Target zero-emission equipment programs to customers using expensive fuels and technologies like oil, propane, and electric resistance, as these customers will realize the greatest lifetime cost savings from making the switch.[249]

EO PUC

Design incentives and rebates to reduce or eliminate the need for large out-of-pocket expenses for zero-emission projects, with a focus on LMI customers. Examples include designing incentives as instant discounts at time of sale and structuring state tax credits for zero-emission equipment as "direct pay" upfront payments rather than delayed tax credits claimed after the customer has filed a tax return.

EO PUC

Bundle information and incentives for zero-emission equipment and weatherization with distributed energy resources (DER), power efficient technologies, and other measures that can lower operating costs for customers and support a clean and resilient electricity system, including:

- Incentives to encourage customers to adopt power efficient technologies such as smart panels, circuit splitters, circuit pausers, and meter socket adaptors.[250]
- Community solar programs, which allow homeowners and renters to purchase a share in a solar project and achieve monthly electricity savings without installing their own solar array.[251]
- Demand response and virtual power plant (VPP) programs, where customers reduce, increase, or shift their electricity consumption in response to economic, reliability, or other programmatic signals. The change in energy consumption can be provided by a variety of behind-the-meter (customer-sited) DERs such as smart thermostats, heat pump water heaters, batteries, and EVs.[252] Demand response provides direct bill savings to participants while also creating benefits for non-participating customers by reducing overall grid costs through avoiding the purchase of expensive capacity (often from polluting peaker plants), and reducing transmission and distribution infrastructure upgrade needs.[253]

MIDSTREAM AND UPSTREAM PROGRAMS

The recommendations in this section relate to programs that leverage the supply chain – manufacturers, distributors, retailers, and contractors – to transform the heat pump market. Expanding equipment availability, reducing supply chain costs, growing the number of skilled workers,[254] and increasing contractor awareness of and comfort with zero-emission technology, can reduce the costs that are ultimately passed down to consumers. A variety of program approaches can be used to target market actors to achieve these goals.

EA EO

Design and implement midstream and upstream incentive programs for zero-emission technologies. In contrast to rebates paid to end-use customers (downstream incentives), these programs apply incentives higher up the supply chain: to contractors, retailers, and wholesale distributors (midstream incentives) or manufacturers (upstream incentives). Midstream incentives can also be passed through, in whole or in part, to customers as instant discounts at the point-of-sale. This approach can be used to reduce the upfront cost of zero-emission equipment rather than expecting customers to pay more at the point of purchase and then wait for a rebate payment on the back end. While additional oversight and rebate transparency may be needed to ensure rebates are passed through to consumers, well-designed midstream incentives can prompt enduring changes to the market while delivering multiple benefits, including:[255]

- Increased program participation, especially if upfront rebates are combined with prompt payments to contractors and distributors. Midstream incentives can also be used to leverage manufacturer and distributor relationships and expertise to increase contractor participation in heat pump training programs, improve contractor comfort with heat pumps, and ensure higher-quality installations, resulting in better outcomes for consumers.
- A faster market transition to zero-emission technologies by effectively engaging the supply chain with collaborative sales and marketing strategies that encourage contractors to recommend heat pumps to potential customers while improving contractor and customer understanding of heat pump technologies. Midstream incentives can also ensure that zero-emission equipment is consistently stocked by retailers and distributors and easy for contractors to access.

Efficiency Maine works with distributors to provide point-of-sale discounts on HPWHs for contractors and larger customers who purchase HPWHs directly from distributors. These midstream incentives motivate HPWH sales and incentivize distributors to collect and report sales data.[256] As a result, Maine has become a leader in HPWH installations, with HPWHs capturing more than 50% of the state's electric water heater sales in recent years (compared to 3%–4% nationally).[257]

MIDSTREAM PROGRAM BEST PRACTICES

Midstream programs can be strong market transformation tools if designed intentionally to maximize distributor and contractor participation. Best practices in midstream program design include:[258,259]

- **Simplified data collection.** Distributors and contractors are more likely to participate in midstream programs when data reporting requirements are easy to comply with.
- **Quick incentive payments.** Midstream programs often require contractors and distributors to bear the upfront expense of providing point-of-sale discounts to customers, and receive reimbursement only after successfully applying for the rebate amount. Slow rebate processing times can jeopardize contractor participation by requiring contractors to front large sums for the incentives. Payments should be made as soon as possible (well within a month) to enable contractor and distributor participation in incentive programs.
- **Account management.** Successful midstream programs offer robust support to help distributors participate in programs and answer questions.
- **Coordination on sales, marketing, training and inventory strategies.** Program implementers can collaborate with manufacturers and distributors on contractor training, offer joint promotions, and plan ahead to ensure sufficient equipment inventory to meet customer demand.
- **Risk reduction.** Program implementers should provide clear guidelines and procedures to contractors and distributors regarding how program participation works and what participants can expect.
- **Program consistency and communication.** Program requirements and incentive levels should remain consistent over time. Regular communication should ensure that midstream partners receive early indications of upcoming changes so they can prepare and adapt, and should enable administrators to collect feedback and implement program improvements.

EO

Pilot innovative incentive and procurement strategies that engage market actors in new ways. Ideas include:

- Offering incentives to builders through utility energy efficiency programs for all-electric or electric-ready new construction, to avoid the cost of future electrical upgrades needed to accommodate heat pumps.
- Incentivizing contractors to loan customers emergency heating equipment while temporary building upgrades are performed to enable the installation of zero-emission equipment.

MCE, a community choice aggregator in California, offers contractors an incentive of $1,500 per unit to install a HPWH after installing (and removing) an emergency loaner.[260]

- Using incentives to encourage manufacturers to increase heat pump sales, as defined by targets for percentage-of-sales or truckloads-of-shipments of zero-emission equipment, for example.
- Facilitating bulk purchases from heat pump manufacturers to make upfront costs more transparent, reduce contractor and customer acquisition costs, and facilitate economies of scale. Bulk purchasing can be achieved through state procurement, partnering with or funding aggregators, or by supporting community group-buy programs.[261]
- Adopting retrofit programs that utilize measured savings. Measured savings programs reward reductions in energy consumption, ensuring that rebates are allocated based on real-world impact. They can also be designed to advance equity objectives by providing "multipliers" for savings achieved in LMI households.

The New Jersey High-Efficiency Electric Home Rebate (HEEHR) program varies incentives based on energy savings. Incentives for high-efficiency electric home upgrades change based on a combination of pre-installation modeled and post-installation measured energy savings. Higher energy savings are rewarded with greater incentives.[262]

INCLUSIVE AND ACCESSIBLE FINANCING

Creating and expanding low- or zero-money-down financing offerings for heat pumps and whole-home retrofits can fill funding gaps for customers who cannot afford the upfront cost of zero-emission equipment, while also providing a compelling value proposition that spurs the heat pump market. Such strategies should be targeted at middle- and upper-income households to avoid increasing the debt burden on low-income households; low-income households should have access to robust, direct-install programs that provide whole-home retrofits at no cost. States should seek to make a suite of different financing mechanisms available to cover the needs of a range of consumers including renters, owners of single-family and multifamily properties, and middle-income residents, as well as situations where energy bills are likely to increase (e.g., when cooling is installed in a home that did not previously have it). Financing options are included in this section because many utility energy efficiency and building decarbonization programs have them, but it is important to note that some recommendations could be implemented outside of a utility regulatory framework, such as through green banks, housing finance agencies, or other market actors.

EO

Design financing programs to work for unplanned equipment replacements, which represent the majority of HVAC and water heater installations. Homeowners are unlikely to utilize financing during emergency situations if it requires a multi-day application and approval process, a detailed energy audit, and/or the engagement of a third party (e.g., navigating to a program website). Financing programs should also include offerings for households that have already transitioned to heat pumps and need support for end-of-life replacements.

EO PUC

Work with utilities to offer on-bill financing that enables customers to pay for energy efficiency and zero-emission measures through their utility bills. Tariffed on-bill programs, also known as inclusive utility investments, allow utilities to pay for an energy retrofit and recover the cost through a fixed charge on the customer's utility bill. Tariffed on-bill programs increase access for customers who may not qualify for conventional loans (including renters). Because on-bill programs do not require consumer credit or income qualification, there is no upfront cost to the customer, and cost recovery is associated with the meter rather than an individual. Importantly, on-bill programs can be designed with affordability safeguards by structuring payments so that customers pay for the measures out of their energy cost savings without increasing the amount due on their utility bills.[263,264] Other on-bill financing options take the form of loans that are repaid on the utility bill, with either the utility or a third-party bank or credit union acting as the lender.[265]

EO HFA

Work with local credit unions, green banks, contractor financiers, or dedicated energy efficiency financing providers to offer zero- or low-interest loans to homeowners to defray the upfront costs of zero-emission equipment and associated building upgrades. Residential financing options should be designed to incorporate the following best practices:[266,267,268]

- A simplified application process, with same-day approval in at least some instances.
- Direct integration into contractors' existing financing offerings and sales processes.
- Loan programs packaged with available incentives and rebates.
- Attractive loan terms such as zero-money-down, subsidized interest rates, long repayment terms (generally 10+ years, but less than expected equipment life), and/or monthly repayments equivalent to the monthly savings provided by the upgrade.
- Guardrails to prevent predatory lending. Examples include provisions that limit eligibility to contractors who are verified through utility or state programs, fraud reporting and cost recovery processes, cost-effectiveness screening or other means for targeting the efficiency measures most likely to yield tangible long-term savings and non-monetary comfort and health benefits, utility disconnection and/or arrearage management programs to prevent utility shutoffs, enhanced disclosure practices, and/or third-party navigator programs.

EO HFA

Incorporate energy efficiency and emissions requirements in the lending programs administered by housing finance agencies. This may require coordinating or consolidating a variety of existing financing options and programs that serve affordable housing and multifamily buildings. Where it is feasible to incorporate energy standards into financing programs, this approach can encourage (or require) owners of multifamily building owners to consider energy upgrades they might not consider otherwise when applying for funding.

UTILITY BUSINESS MODELS

In many areas, utility reform may be needed to accelerate the transition to zero-emission buildings and prepare the grid for a decarbonized future. The recommendations in this section are mostly directed at PUCs but implementing them may require legislative action to update regulatory frameworks. This could include changes to electricity and methane gas utility business models and performance standards so that utilities are held accountable for reducing emissions, delivering clean heat, and utilizing energy resources more effectively.

SL PUC

Reform electric utility business models to link compensation to performance requirements for decarbonization, load flexibility, and equity. Under conventional utility business models, utilities earn a rate of return only on capital investments, such as investments in poles and wires. This can cause utilities to favor costly infrastructure projects over investments that enable better utilization of the existing grid, such as demand flexibility and energy efficiency.[269] To address this issue and incentivize investments that are better aligned with state goals for decarbonization, affordability, grid modernization, and reliability, states can establish performance incentive mechanisms (PIMs) that reward utilities for specific performance improvements such as reducing service disconnections, improving service reliability, installing advanced metering infrastructure in residential homes, reducing peak demand, or achieving targets for clean peak or load flexibility. Equity targets, such as delivering energy efficiency to low-income households, can be included in these performance requirements.[270] PIMs can also be established for specific components of a utility's portfolio; for example, many utility energy efficiency programs include performance targets set by regulators and associated incentives for achieving them.

The Massachusetts Clean Peak Standard requires electricity suppliers to meet a minimum percentage of sales during peak demand times with clean energy resources or load reductions.[271] Examples of qualifying measures include battery storage, time-of-use rates that produce measurable changes in consumer energy usage, and incentive payments for participation in demand-response programs.[272] The Clean Peak Standard also creates incentives to reward utilities for implementing these measures.

SL EO PUC

Direct utilities to invest in zero-emission technology, load flexibility, distribution system planning, and electrification readiness programs. Regulators can direct electric and gas utilities to implement specific programs that align with state decarbonization goals and improve energy affordability. Programs can be developed in the context of new PIMs or performance targets, or as a separate effort, and may include:

- Clean heat, electrification, and building decarbonization programs, which can be offered by both electric and methane gas utilities. Such programs are commonly used to fund heat pump incentives and can be developed in the context of a CHS policy or as a separate initiative under PUC direction.

The NJBPU directed electric utilities to develop "building decarbonization start-up programs" with the aim of helping customers adopt zero-emission equipment while reducing overall energy consumption. NJBPU specifies that these programs "should offer financial incentives for New Jersey consumers currently using fossil-fueled equipment to adopt more efficient electric equipment." This directive was issued as part of New Jersey's Triennium 2 energy efficiency programs, launched in January 2025.[273]

Currently, about 27% of U.S. residential electric meters do not have advanced metering capabilities, limiting these households' ability to participate in load flexibility programs. Closing this gap expands access to potential bill savings for those customers and increases the base for utilities to draw on for demand response.[274]

- Load flexibility programs, which are offered by electric utilities to minimize strain on the grid and mitigate peak demand as more customers transition to zero-emission technology. They can include demand-response or load management programs for water heaters, smart thermostats, and EVs, and can include payments to customers for reducing demand or supplying stored electricity during peak hours. Aggregations of load management programs across many households and areas are sometimes called virtual power plants (VPPs); they represent an important resource for managing peak loads as heat pump deployment increases.[275]
- Distribution system planning by electric utilities, which is important to maximize the effectiveness of their electrification efforts and expand their capacity to offer DER and electrification solutions. Utilities should engage in asset planning practices to assess the state of distribution system infrastructure and identify components that must be upgraded before large-scale electrification and DER deployment. Utilities can use the insights gained from planning processes, such as granular locational forecasts, to inform targeted electrification and DER projects.[276]

Participants in Portland General Electric's Peak Time Rebates and Smart Thermostat programs shifted enough peak electricity load to power 5,450 homes in winter or 18,500 homes in the summer.[277]

- Electrification readiness programs can provide funding from the electric utility for upgrades to electrical service, panels ("heavy-ups"), and wiring, as well as for lower-cost alternatives to electrical upgrades, such as meter socket adapters and other load management devices.[278] These programs can also provide targeted subsidies or financing options to help multifamily building owners undertake improvements, and cap how much utilities can charge building owners for distribution system upgrades. Costs for these types of upgrades can otherwise pose a major barrier, particularly to multifamily building owners, who are often charged the full cost of any utility distribution system upgrades needed to support increased load from zero-emission heating.[279] Relatedly, electric utilities could be required to publish maps showing load capacity headroom in different areas. This would help utilities, developers, and other stakeholders locate areas with additional grid capacity where distributed energy resources and building electrification projects are less likely to encounter delays and costs for grid capacity upgrades.[280]

In 2024, the Colorado state legislature passed Senate Bill 24-218, which contained provisions to cap costs for interconnection, connecting new load, or upgrading electrical service for affordable housing. Costs are limited to $300 per residential unit, as long as the utility can still recover costs above the cap.[281]

SL PUC

Enact policies that change the business model for methane gas utilities and protect remaining gas customers from rising costs, such as:

- Accelerated depreciation, which reduces the time over which utilities recover investments in gas infrastructure from ratepayers; or depreciation proportional to demand, which ties depreciation expenses to gas infrastructure use. Utility depreciation schedules can span decades, which will put the burden of paying for current investments on a dwindling customer base as more customers electrify. Accelerated or proportional depreciation schedules spread the cost of infrastructure investments over a larger customer base, but must be paired with lower gas utility spending to prevent untenably high short-term rates.[282]
- Securitization that allows gas utilities to recover the costs of retiring assets that are no longer needed. Enabling securitization may require passing state legislation. By selling future ratepayer revenue as debt security, utilities can avoid increasing costs for consumers.[283]
- A minimum fixed charge for all gas customers to ensure that low-volume, higher-income gas users (such as customers who only use methane gas for cooking or to operate a fireplace) continue to cover the cost of their service connections. This can help ensure that the burden of maintaining gas system infrastructure does not fall only on those who can least afford electrification.[284]
- Heat as a service, which diversifies how gas utilities can provide heat (beyond selling pipeline gas) to include installation and maintenance of zero-emission heating such as networked geothermal and heat pumps.

EO PUC EDA

Account for non-energy benefits in cost-benefit analyses of utility programs and investments by:[285]

- Including or expanding the assessment of non-energy benefits, such as avoided GHG emissions and health impacts, in cost-benefit analyses.
- Evaluating programs using equity metrics like proportion of spending allocated to low-income households or disadvantaged communities.
- Exploring cost-effectiveness tests that center equity concerns, such as increasing the weight given to benefits achieved in low-income households and disadvantaged communities or factoring in the impact of higher electricity rates on low-income households.[286]
- Monitoring outcomes for program participants to identify unintended, adverse consequences, such as increased housing displacement, higher housing/rent costs, or greater energy burdens.

States should carefully consider how they design and use non-energy benefits in cost-effectiveness analyses. Some measures that may score higher in a social benefits test than in a traditional cost-effectiveness analysis may result in procurement of more expensive energy, and an associated increase in energy bills.[287] Given that electricity costs are often inherently regressive (e.g., lower-income households pay a significantly higher proportion of their income on energy bills relative to wealthier households),[288] higher energy rates can introduce unintended equity concerns. Combining non-energy benefit assessments with other metrics can help account for the broader harms of air pollution and climate change while balancing the immediate issue of energy affordability.

UTILITY SYSTEM PLANNING

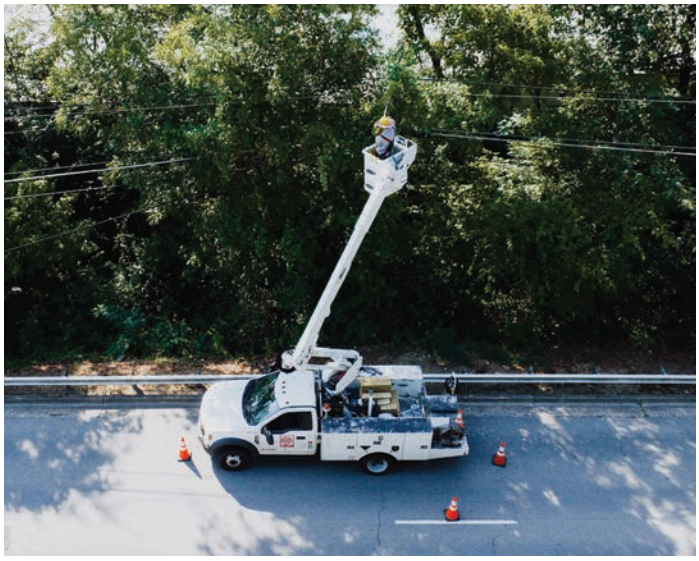
New planning requirements for methane gas utilities are needed to align gas utility investments with state climate targets, while maintaining reliability and affordability for gas customers. Proactive planning for the future of gas is a crucial part of the transition to zero-emission residential buildings; without such planning to address the stranded costs associated with long-term maintenance of the gas network, those costs will present a major challenge to affordability. Proactive planning for the electric system is also crucial, as electric utilities make proactive investments to prepare the grid for widespread electrification and load growth. This section recommends several utility system planning requirements and processes for states and PUCs to consider.

PUC

Pursue integrated electric and gas system planning to optimize investments in electrical and gas infrastructure, improve reliability, and reduce energy bills.[289] Planning processes for gas and electric utilities are typically siloed, which can add costs and lead to suboptimal outcomes. Integrated planning could involve improved communications between electric and gas utility staff, cross-functional teams, coordinated forecasts with improved data inputs and modeling approaches, and joint assessments of electric and gas system impacts and costs.

PUC

Target electrification upgrades to locations with aging gas equipment and infrastructure and require gas utilities to share data to support infrastructure planning. This strategy can reduce systemwide costs by targeting electrification upgrades to areas with the oldest, least efficient, and potentially costliest to replace, gas infrastructure. In some cases, legislation or regulatory action may be needed to require gas utilities to share customer or utility infrastructure data to facilitate targeted electrification. At the distribution infrastructure level, gas utilities routinely replace aging main and service pipelines and regulator stations, which can take years to complete and potentially cost more than electrification. Access to these plans can help PUCs identify areas where gas infrastructure upgrades can be avoided, target programs to specific communities, and maximize cost savings.



California's SB 1221 requires that methane gas utilities provide the California Public Utilities Commission with maps of the locations of their planned and foreseeable gas distribution replacement projects. The Commission has directed utilities to provide maps that cover about ten years' worth of projects.[290]

PUC

Require electric utilities to assess the age and capacity of existing electric infrastructure at premise and service transformer level to improve electrical infrastructure planning and enhance grid reliability and safety.

PUC

Eliminate subsidies for methane gas line extensions to reduce costs passed to ratepayers and encourage zero-emission new construction.[291] Many gas utilities currently subsidize new gas connections, effectively transferring the cost of gas line extensions from individual developers to all gas ratepayers. Eliminating these subsidies would discourage new connections to the gas network and help encourage zero-emission new construction.

California became the first state in the nation to eliminate gas line extension subsidies for new mixed-fuel buildings starting in 2023, and subsequently ended all subsidies associated with gas infrastructure expansion by also removing electric line subsidies for new mixed fuel construction starting in 2024.[292]

PUC

Require gas utilities to assess non-pipeline alternatives (NPAs) when considering upgrades to methane gas distribution infrastructure, such as gas distribution line replacements and repairs. NPAs could include energy efficiency, demand response, and electrification, including through thermal energy networks, which can eliminate the need for additional gas infrastructure. Implementing such alternatives can reduce the long-term costs borne by ratepayers without compromising the safety of the gas system.[293]

The Massachusetts Department of Public Utilities requires gas utilities to demonstrate that they considered NPAs and found them to be cost-prohibitive, in order to maintain eligibility for full cost recovery on methane gas infrastructure investments.[294]

SL PUC

Promote thermal energy networks (TENs) as an emerging option for community-wide building decarbonization that offers a viable business model for methane gas utilities and workers. TEN construction creates an ideal opportunity to repurpose skills such as pipefitting and pipe laying from the existing gas workforce.[295] States can support TENs by:

- Revising utilities' legal "obligation to serve" as an obligation to serve ***heat*** to every customer, rather than gas. Many utilities are required by law to deliver gas to any customer in their territory who asks for it and who can be served at a reasonable cost. This can hinder neighborhood-scale decarbonization because it means that if a single resident continues to ask for gas, that resident can effectively veto a project that would serve the entire neighborhood.[296] Changing the obligation from providing "gas" to providing "heat" in statute or PUC rules can clear the path for neighborhood-level thermal energy networks or other zero-emission upgrades if most residents agree.
- Providing funding for state agencies, municipalities, and utilities to initiate TEN feasibility studies and demonstration projects. To advise these efforts, funding should also be provided for stakeholder committees that incorporate a diverse array of expertise and interests, including those of utilities, labor, consumers, climate and environmental advocates, and regulators.
- Requiring or providing incentives for utilities to develop gas system planning tools that enable the selection of sites for targeted, cost-effective decommissioning of gas infrastructure and potential TEN development.

In California, PG&E developed a Geographic Information System-based Gas Asset Analysis Tool that includes data on gas pipeline segments, gas meters, and customer gas consumption, to support gas system planning.[297,298] The utility makes the tool available to some external stakeholders, who can use it to identify optimal targets for gas decommissioning and TEN construction, such as by identifying pipeline segments with high operational risk and few customers.

- Establishing labor standards for TEN construction, operation, and maintenance, and offering retraining programs to help the methane gas workforce transition to TEN installation, maintenance, and operation. Labor standards are needed to ensure that the transition to clean buildings is just and supports high-quality jobs, including by requiring project labor agreements and labor peace agreements, preserving collective bargaining agreements, and paying prevailing wages.

The New York Utility Thermal Energy Network and Jobs Act directs the state PUC to develop a regulatory framework for TENs, redefines a "gas corporation" as a company that delivers gas or thermal energy, and requires the seven largest energy utility companies in the state to propose at least one TEN pilot in a disadvantaged community for potential implementation. The bill also includes strong labor standards for TEN projects, including provisions that address prevailing wages, apprenticeship and pre-apprenticeship requirements, and labor peace agreements between unions and utilities.[299]

A labor peace agreement is an agreement between a union and employer that generally includes employer commitments on neutrality regarding union organizing, worksite access for union organizers, and a process for employer recognition of a union, along with union commitments not to disrupt work at the site.

APPENDIX 1

ACRONYMS AND ABBREVIATIONS

AC	Air Conditioning
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
AIM Act	American Innovation and Manufacturing Act
ARPA	American Rescue Plan Act
ASHP	Air-Source Heat Pump
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BEPS	Building Energy Performance Standard
BPS	Building Performance Standard
BTU	British Thermal Unit
CB	Community-Based Organization
CHS	Clean Heat Standard
CH_4	Methane
CO_2	Carbon Dioxide
DAC	Disadvantaged Community
DER	Distributed Energy Resource
DOE	U.S. Department of Energy
DOL	State Department of Labor
EA	State Environmental Agency
EDA	State Economic Development Agency
EO	State Energy Office
EPA	U.S. Environmental Protection Agency
EPCA	Energy Policy and Conservation Act
EPR	Extended Producer Responsibility
EV	Electric Vehicle
GHG	Greenhouse Gas
GO	Governor's Office
GSHP	Ground-Source Heat Pump
GWP	Global Warming Potential
HARDI	Heating, Air-Conditioning, and Refrigeration Distributors International
HERS	Home Energy Rating System
HFA	State Housing Finance Agency
HFC	Hydrofluorocarbon
HPWH	Heat Pump Water Heater
HVAC	Heating, Ventilation, and Air Conditioning
IECC	International Energy Conservation Code
KWH	Kilowatt-Hour
LIHEAP	Low-Income Home Energy Assistance Program
LMI	Low-and-Moderate-Income
MMBTU	Million British Thermal Unit
MOU	Memorandum of Understanding
NAAQS	National Ambient Air Quality Standards
NESCAUM	Northeast States for Coordinated Air Use Management
NFPA	National Fire Protection Association
NO_x	Nitrogen Oxides
N_2O	Nitrous Oxide
NPA	Non-Pipeline Alternative
PIM	Performance Incentive Mechanism
PIPP	Percentage of Income Payment Plan
$PM_{2.5}$	Fine Particulate Matter
PUC	Public Utility Commission
RGGI	Regional Greenhouse Gas Initiative
SL	State Legislature
SNAP	Significant New Alternatives Policy
TEN	Thermal Energy Network
TOU Rate	Time-Of-Use Rate
TT Rule	Technology Transitions Rule
UL	Underwriters Laboratories
USDA	U.S. Department of Agriculture
VOC	Volatile Organic Compound
VPP	Virtual Power Plant
WAP	Weatherization Assistance Program
ZEB	Zero-Emission Building
ZEHES	Zero-Emission Heating Equipment Standard

APPENDIX 2

ZERO-EMISSION TECHNOLOGIES

ZERO-EMISSION SPACE HEATING

Air-Source Heat Pump (ASHP): ASHPs use refrigerant to draw warmth from the air, moving heat inside in the winter, and outside in the summer. Refrigerant cycling enables ASHPs to move up to four times more heat energy than the electrical energy they consume.[300] In the Northeast, cold-climate ASHPs, designed to operate at high efficiencies in temperatures below 5°F, are often the most energy-efficient options. A range of ASHP technologies are available, including standard-efficiency and cold-climate options.

Ducted ASHP: Several types of ducted ASHPs are currently available on the market but all of them have an outdoor unit that exchanges heat with the outside air, an air handler that distributes warm or cool air, and ductwork that delivers air throughout a home. In cases where existing ductwork can support heat pumps, ducted ASHPs can often be "drop-in" replacements for homes with central furnaces or ACs.[301] The main types of ducted ASHPs include:

- Split unitary ASHPs, which separate the compressor (responsible for cycling refrigerant) and air handler into separate indoor and outdoor units connected by refrigerant lines.
- Packaged unitary ASHPs, which contain the compressor and air handler in a single outdoor unit.
- Ducted multi-splits, which connect the outdoor unit to one or multiple indoor air handlers that deliver heat through short duct runs.[302,303]

Ductless Minisplit ASHP: Minisplit heat pumps connect outdoor units to one or multiple indoor "heads" – i.e., air handlers mounted on walls or ceilings that distribute hot or cold air. These can be installed in homes with inadequate or nonexistent ductwork to reduce costs associated with duct installation. Ductless minisplits can also be more efficient than ducted systems because they move heat by pumping fluid through refrigerant lines, which reduces heat loss compared to air ducts and uses less energy than blowing air.[304] An average residential home would require multiple indoor units to provide heating and cooling for the whole home.

Ground-Source Heat Pump (GSHP): GSHPs (also called geothermal heat pumps) use the ground as a heat source. Because the below-ground temperature is more consistent than air temperature, GSHPs are more efficient than ASHPs – particularly in cold climates. However, this technology costs significantly more to install, because it involves drilling vertical boreholes or horizontal trenches into the earth and installing underground piping.[305] Like ASHPs, GSHPs can be ducted and ductless, and/or provide hot water for space or water heating. GSHP systems can be used to heat and cool individual homes, and can also service multiple buildings through a thermal energy network.

Thermal Energy Network (TEN): TENs transfer heat at a neighborhood scale between buildings using a network of pipes and often heat pumps. They can use a variety of energy sources for heat exchange, including the ground or a body of water, as well as waste heat from buildings and wastewater. Given their ability to transfer heat between buildings and draw from warmer heat sources than ambient air, heat pump-based TENs, which are currently being piloted in several states,[306] can be a highly efficient heating option. In addition, TEN construction leverages skills that are already common in the gas industry, such as installing and maintaining pipes. Deploying this technology can thus provide new employment opportunities for gas utility workers.[307]

Active Solar Heating: These systems transfer solar heat into an air or liquid medium that can provide instantaneous heat or be stored for later. Solar heating systems can distribute heat through radiant floors, hot water radiators, or forced-air systems, but may require supplemental heat on cloudy or high-demand days.[308]

Electric Resistance Space Heaters: Electric resistance space heaters convert electricity into heat like a toaster. They are less efficient and more costly than heat pumps, which move heat rather than generate it. Electric resistance space heaters are generally only an economical option in warmer climates with modest heating needs, and even in these cases, heat pumps can be preferable because they also provide energy-efficient cooling.[309]

ZERO-EMISSION WATER HEATING

Heat Pump Water Heaters (HPWHs): HPWHs produce hot water by transferring heat from the air to a water tank. Most HPWHs include a heat pump located directly on top of a water tank to form an integrated unit that can be installed indoors. HPWHs generally need to be located in conditioned or semi-conditioned spaces (for example, basements) that maintain temperatures above 40˚F.[310] They are available in two configurations:

- **240-Volt HPWHs** require a higher-voltage electrical outlet, which is usually already present in homes with existing electric resistance water heaters. Other households may need to add a dedicated electrical circuit or optimize or upgrade their electrical panel to support a 240V HPWH. This can increase installation costs.[311]
- **120-Volt HPWHs** are a more recent innovation that can plug into standard electrical outlets. As such, they can be less expensive and easier to install than a 240V HPWH that requires an electrical upgrade.[312]
- **Split-type HPWHs** have two units: an indoor storage tank and an outdoor compressor. This type of HPWH can work efficiently in temperatures down to -25°F and offers more flexibility for buildings that cannot fit the full packaged unit indoors. Because the indoor units can be installed in smaller spaces, split HPWHs can be an effective solution for mobile/manufactured homes and some multifamily buildings.

Solar Water Heaters: Solar water heaters use solar power to heat and store water. Solar water heaters can be a cost-effective source of hot water since they use free energy from the sun for heating, but typically require backup systems for high demand or cloudy days.[313]

Electric Resistance Water Heaters: Electric resistance water heaters use electricity to heat water using a resistance element and store the heated water in a tank. They are less expensive to purchase than HPWHs but operate less efficiently, which may result in higher electricity costs over time.[314]

UP-AND-COMING ZERO-EMISSION TECHNOLOGIES

Air-to-Water Heat Pumps (AWHPs): AWHPs are a type of ASHP, common in Europe and emerging in the U.S. market, that uses heat in the air to produce hot water that can distribute radiative warmth through pipes. Split AWHPs have refrigerant lines running from an outdoor unit to an indoor heat exchanger for heating or cooling water. In packaged monobloc AWHPs, the entire refrigeration cycle is contained in the outdoor unit and heated or cooled water is circulated to and from indoor air handlers, fan coils, or radiators. Both split and monobloc AWHPs can also provide domestic hot water as well as forced air heating and air conditioning by running heated or cooled water through an air handler or fan coils.[315] AWHPs can be a good replacement option in homes with hydronic heating (e.g., boilers paired with high-temperature baseboard or low-temperature radiant distribution systems).

Window Heat Pump: Window heat pumps are an emerging solution for multifamily buildings that can provide zero-emission heating and cooling using equipment that can be inserted into a window and plugged into a standard electrical outlet, like a typical window AC unit. As such, window heat pumps can be especially useful in multifamily buildings. They can operate below 0°F, reduce the risk of refrigerant leaks, and do not require drainage or plumbing for condensation management.[316]

Hydrogen Heating Systems: While hydrogen-based residential heating systems are not currently commercially available, production and use of clean hydrogen is under active exploration.[317] Hydrogen boilers are similar in design to gas boilers but burn hydrogen instead of gas, producing water vapor. Hydrogen combustion is inherently GHG-free, but equipment should include controls to prevent harmful NO_x emissions.

ENDNOTES

1 U.S. EPA, "Sources of Greenhouse Gas Emissions," last updated July 8, 2024.

2 U.S. EPA, "2020 NEI Supporting Data and Summaries," March 30, 2023.

3 U.S. Energy Information Administration (EIA), "2020 Residential Energy Consumption Survey (RECS): Table CE4.1," updated March 2024.

4 U.S. EIA, "2018 Commercial Buildings Energy Consumption Survey (CBECS): Tables E7, E9," released December 2022.

5 U.S. EIA, "Residential Energy Consumption Survey (RECS): Table CE2.1," March 2024.

6 Sun, L., et al., (2025), "Associations between residential fossil fuel combustion and indoor concentrations of nitrogen dioxide, carbon monoxide, and aldehydes in Canadian homes," Journal of Exposure Science and Environmental Epidemiology.

7 U.S. EPA, "Commercial and Residential Sector Emissions," last updated January 16, 2025.

8 RMI, "How air agencies can help end fossil fuel pollution from buildings," 2021.

9 NESCAUM, "Accelerating the Transition to Zero-Emission Residential Buildings: Multistate Memorandum of Understanding," signed May 24, 2024.

10 U.S. EIA, 2020 "2020 Residential Energy Consumption Survey (RECS): Table CE2.1ST," revised June 13, 2023.

11 Nadel, S. and Fadali, L., "Analysis of Electric and Gas Decarbonization Options for Homes and Apartments," ACEEE, July 2022.

12 NESCAUM, "Accelerating the Transition to Zero-Emission Residential Buildings: Multistate Memorandum of Understanding," signed May 24, 2024.

13 U.S. EIA, "2020 RECS Survey data: CE2.1.ST – Household Site Fuel Consumption in U.S. Homes by State, 2020," June 13, 2023.

14 U.S. Climate Alliance, "U.S. Climate Alliance Announces New Commitments to Decarbonize Buildings Across America, Quadruple Heat Pump Installations by 2030," September 21, 2023.

15 Tan, L. and Teener, J., "Now is the Time to Go All In on Heat Pumps," RMI, July 6, 2023.

16 U.S. Department of Energy (DOE), "Heat Pump Systems," accessed December 24, 2024.

17 Rewiring America, "Do heat pumps work in cold climates?" accessed February 4, 2025.

18 Beaini, S., et al., "Field Deployment of Window Heat Pumps in Multi-Family and Single-Family Low-to-Medium Income Homes," ACEEE Sumer Study on Energy Efficiency in Buildings, 2024.

19 *Ibid*.

20 Alternative Energy Systems Consulting and ASK Energy, "Testing Heat Pump Water Heaters in Manufactured Housing," TECH Clean California Quick Start Grant Final Report, March 2025.

21 This number reflects the variety of sizes and types of indoor and outdoor units available on Northeast Energy Efficiency Partnerships (NEEP)'s Cold Climate Air Source Heat Pump List (accessed April 23, 2025). The NEEP list may be an underestimate given that it may not include all manufacturers. The total number of cold-climate heat pump configurations that can be achieved by matching different indoor and outdoor units exceeds 200,000.

22 American Society of Plumbing Engineers, "DOE Efforts Send New and Improved Cold-Climate Heat Pumps to the Market," October 23, 2024.

23 California Air Resources Board, "High-GWP Refrigerants," accessed February 6, 2025.

24 Heat Pumps UK, "Monobloc v Split System Heat Pumps," August 19, 2024.

25 Wolf, "Heat Pumps: Monoblock or Split?" accessed February 5, 2025.

26 Stewart, M., et al., "Propane (R-290) Air-to-Water Heat Pump (AWHP) Market Study," CalNEXT, December 12, 2023.

27 U.S. DOE, "Decarbonizing the U.S. Economy by 2050," April 2024.

28 U.S. EPA, "NAAQS Table," last updated December 16, 2024.

29 American Lung Association, "Nitrogen Dioxide," accessed February 10, 2025.

30 American Lung Association, "Ozone," accessed February 10, 2025.

31 Seltenrich, N., (2024), "Clearing the Air: Gas Stove Emissions and Direct Health Effects," Environmental Health Perspectives 132(2): 022001.

32 Sun, L., et al., (2025), "Associations between residential fossil fuel combustion and indoor concentrations of nitrogen dioxide, carbon monoxide, and aldehydes in Canadian homes," Journal of Exposure Science and Environmental Epidemiology.

33 U.S. EPA, Current Nonattainment Counties for All Criteria Pollutants, updated August 31, 2025.

34 Kanj, W., Gruenwald, T., and Herr, A., Breathe easy: Household electrification as a public health intervention to improve air quality," Rewiring America, December 2024; Health Impacts Dashboard.

35 U.S. EPA, 2020 NEI Supporting Data and Summaries," March 30, 2023.

36 Gilmore, E., et al., (2019), "An inter-comparison of the social costs of air quality from reduced-complexity models," Environmental Research Letters 14: 074016.

37 Tessum, C.W., et al., (2021), "$PM_{2.5}$ polluters disproportionately and systemically affect people of color in the United States," Science Advances 7(19): eabf4491.

38 NESCAUM analysis of: U.S. EPA Green Book Data Download, NAYRO export, last updated March 27, 2025.

39 Mass Save, "Air Source Heat Pumps," accessed December 23, 2024.

40 U.S. Department of Energy, "Weatherization Program Notice 19-5," September 6, 2019.

41 Sollod, J., "National Labs Study Finds Updated Building Energy Codes Save Lives in Face of Intensifying Climate Hazards," Building Safety Journal, July 25, 2023.

42 Virginia Department of Health and Community Development, "Weatherization Deferral Repair Program Guidelines 2023-2024," July 2023.

43 Tonn, B., et al., (2023), "Saving lives by saving energy? Examining the health benefits of energy efficiency in multifamily buildings in the United States," Building and Environment 228(15): 109716.

44 Green & Healthy Homes Initiative, "Whole-House Repair Programs Incorporating Electrification," accessed March 13, 2025.

45 U.S. Centers for Disease Control and Prevention, "Inadequate and Unhealthy Housing, 2007 and 2009" in CDC Health Disparities and Inequalities Report – United States, 2011, 2011.

46 Williams, D. and Collins, C., (2001), "Racial residential segregation: A fundamental cause of racial disparities in health," Public Health Reports 116(5): 404-416.

47 Climate and Community Project, "Decarbonization Without Displacement: Tenant Advocacy in the Context of Inflation Reduction Act Implementation," January 2024.

48 Kirk. C., et al., "Tenants at the Center: An Equitable Path to Building Decarbonization," Strategic Actions for a Just Economy, Public Health Law Center, & Institute for Market Transformation, March 2025.

49 IPCC, "Chapter 11: Weather and climate extreme events in a changing climate," in Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, 2021.

50 Clark, A, et al., (2024), "Identifying groups at-risk to extreme heat: Intersections of age, race/ethnicity, and socioeconomic status," Environment International 191: 108988.

51 Gronlund, C., (2014), "Racial and socioeconomic disparities in heat-related health effects and their mechanisms: a review," Current Epidemiology Reports 1: 165-173.

52 Gabbe, C.J., Mallen, E., and Varni, A., (2022), "Housing and Urban Heat: Assessing Risk Disparities," Housing Policy Debate 33(5): 1078-1099.

53 U.S. Environmental Protection Agency, "Protecting Children and Maternal Health from Extreme Heat," last updated July 22, 2025.

54 National Institutes of Health, National Institute on Aging, "Hot weather safety for older adults," September 2, 2022.

55 New York State Energy Research & Development Authority (NYSERDA), "Analysis of residential heat pump potential and economics," January 2019.

56 Heat pumps provide cooling with up to 29% greater energy efficiency than window units. See National Renewable Energy Laboratories (NREL), "How heat pumps can bring relief to households," August 7, 2024.

57 New York City Department of Health, "Health Department Releases Report on Heat-Related Mortality in New York City," June 18, 2024.

58 Hu, X., Hines, E., and Henchen, M., "Resilient, Carbon-Free Buildings are Within Reach," RMI, October 22, 2024.

59 National Renewable Energy Laboratories (NREL), "How heat pumps can bring relief to households," August 7, 2024.

60 Lee, M. and Billimoria, S., "Eight Benefits of Building Electrification for Households, Communities, and Climate," RMI, March 29, 2021.

61 Energy & Environmental Economics, "Residential Building Electrification in California: Consumer Economics, Greenhouse Gases, and Grid Impacts," April 2019.

62 New Buildings Institute and Natural Resources Defense Council, "Cost Study of the Building Decarbonization Code," April 2022.

63 Building Performance Association and E4TheFuture, "Frequently Asked Questions," December 2024.

64 Herr, A., Kanj, W., and Wyent, C., "Electrification that Works: Jobs for a Clean and Healthy Future," Rewiring America, October 2024.

65 Building Performance Association and E4TheFuture, "Energy Efficiency Jobs in America," December 2024.

66 *Ibid.*

67 Inclusive Economics, "High-Road Workforce Guide for City Climate Action," April 2021.

68 Booth, K., et al., "Heat Pumps in the Northeast and Mid-Atlantic: Costs and Market Trends," Energy Solutions, October 30, 2024.

69 Booth, K., et al., "Heat Pump Water Heaters in the Northeast and Mid-Atlantic: Costs and Market Trends," Energy Solutions, June 17, 2024.

70 Gruenwald, T., "Reality Check: The Myth of Stable and Affordable Natural Gas Prices," RMI, November 17, 2021.

71 American Council for an Energy Efficient Economy (ACEEE), "Impact of Electrification and Decarbonization on Gas Distribution Costs," June 6, 2023.

72 U.S. EPA, "Greenhouse Gas Inventory Data Explorer," last updated August 18, 2023.

73 Levin, E., Louis-Prescott, L., and Breit, R., "Zero-Emission Heating Equipment Standards: A New Tool in the Policy Toolbox," ACEEE Summer Study on Energy Efficiency in Buildings, 2024.

74 Environmental Defense Fund, "U.S. States with Binding, Economy-Wide Climate Targets," accessed January 30, 2025.

75 California AB 1279: The California Climate Crisis Act, approved and filed September 16, 2022; Colorado SB 23-016: Greenhouse Gas Emission Reduction Measures, approved May 11, 2023; D.C. Law 24-176: Climate Commitment Act of 2022, effective September 21, 2022; Maine Revised Statutes, 38 MRSA 576-A: Waters and Navigation – Climate Change, revised 2022; Maryland SB0528/CH0038: Climate Solutions Now Act of 2022, effective June 1, 2022; Massachusetts SB 9: An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy, approved March 26, 2021; New Jersey Department of Environmental Protection, "Greenhouse Gas Emissions Goals," accessed July 18, 2025; New York SB S6599: New York State Climate Leadership and Community Protection Act, signed July 18, 2019; Oregon Climate Action Commission, "Meeting Our GHG Goals," accessed July 18, 2025; Rhode Island SB 78: 2021 Act on Climate, signed April 10, 2021.

76 Governor Gavin Newsom, Letter to the Chair of the California Air Resources Board, July 22, 2022; Colorado HB21-1286: Energy Performance for Buildings, approved June 24, 2021; Washington, D.C. Department of Energy & Environment, "Building Performance Helpdesk," accessed July 25, 2025; Office of Governor Janet T. Mills, "After Maine Surpasses 100,000 Heat Pump Goal Two Years Head of Schedule Governor Mills Sets New, Ambitious Target," July 21, 2023; Maryland Department of Environment, "Building Energy Performance Standards," accessed July 25, 2025; Massachusetts Executive Office of Energy & Environmental Affairs, "2024 Massachusetts Climate Report Card – Building Decarbonization," accessed July 18, 2025; New Jersey Executive Order 316: To Electrify Space Heating and Cooling Systems in 400,000 Homes and 20,000 Commercial Properties, signed February 15, 2023; Governor Kathy Hochul, Governor Hochul Announces Plan to Achieve 2 Million Climate-Friendly Homes by 2030, January 5, 2022; Oregon HB 3409: Relating to Climate and Declaring an Emergency, effective July 27, 2023; Rhode Island Executive Order 23-06: State Agencies To Lead By Example And Act On Climate, May 9, 2023.

77 Bastian, H. and Cohn, C., "Ready to Upgrade: Barriers and Strategies for Residential Electrification," ACEEE, October 2022.

78 Roberts, D. and Sparn, B., "Split HPWHs as an Efficient Solution for Multifamily Buildings with In-Unit Water Heaters," National Renewable Energy Laboratory (NREL), August 23, 2022.

79 Murto, P., et al., (2019), "Devices and strategies: An analysis of managing complexity in energy retrofit projects," Renewable and Sustainable Energy Reviews 114: 109294.

80 Dunsky Energy + Climate Advisors, Consortium for Power Efficiency, "Overview of Power Efficient Design Strategies," December 2024.

84 Santos, C., Cetin, K., and Salehi, H., (2022), "Energy-efficient technology retrofit investment behaviors of Midwest households in lower and higher income regions," Sustainable Cities and Society 86: 104141.

83 CalNEXT, "Emergency Replacement heat Pump Water Heater Market Study," June 26, 2024.

84 Bastian, H. and Cohn, C., "Ready to Upgrade: Barriers and Strategies for Residential Electrification," ACEEE, October 2022.

85 U.S. Department of Energy, "Residential HVAC Installation Practices: A Review of Research Findings," June 2018.

86 NESCAUM, "Technical Support Document 1.2 for Model Rule 1.0: NO_x and GHG Emissions Standards for Space and Water Heaters," December 12, 2024.

87 Booth, K., et al., "Heat Pumps in the Northeast and Mid-Atlantic: Costs and Market Trends," Energy Solutions, October 30, 2024.

88 Booth, K., et al., "Heat Pump Water Heaters in the Northeast and Mid-Atlantic: Costs and Market Trends," Energy Solutions, June 17, 2024.

89 Takemura, A., "How closing the 'spark gap' can boost heat pump adoption," Canary Media, March 11, 2025.

90 Bastian, H. and Cohn, C., "Ready to Upgrade: Barriers and Strategies for Residential Electrification," ACEEE, October 2022.

91 Booth, K., et al., "Heat Pumps in the Northeast and Mid-Atlantic: Costs and Market Trends," Energy Solutions, October 30, 2024.

92 Takemura, A., "When it comes to heat pumps, bigger is not always better," Canary Media, March 22, 2023.

93 U.S. DOE, "Residential HVAC Installation Practices: A Review of Research Findings," Office of Energy Efficiency & Renewable Energy, June 2018.

94 Winkler, J., et al., (2020), "Impact of installation faults in air conditioners and heat pumps in single-family homes on U.S. energy usage," Applied Energy 278(15): 115533.

95 Reeg, L. and Smedick, D., "Gaps and Barriers to Stacking Federal, State, and Local Incentives," RMI, December 2023.

96 RMI, "Gaps and Barriers to Stacking Federal, State, and Local Incentives," December 2023.

97 ACEEE, "Toward More Equitable Energy Efficiency Programs," 2023.

98 Bird, S. and Hernandez, D., (2012), "Policy options for the split incentive: Increasing energy efficiency for low-income renters," Energy Policy 1(48): 506-514.

99 Levin, E., Schaaf, B., and Nedwick, T., "Equitable Electrification: Solving the Affordability Catch-22 for LMI Households that Heat with Natural Gas," ACEEE Summer Study on Energy Efficiency in Buildings, 2022.

100 International Energy Agency (IEA), "The Future of Heat Pumps," December 2022.

101 Shea, R., et al., "Electrify Your Community: Support Local Contractor Engagement," RMI, November 20, 2024.

102 Northwest Energy Efficiency Alliance (NEEA), "Residential HVAC Contractor Market Research," Report #E22-442, March 29, 2022.

103 "How Will I Heat and Cool My Home When the Power Goes Out?," accessed January 2, 2025.

104 City of Vancouver, "Heat Pumps & Noise," June 2020.

105 See, for example, Trane, "XV19 Variable Speed Low Profile Heat Pump," accessed March 21, 2025; Daikin, "Flexible Innovative Technology," 2023.

106 Dammel, J., Henchen, M., and Shah, A., "Electric Rates can Help or Hinder Heat Pump Progress," RMI, December 5, 2024.

107 ISO New England, "CELT 2024: Heating electrification will drive higher energy use, winter peaks," ISO Newswire, May 9, 2024.

108 Dammel, J., Henchen, M., and Shah, A., "Electric Rates can Help or Hinder Heat Pump Progress," RMI, December 5, 2024.

109 ISO New England, "2025 Capacity, Energy, Loads, and Transmission Report," May 6, 2025.

110 New York ISO, "Fuel Security: A Growing Winter Reliability Concern," February 10, 2025.

111 NEEP, NESCAUM, & RAP, "Decarbonizing Buildings: How States Can Set the Table for Success," June 2024.

112 *Ibid.*

113 Commonwealth of Massachusetts, "Governor Healey Signs Executive Order Creating Massachusetts' First Ever Climate Chief," January 6, 2023.

114 Massachusetts Executive Office of Energy & Environmental Affairs, "Healey-Driscoll Administration Establishes Nation's First Office of Energy Transformation," March 15, 2024.

115 State of New Jersey, "Governor Murphy Announces Launch of Statewide Clean Buildings Working Group," October 3, 2022.

116 Battaglia, R., "Ashland becomes the first city in Oregon to impose a fee on new natural gas hookups," Oregon Public Broadcasting, February 20, 2025.

117 Emerald Cities Collaborative, "Anchor-Community Engagement Workbook," 2023.

118 WE ACT for Environmental Justice, "Community Engagement Brief," 2022.

119 Rhode Island Energy Efficiency Council, "About the Energy Efficiency Council," accessed March 30, 2025.

120 Washington, D.C. Department of Energy & Environment (DOEE), "BEPS Task Force," accessed October 4, 2024.

121 McCullough, et al., (2024), "Power on the Block: Empowering Residents to Impact Community Change Through Electrification and Decarbonization," ACEEE Summer Study on Energy Efficiency in Buildings.

122 NYSERDA, "Paying for Community Expertise," accessed January 9, 2025.

123 Oregon Department of Energy, "Oregon Rental Home Heat Pump Program," accessed March 21, 2025.

124 California Energy Commission, "Equitable Building Decarbonization Direct Install Program Guidelines," updated October 25, 2023.

125 Strategic Actions for a Just Economy (SAJE), "Decarbonizing California Equitably: A Guide to Tenant Protections in Building Upgrades/Retrofits Throughout the State," October 2023.

126 Kirk, C., et al., "Tenants at the Center: An Equitable Path to Building Decarbonization," SAJE, Public health Law Center, and Institute for Market Transformation, March 2025.

127 Sitkin, L. and Grow, J., "Survey of State Tenant Protection Policies for the Weatherization Assistance Program (WAP)," National Housing Law Project, November 2018.

128 Norton, R.A., et al., "Leading with Equity and Justice in the Clean Energy Transition: Getting to the Starting Line for Residential Building Electrification," Green and Health Homes Initiative, accessed January 14, 2025.

129 U.S. DOE, "Weatherization Program Notice 19-5," effective September 6, 2019.

130 NYSERDA, "All About Home Electrical Panels: Funding for Home Electrical Upgrades," accessed March 19, 2025.

131 Green and Healthy Homes Initiative, New Jersey Comfort Partners, New Jersey BPU, "New Jersey Whole House Pilot Program Frequently Asked Questions," accessed January 14, 2025.

132 E4TheFuture, "Weatherization Barriers Toolkit," April 2022.

133 Philadelphia Energy Authority, "Built to Last," accessed March 11, 2025.

134 NY HCR, "Clean Energy Initiative," accessed March 21, 2025.

135 Mass Save, "The Massachusetts 2025-2027 Energy Efficiency and Building Decarbonization Plan," October 31, 2024.

136 New York State Senate, "Assembly Bill A8488: Relates to Automated Identification of OTDA Assistance Program Participants," signed February 13, 2024.

137 Consortium for Power Efficiency and Dunsky Energy + Climate Advisors, "Overview of Power Efficient Design Strategies," Consortium for Power Efficiency, December 2024.

138 Bright Power, "Aligning Utility Allowances with Electrification," TECH Clean CA Quick Start Grant Final Report, October 29, 2024.

139 NYSERDA, RMI, Building Energy Exchange, Urban Land Institute, "Retrofit Playbook for Large Buildings," accessed January 10, 2025.

140 NYSERDA, "Flexible Technical Assistance (FlexTech) Program," accessed January 10, 2025.

141 U.S. DOE, "A New Frontier – Electrification in Multifamily Housing," 2021 Better Buildings Summit.

142 U.S. DOE, "Central Heat Pump Water Heaters for Multifamily Buildings," last updated July 19, 2024.

143 Maryland Department of Housing and Community Development, "Multifamily Energy Efficiency and Housing Affordability Program," accessed January 14, 2025.

144 New York City Housing Authority (NYCHA), "NYCHA Climate Mitigation Roadmap," accessed January 14, 2025.

145 Scott, J. and Mills, C.K., "Window of Opportunity: New York's Small Multifamily Buildings, Expiring Equipment, and Clean Energy Goals," October 2023.

146 State of New York Public Service Commission, "Proceeding on Motion of the Commission to Examine Programs to Address Energy Affordability for Low Income Utility Customers," issued and effective August 15, 2024.

147 Building Decarbonization Coalition, "The Switch Is On," accessed January 10, 2025.

148 Massachusetts Clean Energy Center, "Home Modernization Navigator," accessed March 11, 2025.

149 California Heat Pump Partnership, "6M Heat Pumps by 2030," accessed June 30, 2025.

150 Wein, O., "The Low-Income Home Energy Assistance Program (LIHEAP)," National Consumer Law Center, 2024.

151 Xerohome, "Technology," accessed January 14, 2025.

152 Foster, B., "Bridging the Gap to Heat Pump Adoption: Water Heater Loaner Program," Barnett Plumbing & Water Heaters, July 27, 2023.

153 NJ Department of Labor and Workforce Development, "Workforce Innovation and Opportunity Act: Annual Report Narrative," 2023.

154 Massachusetts Clean Energy Center, "Climate-Critical Underrepresented Business Support," accessed April 25, 2025.

155 California Energy Commission, "Equitable Building Decarbonization Program," accessed March 11, 2025.

156 State of Maine Governor's Energy Office, "Clean Energy Partnership," accessed March 11, 2025.

157 Maine AFL-CIO, "Union Construction Academy of Maine," accessed April 2, 2025.

158 He, Y., "Growing an Equitable Energy Efficiency Workforce," NEEP, September 26, 2024.

159 Building Futures RI, "Construction Pre-Apprenticeship," accessed April 2, 2025.

160 New Jersey Office of Clean Energy, "Find a Trade Ally," accessed March 12, 2025.

161 ACEEE, "Building a Workforce for Energy-Efficient Homes," February 18, 2025.

162 California Department of Consumer Affairs, Contractors State License Board, "Reciprocal Classifications List," accessed March 12, 2025.

163 California Energy Commission, "Equitable Building Decarbonization Program," accessed March 11, 2025.

164 Efficiency Vermont, "Efficiency Excellence Network," accessed January 13, 2025.

165 TECH Clean California, "Heat Pump Data," accessed February 6, 2025.

166 Massachusetts Department of Environmental Protection, "Heating Fuels Emissions Reporting Regulation," accessed April 25, 2025.

167 Stebbins, G. and Neme, C., "A Comparison of Clean Heat Standards: Current Progress and Key Elements," Energy Futures Group and Environmental Defense Fund, February 2024.

168 *Ibid*.

169 Colorado General Assembly, "SB21-264: Adopt Programs to Reduce Greenhouse Gas Emissions from Utilities," signed June 24, 2021.

170 Fickling, M., "Colorado's Landmark Climate Win: the Xcel Clean Heat Plan Explained," Western Resource Advocates, June 11, 2024.

171 California Climate Investments, "Data Dashboard," accessed April 25, 2025.

172 Norton, R.A., et al., "Leading with Equity and Justice in the Clean Energy Transition: Getting to the Starting Line for Residential Building Electrification," Green and Health Homes Initiative, accessed January 14, 2025.

173 Lejano, R.P., Kan, W.S., and Chau, C.C., (2020), "The Hidden Disequities of Carbon Trading: Carbon Emissions, Air Toxics, and Environmental Justice," Frontiers in Environmental Science 8: 593014.

174 Cowart, R., et al., "Meeting the Thermal Challenge: A Clean Heat Standard for Maryland," RAP, October 2023.

175 California Air Resources Board, "High-GWP Refrigerants," accessed February 6, 2025.

176 Pistochini, T., et al., (2022), "Greenhouse gas emission forecasts for electrification of space heating in residential homes in the US," Energy Policy 163: 112813.

177 U.S. EPA, "Technology Transitions," last updated October 28, 2024.

178 U.S. EPA,"Analysis of the U.S. Hydrofluorocarbon Reclamation Market: Stakeholders, Drivers, and Practices," September 2024.

179 U.S. EPA, "Greenhouse Gas Inventory Data Explorer, 2022," last updated August 18, 2023.

180 *Ibid*.

181 Theodoridi, C., et al., "The 90 Billion Ton Opportunity: Lifecycle Refrigerant Management," Natural Resources Defense Council, Energy Investigation Agency, Institute for Governance & Sustainable Development, 2022.

182 U.S. EPA, "Stationary Refrigeration – Prohibition on Venting Refrigerants," last updated December 13, 2024.

183 Hoover, B., Kilgore, B., and Torok, C., "Refrigerants, taking the chill out of heat pumps," ACEEE Summer Study on Energy Efficiency in Buildings, 2024.

184 CARB, "About SB 1206," accessed August 22, 2025.

185 Hoover, B., Kilgore, B., and Torok, C., "Refrigerants, taking the chill out of heat pumps," ACEEE Summer Study on Energy Efficiency in Buildings, 2024.

186 North American Sustainable Refrigeration Council, "HFC Policy Tracker," accessed May 5, 2025.

187 New York State Department of Environmental Conservation, "Part 494 Fact Sheet: Reducing Hydrofluorocarbon Emissions," accessed February 7, 2025.

188 Velders, G.J.M., et al., (2022) "Projections of hydrofluorocarbon (HFC) emissions and the resulting global warming based on recent trends in observed abundances and current policies," Atmos. Chem. Phys., 22, 6087–6101.

189 CARB, "About SB 1206," accessed August 22, 2025.

190 AHRI, "New A3 Refrigerant Testing Results Issued," July 22, 2019.

191 International Electrotechnical Commission, "IEC 60335-2-40 Revised," published May 5, 2022.

192 Environmental Investigation Agency (EIA), "Enabling Ultra-low GWP Cooling and Heating: Updating US Safety Standards and Codes," 2025.

193 See, for example, Rhode Island's A2L refrigerant legislation.

194 Spielman, S., et al., "Overcoming Barriers to Natural Refrigerants: 'Why can I buy a propane boiler, but not a propane heat pump," ACEEE Summer Study on Energy Efficiency in Buildings, 2024.

195 *Ibid.*

196 Northeast Energy Efficiency Partnerships, "Electrification and Energy Codes Primer," December 2023.

197 Sherman, E., Carpenter-Gold, D., Kocher, J., and Long, J., "The Energy Code Safe Harbor Toolkit," RMI, December 2024.

198 Tan, L., Fatzhollahzadeh, M.H., and Taylor, E., "The Economics of Electrifying Buildings: Residential New Construction," RMI, 2022.

199 Colorado Energy Office, "Colorado's Building Energy Codes," accessed February 7, 2025.

200 Garfunkel, E. and Waite, M., "Utility Energy Codes Programs and Their Potential Extension to Building Performance Standards," ACEEE, July 25, 2024.

201 National Fire Protection Association (NFPA), "NFPA 70: National Electrical Code," Next Edition: 2026.

202 Feinstein, L., et al., "Solving the Panel Puzzle: Avoiding and Streamlining Electric Panel and Service Upsizing to Accelerate Building Decarbonization," SPUR, May 2024.

203 Hart, Z., "The Benefits of Benchmarking Building Performance," Institute for Market Transformation and Pacific Coast Collaborative, December 2015.

204 Institute for Market Transformation, "Building Performance Standards," accessed January 17, 2025.

205 Maryland Department of the Environment, "Subtitle 28: Building Energy Performance Standards," January 2025.

206 Garfunkel, E. and Waite, M., "Utility Energy Codes Programs and Their Potential Extension to Building Performance Standards," ACEEE, July 25, 2024.

207 District of Columbia Sustainable Energy Utility, "Affordable Housing Retrofit Accelerator," accessed May 6, 2025.

208 U.S. DOE, "Home Energy Score," accessed March 20, 2025.

209 Residential Energy Services Network, "What is the HERS Index," accessed March 20, 2025.

210 Ribiero, D. and Cluett, R., "Residential Energy Use Disclosure: A Guide for Policymakers," June 2014.

211 City of Boulder, "SmartRegs Guide," accessed March 31, 2025.

212 Levin, E., Louis-Prescott, L., and Breit, R., "Zero-Emission Heating Equipment Standards: A New Tool in the Policy Toolbox," ACEEE Summer Study, 2024.

213 NESCAUM, "Zero-Emission Heating Equipment Standards," accessed May 5, 2025.

214 Bay Area Air District, "Staff Report – Informational Update Regarding Regulation 9, Rule 6: Nitrogen Oxides Emissions from Natural Gas-Fired Water Heaters Less than 75,000 BTU/hr," December 2024.

215 *Ibid*.

216 Air-Conditioning, Heating, & Refrigeration Institute (AHRI), "AHRI Releases December 2024 U.S. Heating and Cooling Equipment Shipment Data," February 14, 2025.

217 Pantano, S., et al., "3H 'Hybrid Heat Homes'," CLASP, May 26, 2021.

218 City of Vancouver, "Home, property, and development: Mechanical permit," Effective January 1, 2023.

219 Takemura, A.F., "A call to replace air conditioners with heat pumps in California," Canary Media, May 28, 2024.

220 Denver, Colorado – Code of Ordinances, Section 10-20(d)(2).

221 States interested in pursuing this policy can reference the Institute for Market Transformation and Regulatory Assistance Project's "Model Utility Data Access Law."

222 U.S. Department of Energy, "Open Energy Data: Green Button," accessed March 31, 2025.

223 Chhabra, M., et al., "Doing The Right Thing Now Will Eventually Pay Off: Cost-Effective & Equitable Building Decarbonization Requires (More) Proactive Planning and (Completely) Rethinking Rate Design," ACEEE Summer Study on Energy Efficiency in Buildings, 2024.

224 U.S. EIA, "Electric Power Monthly – Table 5.6.A Average Price of Electricity to Ultimate Customers by End-Use Sector," October 2024.

225 CA Public Utilities Code, Section 739(b).

226 *Ibid*.

227 Malkani, V., et al., "Near-Term Rate Design to Align with the Commonwealth's Decarbonization Goals," Energy and Environmental Economics, December 2024.

228 ISO New England, "CELT Reports," accessed March 31, 2025.

229 Central Maine Power, "Seasonal Heat Pump Rate," accessed January 15, 2025.

230 California Public Utility Commission, "CPUC Response to Executive Order N-5-24," February 18, 2025.

231 Malkani, V., et al., "Near-Term Rate Design to Align with the Commonwealth's Decarbonization Goals," Energy and Environmental Economics, December 2024.

232 California Public Utility Commission, "Decision Addressing Assembly Bill 205 Requirements For Electric Utilities," May 9, 2024.

233 Chitkara, A., et al., "A Review of Alternative Rate Designs," RMI, May 2016.

234 City of Fort Collins, "Residential Electric Rates," accessed January 15, 2025.

235 California Public Utilities Commission, "CARE/FERA Program," accessed July 1, 2025.

236 Yim, E. and Subramanian, S., "Equity and Electrification-Driven Rate Policy Options," ACEEE, September 2023.

237 Nevada Division of Welfare and Supportive Services, "Nevada Fund for Energy Assistance and Conservation State Plan," effective July 1, 2022.

238 Yim, E. and Subramanian, S., "Equity and Electrification-Driven Rate Policy Options," ACEEE, September 2023.

239 Borenstein, S., Fowlie, M., and Sallee, J., "Designing Electricity Rates for an Equitable Energy Transition," Energy Institute at Haas, February 2021.

240 Silicon Valley Clean Energy, "SVCE Customer Bill Protection for New Time-of-Use Rate," accessed January 15, 2024.

241 See, for example: Jonathan Rose Companies, "Location Efficiency and Housing Type: Boiling it Down to BTUs," March 2011; Lazar, J. et al., "Electric Cost Allocation for a New Era: A Manual," Regulatory Assistance Project, January 2020.

242 NVEnergy, "Sierra Pacific Power Company d/b/a NV Energy Electric Rate Schedules for Residential Customers," Accessed March 6, 2025.

243 Commonwealth of Massachusetts, "Interagency Rates Working Group," updated August 12, 2024.

244 Shemkus, S., "Massachusetts heat pump owners could pay less for electricity next winter," Canary Media, April 16, 2025.

245 Unitil Corporation, "Heat Pump Rate," accessed April 25, 2025.

246 Mass Save, "The Massachusetts 2025-2027 Energy Efficiency and Building Decarbonization Plan," October 31, 2024.

247 Mass Save, "2024 Discontinuation of Rebates and Incentives for Natural Gas, Oil, and Propane Heating Equipment," April 12, 2024.

248 Berg, W., "State Policies and Rules to Enable Beneficial Electrification in Buildings through Fuel Switching," ACEEE, July 21, 2022.

249 Gartman, M., et al., "What a 20 million heat pump commitment means for the U.S.," RMI, September 21, 2023.

250 U.S. DOE, "Community Solar Basics," accessed January 14, 2025.

251 LaFarge, P., "Distributed capacity procurement: A new model for utilities to deploy DERs at scale," Utility Dive, September 5, 2024.

252 California Energy Commission and UCLA Luskin Center for Innovation, "Identifying Effective demand Response Program Designs for Residential Customers," November 2020.

253 U.S. DOE, "Virtual Power Plants Projects," accessed January 14, 2025.

254 Dunham, J. and Flaherty, M., "Blocked Pipes: The Economic Consequence of Skilled Worker Shortages," July 6, 2023.

255 Cohn, C. and Esram, N.W., "Building Electrification: Programs and Best Practices," ACEEE, February 2022.

256 Efficiency Maine Trust, "FY2021 Annual Report," November 17, 2021.

257 Efficiency Maine Trust, "Executive Director's Summary Report to the Board of Trustees," March 27, 2024.

258 NEEP, "High-Performance HVAC Midstream Program Best Practice Guide," May 2025.

259 Merson, et al., "Driving Upstream Markets through Strategic Partnerships and Excellence in Supply Chain Management," ACEEE Summer Study on Energy Efficiency in Buildings, 2016

260 MCE, "MCE Launches Emergency Water Heater Loaner Program," September 23, 2024.

261 Sealed, "How aggregators simplify rebate programs," accessed May 5, 2025.

262 New Jersey Board of Public Utilities, "Federal Incentives," accessed May 5, 2025.

263 U.S. DOE, "Issue Brief: Low-income Energy Efficiency Financing through On-Bill Tariff Programs," accessed January 17, 2025.

264 U.S. EPA, "Inclusive Utility Investments: Tariffed On-Bill Programs," last updated January 24, 2025.

265 U.S. EPA, "On-Bill Loan Programs," last updated January 24, 2025.

266 U.S. EPA, "Inclusive Utility Investments: Tariffed On-Bill Programs," last updated January 24, 2025.

267 Hayes, S., et al., "What Have We Learned from Energy Efficiency Financing Programs?," ACEEE, September 2011.

268 Prieto, O. and Unger, R., "Making Decarbonization Financing Work for Homeowners and Contractors," RMI, 2024.

269 ACEEE, "Utility Business Models," accessed January 20, 2025.

270 Gold, R. and Rosenbach, C., "Transforming the Way We Serve Vulnerable Communities: Performance Incentive Mechanisms and Beyond," RMI, April 26, 2024.

271 Commonwealth of Massachusetts, "Clean Peak Energy Standard History of Program Development," accessed February 7, 2025.

272 Commonwealth of Massachusetts, "Clean Peak Resource Eligibility Guide," September 10, 2021.

273 New Jersey Board of Public Utilities, "Order Directing the Utilities to Propose Second Triennium Energy Efficiency and Peak Demand Reduction Programs," July 2023.

274 U.S. EIA, How Many Smart Meters are Installed in the U.S., and Who Has Them?, October 20, 2023.

275 Brehm, K. and Tobin, M., "Virtual Power Plant Flipbook," RMI, 2024.

276 De Martini, et al., "Modern Distribution Grid," June 2020. U.S. Department of Energy.

277 Brehm, K. and Tobin, M., "Virtual Power Plant Flipbook," RMI, 2024.

278 The California Public Utilities Commission released Decision 25-06-034, which provides a pathway for customer-owned load-managing meter socket adapters to receive utility approval for deployment and directs utilities to provide to customers resources on how to potentially avoid upsizing when adding electrification loads

279 Bastian, H. and Cohn, C., "Ready to Upgrade: Barriers and Strategies for Residential Electrification," ACEEE, October 2022.

280 U.S. DOE, "U.S. Atlas of Electric Distribution System Hosting Capacity Maps," updated May 2024.

281 General Assembly of the State of Colorado, "Senate Bill 24-218," signed May 22, 2024.

282 Aas, D., et al., "The Challenge of Retail Gas in California's Low-Carbon Future," California Energy Commission and California Natural Resources Agency, April 2020.

283 Varadarajan, U., Posner, D., and Fisher, J., "Harnessing Financial Tools to Transform the Electric Sector," Sierra Club, 2018.

284 Gridworks, "California's Gas System in Transition: Equitable, Affordable, Decarbonized and Smaller," 2019.

285 Cosgrove, E., et al., "Centering Equity with Metrics: How to Incorporate Equity and Justice in Evaluation, Measurement, and Verification," NEEP, August 2022.

286 Adler, M., "Benefit–Cost Analysis and Distributional Weights: An Overview," Review of Environmental Economics and Policy, volume 10, issue 2, Summer 2016.

287 California Public Utilities Commission, "Decision 24-07-015: Decision Adopting the Societal Cost Test," issued July 15, 2024.

288 Next 10 and Energy Institute at Haas, University of California, "Paying for Electricity in California: How Residential Rate Design Impacts Equity and Electrification," 2022.

289 Lebel, M., et al., "Opportunities for Integrating Electric and Gas Planning," Regulatory Assistance Project and Lawrence Berkeley National Laboratory, January 2025.

290 California Public Utilities Commission, "SB 1221 Implementation" accessed July 24, 2025.

291 Alter, A., Billimoria, S., Henchen, M., "Overextended: It's Time to Rethink Subsidized Gas Line Extensions," RMI, December 2021.

292 California Public Utilities Commission, "CPUC Eliminates Last Remaining Utility Subsidies for New Construction of Buildings Using Natural Gas," December 14, 2023.

293 Nelson, R., et al., "Non-Pipeline Alternatives to Natural Gas Utility Infrastructure: An Examination of Existing Regulatory Approaches," Strategen, November 2023.

294 Massachusetts Department of Public Utilities, "Department of Public Utilities Issues Order 20-80," December 6, 2023.

295 Camargo, A.M., et al., "The Future of Heat: Thermal Energy Networks as an Evolutionary Path for Gas Utilities Toward a Safe, Equitable, Just Energy Transition," ACEEE Summer Study on Energy Efficiency in Buildings, 2024.

296 Bagdanov, K.G., "Decarbonizing the Obligation to Serve," Building Decarbonization Coalition, March 2024.

297 Gold-Parker, A., et al., "Strategic Pathways and Analytics for Tactical Decommissioning of Portions of Gas Infrastructure in Northern California: Interim Report," E3, Gridworks, and East Bay Community Energy, June 2023.

298 Halbrook, C., "Targeted Electrification and Gas System Decommissioning: Lessons Learned To Date and Key Recommendations," Gridworks, August 31, 2023.

299 New York State Senate, Senate Bill S9422: "Utility Thermal Energy Network and Jobs Act," signed July 5, 2022.

300 U.S. DOE, "Air-Source Heat Pumps," accessed February 5, 2025.

301 U.S. EPA ENERGY STAR, "Air-Source Heat Pumps," accessed December 24, 2024.

302 Booth, K., et al., "Heat Pumps in the Northeast and Mid-Atlantic: Costs and Market Trends," Energy Solutions, October 30, 2024.

303 Turpin, J.R., "Ducted Mini Splits Offer Hidden Benefits," ACHR News, May 29, 2017.

304 U.S. EPA ENERGY STAR, "Ductless Heating & Cooling," accessed December 24, 2024.

305 U.S. DOE, "Heat Pump Systems," accessed December 24, 2024.

306 Building Decarbonization Coalition, "Thermal Energy Networks (TENs)," accessed January 23, 2025.

307 *Ibid.*

308 U.S. DOE, "Active Solar Heating," accessed June 27, 2025.

309 NYSERDA, "Heating & Cooling Systems," accessed June 27, 2025.

310 U.S. DOE, "Heat Pump Water Heaters," accessed March 11, 2025.

311 NYSERDA, "All About Heat Pump Water Heaters," accessed October 1, 2024.

312 Advanced Water Heating Initiative, "2024 State of the Heat Pump Water Heater: Market Report," New Buildings Institute, 2025.

313 U.S. DOE, "Solar Water Heaters," accessed June 27, 2025.

314 NYSERDA, "Water Heaters," accessed June 27, 2025.

315 U.S. EPA ENERGY STAR, "2019-2020 Air-to-Water Heat Pumps," accessed December 24, 2024.

316 U.S. EPA ENERGY STAR, "Window of Opportunity: New Room Heat Pumps," ENERGY STAR Products Partner Meeting, 2024.

317 U.S. DOE, "US National Clean Hydrogen Strategy and Roadmap," June 2023.

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