Multistate Action Plan: Accelerating the Transition to Zero-Emission Residential Buildings

DRAFT FOR PUBLIC INPUT

Released for Input: April 2, 2025

Note: This draft Action Plan has been made available to support public engagement and comment. It has not been approved by MOU states and is subject to change. NESCAUM and MOU states will review all public input received, but final content of the Action Plan will be determined by MOU states.

NESCAUM
NORTHEAST STATES FOR COORDINATED AIR USE MANAGEMENT

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I. EXECUTIVE SUMMARY

Fossil fuel combustion in buildings is a significant source of greenhouse gas (GHG) and air pollutant emissions that exacerbate climate change and harm human health. To address these building-sector emissions, 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.

Organized by Northeast States for Coordinated Air Use Management (NESCAUM), the MOU aims to improve air quality and public health and reduce GHG emissions by transitioning residential space and water heating to zero-emission heat pumps. 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.

MOU states also committed to develop this Multistate Action Plan: Accelerating the Transition to Zero-Emission Residential Buildings ("Action Plan"). The Action Plan reviews the market for zero-emission technologies, the need for an equitable transition to zero-emission residential buildings, and key barriers to the transition. The foundation of the Action Plan is a set of 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 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 all the recommendations in this Action Plan.

Taken together, the recommendations provide a roadmap for states to center affordability and equity in the transition to zero-emission residential buildings. If fully implemented, they would ensure that all residents have access to zero-emission technologies and enjoy the benefits of improved air quality, health, and comfort. States that follow these recommendations will also help residents experience lower and more stable energy bills, even as they adopt zero-emission technologies like heat pumps.

Recommendations for state action are organized into four categories – equity and workforce, carbon reduction obligations, codes and standards, and utility planning and regulation – according to a framework introduced in a 2024 policy brief, "Decarbonizing Buildings: How States Can Set the Table for Success." However, each state has a unique context for building decarbonization, and each is at a different step in the process. As a result, each state will have different priorities for implementing the recommendations in this Action Plan. Table 1 identifies priority recommendations for states depending on their goals and current context.

Table 1. Priority Recommendations for Different State Contexts		
Characteristic	**Priority Recommendations**	**Rationale**
State has adopted binding targets for economy-wide decarbonization by 2050	• Set zero-emission heating equipment standards for space and water heating equipment • Enact AC-to-Heat Pump policies to shift purchases from central AC to heat pumps • Adopt statewide building energy performance standards (BEPS)	All new HVAC and water heating equipment installed after 2030-2035 should have zero emissions, or will likely remain in operation after the decarbonization date and make it harder for states to meet targets. Large buildings will also need to make energy upgrades in that time frame.
State has many residents that use methane gas and a large spark gap between gas and electric rates	• Direct electric utilities to adopt electrification-friendly rates • Change the business model for methane gas utilities to protect remaining gas customers from rising costs • Pursue gas system planning	Electrification-friendly rates can help customers that install heat pumps realize immediate reductions in energy bills. Updates to gas utility business models and planning processes are crucial for long-term affordability.
State is early in its decarbonization journey or is not in a position to adopt significant new policies	• Coordinate between agencies to consolidate and streamline incentive programs • Phase out energy efficiency incentives for equipment that does not align with climate goals and redirect program funding toward electrification and weatherization • Update efficiency program rules to allow fuel switching to zero-emission equipment	States can make progress by coordinating and optimizing existing energy efficiency and housing programs to better support decarbonization goals, without needing to pass major legislation or regulations.
State has strong climate and air quality goals, but insufficient funding to implement programs	• Direct utilities to implement clean heat, load flexibility, and electrification readiness programs • Enact Clean Heat Standards (CHS) or cap-and-invest policies covering the thermal sector	States can create new, sustainable sources of funding for building decarbonization programs by directing electric and gas utilities to create new programs, and/or by developing new policies that cap emissions from fuel suppliers and generate revenues from auctions or credit sales.

Table 2 summarizes all Action Plan recommendations. States are excited to work together to implement these actions to accelerate the transition to zero-emission residential buildings, and look forward to reporting their collective progress toward the MOU targets.

TABLE 2. SUMMARY TABLE OF RECOMMENDATIONS		
Category	**Subcategory**	**Recommendation**
General	Policy Coordination & Accountability	Establish an office to coordinate a whole-of-government, cross-agency approach Create regular touchpoints between agencies to coordinate on buildings policies Clarify local authority and empower local governments Plan for and provide resources to ensure appropriate implementation and enforcement
Equity & Workforce	Stakeholder Engagement & Inclusive Process	Establish community and stakeholder advisory boards Partner with public experts like Community Based Organizations (CBOs) on policy design Improve public access to policy processes
	Ensuring that Underserved Households Benefit	Set equity targets for program spending or impact Work across agencies to include tenant protections in incentive programs Promote utility-scale solutions
	Equitable Program Design & Implementation	Create and expand whole-home programs serving low- and moderate-income (LMI) households Coordinate between agencies to consolidate and streamline incentive programs Streamline income verification for LMI and disadvantaged community programs Provide technical assistance to multifamily and affordable housing owners Offer multifamily and affordable housing-specific incentive programs Expand financing options for multifamily and affordable multifamily decarbonization
	Education, Awareness, & Access	Deliver consumer campaigns Create "one-stop-shop" hubs and clearinghouses for information and financing Partner with CBOs and other trusted partners on outreach, campaigns, and messaging Develop or fund "train the trainer" programs Design programs to support emergency replacement scenarios
	Workforce Development & Economic Empowerment	Form workforce advisory committees Support small energy efficiency and electrification businesses Encourage aggregation of work across multiple buildings or households Expand apprenticeship and training programs Create contractor networks
Carbon Reduction Obligations	Climate Goal-Setting & Progress Tracking	Establish and track progress towards measurable targets Make relevant data publicly available
	Clean Heat & Cap-and-Invest Policies	Establish reporting requirements for fuel suppliers Enact Clean Heat Standards (CHS) or cap-and-invest programs covering the thermal sector
	Refrigerant Policies & Programs	Improve lifecycle refrigerant management Adopt state-level "backstop" regulations to support implementation of the federal AIM Act

		Develop regulatory programs that further codify the AIM Act timeline and support the full market transition away from HFCs Support research, demonstration, and deployment efforts for emerging refrigerants Remove barriers to low-global warming potential refrigerant use
Codes & Standards	Building Energy Codes Building Energy Codes	Adopt and update building energy codes Develop model all-electric codes for local jurisdictions to implement
	Building Energy Performance Standards & Disclosure	Require energy benchmarking and disclosure for large residential buildings Adopt statewide building energy performance standards (BEPS) Require residential homes to provide energy efficiency disclosure at point of sale Require residential homes to meet energy performance criteria at point of sale or lease
	Equipment Emissions Standards	Set zero-emission heating equipment standards for space and water heating equipment
	AC-to-Heat Pump Policies	Enact AC-to-Heat Pump policies to shift purchases from central AC to heat pumps
Utility Planning & Regulation	Utility Business Models & Performance Requirements	Reform electric utility business models to link compensation to performance Direct utilities to implement clean heat, load flexibility, and electrification readiness programs Change the methane gas utility business model to protect gas customers from price increases Account for non-energy benefits in cost-benefit analysis of utility programs
	Access to Utility Data	Pass legislation requiring utilities to make historic energy consumption data available
	Rate Reform	Direct electric utilities to adopt electrification-friendly rates Direct electric and methane gas utilities to incorporate equity and affordability into rate design Establish a statewide interagency rates working group Require that utilities increase enrollment in rates that benefit customers
	Consumer-Facing Programs & Incentives	Phase out efficiency incentives for equipment that does not align with climate goals Update energy efficiency program rules to allow fuel switching to zero-emission equipment Target oil, propane, and electric resistance customers for zero-emission incentives Reduce the need for large out-of-pocket expenses Bundle information and incentives for electrification and weatherization
	Midstream & Upstream Incentives & Programs	Design and implement midstream and upstream incentive programs Pilot innovative incentive and procurement strategies
	Inclusive & Accessible Financing	Design financing to work for unplanned equipment replacements Work with utilities to offer on-bill financing Work with local credit unions, green banks, and others to offer zero- or low-interest loans Attach energy efficiency and electrification requirements to existing lending programs
	Gas System Planning	Require integrated methane gas and electric utility planning Eliminate methane gas line extension subsidies Require gas utilities to conduct non-pipeline alternative assessments Promote thermal energy networks

II. INTRODUCTION

1. Background

Fossil fuel combustion in buildings is a significant source of greenhouse gas (GHG) and air pollutant emissions that exacerbate climate change and harm human health. Across the country, seventy million homes and businesses burn fossil fuels such as methane gas,[1] oil, or propane onsite,[2] mostly for space and water heating.[3] Because heating equipment vents directly outdoors, harmful pollutants like nitrogen oxides (NOx) and fine particulate matter (PM2.5) are released straight into communities.

As states have reduced air pollution from the transportation and power sectors, buildings represent a growing share of GHG and air pollutant emissions.[4] Fossil fuel equipment in buildings now generates more NOx emissions in the U.S. than gas-fired power plants.[5] 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 co-pollutants like NOx and PM2.5.[6]

Nationally, space and water heating make up around 90% of direct fuel combustion and associated emissions in residential buildings, making heating equipment a primary opportunity for this transition.[7] While a variety of technologies can reduce building pollution, electrifying equipment end uses can eliminate onsite emissions while leveraging an increasingly clean electric grid. Electric heat pumps have emerged as a leading option for 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.[8]

[1] In this report, 'methane gas' refers to a fossil fuel commonly combusted in gas furnaces, boilers, and water heaters, also known as "natural gas," "pipeline gas," and "fossil gas." For the purposes of this report, methane gas does not necessarily refer to pure CH4, but rather to a gaseous mixture of hydrocarbon compounds with CH4 as the primary compound with sufficient energy content and a small enough share of impurities for transport through commercial gas pipelines and sale to end-users.
[2] RMI, "The Impact of Fossil Fuels in Buildings," 2019.
[3] U.S. Energy Information Administration (EIA), "Use of energy explained: Energy use in homes," last updated December 18, 2023.
[4] U.S. EPA, "Commercial and Residential Sector Emissions," last updated January 16, 2025.
[5] RMI, "How air agencies can help end fossil fuel pollution from buildings," 2021.
[6] NESCAUM, "Accelerating the Transition to Zero-Emission Residential Buildings: Multistate Memorandum of Understanding," signed May 24, 2024.
[7] Nadel, S., "Comparative Energy Use of Residential Gas Furnaces and Electric Heat Pumps," American Council for an Energy Efficient Economy Report A1602, May 2016.
[8] Nadel, S., and Fadali, L., "Analysis of Electric and Gas Decarbonization Options for Homes and Apartments," ACEEE, July 2022.

2. 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.[9] Organized by Northeast States for Coordinated Air Use Management (NESCAUM), the MOU aims to promote public health and mitigate climate change by transitioning residential space and water heating to zero-emission heat pumps. 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.[10] Together, MOU signatories represent over 32% of U.S. residential fossil fuel consumption.[11] **[INSERT: Map of MOU states]**

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 quadruple heat pump installations and install 20 million heat pumps by 2030.[12] The MOU also leverages in-state efforts to coordinate between environment, energy, housing, and other agencies to reduce building-related emissions.[13]

In addition to setting targets for heat pump market share, MOU signatory states agreed to support accountability and equity measures in building decarbonization policy, including:

- Multistate collaboration on efforts to reduce residential building emissions;
- Supporting development of improved data tracking and reporting systems for zero-emission heating equipment sales;
- Leading by example by establishing zero-emission standards for newly constructed state-owned buildings and promoting installation of zero-emission, grid-interactive technologies in existing state buildings; and
- Centering environmental justice by directing 40% of investments in building decarbonization and energy efficiency to low-income households and disadvantaged communities.

Signatory states also agreed to work with NESCAUM to develop an Action Plan to Accelerate the Transition to Zero-Emission Residential Buildings ("Action Plan") and, with NESCAUM and Northeast Energy Efficiency Partnerships (NEEP), to produce an annual report on zero-emissions space and water heater sales that assesses each state's progress

[9] For simplicity, this Action Plan refers to participating jurisdictions, including the District of Columbia, as "states."
[10] NESCAUM, "Accelerating the Transition to Zero-Emission Residential Buildings: Multistate Memorandum of Understanding," signed May 24, 2024.
[11] U.S. EIA, "2020 RECS Survey data: CE2.1.ST – Household Site Fuel Consumption in U.S. Homes by State, 2020," June 13, 2023.
[12] 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.
[13] NESCAUM, "Accelerating the Transition to Zero-Emission Residential Buildings: Multistate Memorandum of Understanding," signed May 24, 2024.

toward the 2030 and 2040 targets, the state of the residential building electrification market, key barriers, and high-priority opportunities to accelerate market transition. 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. States are not required to endorse or enact every recommendation in the Action Plan, but can use it as a roadmap to achieve equitable decarbonization and air quality goals.

[INSERT GRAPHIC: To develop the Action Plan, NESCAUM convened a Building Electrification Initiative (BEI) Task Force of state agency staff to identify recommendations and best practices to accelerate the transition to zero-emission residential buildings. NESCAUM also convened an Environmental Justice Advisory Group (EJAG) of nine environmental justice organizations[14] and a Stakeholder Advisory Group (SAG) of technical and policy experts[15] to guide recommendations and ensure Action Plan strategies lead to equitable outcomes. Additional support for Action Plan development was provided by NEEP and RMI.**]**

3. Organization of the Action Plan

The Action Plan is organized as follows:

- Section III makes the case for action. It 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. It also contains a set of equity principles developed by NESCAUM's EJAG to guide states as they continue to develop decarbonization policies.
- Section IV describes the key barriers to transitioning to zero-emission residential buildings.
- Section V provides recommendations for 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.

[14] Organizations participating in the EJAG include: Alternatives for Community & Environment, CASA, Connecticut Coalition for Environmental Justice, Emerald Cities Collaborative, Green & Health Homes Initiative, Maine People's Alliance, National Housing Trust, New Jersey Environmental Justice Alliance, and WE ACT for Environmental Justice.

[15] Organizations participating in the SAG include: American Council for an Energy Efficient Economy, Appliance Standards Awareness Project, Building Decarbonization Coalition, Center for Energy & Environment, Climate Imperative, Climate Jobs National Resource Center, Climate Jobs RI, Community Preservation Corporation, Conservation Law Foundation, Ceres, Evergreen Action, Greenhouse Institute, Maine Labor Climate Council, Natural Resources Defense Council, New Buildings Institute, Public Health Law Center, Regulatory Assistance Project, Rewiring America, RMI, Sierra Club, Stewards of Affordable Housing for the Future, Urban Green Council, and members at educational institutions including Harvard University, New York University, and University of California Berkeley.

III. THE CASE FOR ACTION

1. Zero-Emission Technologies Are Widely Available and Rapidly Improving

Zero-emission technologies are now widely available to provide space and water heating in residential buildings. Heat pumps are a leading zero-emission option because they use electricity to move heat rather than create it, enabling them to reach efficiencies of up to four times those of furnaces without producing onsite combustion-related emissions.[16] Air- and ground-source heat pumps can provide space heating and cooling in a single system, eliminating the need for separate heating and air conditioning (AC) equipment,[17] and can also be used for water heating. While heat pumps have historically been more prevalent in warmer climates, models designed to work well in cold areas and high altitudes continue to improve and come to market.[18] They have been successfully deployed in cold regions from Maine to Norway, providing a viable decarbonization solution for most residential applications.[19] Appendix A provides an overview of heat pump technologies for space and water heating. **[INSERT: Labeled diagram of heat pump]**

[CALL-OUT BOX: Overall, signatory states collectively need to more than double heat pump space heater sales and make even greater progress on HPWH sales over the next five years to achieve the goal of making heat pumps 65% of the HVAC and water heater market by 2030.]

[NOTE: Much of the next two paragraphs will be converted to charts and graphs.]

Air-source heat pumps (ASHPs) are currently estimated to make up around 32% of residential heating, ventilation, and air conditioning (HVAC) sales nationally.[20] ASHPs have outsold furnaces since 2023,[21,22] though they only make up 43% of the central cooling equipment market, with the rest of the market dominated by one-way ACs with no heating capabilities.[23] Given that heat pumps are efficient ACs that also provide zero-emission heat, increasing the share of heat pump installations relative to ACs can be a gateway to zero-emission home heating.[24] It is important to note that these market indicators are based on national and regional data trends; NESCAUM is working with the Heating, Air Conditioning, and Refrigeration Distributors International (HARDI) and other partners to improve access to state-level data on heat pump sales.

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[16] Tan, L., and Teener, J., "Now is the Time to Go All In on Heat Pumps," RMI, July 6, 2023.
[17] U.S. Department of Energy (DOE), "Heat Pump Systems," accessed December 24, 2024.
[18] U.S. DOE, "DOE Efforts Send New and Improved Cold-Climate Heat Pumps to the Market," accessed February 4, 2025.
[19] Rewiring America, "Do heat pumps work in cold climates?" accessed February 4, 2025.
[20] AHRI December 2024 U.S. Heating and Cooling Equipment Shipment Data, https://www.ahrinet.org/system/files/2025-02/December2024Statistical%20Release2.docx.
[21] Takemura, A.F., "Heat pumps outsold gas furnaces again last year — and the gap is growing," Canary Media, February 13, 2024.
[22] RMI, "Tracking the Heat Pump & Water Heater Market in the United States," last updated March 2025.
[23] Atlas Buildings Hub, "Appliance Shipments: Cooling," accessed March 12, 2025.
[24] Urban Green Council, "Cool Switch," October 30, 2024.

In the water heater market, heat pump water heater (HPWH) shipments have increased eightfold nationally over the past decade, from 23,000 in 2011 to 190,000 in 2023.[25] Despite this growth, HPWH market penetration remains low, with electric resistance and gas water heaters making up the vast majority of the market.[26] Federal efficiency standards scheduled to take effect in 2029 would dramatically shift the water heating market to more efficient HPWHs, if not rolled back.[27,28]

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. For example, 120-volt HPWHs can plug into a standard outlet, avoiding the need for electrical upgrades that add time and cost. New window heat pumps connect indoor and outdoor units across a windowsill, and can be installed in dense multifamily housing in place of window AC units,[29] while single-unit heat pumps with no outdoor unit can connect directly to the outside air through a wall.[30] While there are already a variety of cold-climate heat pump models that maintain heat and comfort at very low temperatures,[31] state-of-the-art heat pumps can operate even more efficiently and at even colder (down to -15°F) temperatures than prior models.[32]

Refrigerants used in HVAC equipment are also transitioning in response to international agreements and federal law. Today, the most commonly used refrigerants in ACs and heat pumps are hydrofluorocarbons (HFCs), a group of synthetic chemicals that have global warming potentials (GWPs) hundreds to thousands of times more potent than CO2.[33] HFCs are 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 additional HVAC technology updates, and there is growing interest in heat pump technologies that use ultra-low GWP refrigerants. 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 R-290 refrigerant, which has very low GWP but is more flammable than

[25] Advanced Water Heating Initiative, "2024 State of the Heat Pump Water Heater: Market Report," New Buildings Institute, 2025.
[26] Ibid. Electric water heaters made up approximately 50% of the total water heater market, while HPWHs made up 2.1% of all water heater and 3.9% of electric water heater sales in 2023.
[27] RMI, "Tracking the Heat Pump & Water Heater Market in the United States," last updated December 2024.
[28] Northwest Energy Efficiency Alliance (NEEA), "Department of Energy Residential Water Heater Final Rule," August 2024.
[29] 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.
[30] Ibid.
[31] Northeast Energy Efficiency Partnerships (NEEP), "Cold Climate Air Source Heat Pump List," accessed December 24, 2024.
[32] American Society of Plumbing Engineers, "DOE Efforts Send New and Improved Cold-Climate Heat Pumps to the Market," October 23, 2024.
[33] California Air Resources Board, "High-GWP Refrigerants," accessed February 6, 2025.

refrigerants widely used in the U.S. market.[34,35] AWHPs are common in Europe but newer to the North American market.[36]

2. Zero-Emission Buildings Improve Health and Housing Quality

[NOTE: In the final Action Plan, this section may be turned into an infographic-style two-page spread**]**

A. Air Quality and Health

Fossil fuel combustion in buildings produces a variety of air pollutants known to harm human health.[37,38] NOx contributes to airway inflammation, coughing and wheezing, reduced lung function, and higher risk of asthma attacks.[39] It also reacts in the atmosphere with volatile organic compounds (VOCs) and sunlight to form ozone (smog), which is linked to acute respiratory symptoms and serious health effects including nervous system impairment, reproductive issues, and cancer.[40]

Over 90 counties in MOU states are 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,[41] resulting in nearly 50 million people within MOU states living in counties with unhealthy air quality.[42] Furthermore, fossil fuel combustion in buildings emits pollutants into neighborhoods at ground level, which can cause more serious health impacts than industrial or electricity sector emissions released from tall smokestacks,[43] and create an environmental justice concern by disproportionately exposing people of color to PM2.5 pollution.[44] Eliminating outdoor air emissions from buildings could prevent approximately 1,942 premature deaths per year among MOU states,[45] as well as reduce emergency visits and disease symptoms.[46]

Fossil fuel combustion in buildings also produces indoor air pollution from unvented equipment like stoves and improperly vented space and water heaters, creating chronic

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[34] Heat Pumps UK, "Monobloc v Split System Heat Pumps," August 19, 2024.
[35] Wolf, "Heat Pumps: Monoblock or Split?" accessed February 5, 2025.
[36] Stewart, M., et al., "Propane (R-290) Air-to-Water Heat Pump (AWHP) Market Study," CalNEXT, December 12, 2023.
[37] U.S. DOE, "Decarbonizing the US Economy by 2050," April 2024.
[38] U.S. EPA, "NAAQS Table," last updated December 16, 2024.
[39] American Lung Association, "Nitrogen Dioxide," accessed February 10, 2025.
[40] American Lung Association, "Ozone," accessed February 10, 2025.
[41] U.S. EPA, "Current Nonattainment Counties for All Criteria Pollutants," updated February 28, 2025.
[42] According to the U.S. EPA Green Book, 95 counties with a combined population of over 47 million were partly or fully in a NAAQS nonattainment area in an MOU state as of February 2025.
[43] Gilmore, E., et al. (2019), "An inter-comparison of the social costs of air quality from reduced-complexity models," *Environmental Research Letters* 14: 074016.
[44] Tessum, C.W., et al. (2021), "PM2.5 polluters disproportionately and systemically affect people of color in the United States," *Science Advances* 7(19): eabf4491.
[45] 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.
[46] NESCAUM, "Technical Support Document 1.2 for Model Rule 1.0: NOx and GHG Emissions Standards for Space and Water Heaters," December 12, 2024.

health harms and acute risks. Across MOU states, an estimated 178 avoidable deaths annually are caused by carbon monoxide poisoning.[47]

B. Housing Quality and Health

Zero-emission heating equipment can be installed 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.[48] 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.[49,50] In older or poorly maintained homes, weatherization may require addressing safety and structural barriers such as mold, asbestos, and roof damage prior to energy efficiency or electrification upgrades.[51]

Whole-home retrofit programs that comprehensively address all stages of the building decarbonization process, from structural repairs to heat pump installation, can reduce energy bills while generating health benefits such as improved thermal comfort and reduced exposure to mold and pests.[52,53] Given that people of color and low-income residents are significantly more likely to live in poor-quality housing due to historical disenfranchisement and segregation,[54,55] whole-home retrofit programs can be an important tool to reduce housing and health inequities. However, these programs should include renter protections to avoid displacement caused by tenant relocation prior to renovation or rent increases due to improved housing quality.[56]

C. Access to Cooling

Heat pumps provide the additional benefit of heating and cooling in a single piece of equipment. As climate change causes more frequent extreme heat events, access to AC

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[47] U.S. CDC, "Unintentional Carbon Monoxide Poisoning," National Environmental Public Health Tracking Network, accessed March 12, 2025.
[48] MassSave, "Air Source Heat Pumps," accessed December 23, 2024.
[49] U.S. Department of Energy, "Weatherization Program Notice 19-5," September 6, 2019.
[50] Sollod, J., "National Labs Study Finds Updated Building Energy Codes Save Lives in Face of Intensifying Climate Hazards," Building Safety Journal, July 25, 2023.
[51] Virginia Department of Health and Community Development, "Weatherization Deferral Repair Program Guidelines 2023-2024," July 2023.
[52] 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.
[53] Green & Healthy Homes Initiative, "Whole-House Repair Programs Incorporating Electrification," accessed March 13, 2025.
[54] 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.
[55] Williams, D. and Collins, C. (2001), "Racial residential segregation: A fundamental cause of racial disparities in health," *Public Health Reports* 116(5): 404-416.
[56] Climate and Community Project, "Decarbonization Without Displacement: Tenant Advocacy in the Context of Inflation Reduction Act Implementation," January 2024; Strategic Actions for a Just Economy (SAJE), "Decarbonizing California Equitably: A Guide to Tenant Protections in Building Upgrades/Retrofits Throughout the State," October 2023.

becomes increasingly important to human health.[57] People of color, low-income communities, and people without health insurance are at the greatest risk of heat impacts due to higher exposure from risk factors such as housing quality, neighborhood characteristics, and access to medical care.[58,59] Young children and the elderly are also vulnerable due to lower physiological capacity for heat response.[60,61]

Heat pumps provide highly efficient cooling that can save electricity and reduce energy bills compared to conventional ACs, especially when replacing inefficient window units.[62,63] Since many communities who have not historically used AC may be reluctant to install new cooling equipment due to cost concerns, providing heat pumps for heating can be a good option to provide life-saving cooling for households that otherwise would remain without AC during heat waves.[64,65] Pairing heat pumps with weatherization can also reduce AC bills and increase resilience during power outages. In areas that rely on natural ventilation for cooling, these measures can keep temperatures comfortable during wildfire and other air pollution events when windows should be closed.[66]

3. The Transition to Zero-Emission Buildings Can Improve Equity

Beyond the benefits to health and housing quality, transitioning to zero-emission residential buildings can improve equity in other ways. Policy design creates an opportunity to include communities as partners in policy processes – a vital step to developing programs that achieve intended goals and benefit all stakeholders. Additionally, increasing demand for heat pump businesses paired with workforce protections and guidance can

[57] 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.
[58] Clark, A, et al. (2024), "Identifying groups at-risk to extreme heat: Intersections of age, race/ethnicity, and socioeconomic status," *Environment International* 191: 108988.
[59] Gronlund, C. (2014), "Racial and socioeconomic disparities in heat-related health effects and their mechanisms: a review," *Current Epidemiology Reports* 1: 165-173.
[60] U.S. Environmental Protection Agency, "Protecting children's health during and after natural disasters: Extreme heat," last updated October 31, 2024.
[61] National Institutes of Health, National Institute on Aging, "Hot weather safety for older adults," September 2, 2022.
[62] New York State Energy Research & Development Authority (NYSERDA), "Analysis of residential heat pump potential and economics," January 2019.
[63] Heat pumps provide cooling up to 29% more energy efficient than window units. *See* National Renewable Energy Laboratories (NREL), "How heat pumps can bring relief to households," August 7, 2024.
[64] New York City Department of Health, "Health Department Releases Report on Heat-Related Mortality in New York City," June 18, 2024.
[65] Mann, R., and Schuetz, J., "As extreme heat grips the globe, access to air conditioning is an urgent public health issue," *Brookings Institute*, July 25, 2022.
[66] Hu, X., Hines, E., and Henchen, M., "Resilient, Carbon-Free Buildings are Within Reach," RMI, October 22, 2024.

generate training, workforce development, and entrepreneurship opportunities in disadvantaged communities.[67]

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

[EJAG/EQUITY TWO-PAGE SPREAD/CALL-OUT:

The EJAG is composed of nine community-based and national organizations focused on environmental justice and affordable housing. Through a series of meetings, the EJAG developed the following definition of equity in state-level building decarbonization policy:

Definition:

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 several principles that form the foundation of 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.

Principles

- **Affordability:** Upfront costs of electrification can be high, creating affordability challenges for low-income communities. Policies should reduce costs and barriers to

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

entry for low- and moderate-income (LMI) households, including upfront costs for upgrades and operating costs over time. Policies should also enable both renters and homeowners to make decisions about electrifying their homes.

- **Access:** Affordable electrification options must be accessible to all residents, particularly 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 to communities and participation processes are easy to navigate.
- **Legacy Issues:** Decarbonization efforts should prioritize the needs of low-income housing 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 targeting both energy and housing concerns in tandem are recommended.
- **Air Quality and Human Health:** Policies should reduce emissions in a manner that contributes to improvements in indoor and outdoor air quality as well as public health. Reductions in criteria air pollutants from building electrification and associated changes in emissions from fossil fuel-based electricity generation should be measured to determine the air quality and health impacts of decarbonization policies.
- **Education and Awareness:** Policy development should include broad-scale educational and awareness activities, particularly in historically underserved communities where there may be a general lack of awareness and knowledge regarding zero-emission technology, its applications, and financial resources available. Additionally, there should be culturally appropriate education and awareness campaigns to meet people where they are in exploring zero-emission heating equipment.
- **Resilience and Reliability:** Power outages can have severe consequences, particularly for vulnerable communities 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, reliability and mitigate the impacts of grid failures on furnaces and heat pumps, ensuring that communities are not disproportionately affected during emergencies.
- **Governance and Decision-Making:** Policies should bring communities into partnership 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.

- **Employment and Entrepreneurship:** Decarbonization policies should be designed to include workforce and entrepreneurial development programs, particularly targeted at historically marginalized and underserved communities, to ensure that the jobs associated with clean energy and electrification benefit all communities. Policies should also expand and support inclusive workforce pathways, including education and pre-apprenticeship programs, while upholding fair labor standards that ensure clean energy and electrification jobs are accessible, well-compensated, and provide meaningful benefits to local communities. These efforts should prioritize both community-based workers and businesses, alongside established workforce development programs, to maximize opportunities for economic participation.
- **Enforceability:** Policies should be designed to include measures that ensure compliance with established standards and that track progress towards successful program implementation.**]**

4. Zero-Emission Technologies Create Economic Benefits

The majority of customers using delivered fuels or electric resistance heating will realize immediate bill savings by upgrading to efficient zero-emission appliances like heat pumps.[68,69] For residents who switch from methane gas, bill impacts can be more variable, based on factors ranging from local climate to the relative price of gas and electricity. However, as changing consumer preferences and decarbonization policies reduce gas use, and as aging gas infrastructure undergoes significant upgrades, methane gas costs are expected to rise.[70,71] Transitioning to heat pumps can reduce exposure to volatile commodity prices for fossil fuels and insulate consumers from unexpected increases in future bills.

At present, zero-emission technologies like heat pumps often have higher upfront costs than conventional alternatives. However, residents in signatory states have access to a wide range of utility, state, local, and federal incentives, tax credits, and financing to make them cost-competitive.[72] Installation costs are expected to decrease as contractors grow more familiar with the technology.

[NOTE: Much of the following paragraph will be converted to a numbers side bar]

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[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] While uncertainty remains regarding the persistence of federal funding for zero-emission technologies, the Inflation Reduction Act (IRA) and Bipartisan Infrastructure Law (BIL) created significant funding opportunities for zero-emission technologies like heat pumps, including expanded federal tax credits and the Home Electrification and Appliances Rebate program.

Building decarbonization also drives job creation, entrepreneurship, and economic development. Almost 75,000 energy efficiency jobs[73] were added in 2023, with nearly 2.3 million energy efficiency workers currently employed across the country (over twice the number employed by the fossil fuel industry).[74] Estimates for electrification, a more expansive job market ranging from energy efficiency to electric transportation and grid expansion, indicate that transitioning to zero-emission residential buildings could create over 3 million new jobs by 2035.[75] Pairing building decarbonization programs with high-quality workforce development and strong labor standards can create jobs that provide quality wages and career advancement opportunities.[76]

5. Zero-Emission Buildings Can Help States Meet Climate Goals

In addition to helping states meet NAAQS targets, zero-emission buildings are a key pathway to achieve state climate goals. Nationally, the buildings sector contributes around 13% of all U.S. GHGs through direct emissions from onsite combustion, and over 30% of U.S. GHG emissions overall.[77] Heating equipment is only replaced every 10-15 years for water heaters and 15-20 years for space heaters, locking in polluting technology for at least a decade after installation.[78] Many MOU states have set goals to achieve net-zero emissions economy-wide by 2050;[79] in these states, any space or water heater installed between 2030-2040 is likely to continue producing emissions beyond the net-zero target date. Decarbonizing buildings now is essential to help states yield immediate emissions benefits and reach future climate targets.

IV. BARRIERS TO ADOPTION OF ZERO-EMISSION TECHNOLOGIES IN RESIDENTIAL BUILDINGS

1. Cost and Accessibility

High cost is one of the greatest barriers to the adoption of zero-emission heating equipment, primarily driven by:

[73] Energy efficiency jobs include those related to the manufacturing of energy-efficient equipment like heat pumps, installation of energy-efficient products and weatherization measures, and energy-efficient building design. *From:* Building Performance Association and E4TheFuture, "Frequently Asked Questions," December 2024.
[74] Building Performance Association and E4TheFuture, "Energy Efficiency Jobs in America," December 2024.
[75] Herr, A., Kanj, W., and Wyent, C., "Electrification that Works: Jobs for a Clean and Healthy Future," Rewiring America, October 2024.
[76] Inclusive Economics, "High-Road Workforce Guide for City Climate Action," April 2021.
[77] US EPA, "Sources of Greenhouse Gas Emissions," last updated July 8, 2024.
[78] 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.
[79] Environmental Defense Fund, "U.S. States with Binding, Economy-Wide Climate Targets," accessed January 30, 2025.

Relative Cost of Energy: Heat pumps offer significant operating cost savings compared to oil, propane, and electric resistance heating.[80] However, the relative price of electricity compared to methane gas can increase bills for gas users who switch to heat pumps, discouraging customers from transitioning.[81,82] The higher the "spark gap" (the ratio of electricity costs to fossil fuel costs), the more expensive electricity is in relation to fossil fuels.[83]

Installation Cost and Complexity: Heat pumps often cost more to install than a furnace or central AC, though they can be cost-competitive for customers replacing both a furnace and AC at the same time. Most heat pump space heaters cannot be installed as a simple "box swap" in the same way that a new furnace replaces an old one. Installation complexities can increase prices, deter residents from making the switch, and discourage contractors from recommending it. Common challenges include:

- Space Constraints: Some homes and many multifamily buildings do not have readily available space for zero-emission technology such as HPWHs, which require more area than fossil fuel-based water heaters to support heat exchange. Creating space for zero-emission appliances can require equipment siting in areas like balconies that disrupt resident use or building modifications that increase project cost.[84] One potential solution is split HPWH systems, which are currently being brought to market to address this issue.[85]
- Retrofit Complexity: Some buildings may need pre-electrification upgrades to address issues with building envelopes, electrical panels and wiring, or duct airflow constraints before heat pump installation. This increases project time, cost, and administrative burden by requiring home and building owners to coordinate with multiple contractors to address each upgrade.[86] Retrofit complexity is particularly salient for multifamily buildings, which have more complicated heating systems than single-family homes, and for low-income households, which more frequently require weatherization and pre-weatherization upgrades to enable heat pump installation.

[80] NESCAUM, "Technical Support Document 1.2 for Model Rule 1.0: NOx and GHG Emissions Standards for Space and Water Heaters," December 12, 2024.
[81] Booth, K., et al., "Heat Pumps in the Northeast and Mid-Atlantic: Costs and Market Trends," Energy Solutions, October 30, 2024.
[82] Booth, K., et al., "Heat Pump Water Heaters in the Northeast and Mid-Atlantic: Costs and Market Trends," Energy Solutions, June 17, 2024.
[83] Chretien, L., and Vanderspek, A., "Closing the Spark Gap is Key to Electrification," Green Energy Consumers Alliance, December 4, 2024.
[84] Bastian, H., and Cohn, C., "Ready to Upgrade: Barriers and Strategies for Residential Electrification," ACEEE, October 2024.
[85] 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.
[86] Murto, P., et al. (2019), "Devices and strategies: An analysis of managing complexity in energy retrofit projects," *Renewable and Sustainable Energy Reviews* 114: 109294.

- Emergency Replacements: Most HVAC and water heater replacements are completed due to emergency failures.[87,88] This practice encourages homeowners and contractors to default to "like-for-like" replacements to minimize time without heat, hot water, or air conditioning. Heat pumps may not be stocked and available from wholesale distributors on short notice,[89] and time pressure can increase installation fees and make it difficult to adhere to best practices such as proper sizing.[90]
- 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.

Underdeveloped Workforce: Lack of consistent training and licensing requirements for qualified workers, along with low wages and poor job quality in the residential sector, hinders the growth of a skilled workforce. Many areas are also experiencing a shortage of HVAC installers, electricians, and plumbers, which can increase costs as heat pump demand outstrips available contractors.[91] Contractor inexperience with heat pumps can also cause them to price perceived risk into installation prices,[92] oversize heat pumps,[93] or make other installation errors that require repairs or result in higher energy bills.[94,95]

Lack of Access to Incentives: While incentives and financing options can reduce upfront costs, available incentives 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.[96] 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.[97] This administrative burden particularly hinders participation among LMI and

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[87] 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.
[88] CalNEXT, "Emergency Replacement heat Pump Water Heater Market Study," June 26, 2024.
[89] Merson, H., et al., "Driving Upstream Markets through Strategic Partnerships and Excellence in Supply Chain Management," ACEEE Summer Study on Energy Efficiency in Buildings, 2016.
[90] U.S. Department of Energy, "Residential HVAC Installation Practices: A Review of Research Findings," June 2018.
[91] Bastian, H., and Cohn, C., "Ready to Upgrade: Barriers and Strategies for Residential Electrification," ACEEE, October 2024.
[92] Booth, K., et al., "Heat Pumps in the Northeast and Mid-Atlantic: Costs and Market Trends," Energy Solutions, October 30, 2024.
[93] Takemura, A., "When it comes to heat pumps, bigger is not always better," Canary Media, March 22, 2023.
[94] U.S. DOE, "Residential HVAC Installation Practices: A Review of Research Findings," Office of Energy Efficiency & Renewable Energy, June 2018.
[95] 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.
[96] Reeg, L., and Smedick, D., "Gaps and Barriers to Stacking Federal, State, and Local Incentives," RMI, December 2023.
[97] RMI, "Gaps and Barriers to Stacking Federal, State, and Local Incentives," December 2023.

disadvantaged communities who often face additional barriers (e.g., language, time) to access.[98]

Owner-Resident Dynamics: In rental housing, owner-resident dynamics can complicate decision-making around electrification opportunities. Split incentives can decrease owners' willingness to pay higher upfront costs for measures that deliver bill savings to residents.[99] In multifamily properties where methane gas is not metered to residents or the property is served by central systems, a switch to electric or in-unit systems 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.[100]

2. Education and Awareness

Another significant barrier to zero-emission heating is a general lack of awareness of zero-emission technologies – particularly in colder climates. Even when consumers know about the benefits of heat pumps, the absence of accessible information for choosing equipment, finding an installer, and navigating incentives can prevent them from moving forward.[101] Contractors also present a challenge, with many of them discouraging customers from choosing heat pumps because they are not aware of the latest technologies, are concerned about negative customer feedback, or hold outdated perceptions of heat pump performance.[102] Because contractors are a primary source of information when consumers are replacing old equipment, their recommendations for (or against) heat pump installation can significantly influence consumer decisions.[103] Common misconceptions held by consumers and contractors include:

Myth	Fact
Heat pumps are unreliable and do not work in cold climates.	Properly installed heat pumps already provide reliable, comfortable heat in cold climates, including in Maine, Alaska, and Norway, and the technology is continuing to improve in performance and efficiency.[104]
Fossil fuel heating systems can provide heat in a power outage and are the better option for consumers with electricity reliability concerns.	Gas furnaces and other fossil fuel heating systems require electricity for start-up and air circulation, and generally do not work in power

[98] ACEEE, "Toward More Equitable Energy Efficiency Programs," 2023.
[99] 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.
[100] 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.
[101] International Energy Agency (IEA), "The Future of Heat Pumps," December 2022.
[102] Shea, R., et al., "Electrify Your Community: Support Local Contractor Engagement," RMI, November 20, 2024.
[103] Northwest Energy Efficiency Alliance (NEEA), "Residential HVAC Contractor Market Research," Report #E22-442, March 29, 2022.
[104] U.S. DOE, "Information for Consumers," accessed January 2, 2025.

	outages.[105] Only homes with a backup generator that can start a fossil fuel-based heater would see a reliability advantage 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 electrification 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),[106] with newer models reaching as low as 43 to 45 decibels (comparable to a suburban area at night).[107,108]

3. Utility and Grid

Many current electric rate structures and utility business models do not encourage electrification. Electricity rates commonly charge customers volumetrically, based on the quantity of electricity they consume, which encourages conservation but can discourage electrification if electricity prices are high.[109] Due to cooling needs, many grids experience peak electricity demand in the summer and build the electric distribution system 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 volumetric rate year-round. However, since heat pump users draw the most energy during winter – usually off-peak for the electric system – while paying the same flat volumetric rates as summer AC users, this rate design can overcharge heat pumps relative to their actual cost to the grid.[110,111] Unaffordable rates particularly harm lower-income households, who already experience high energy burdens and cannot electrify if doing so would increase their bills.

Electric load growth also presents a barrier to building decarbonization. Winter peaking due to heating electrification, while a potential longer-term concern, may require grid system upgrades and will require load flexibility strategies that utilities need to incorporate into planning processes now. Additionally, electricity demand from data centers is

[105] NYSERDA, "How Will I Heat and Cool My Home When the Power Goes Out?" accessed January 2, 2025.
[106] City of Vancouver, "Heat Pumps & Noise," June 2020.
[107] Trane, "XV19 Variable Speed Low Profile Heat Pump," accessed March 21, 2025.
[108] Daikin, "Flexible Innovative Technology," 2023.
[109] Dammel, J., Henchen, M., and Shah, A., "Electric Rates can Help or Hinder Heat Pump Progress," RMI, December 5, 2024.
[110] ISO New England, "CELT 2024: Heating electrification will drive higher energy use, winter peaks," ISO Newswire, May 9, 2024.
[111] Dammel, J., Henchen, M., and Shah, A., "Electric Rates can Help or Hinder Heat Pump Progress," RMI, December 5, 2024.

projected to rise from 4% to 12% of all U.S. electricity by 2028,[112] placing additional pressure on electricity supply. States, utilities, and grid operators are working to improve grid reliability, resilience, and flexibility in tandem with planning for building electrification.

V. RECOMMENDATIONS FOR STATE ACTION

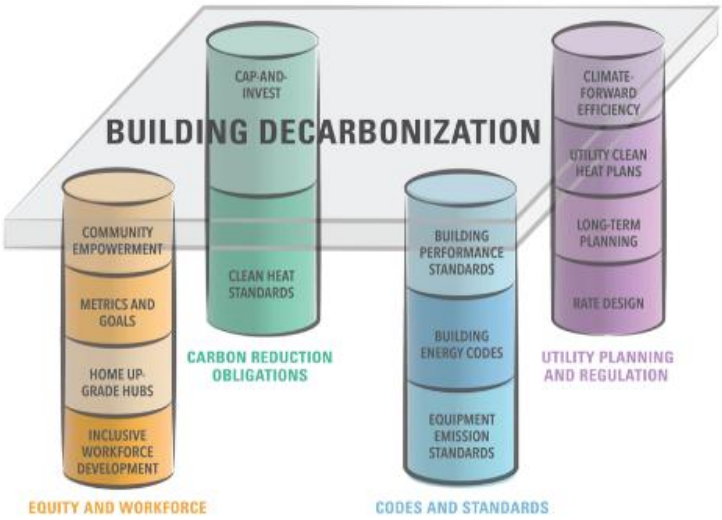
With a focus on near-term strategies, this section includes more than 50 recommendations for state policymakers to support the rapid, equitable, and widespread transition to zero-emission residential buildings. The large number of recommendations reflects that there are many options for states to make progress, not that each state is expected to pursue every recommendation. A state's participation in the MOU should not be interpreted as an endorsement of all the recommendations included in this Action Plan. There is considerable diversity in the economic base, population density, climate zone, governance structure, and other key characteristics that shape MOU states' policy needs and opportunities. As such, these recommendations are not intended to provide 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 recommendations for a whole-of-government approach to building decarbonization and policy coordination. Specific recommendations for state action are then organized according to a framework first presented in a policy brief, "Decarbonizing Buildings: How States Can Set the Table for Success," written by NEEP, NESCAUM, and the Regulatory Assistance Project (RAP).[113] The brief describes four key policy areas, which can be thought of as legs of a table for effectively supporting building decarbonization:[114]

1) Equity and Workforce: Actions to address housing and workforce inequities and ensure that the transition to zero-emission buildings is inclusive and just.
2) Carbon Reduction Obligations: Performance requirements for obligated parties to reduce carbon emissions or install clean heating systems.
3) Codes and Standards: Regulations that establish a clear timeline for building emissions reductions and spurt a market transition to clean heating.
4) Utility Planning and Regulation: Actions that ensure that utility investments, rates, and programs align with building decarbonization goals.

[INSERT: Table Brief Graphic]

[112] U.S. DOE, "DOE Releases New Report Evaluating Increase in Electricity Demand from Data Centers," December 20, 2024.d
[113] NEEP, NESCAUM, & RAP, "Decarbonizing Buildings: How States Can Set the Table for Success," June 2024.
[114] NEEP, NESCAUM, & RAP, "Decarbonizing Buildings: How States Can Set the Table for Success," June 2024.



1. Policy Coordination and Accountability

Transforming residential buildings involves a whole-of-government approach to overcome barriers and initiate change across energy, environment, housing, and labor sectors. Cross-agency collaboration is essential to develop policies that meet states' overarching decarbonization, air quality, and equity goals; coordinate and sequence policy implementation; and streamline programs for consumers and market actors. In situations where policies are not feasible at the state level, states can encourage local governments to act.

Each state will have different priorities for interagency collaboration and coordination to support the transition to zero-emission residential buildings. Each state also faces different political, economic, and legal constraints; in some states, relevant agencies may not have the authority to implement certain Action Plan recommendations. Legislative changes, additional staffing, new and sustainable sources of funding, and strong partnerships may be needed.

[CALL-OUT BOX -- KEY POLICY ACTORS:

While states have different agencies and governing structures, governors' offices may be in the best position to set a whole-of-government vision and coordinated agenda, with the following state bodies responsible for different aspects of the transition:

- **State Legislatures:** State legislatures are responsible for passing clean energy and building decarbonization laws. Legislation can set binding climate targets, enable and require state agencies to initiate new policies and programs, and revise the governing frameworks for regulators and utilities.
- **Environmental Agencies:** State environmental agencies are responsible for protecting the natural environment and 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 most often concern the air emissions or climate impacts associated with direct combustion in buildings.

- **Energy Offices:** State energy offices develop and implement policies that promote energy efficiency, reliability, and sustainability. Energy offices help design and implement state-level incentives, consumer education, building codes, and training programs related to energy efficiency and building decarbonization.
- **Public Utility Commissions (PUCs):** State PUCs (which can go by other names, such as Public Service Commissions) regulate electricity and methane gas utilities. PUCs are responsible for setting fair electric and gas rates, overseeing utility planning processes and budgets (including investments related to grid reliability, resilience, flexibility, and decarbonization), and often supervising 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.
- **Housing Finance Agencies:** State housing 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 electrification, weatherization, and pre-weatherization measures in new and existing affordable housing.
- **Departments of Labor:** State labor departments oversee registered apprenticeship programs, maintain lists of qualified contractors, enforce labor standards, and assess workforce needs and gaps to ensure a well-trained and adequately supported workforce for the transition to zero-emission residential buildings.
- **Economic Development Agencies:** These agencies are responsible for promoting business and entrepreneurship in their states, including by providing financial assistance to encourage local business growth.

While NESCAUM primarily works with state air divisions and environmental agencies, the Action Plan provides recommendations across state government. Each of the agencies listed above is essential to an equitable, affordable, and durable transition to zero-emission residential buildings. Icons representing each state government entity are used throughout the recommendations in this report to identify which agencies are likely to be responsible for each action. **END CALL-OUT BOX]**

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

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

- EXAMPLE: In Massachusetts, an executive order established the Office of Climate Innovation and Resilience to advance the state's climate innovation, mitigation, adaptation, and resilience policies.[115] In addition to creating a new cabinet-level Climate Chief, the executive order required each Cabinet Secretary to appoint a Climate Officer responsible for implementing climate-related efforts within their agency. Recognizing the need for additional coordination on grid and utility issues, the Massachusetts 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, facilitate 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.[116]

2) **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.
    - EXAMPLE: In 2022, 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, and other stakeholders and industry experts.[117] The group informed the development of New Jersey's Strategic Buildings Roadmap to reach state building electrification and clean energy goals.
3) **Clarify local authority and empower local governments** to adopt measures that may not be feasible statewide. This may include issuing an attorney general 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 on climate pollution or adopt more stringent building energy codes than those required by the state, which can reduce legal risk for local governments and empower local action.
4) **Plan for and 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 play out on the ground without proper enforcement. At the same time, many state agencies are constrained by budget and staffing limitations and can often be unable to carry out detailed enforcement

[115] Commonwealth of Massachusetts, "Governor Healey Signs Executive Order Creating Massachusetts' First Ever Climate Chief," January 6, 2023.
[116] Massachusetts Executive Office of Energy & Environmental Affairs, "Healey-Driscoll Administration Establishes Nation's First Office of Energy Transformation," March 15, 2024.
[117] State of New Jersey, "Governor Murphy Announces Launch of Statewide Clean Buildings Working Group," October 3, 2022.

regimens. To overcome this challenge, states may need to allocate additional resources to enforcement, redesign policies to be easier to enforce, empower accountability and enforcement at the local or municipal level, coordinate with neighboring states to make policies easier to monitor across state lines, and increase public reporting of data on target metrics to enable the public to directly track policy outcomes.

2. Equity and Workforce Investments

To ensure an equitable transition to zero-emission buildings, policies and programs must meet the needs of populations that have been historically underserved and underrepresented. Building decarbonization policies and programs should be designed to deliver not only an equitable distribution of benefits but expanded access to the economic opportunities and jobs created by energy efficiency investments. These recommendations highlight processes and practices that states should consider early in policy and program design and throughout implementation. Through these actions, states can engage all stakeholders in building decarbonization, from communities and manufacturers to government agencies and utilities, and make the transition to zero-emission residential buildings accessible to all households and communities.

A. Stakeholder Engagement and Inclusive Process

Engaging communities and stakeholder groups in policy design and oversight is critical to ensure program success. Community engagement refers to bringing all groups – including historically marginalized low-income residents and communities of color – into decision-making processes that will affect them.[118] Successful community engagement requires partnering with communities at every stage of policy development,[119] 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 including industry experts, local policymakers, community representatives, and nonprofit organizations during policy development.[120] The following recommendations 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.

1) **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.

[118] Emerald Cities Collaborative, "Anchor-Community Engagement Workbook," 2023.
[119] WE ACT for Environmental Justice, "Community Engagement Brief," 2022.
[120] US DOE, "Creating a Community and Stakeholder Engagement Plan," August 2022.

- EXAMPLE: 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.[121]

2) **Partner with "public experts"** such as community-based organizations (CBOs), housing groups, contractors, and tenant associations on policy design. Working with these groups should also engage tenants, who often have the least access to and agency in home electrification upgrades, as well as low-and-moderate income (LMI) households, disadvantaged communities, and the contractors who work in these communities.
3) **Make it easier for CBOs and residents to participate in policy processes by**:
    - Providing compensation to and convening at times convenient for CBOs or residents who participate in advisory boards, focus groups, or other forums that assist with the regulatory process.
        - EXAMPLE: NYSERDA established a Disadvantaged Community (DAC) Honorarium to reimburse CBOs and individuals who provide input on NYSERDA programs. The reimbursement process includes eligibility criteria for determining groups or individuals who may 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 up.[122]
    - Creating plain language explanations of policy proposals and regulations.
    - Performing language translation for all workshops, community meetings, and documents.
    - Holding community meetings at convenient times (including after work hours) and in multiple formats to maximize engagement.
    - Providing or compensating for additional services such as transportation, childcare, and meals to remove additional barriers to resident participation.
        - EXAMPLE: The Washington, DC Department of Energy and Environment (DOEE) utilized two systems to engage stakeholders in building electrification 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, with representatives for commercial and rent-controlled apartment buildings, affordable housing, energy utilities, and energy efficiency nonprofits.[123] To inform its clean energy plan, DOEE partnered with affordable housing nonprofit National Housing Trust

[121] Rhode Island Energy Efficiency Council, "About the Energy Efficiency Council," accessed March 30, 2025.
[122] NYSERDA, "Paying for Community Expertise," accessed January 9, 2025.
[123] Washington, D.C. Department of Energy & Environment (DOEE), "BEPS Task Force," accessed October 4, 2024.

(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 building electrification, and 2) hold small group discussions facilitated by the CBOs for residents to voice concerns, discuss the benefits of electrification, and share recommendations for the clean energy plan.[124]

B. Ensuring that Underserved Households and Communities Benefit

Building decarbonization policies should be thoughtfully designed to enhance equity by improving affordability, housing quality, and health, and to avoid unintended inequitable consequences. The below recommendations can help states embed equity in decarbonization policies and programs to protect against inequitable outcomes such as gentrification.

1) **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 upgraded in disadvantaged communities or targeting a certain percentage of energy efficiency program spending toward LMI households. Targets can also include holistic retrofits that address pre-weatherization, weatherization, and heat pump installation, to ensure that people living in housing with these problems also benefit. The Multistate MOU sets a target for states to strive to direct at least 40% of new investments in efficiency and electrification upgrades to residential buildings in low-income and disadvantaged communities.
    - EXAMPLE: In 2022, the Oregon Department of Energy created a heat pump program to increase access to cooling after an extreme heat event killed around 100 people. As part of the broader heat pump initiative, 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 installing heat pumps in rental housing occupied by members of the seven federally recognized tribes in Oregon.[125]
2) **Work with state housing finance and local housing agencies to include tenant protections as a requirement for building owner participation in incentive programs** for which these entities have management or oversight responsibilities. Protections should remain in place for the term of the agreement, even if the landlord sells the property. Noncompliance with tenant protections should result in the building

[124] 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.
[125] Oregon Department of Energy, "Oregon Rental Home Heat Pump Program," accessed March 21, 2025.

owner repaying the cost of the subsidy they received, in addition to the cost of any enforcement actions.

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

- Preventing building owners from increasing rent to recover the cost of energy efficiency or electrification upgrades.
- Capping rent increases for 5-15 years after a subsidized upgrade has been completed, even if the tenant changes.
- Restricting evictions to only cases of nonpayment and violations of the law for 5-15 years after a subsidized upgrade has been completed.
- In the case of a landlord-paid centralized heating system transitioning to renter-paid electric heating (such as minisplit heat pumps), adjusting utility allowances to reduce rent by the previously paid heating amount to maintain affordability for renters.
- Incorporating anti-harassment regulations 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.
- EXAMPLE: The California Energy Commission's Equitable Building Decarbonization Direct Install Program supports energy efficiency and electrification upgrades for low-income households in subsidized and unsubsidized single and multifamily homes. Multifamily 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 communicate with landlords and tenants about upgrade benefits, landlord responsibilities, and tenant rights from program participation.[128]**]**

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

[127] Sitkin, L., & Grow, J. (2018). *Survey Of State Tenant Protection Policies for the Weatherization Assistance Program (WAP).* National Housing Law Project. https://www.nhlp.org/wp-content/uploads/2019.02.14-WAP-Tenant-Protection-Memo-with-Appendices1.pdf

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

3) **Promote utility-scale solutions and remove barriers to implementing them** to better serve LMI households. Zonal electrification, TENs, and other neighborhood-scale solutions offer stronger leverage points to ensure that LMI households benefit by:
    - Utilizing utilities' existing customer relationships and billing mechanisms to facilitate household participation.
    - Spreading costs over time, reducing the burden of high upfront expenses for LMI households.
    - Lowering costs through bulk purchasing and large-scale project deployment.
    - Offering additional co-benefits, including energy cost savings and community resilience.

C. Equitable Program Design and Implementation

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

1) **Create and expand whole-home programs serving LMI households.** These programs typically offer no-cost direct installation of whole-home retrofit measures including weatherization, heat pumps, and any needed pre-electrification measures, ideally through a concierge model that delivers multiple upgrades through one consolidated service. Whole-home retrofits that bundle electrification with weatherization and, where available, installation of solar panels or enrollment in community solar programs, improve health and housing quality while mitigating the risk of bill increases for customers who switch from methane gas. Pre-electrification measures include:
    - Health and safety measures such as moisture, mold, and asbestos remediation that should be addressed to ensure safe installation of weatherization measures. Without appropriate support for these measures, low-income and disadvantaged residents (who are more likely to live in poor housing quality) will be unable to access energy and electrification upgrades.[129]
    - Incidental repairs including roof, door, and window upgrades that are necessary 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).[130]
    - Electrical wiring and panel optimization or upgrades for residents whose homes do not have sufficient capacity to support electric heating.

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

    - EXAMPLE: New York offers funding for electrical panel and wiring upgrades when paired with home energy upgrades such as a heat pump clothes dryer, heat pump space heater, or HPWH.[131]
- Ductwork improvements for homes that intend to utilize central heat pumps.
- EXAMPLE: New Jersey Whole House Pilot: The New Jersey Board of Public Utilities worked with major electric and gas utilities in the state to launch a "holistic housing intervention program" in Trenton, NJ, 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 through several ways, including 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.[132]
- **[CALL-OUT BOX:** Potential source of funding for pre-electrification measures include:[133]
    - Federal: Low-Income Home Energy Assistance Program (LIHEAP), American Rescue Plan Act (ARPA) grants, DOE Weatherization Assistance Program (WAP), and U.S. Department of Agriculture (USDA) Housing Repair Program.
    - State: Appropriations, fuel fees, carbon market revenues (see Section V.3.B for more information on cap-and-invest and clean heat standards).
    - 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). **END CALL-OUT BOX**]

2) **Coordinate between agencies to consolidate and streamline incentive programs where possible.** Examples include:
    - Enabling customers to apply for multiple programs or incentives through a single application.
        - EXAMPLE: 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 housing improvements through a single application process. The program coordinates with partner organizations and state agencies to layer funding and carry out necessary repairs and installations, including health and safety fixes, energy upgrades, and even rooftop solar.[134]

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[131] NYSERDA, "All About Home Electrical Panels: Funding for Home Electrical Upgrades," accessed March 19, 2025.
[132] 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.
[133] E4TheFuture, "Weatherization Barriers Toolkit," April 2022.
[134] Philadelphia Energy Authority, "Built to Last," accessed March 11, 2025.

- Aligning incentive requirements such as income qualifications or equipment specifications across programs.
- Layering incentives from multiple state agencies (such as environment, energy, and housing) for different types of upgrades to support holistic, whole-home approaches to electrification.
    - EXAMPLE: New York State Homes and Community Renewal (NY HCR) and New York State Energy Research and Development Authority (NYSERDA) partnered to create the Clean Energy Initiative, which provides incentives and technical support for zero-emission affordable housing.[135] Electrification retrofits are managed by NY HCR, and benefit from NYSERDA funding without the need for a separate NYSERDA application.

3) **Streamline income verification for LMI and DAC programs**, such as by:
    - Considering geographic options to determine eligibility, such as if a census tract meets a certain threshold, rather than testing for eligibility at the individual household or building level.
        - EXAMPLE: The Massachusetts statewide energy efficiency program, MassSave, designates 21 equity communities in its most recent plan that have access to enhanced incentives and services.[136]
    - Establishing categorical eligibility with non-energy programs such as SNAP or Medicaid, so that individuals qualified for those benefits are automatically eligible for income-eligible home energy programs.
4) **Provide technical assistance to multifamily and affordable housing owners**, as well as to public housing authorities, such as:
    - "How-to" guides with step-by-step information on phasing electrification retrofits into large buildings and incorporating zero-emission upgrades into scopes for other building projects.
    - Guidance on planning upgrades to complete during tenant turnover to minimize tenant disruption.
    - Opportunities to "pilot" upgrades in one unit to assess implementation issues and get resident, onsite staff, and property owner feedback before expanding throughout a whole building.
    - Case studies with technical and cost information.
    - Connections to project managers or external organizations who can assist with creating a plan and communicating about zero-emission equipment benefits, operation, and maintenance with tenants.
        - EXAMPLE: NYSERDA developed a Retrofit Playbook for Large Buildings[137] that provides step-by-step instructions and resources to

[135] NY HCR, "Clean Energy Initiative," accessed March 21, 2025.
[136] Mass Save, "The Massachusetts 2025-2027 Energy Efficiency and Building Decarbonization Plan," October 31, 2024.
[137] NYSERDA, RMI, Building Energy Exchange, Urban Land Institute, "Retrofit Playbook for Large Buildings," accessed January 10, 2025.

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 electrification opportunities, reduce energy bills, and create long-term energy plans.[138]

- Technical assistance and funding for operation and maintenance of zero-emission equipment in multifamily buildings.

5) **Offer multifamily and affordable housing-specific incentive programs that support installations of HVAC and water heating system types unique to multifamily buildings.** Improving the value proposition of electrification measures is particularly important for affordable housing developers, who operate on low margins and often cannot afford complex electrification upgrades. Measures program administrators can consider incentivizing to benefit multifamily buildings include:
    - Submetering infrastructure (to encourage residents to reduce electricity use while maintaining lower costs from utility-managed master metering).[139] Any addition of submetering to a master-metered building should be carefully managed to ensure that tenants 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.
    - 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 transitioning their buildings from central to individual heating deduct previously covered heating bills from rent.[140]
    - Central HPWH equipment instead of in-unit HPWHs to increase convenience for installation and maintenance and avoid in-unit space and noise complications – particularly in buildings with preexisting central water heating systems.[141] Central HPWHs are relatively new and would likely require pilot funding and ongoing technical support.
    - EXAMPLE: Maryland's Multifamily Energy Efficiency and Housing Affordability Program offers funding for affordable multifamily buildings under two income-eligible funding streams: EmPOWER, which reduces gas and electricity consumption, and the Greenhouse Gas Reduction Program, which provides funding for multifamily buildings to reduce greenhouse gas emissions through zero-emission equipment installation.[142]
6) **Work with lenders to expand financing options for multifamily and affordable multifamily electrification**, including predevelopment capital to assist building

[138] NYSERDA, "Flexible Technical Assistance (FlexTech) Program," accessed January 10, 2025.
[139] New York City Housing Authority (NYCHA), "NYCHA Climate Mitigation Roadmap," accessed January 14, 2025.
[140] U.S. DOE, "A New Frontier – Electrification in Multifamily Housing," 2021 Better Buildings Summit.
[141] U.S. DOE, "Central Heat Pump Water Heaters for Multifamily Buildings," last updated July 19, 2024.
[142] Maryland Department of Housing and Community Development, "Multifamily Energy Efficiency and Housing Affordability Program," accessed January 14, 2025.

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 more risky, they are good candidates for green banks to fund.[143]

D. Education, Awareness, and Access

State agencies can use the following recommendations to improve awareness of zero-emission heating equipment and improve access to program offerings.

1) **Work with program administrators to deliver consumer campaigns** that increase awareness of zero-emission options and combat misinformation about heat pump installation and operating costs, viability in cold weather, sizing, and other topics.
2) **Create "one-stop-shop" hubs and clearinghouses** where homeowners, building owners (including multifamily and affordable housing owners), and contractors can find comprehensive information on building programs and financing. Hubs can include:
    - Educational information about building improvement measures and zero-emission technologies.
    - Links to schedule an energy assessment.
    - Cost estimates and case studies, including tools to help home and building owners compare the cost of immediate versus deferred upgrades.
    - A searchable incentive and financing database that provides a comprehensive list of stackable incentives depending on customer-specific inputs. States should increase awareness of these resources by promoting them through renter, landlord, and property owner and other mediums.
    - Links to connect with approved contractors, such as those participating in a trade ally network.
    - Information on project costs, to improve transparency for customers and place downward pressure on contractor pricing.
        - EXAMPLE: The Switch is On is the comprehensive marketing partner for the TECH Clean California program, a statewide initiative accelerating the adoption of clean water and space heating technology across California. It provides consumers with one place to explore electric alternatives for space and water heating, clothes drying, cooking, transport, 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, and connect with contractors. The site also provides information for contractors looking to find incentives or join a contractor network.[144] The Switch Is On is also available in Washington state.

[143] Scott, J., and Mills, C.K., "Window of Opportunity: New York's Small Multifamily Buildings, Expiring Equipment, and Clean Energy Goals," October 2023.
[144] Building Decarbonization Coalition, "The Switch is On," accessed January 10, 2025.

3) **Partner with CBOs and other trusted local partners** on outreach, campaigns, messaging, and technical efforts, including language translation, to ensure that communities that might otherwise be underserved have full access to programs and incentives.
    - EXAMPLE: The Massachusetts Clean Energy Center (MassCEC) Home Modernization Navigator offers technical support and help navigating incentives and financing for decarbonization and energy efficiency projects for owners and occupants of one- to four-unit residential buildings. The program is currently offered in two towns, focusing on equitable customer outreach and support, particularly for renters, LMI residents, and environmental justice communities.[145]
4) **Partner with manufacturers, distributors, and retailers** to promote electrification education and engagement. 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 cold climate performance, reliability, and cost.
    - Bring contractors into contact with those 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.
5) **Develop or fund "train the trainer" programs** that train contractors and residents to coach others on the benefits and process of upgrading to highly efficient heat pump heating equipment.
6) **Address emergency replacement scenarios and help customers plan ahead for electrification,** to encourage early replacement of HVAC and water heating equipment before end-of-life. Specific strategies include:
    - Designing programs that target homes with aging equipment by incentivizing pre-electrification and electrification work if existing heating systems are over ten years old.
    - Modifying LIHEAP programs within existing program parameters that allow for some program flexibility, so that heater repairs, weatherization, and home improvements include a heater age check and an electrification plan for homes with older heaters.[146]
    - Partnering with local governments to use permit databases to target marketing and outreach toward home and building owners where an HVAC or water heater permit has not been issued within the past ten years. States may also be able to obtain this information through up-and-coming software that aggregates permit and property assessment data.[147]

[145] Massachusetts Clean Energy Center, "Home Modernization Navigator," accessed March 11, 2025.
[146] Wein, O., "The Low-Income Home Energy Assistance Program (LIHEAP)," National Consumer Law Center, 2024.
[147] Xerohome, "Technology," accessed January 14, 2025.

- 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 residents can assess heat pump feasibility and conduct any upgrades necessary to transition to heat pumps while maintaining access to heating, cooling, and hot water.
    - EXAMPLE: As part of a pilot project, TECH Clean California funded a plumbing company to offer customers a no-cost temporary methane gas water heater to make time for a larger HPWH upgrade. The temporary replacement option increased the proportion of customers upgrading to HPWHs from less than one percent to 17.1% of the company's customer conversion rate.[148]

E. Workforce Development and Economic Empowerment

The following workforce development recommendations identify actions that states can take to bring contractors and other workers into the transition to zero-emission residential buildings, ensure that decarbonization jobs are well-paid and high-quality, and meet the demand for zero-emission equipment installations.

1) **Form workforce advisory committees** to guide state agencies on workforce needs, career pathways, labor standards, and training opportunities to support building decarbonization workers, including HVAC, building envelope, electrical, and plumbing contractors. Committee members should include representation from contractors, apprenticeship and pre-apprenticeship programs affiliated with labor organizations, and labor organizations with knowledge of home electrification or weatherization.
    - EXAMPLE: New Jersey Business and Industry Leadership Team (BILT) initiative led by NJ Board of Public Utilities (NJBPU) and the NJ Department of Labor Workforce Development (NJDOL) convenes key stakeholders including employers, contractors, technical training providers, labor unions, community-based organizations, and academic institutions, to assess the needs of the energy efficiency industry, align skill-sets with training programs, and support wraparound support networks, to create long-term career pathways.[149]
2) **Support small businesses** focused on energy efficiency and electrification by:
    - Setting aside a portion of program funding for small businesses and businesses and organizations based in disadvantaged communities.
    - Creating programs that connect small businesses to community development financial institutions or others to provide credit lines, loans, and other sources of funding to help contractors carry the financial cost of performing building upgrades until incentives are released.
    - Promoting joint ventures or mentoring programs between new and established businesses through preferential contracts, requiring vendors to include small

[148] Foster, B., "Bridging the Gap to Heat Pump Adoption: Water Heater Loaner Program," Barnett Plumbing & Water Heaters, July 27, 2023.
[149] NJ Department of Labor and Workforce Development, "Workforce Innovation and Opportunity Act: Annual Report Narrative," 2023.

business purchasing plans in state procurement opportunities, or other mechanisms.

3) **Encourage aggregation of work across multiple buildings or households** within a neighborhood, for example by incentivizing contracts that aggregate multiple smaller jobs into a single bid (e.g., installing heat pumps across the whole portfolio of a public housing authority or private landlord). These projects can achieve the scale needed to incorporate project 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 can be incorporated into programs that already support large-scale projects, such as large multifamily building retrofits.
    - EXAMPLE: California's Equitable Building Decarbonization Direct Install Program requires program administrators to group projects per contractor for economies of scale and to encourage contractor participation, and includes labor standards such as participation in state-approved apprenticeship programs.[150]
4) **Equitably grow the workforce** and enhance job quality by expanding apprenticeship and training programs and ensuring access for new entrants to the workforce, with particular 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 efforts.
        - EXAMPLE: The Maine Governor's Energy Office runs the Clean Energy Partnership, which 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), and plans to allocate portions of the technical assistance allowance within other federal grants to sustain this work.[151]
    - Partnering with CBOs, labor organizations, state departments of labor, community colleges, trade schools, and high schools to inform communities about energy efficiency trainings and career opportunities, and expand workforce development infrastructure like registered apprenticeship and pre-apprenticeship programs.
        - EXAMPLE: The Union Construction Academy of Maine (UCA),[152] together with electrical and plumber unions, is developing a training partnership with the four federally recognized tribes in Maine to train tribal members on heat pump installation and service, expand access to on-the-job learning opportunities in tribal communities, and help tribal members enter these unions' registered apprenticeship programs.

[150] California Energy Commission, "Equitable Building Decarbonization Program," accessed March 11, 2025.
[151] State of Maine Governor's Energy Office, "Clean Energy Partnership," accessed March 11, 2025.
[152] Main AFL-CIO, "Union Construction Academy of Maine," accessed April 2, 2025.

- Funding wraparound services in training programs such as case management, childcare, transportation support, living wage stipends, and job placement in addition to traditional certifications.[153]
- Supporting trainings on basic business skills, access to working capital, and development of business systems as part of energy curriculums.
    - EXAMPLE: Building Futures RI provides a pre-apprenticeship program that plays a crucial role in preparing individuals (and particularly those from historically disinvested communities) to enter apprenticeship programs.[154] Graduates earn several relevant certifications, and receive wraparound services such as case management, transportation support, and living wage stipends to help them enter the workforce.

5) **Create contractor networks** within building decarbonization programs – potentially drawing on joint labor/management apprenticeship training programs, existing manufacturer and distributor contractor channels, and community colleges – to disseminate best practices, support qualified and well-trained contractors, and make it easier for customers to find them.[155] States and program administrators can leverage contractor networks by:
    - Expanding training opportunities:
        - Supporting training on topics such as heat pump sizing, refrigerant handling, and navigating consumer-facing incentives.[156]
        - Improving contractor ability to sell heat pumps through business and sales training, including tactics to broach conversations with customers about proactively replacing aging equipment, as opposed to waiting until the equipment fails.
        - Partnering with manufacturers and distributors to provide trainings and bring new training centers to the state.
    - Coordinating with other states on contractor network requirements (e.g., ENERGY STAR credentials)[157] licensing requirements, and training programs to improve regional consistency in installation quality – particularly since many contractors work across state lines.
        - EXAMPLE: 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.[158]
    - Improving job quality and leveling the playing field by requiring contractors on the contractor network or a related "preferred contractor" list to fulfill requirements such as carrying liability and workers compensation insurance,

[153] He, Y., "Growing an Equitable Energy Efficiency Workforce," NEEP, September 26, 2024.
[154] Building Futures RI, "Construction Pre-Apprenticeship," accessed April 2, 2025.
[155] New Jersey Office of Clean Energy, "Find a Trade Ally," accessed March 12, 2025.
[156] ACEEE, "Building a Workforce for Energy-Efficient Homes," February 18, 2025.
[157] EPA, ENERGY STAR, "Find Credentialed Contractors," accessed January 13, 2025.
[158] California Department of Consumer Affairs, Contractors State License Board, "Reciprocal Classifications List," accessed March 12, 2025.

paying the state prevailing wage, committing to local hire provisions, and working with registered apprenticeship programs.
    - EXAMPLE: California's Equitable Building Decarbonization Direct Install Program mandates "workforce plans" from program administrators for multifamily retrofits that include compliance with "skilled and trained" standards per the Public Contracts Code, participation in state-approved apprenticeship programs, community workforce and training agreements, minimum training and experience requirements for workers, and a requirement that more than a third of all workers on a project meet minimum training and experience requirements.[159]
- 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 support qualified and well-trained contractors and workers by offering accessible educational materials that foster accurate knowledge about the technology and point contractors in the direction of real training opportunities.
    - EXAMPLE: Efficiency Vermont's "Efficiency Excellence Network" (EEN) provides a trainings and communications forum for 642 contractors, distributors, and suppliers.[160] Through the EEN, a team of relationship managers works to increase contractor participation in trainings on new technologies, improve high-quality heat pump installations, address distrust of new technologies, and keep contractors updated on new programs, rebates, and other resources.

3. Carbon Reduction Obligations

The next group of recommendations encompasses carbon reduction obligations, including climate goals, clean heat standards, and GHG emission caps and phase-down requirements. These policies set clear decarbonization targets and require regulated entities serving the building sector, such as fuel suppliers, gas utilities, and manufacturers of equipment using 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, and create sustained, long-term incentives that unlock resources for the transition to zero-emission buildings.

A. Climate Goal-Setting and Progress Tracking

States can hold themselves accountable for making progress on the transition to zero-emission residential buildings by setting clear goals and benchmarks to measure program

[159] California Energy Commission, "Equitable Building Decarbonization Program," accessed March 11, 2025.
[160] Efficiency Vermont, "Efficiency Excellence Network," accessed January 13, 2025.

success and making progress toward those benchmarks visible to the public. States can utilize the following recommendations to measure progress and build public trust.

1) **Establish and track progress** towards measurable and enforceable targets for decarbonization and equity, on a statewide basis and within individual programs offered by states and utilities.
    - 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 to be fuel-neutral (e.g., measured in GHG reduction or total MMBtus saved), rather than in fuel-specific terms as kWhs of electricity or therms 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 (e.g., designated environmental justice communities, renters, people living in mobile/manufactured housing). While it is better to measure equity impact based on outcomes, at minimum, a set level of program spending can be dedicated to serve these households and communities.
2) **Make data related to decarbonization and equity targets achieved by state programs publicly available** in a timely manner. Information transparency enables the public to hold states accountable for following through on commitments. Data can also inform decision-making, for consumers and policy makers, by shedding light on the real-world costs and savings associated with heat pump installations.
    - EXAMPLE: TECH Clean California publishes data on heat pump space and water heating throughout the state for public use. Information available includes 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 for equity-related projects.[161]

B. Clean Heat and Cap-and-Invest Policies

Among MOU states, economy-wide cap-and-invest policies have already been implemented in California and Oregon, and New York is currently developing one. Additionally, 11 states in the Northeast belong to the Regional Greenhouse Gas Initiative (RGGI), a cap-and-invest program. However, RGGI caps emissions from regulated power plants and only touches the buildings sector as a discretionary source of funding for energy efficiency and building decarbonization programs. States can consider the following options to advance binding performance obligations to deliver GHG reductions or provide clean heat services on heating fuel suppliers – potentially at a pace that aligns with state GHG reduction targets for the sector.

[161] TECH Clean California, "Heat Pump Data," accessed February 6, 2025.

1) **Establish reporting requirements for fuel suppliers** – including methane gas utilities and/or delivered fuel (e.g., heating oil, propane) suppliers – as a first step, to lay the groundwork for future carbon reduction obligations like clean heat standards (CHS) or cap-and-invest policies. Many states lack solid data on the amount of fuel used in the building sector and associated emissions, particularly from delivered fuel suppliers who are not regulated by PUCs. These requirements require fuel suppliers to annually report the amount of fossil fuels sold and/or the GHG emissions that result from the use of fuels sold, transferred, or delivered to end users in a state.
2) **Enact clean heat standards (CHS) or cap-and-invest policies covering the thermal sector.** CHS policies require fuel suppliers to deliver clean heat to customers, often measured by emissions reductions achieved through various clean heat measures.[162] CHS can offer flexibility for fuel suppliers, with a variety of options available for meeting the clean heat targets, such as installing heat pumps, completing weatherization projects, recovering and properly disposing of refrigerants at equipment end-of-life, and switching to biofuels. CHS can be implemented without credit trading (e.g., each heating provider is responsible for achieving a set level of clean heat), or with credit trading (e.g., one provider sell credits they earn by installing heat pumps to another provider), and can also incorporate equity requirements into program design.[163] States can also consider adopting economy-wide cap-and-invest policies that cover heating fuel suppliers and generate funds for building decarbonization programs.
    - EXAMPLE: In 2021, the Colorado legislature passed a bill requiring methane gas utilities to file clean heat plans with the state PUC aimed at reducing GHGs below 2015 levels 4% by 2025 and 22% by 2030, without raising utility bills above 2.5%.[164] In 2024, the Colorado PUC approved the state's largest utility's proposal to meet GHG reduction targets through primarily electrification and energy efficiency, with 20% of investments carved out as rebates for low-income households.[165]

[CALL-OUT BOX: Credit trading policies and equity. While CHS with credit trading may meet less resistance from fuel suppliers because of the additional flexibility they create, credit trading can create significant equity issues if not thoughtfully designed. NESCAUM's EJAG has flagged that any policies that include trading credits or purchasing offsets, such as CHS or cap-and-invest, should be designed to ensure that environmental justice and disadvantaged communities can benefit in proportion to other communities, such as by requiring a minimum number of credits to be earned through electrification and energy efficiency improvements in environmental justice and disadvantaged communities. Without guardrails, credit trading systems can exclude disadvantaged communities from

[162] 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.
[163] Ibid.
[164] Colorado General Assembly, "SB21-264: Adopt Programs to Reduce Greenhouse Gas Emissions from Utilities," signed June 24, 2021.
[165] Fickling, M., "Colorado's Landmark Climate Win: the Xcel Clean Heat Plan Explained," Western Resource Advocates, June 11, 2024.

vital home improvements because measures often cost more to implement in those areas, incentivizing fuel suppliers to purchase credits over completing upgrades.[166] This can create or exacerbate "sacrifice zones," where already disadvantaged areas become air pollution hubs even as surrounding areas experience pollution reductions.[167] However, if properly designed, CHS with credit trading and equity carve-outs can generate emissions and energy savings in communities with the highest GHG-emitting building stock, and ensure that all residents benefit from air pollution reductions.[168]**]**

C. Refrigerant Policies and Programs

ACs and heat pumps use refrigerants to transfer heat. Synthetic hydrofluorocarbon refrigerants (HFCs) are widely used 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, HFCs also have high global warming potentials (GWPs) and are hundreds to thousands of times more potent GHGs than CO2.[169] While the global warming impact of HFC releases does not outweigh the emissions benefits of using a heat pump,[170] management of existing HFC equipment and a careful transition away from high-GWP refrigerants is an important opportunity to prevent an outsized source of potential climate harm.

Given their impact on climate change, HFCs are currently being phased down globally and domestically. So far, EPA has promulgated several regulations under the AIM Act including the Technology Transitions (TT) Rule, which applies a GWP limit of 700 to refrigerants in new residential and light commercial ACs and heat pumps. This will reduce the warming impact of refrigerants used in those equipment types by almost 70% compared to the most common HFC refrigerant currently used.[171] While this is significant progress, more work is needed to ensure that buildings meet state emissions targets, particularly since refrigerant emissions are expected to rise under increasing AC and heat pump demand.[172]

These recommendations identify steps that states can take to transition the residential HVAC and water heating sector to the best available refrigerants and improve management of existing refrigerants by limiting leaks and improving HFC recovery, reuse, and disposal.

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[166] 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.
[167] 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.
[168] Cowart et al. "Meeting the Thermal Challenge: A Clean Heat Standard for Maryland," RAP, October 2023.
[169] California Air Resources Board, "High-GWP Refrigerants," accessed February 6, 2025.
[170] Pistochini, T., et al., (2022), "Greenhouse gas emission forecasts for electrification of space heating in residential homes in the US," Energy Policy 163: 112813.
[171] 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.
[172] 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.

1) **Improve lifecycle refrigerant management**, which includes refrigerant leak recovery and reuse when possible, and destruction when the refrigerant becomes obsolete.[173] Despite federal laws preventing intentional venting of HFCs during equipment servicing or disposal,[174] enforcement is lax in the residential sector, with HVAC contractors having little incentive to properly recover refrigerant.[175] Furthermore, updated federal HFC reclamation requirements do not apply to residential equipment due to small charge sizes. Currently, across all sectors, less than 4% of all refrigerants are reported as reclaimed.[176] Key actions to improve refrigerant management, reclamation, and reuse include:
    - Adopting laws and regulations that promote the reuse of recovered HFCs, such as by limiting the use of virgin or newly produced HFCs and requiring the use of reclaimed HFCs in state-owned buildings.
    - Conducting field studies to gather improved data on actual refrigerant leakage rates for residential HVAC and water heating equipment.
    - Improving service technicians' training on proper installation, leak detection, and reclamation techniques for current refrigerants used in residential HVAC and water heating equipment.
    - Offering incentives and technical assistance to help HVAC service technicians, consumers, and municipalities 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 equipment as a cause of illegal refrigerant venting.[177]
    - Requiring annual reporting and recordkeeping for entities in the refrigerant supply chain – e.g., distributors, wholesalers, reclaimers, service contractors, and technicians – on refrigerant purchases, sales, recovery, recycling, reclamation, and destruction.
2) **Adopt state-level "backstop" regulations** to support full implementation of the AIM Act. Codifying this transition into state laws or regulations would provide regulatory certainty should rollbacks occur at the federal level. To date, nineteen states have adopted regulations or legislation to codify some portion of the initial HFC phasedown.
3) **Develop regulatory programs that further codify the AIM Act timeline and support the full market transition away from HFCs** by establishing more stringent GWP limits for the refrigerants used in HVAC and water heating equipment and establishing future dates by which the industry must shift to ultra-low GWP refrigerants.

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[173] 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.
[174] U.S. EPA, "Stationary Refrigeration – Prohibition on Venting Refrigerants," last updated December 13, 2024.
[175] Hoover, B., Kilgore, B., and Torok, C., "Refrigerants, taking the chill out of heat pumps," ACEEE Summer Study on Energy Efficiency in Buildings, 2024.
[176] U.S. EPA, "Analysis of the U.S. Hydrofluorocarbon Reclamation Market: Stakeholders, Drivers, and Practices," September 2024.
[177]Hoover, B., Kilgore, B., and Torok, C., "Refrigerants, taking the chill out of heat pumps," ACEEE Summer Study on Energy Efficiency in Buildings, 2024.

- EXAMPLE: California's Senate Bill (SB) 1206 directed the California Air Resources Board to initiate a rulemaking that requires the transition to low (GWP <150) or ultra-low (GWP <10) alternatives to HFCs. SB 1206 also placed prohibitions on the sale of newly produced refrigerants above certain GWP thresholds and mandated the use of reclaimed refrigerants in state-owned equipment.

4) **Support research, demonstration, and deployment efforts for emerging heat pump technologies** that can more safely use ultra-low GWP A3 refrigerants, such as residential monobloc air-to-water heat pumps and direct small charge systems in window heat pumps and HPWHs.[178]
5) **Remove barriers to new refrigerants** by updating state and municipal building codes to reference the most up-to-date safety standards, which would allow for increasing the charge limit for A3 refrigerants to levels used safely in other countries, once ASHRAE updates its standard.[179] Many states have already made similar updates to building codes to allow the use of mildly flammable A2L refrigerants.[180] Specifically, states should enact legislation to allow the use of A3 refrigerant in equipment that has a UL listing and meets ASHRAE 15. Legislation should specify that no provision of the building code, or other local code, may prohibit or otherwise limit the use of heat pumps with UL listings and ASHRAE 15. States can also consider engaging in the process to advance UL listing and ASHRAE 15 for heat pumps with ultra-low GWP A3 refrigerant. Once codes are updated, states should offer training for local code officials so they are up to date on refrigerant safety standards.

4. Codes and Standards

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

[178] 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. This safety risk presents a major barrier to A3 refrigerant adoption in the U.S., although R-290 is already widely and safety used in heat pumps in Europe.

[179] 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. 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.

[180] See, for example, Rhode Island's A2L refrigerant legislation. https://webserver.rilegislature.gov/BillText/BillText23/SenateText23/S0802A.pdf

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

A. Building Energy Codes

These recommendations identify ways for states to promote energy efficiency and electrification in new construction and retrofits. Different states have distinct frameworks around state and local authority to set energy codes, so these recommendations should be adapted to each state's unique context.

1) **Adopt and update building energy codes to encourage energy efficiency and electrification by:**
    - Adopting the latest energy codes for residential buildings, if not already adopted, to ensure maximum energy efficiency in new buildings.
    - Updating building codes to adopt the most recent ASHRAE safety standards and allow for higher charges of low-global-warming-potential refrigerants in heat pumps (see more on refrigerant recommendations in Section V.3.C).
    - Updating statewide building energy codes to encourage all-electric new construction 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 electric space and water heating, significantly reducing structural and cost barriers to future heat pump installation.[181] Zero-fuel-bias codes support all-electric new construction by ensuring that buildings are required to reach the same efficiency objectives regardless of the fuels they use, eliminating the historical practice of allowing buildings with combustion appliances to use far more energy than all-electric buildings.[182,183]
2) **Develop model all-electric codes** for local jurisdictions to adopt as base or stretch codes.[184] All-electric energy codes can save builders and homeowners money by eliminating the expenses associated with multiple pieces of equipment (e.g., a gas furnace and a central AC that can be replaced by a single heat pump), gas piping, and

[181] Northeast Energy Efficiency Partnerships, "Electrification and Energy Codes Primer," December 2023.
[182] "Prototype Building Models." US Department of Energy Building Energy Codes Program. https://www.energycodes.gov/prototype-building-models#Residential Accessed 27 February 2025.
[183] Erin Sherman, Daniel Carpenter-Gold, Jonny Kocher, and Jamie Long. "The Energy Code Safe Harbor Toolkit." December 2024. https://rmi.org/insight/the-energy-code-safe-harbor/
[184] State and local authority to require all-electric new construction is currently the subject of litigation; some legal challenges have asserted that state and local regulations such as all-electric codes are preempted under the federal Energy Policy and Conservation Act (EPCA), which regulates the energy efficiency of covered appliances. States in the Ninth Circuit cannot set all-electric requirements in building code following the *California Restaurant Association v. City of Berkeley* decision. *See* https://www.publichealthlawcenter.org/litigation-tracker/california-restaurant-association-v-city-berkeley-2019.

new gas connection costs,[185] and by obviating future expenses associated with electrification retrofits. Where statewide updates to base codes are not feasible, states can develop stretch codes that municipalities can adopt to encourage all-electric new construction, and public utility commissions can incentivize utilities to provide support for stretch code adoption and compliance by municipalities.[186]

- EXAMPLE: Colorado requires any jurisdiction updating any building code to also adopt model electric-ready, solar-ready, and (upcoming) low-carbon codes at the same time.[187] While this measure is less stringent than an all-electric energy code, it ensures that all new construction can easily transition to an all-electric building while reducing legal risk.

B. Building Energy Performance Standards and Disclosure

These policies set requirements for energy or emissions performance that building owners must meet, along with associated requirements for benchmarking and disclosure of energy performance. They can also encourage innovation and investment in clean technologies in the real estate sector.

1) **Require energy benchmarking and disclosure** for large buildings, including multifamily buildings, on a statewide basis. Benchmarking can be a good starting point for emissions reductions, because it requires building owners to calculate and monitor their energy use, highlighting opportunities for improvement. Benchmarking data can be made publicly available, and can be used to target policy, programs, and funding at a state's most energy-inefficient large buildings. Furthermore, benchmarking alone has been shown to increase building performance by simply drawing building owners' attention to how their building performs compared to others, using metrics like energy use intensity.[188]
2) **Adopt statewide building energy performance standards** (BEPS, also known as building performance standards, or BPS). BEPS often start with benchmarking but add requirements to reduce direct building emissions and/or energy use intensity by increasing amounts over time.[189] BEPS allow building owners the flexibility to gradually reduce emissions via measures that work best for their property, rather than requiring them to follow any one specific path. States can also work with program administrators to support BEPS compliance by offering incentives and technical assistance to help building owners make energy upgrades.[190] Multifamily building owners, particularly

[185] Tan, L., Fatzhollahzadeh, M.H., and Taylor, E., "The Economics of Electrifying Buildings: Residential New Construction," RMI, 2022.
[186] Garfunkel, E., and Waite, M., "Utility Energy Codes Programs and Their Potential Extension to Building Performance Standards," ACEEE, July 25, 2024.
[187] Colorado Energy Office, "Colorado's Building Energy Codes," accessed February 7, 2025.
[188] Hart, Z., "The Benefits of Benchmarking Building Performance," Institute for Market Transformation and Pacific Coast Collaborative, December 2015.
[189] Institute for Market Transformation, "Building Performance Standards," accessed January 17, 2025.
[190] Garfunkel, E., and Waite, M., "Utility Energy Codes Programs and Their Potential Extension to Building Performance Standards," ACEEE, July 25, 2024.

affordable housing owners and operators, should be targeted for incentives and technical assistance to help them comply with the standards.

- EXAMPLE: In alignment with state legislation, the Maryland Department of the Environment has begun implementing statewide BEPS. The regulation requires large buildings to begin benchmarking and reporting in 2025 and start meeting direct emissions standards starting in 2030. By 2040, nearly all large buildings will be required to meet zero-emission limits or pay a for their excess GHG emissions.[191]
- **[INSERT:** Map of jurisdictions implementing BEPS**]**

3) **Require residential homes to provide energy performance disclosures at point of sale or lease signing.** Energy performance can be measured using established metrics such as DOE Home Energy Score[192] or Home Energy Rating System (HERS) Index Score.[193] Disclosures may include historic utility bills, a description of a home's energy efficiency characteristics, and/or completion and reporting of a home energy assessment.[194] This policy can increase market pressure for home sellers and landlords to improve energy efficiency and protect home buyers and tenants from unexpected utility bills.
4) **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 since it more easily allows for energy upgrades to occur when the home is unoccupied. Creating exemptions for buildings that already have at least one decarbonization appliance installed, such as a heat pump, heat pump water heater or electric car charger, can help incentivize owners to make these upgrades prior to home sale.
    - EXAMPLE: 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 achieving a HERS score of 120 or less.[195]

C. Equipment Emissions Standards

This policy regulates emissions from equipment sold and installed by manufacturers, distributors, retailers, and contractors. Emission standards rely on longstanding state and regional air district authority to regulate air pollution within the framework of the Clean Air Act and state environmental statutes. They are a helpful tool to send a signal to market actors about the pace of the transition to zero-emission technologies.

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[191] Maryland Department of the Environment, "Subtitle 28: Building Energy Performance Standards," January 2025.
[192] U.S. DOE, "Home Energy Score," https://betterbuildingssolutioncenter.energy.gov/home-energy-score, accessed March 20, 2025.
[193] Residential Energy Services Network, "What is the HERS Index," accessed March 20, 2025.
[194] Ribiero, D., and Cluett, R., "Residential Energy Use Disclosure: A Guide for Policymakers," June 2014.
[195] City of Boulder, "SmartRegs Guide," accessed March 31, 2025.

1) **Set zero-emission heating equipment standards (ZEHES) for space and water heating equipment**.[196] Under this policy, only space and water heating equipment with zero onsite emissions of greenhouse gases and air pollutants such as NOx can be sold and installed after a certain date. These standards do not require early replacement of functioning equipment in buildings, but ensure that polluting equipment will be replaced with zero-emission alternatives, such as high-efficiency heat pumps, at the end of their useful life.[197] ZEHES are a particularly important regulatory tool for states that have binding net-zero GHG targets or that have areas in nonattainment with the ozone NAAQS. Setting a ZEHES compliance date starting at least 15 years before the state's target date to reach net-zero economy-wide emissions can help states stay on track by preventing installation of equipment that will continue to pollute after the target year. By adopting ZEHES well before compliance dates take effect, states can also send a clear signal to market actors and help prepare them for the transition to zero-emission equipment.
    - EXAMPLE: To reduce NOx emissions and secondary ozone and PM2.5 formation in the San Francisco Bay Area, the Bay Area Air Quality Management District (AQMD) amended existing NOx regulations in 2023 to include zero-NOx emissions standards for residential-scale methane gas space and water heating equipment with compliance dates starting in 2027.[198] The regulation also established an Implementation Working Group (IWG) composed of over 40 stakeholders to provide guidance on implementation challenges, and required Bay Area AQMD staff to compile IWG recommendations and provide a status update on overcoming implementation challenges each two years prior to a compliance date.[199]

D. AC to Heat Pump Policies

While many building decarbonization policies focus on replacing fossil fuel heating systems with heat pumps, air conditioning installation and replacement also presents a critical opportunity for intervention – particularly since the market 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 both ASHPs and furnaces.[200] The main difference between ACs and ASHPs is that "one-way" central ACs only provide cooling, while "two-way" heat pumps have a reversing valve that allows them to change the flow of refrigerant, transferring heat indoors during cold months and outdoors during warm months. This section identifies several "AC-to-HP" policies that

[196] Local authority to set ZEHES is currently the subject of litigation; see case status at litigation tracker: "Rinnai America Corp. v. South Coast Air Quality Management District (2024)," by Public Health Law Center.
[197] Levin, E., Louis-Prescott, L., and Breit, R., "Zero-Emission Heating Equipment Standards: A New Tool in the Policy Toolbox," ACEEE Summer Study, 2024.
[198] BAAQMD, "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.
[199] Ibid.
[200] Air-Conditioning, Heating, & Refrigeration Institute (AHRI), "AHRI Releases December 2024 U.S. Heating and Cooling Equipment Shipment Data," February 14, 2025.

states can consider to require or encourage customers to shift purchases from ACs to heat pumps.

1) **Enact AC-to-heat hump policies to shift purchases from central ACs to heat pumps.** Shifting a customer from a one-way AC to a two-way ASHP when they are in the market for a new AC presents a crucial opportunity for decarbonization, since that customer could also use the ASHP for zero-emission heating.[201] Policy options include:
    - Passing legislation or adopting regulations to improve air quality and reduce GHG emissions by requiring new ACs manufactured, distributed, sold, or installed in existing and new homes to be heat pumps that allow operation in heating mode. This policy can also include design requirements to ensure that the heat pump is actually reducing emissions from fossil fuel combustion, such as requiring controls that allow the heat pump to be set as the primary heating source and any other heating equipment as a supplemental heating source.[202] Vancouver, British Columbia has implemented this type of AC-to-HP policy.[203]
    - Updating building energy codes or developing model stretch codes that strongly encourage homeowners to install heat pumps rather than ACs in new construction and additions, and to replace central ACs with HPs 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 needs.[204] Importantly, AC-to-HP provisions in energy codes cannot mandate heat pumps,[205] but they can set performance standards that encourage heat pumps installation by requiring customers that choose to one-way ACs to complete additional upgrades to improve energy performance, such as air sealing and duct insulation.
        - EXAMPLE: The City of Denver has directed that its building code be amended to require commercial and multifamily buildings to install heat pumps instead of unitary ACs when AC equipment is proposed to be replaced.[206]

5. Utility Planning and Regulation

Affordability is a top concern 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

[201] Pantano, S. et al. "3H 'Hybrid Heat Homes'," CLASP, May 26, 2021
[202] It is important that states adopt AC-to-Heat Pump policies for the purpose of air quality and climate benefits and ensure that they are carefully designed to avoid regulating energy efficiency of the equipment covered, to avoid preemption under the federal Energy Policy and Conservation Act (EPCA).
[203] City of Vancouver. "Home, property, and development: Mechanical permit," Effective January 1, 2023.
[204] Takemura, A.F., "A call to replace air conditioners with heat pumps in California," Canary Media, May 28, 2024.
[205] State and local building energy codes must meet specific design criteria to avoid EPCA preemption.
[206] Denver, Colorado – Code of Ordinances, Section 10-20(d)(2).

in this section require action by PUCs, and in some cases legislation may be needed to change regulatory and utility frameworks.

A. Utility Business Models and Performance Requirements

Utility reform may be needed to accelerate the transition to zero-emission buildings and prepare the grid for a decarbonized future. The following recommendations are mostly directed at PUCs and may require legislation to update regulatory frameworks. They include changes to electricity and methane gas utility business models and performance standards that hold utilities accountable for reducing emissions, delivering clean heat, and utilizing energy resources more effectively.

1) **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 new infrastructure, such as poles and wires, which can cause them to favor costly infrastructure investments over investments that enable better utilization of the existing grid, such as demand flexibility and energy efficiency.[207] States can establish performance incentive mechanisms (PIMs) to incentivize investments that align with state goals for decarbonization, affordability, grid modernization, and reliability. PIMs can reward utilities for specific performance improvements, such as reducing service disconnections, improving service reliability, installing advanced metering infrastructure in residential homes,[208] reducing peak demand, or achieving targets for clean peak or load flexibility. They can also include equity targets, such as delivering energy efficiency to low-income households.[209] PIMs can also be established for specific components of a utility's portfolio; for example, utility energy efficiency programs often include performance targets established by regulators and associated incentives for achieving them.
    - EXAMPLE: The Massachusetts Clean Peak Standard requires electricity utilities to meet a minimum percentage of sales with resources that either dispatch clean energy to the grid or reduce load on the grid during peak demand times.[210] Examples of qualifying measures include battery storage, time-of-use rates leading to measurable changes in consumer energy usage, and incentive payments for participation in demand-response programs.[211] The regulation also creates incentives to reward utilities for implementing clean peak measures.
2) **Direct utilities to implement clean heat, load flexibility, and electrification readiness programs.** Regulators can direct electric and gas utilities to implement specific programs that align with state decarbonization goals. Programs can be

[207] ACEEE, "Utility Business Models," accessed January 20, 2025.
[208] Currently, about 27% of U.S. residential electric meters do not have advanced metering capabilities, leaving them unable to participate in load flexibility programs. Closing that gap expands access to potential bill savings for those customers and increases the base for utilities to draw on in demand-response activities.
[209] Gold, R., and Rosenbach, C., "Transforming the Way We Serve Vulnerable Communities: Performance Incentive Mechanisms and Beyond," RMI, April 26, 2024.
[210] Commonwealth of Massachusetts, "Clean Peak Energy Standard History of Program Development," accessed February 7, 2025.
[211] Commonwealth of Massachusetts, "Clean Peak Resource Eligibility Guide," September 10, 2021.

developed in the context of new PIMs or performance targets or as a separate effort, and may include:

- Clean heat programs: Clean heat, electrification, and building decarbonization programs can be offered by both electric and methane gas utilities. They are a common way to fund heat pump incentives, and can be developed in the context of a CHS policy (see Section V.3.B) or as a separate program under PUC direction.
    - EXAMPLE: In New Jersey's Triennium 2 energy efficiency programs, which started in January of this year, the Board of Public Utilities (BPU) directed electric utilities to develop "building decarbonization start-up programs," which are intended to switch customers off fossil fuel equipment while reducing overall energy consumption. The BPU specifies that these programs "should offer financial incentives for New Jersey consumers currently using fossil-fueled equipment to adopt more efficient electric equipment." [212]
- Load flexibility programs: These programs are offered by electric utilities to minimize strain on the grid and mitigate peak demand as more customers transition to electric zero-emission technology. They can include demand response or load management programs for water heaters, smart thermostats, and EV charging.
- Electrification readiness programs: These programs are offered by electric utilities and involve expanding utility funding for electric service upgrades, electrical panels ("heavy-ups"), and wiring; providing subsidies or financing options to help multifamily building owners afford these costs; and capping how much utilities can charge multifamily building owners for distribution system upgrades. Costs for these types of upgrades can pose a major barrier to multifamily building owners, who are often charged the full cost of utility distribution system upgrades needed to support increased electricity load from zero-emission heating.[213] Relatedly, electric utilities could be required to publish load capacity headroom maps that help utilities, developers, and other stakeholders understand where there is additional grid capacity and where distributed energy resources and building electrification projects might be best placed.[214]
    - EXAMPLE: In 2024, the Colorado Legislature passed Senate Bill 24-218, which contained provisions to cap the costs to affordable housing buildings for interconnection, connecting new load, or upgrading electrical service for existing customers. Costs are limited to $300 per

[212] New Jersey Board of Public Utilities, "Order Directing the Utilities to Propose Second Triennium Energy Efficiency and Peak Demand Reduction Programs," July 2023.
[213] Bastian, H., and Cohn, C., "Ready to Upgrade: Barriers and Strategies for Residential Electrification," ACEEE, October 2022.
[214] U.S. DOE, "U.S. Atlas of Electric Distribution System Hosting Capacity Maps," updated May 2024.

residential unit of affordable housing, as long as the utility can still recover costs above the cap.[215]

3) **Change the business model for methane gas utilities to protect remaining gas customers from rising costs by**:
    - Accelerating depreciation schedules or reducing the time over which utilities recover investments in gas infrastructure from ratepayers. Utility depreciation schedules can span decades, which will put the burden of paying for current investments on a dwindling customer base as more ratepayers electrify. Accelerating depreciation schedules ensures that a larger customer base pays for infrastructure investments before widescale electrification, but must be paired with lower gas utility spending to prevent untenably high short-term rates.[216]
    - Enabling securitization, which can allow utilities to recover the costs of retiring assets (e.g., methane gas infrastructure that is no longer used by electrified customers) without increasing costs for consumers by selling future ratepayer revenue as debt security.[217]
    - Transitioning gas cost allocation between customer classes so that the burden of paying for the gas distribution system is more equitably distributed. For example, cost allocation methods can be updated to transition costs from residential payers who will make up a smaller share of the methane gas customer base to industrial customers who will make up a greater share of the customer base.[218]
    - Creating a minimum bill for low volume non-LMI gas users (such as those that only use methane gas for cooking or a fireplace), to pay for their service connections and prevent the burden of maintaining gas system infrastructure from falling only on those who can least afford electrification.[219]
4) **Account for non-energy benefits in cost-benefit analysis of utility programs and investments by**:[220]
    - Including or expanding non-energy benefits, such as avoided GHG emissions and health impacts, used in cost-benefit analysis.
    - Evaluating programs using equity metrics like proportion of spending allocated to low-income households or disadvantaged communities.

[215] General Assembly of the State of Colorado. "Senate Bill 24-218," signed May 22, 2024.
[216] 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.
[217] Varadarajan, U., Posner, D., and Fisher, J., "Harnessing Financial Tools to Transform the Electric Sector," Sierra Club, 2018.
[218] 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.
[219] Gridworks, "California's Gas System in Transition: Equitable, Affordable, Decarbonized and Smaller," 2019.
[220] Cosgrove, E., et al., "Centering Equity with Metrics: How to Incorporate Equity and Justice in Evaluation, Measurement, and Verification," NEEP, August 2022.

- Exploring options for cost-effectiveness tests centered on equity, such as changing the weight given to benefits in low-income households and disadvantaged communities, in place of traditional cost-benefit assessments.[221]
- Monitoring outcomes for program participants to identify unintended consequences, such as inadvertently increasing displacement, housing/rent costs, or energy burdens.

B. Access to Utility Data

Access to utility data is a key enabler of policy development and program implementation on several fronts. Lack of data on electricity and gas consumption can prevent state and local governments, as well as market actors, from targeting 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 tenants' utility consumption data prevents them from being able to accurately benchmark the energy performance of their own buildings and plan for retrofits. This is an issue for nearly all multi-tenant buildings, including multifamily and mixed-use buildings.

1) **Pass legislation requiring utilities to make historic energy consumption data available** to authorized recipients to access buildings' energy consumption data.[222] This would allow owners of multi-tenant buildings to access aggregated whole-building data, while protecting customer privacy by aggregating this data at a reasonable threshold, based on the number of unique tenants within a building. Utility data access 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.[223]

C. 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 methane gas.[224] However, in many states and utility service territories, current rate structures create a "spark gap" that sends the opposite price signal to customers. Rate design is particularly important for Northeast states and California, where some of the highest electricity rates in the country prevent many households from realizing energy bill

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[221] Adler, M. "Benefit–Cost Analysis and Distributional Weights: An Overview," Review of Environmental Economics and Policy, volume 10, issue 2, Summer 2016.
[222] States interested in pursuing this policy can reference the Institute for Market Transformation and Regulatory Assistance Project's "Model Utility Data Access Law."
[223] U.S. Department of Energy, "Open Energy Data: Green Button," accessed March 31, 2025.
[224] 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.

savings when they electrify despite heat pumps' high efficiency.[225] The following section outlines rate reforms that states can advance to support electrification and affordability.

1) **PUCs should direct electric utilities to adopt electrification-friendly rates**. In many states and utility service territories, heat pump customers are overcharged for electricity because they use more electricity in the winter for heating, rather than in the summer when grid costs are higher to meet peak demand. Many standard electricity rates are artificially high in winter, because most utilities charge the same price for electricity year-round, meaning that customers with electrified heating are overcharged relative to their impact on the system.[226] States and PUCs can consider rate designs with the following features to encourage efficient electrification:
    - Seasonal rates: Seasonal rate structures can be offered to all customers, or only to customers using specific technology, such as heat pumps. Seasonal rates reduce electricity prices in the winter and increase them in the summer. This incentivizes heat pump use for heating while maintaining a cost signal to reduce energy consumption during summer peak periods. There is significant historical precedent for electric heating rates, and 88 utilities currently offer them.[227] 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 better enabling better utilization of the existing grid.[228] Seasonal rate structures can be revisited over time if higher rates of heat pump adoption eventually cause systems to shift from summer to winter peaking. 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, as discussed in Section V.5.A.[229]
        - EXAMPLE: 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 by around 50%.[230]
    - Lower volumetric charges. Electric rates typically include two components: a volumetric charge based on quantity of electricity consumed, and a fixed charge

[225] U.S. EIA, "Electric Power Monthly – Table 5.6.A Average Price of Electricity to Ultimate Customers by End-Use Sector," October 2024.
[226] Shea, R., Dammel, J., and Fink, F., "It's Time to Stop Overcharging Heat Pump Customers. Electrified Heating Rates Can Help," RMI, February 13, 2025.
[227] Ibid.
[228] Malkani, V., et al., "Near-Term Rate Design to Align with the Commonwealth's Decarbonization Goals," Energy and Environmental Economics, December 2024.
[229] ISO New England, "CELT Reports," accessed March 31, 2025.
[230] Central Maine Power, "Seasonal Heat Pump Rate," accessed January 15, 2025.

to cover base service to the customer. Many utilities recover most utility costs through volumetric charges.[231] While volumetric charges promote electricity conservation, they can discourage electrification. Lowering 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.[232] This strategy represents a large shift from rate design thinking over the past decades, and can create 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.

    - EXAMPLE: California's new income graduated fixed charge uses fixed charges that change relative to customers' incomes paired 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 have been lowered by 5-7 cents/kWh for all residential customers. This proposal seeks to balance savings for lower-income ratepayers while still sending price signals for energy conservation. [233]

- Time-of-Use (TOU) rates: TOU rates charge customers more for electricity during "on-peak" hours with high demand 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 electric vehicle charging to off-peak times, reducing peak demand and grid costs.[234] TOU rates are more complicated for end uses like space heating, which are harder to shift to off-peak times of day. While space heating is higher during 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. TOU rates can also be difficult for ratepayers to understand and/or rely on advanced metering infrastructure that not all utilities have installed, requiring consumer education and potentially significant utility investments in grid modernization to realize full cost and grid benefits.
    - EXAMPLE: Fort Collins, CO, combines technology-specific, seasonal, and TOU elements in its rate design. Standard customers experience several different rates throughout the year: summer on-peak, non-summer on-peak, off-peak, and an additional charge per kWh over 700 kWh consumed per month. Customers with electric heating can opt into an electric heating rate, which offers slightly higher volumetric

[231] California Public Utility Commission. "CPUC Response to Executive Order N-5-24," February 18, 2025.
[232] Malkani, V., et al., "Near-Term Rate Design to Align with the Commonwealth's Decarbonization Goals," Energy and Environmental Economics, December 2024.
[233] California Public Utility Commission. "Decision Addressing Assembly Bill 205 Requirements For Electric Utilities," May 9, 2024.
[234] Chitkara, A., et al., "A Review of Alternative Rate Designs," RMI, May 2016.

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 explanatory materials to explain the differences in rate classes to residents.[235]

2) **PUCs should direct electric and methane gas utilities to incorporate equity and affordability elements into rate designs** and enrollment practices. Options include:
    - Percentage of Income Payment Plan (PIPP): PIPPs cap consumer energy bills at a set percent of their income. To streamline the application process, states can automatically enroll customers who qualify for the Low-Income Energy Assistance Program (LIHEAP) in a PIPP.[236]
        - EXAMPLE: The Nevada Energy Assistance Program provides a fixed annual credit for income-eligible customers paid directly to the utility. The credit reduces the percentage of household income spent on utility bills to the state median percent of household income spent on utilities.[237] In 2023, this meant an energy bill cap at 2.29% of household income.[238]
    - Progressive fixed charges: Setting the same fixed utility charges for all customers can be socially regressive because the fixed charge represents a greater percentage of income for low-income households compared to high-income households. Switching to progressive fixed charges where higher-income households pay a higher fixed charge can reduce this discrepancy.[239] The California income-graduated fixed charge discussed in Section V.C.1 above is an example of this structure.
    - Bill protection guarantees: Utilities can guarantee customers – particularly low-income customers – bill protection for participating in electrification or rate design programs, to ensure they do not increase bills. Customers who pay more after switching to heat pumps or to a different electricity rate can receive bill credits from the utility for the difference between original and new energy costs.
        - EXAMPLE: 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

[235] City of Fort Collins, "Residential Electric Rates," accessed January 15, 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.

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: 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 improve cost savings for residents in multifamily buildings that electrify. Utilities should also confirm that multifamily buildings are not mistakenly enrolled in more expensive commercial rates, which can include costly demand charges that are not typically applied to residential customers.
    - EXAMPLE: In Nevada, NV Energy offers a rate specific to multifamily residents who have separate meters within a multi-unit complex.[242] These rates are provided to individual ratepayers within the multifamily building rather than building owners, ensuring that households receive the financial benefits of the reduced rate.

3) **Establish a statewide interagency rates 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 process brings key agencies and stakeholders together to determine the optimal mix of rate design elements to meet each state's goals for electrification and affordability. While the PUC will ultimately need to approve rates for each regulated utility, the working group process 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 an individual utility rate case. 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.
    - EXAMPLE: The Massachusetts Interagency Rates Working Group is composed of members from four different state offices and agencies, and is responsible for developing and conducting stakeholder outreach on three reports on current electric rates, near-term rate strategies, and long-term rate strategies.[243] In line with Working Group recommendations, the Massachusetts Department of

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

[241] Multifamily buildings typically have less costly distribution infrastructure on a per-customer basis and have 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). 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.

Public Utilities (DPU) ordered National Grid to propose a lower winter rate for heat pumps, which they are currently developing.[244]

4) **Require that utilities increase enrollment in rates that benefit customers**, such as by automatically enrolling customers in electric heating rates if it decreases their energy bills or noting the amount that they would have paid under different rate structures on each utility bill. This can be accomplished through Performance Incentive Mechanisms (further discussed in Section V.5.A), such as Massachusetts' 2025-2027 statewide energy efficiency plan, which offers an equity performance incentive mechanism that includes increasing enrollment in discount service rates.[245] These types of efforts can increase consumer awareness and uptake of beneficial rate structures.

D. Consumer-Facing Incentives and Programs

Many zero-emission heating and hot water technologies have higher upfront costs than conventional alternatives. The recommendations below can assist states in designing or enhancing incentive programs to increase customers' ability to afford these technologies. They can also help states better align existing energy efficiency programs with electrification priorities and ensure that incentive dollars are being effectively deployed.

1) **Phase out energy efficiency program incentives for equipment types that do not align with climate goals and redirect program funding toward electrification and weatherization.** Specifically, program administrators should phase out incentives for high-efficiency fossil fuel equipment such as furnaces and water heaters and for one-way air conditioners and expand incentives for key measures such as heat pumps and weatherization. In some states and regions, this might also involve increasing incentives for higher-efficiency heat pumps, such as variable-speed ASHPs and cold-climate ASHPs designed to work well at low temperatures.
    - EXAMPLE: In 2024, Mass Save eliminated rebates and 0% loans for methane gas, oil, and propane heating equipment, in alignment with new legislation.[246]
2) **Update energy efficiency program rules to allow programs to offer incentives for measures that involve fuel switching** from fossil fuel equipment – including both methane gas and unregulated fuels (e.g., oil, propane) – to electric equipment such as high-efficiency heat pumps.[247] Setting energy efficiency savings targets in fuel-neutral terms (e.g., GHG or total MMBtu savings), as discussed in Section V.3.A, can also remove a programmatic barrier to fuel switching and electrification within efficiency programs.

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[244] Shemkus, S., "Mass. Regulator Orders National Grid to set Lower Winter Rates for Heat Pumps," Canary Media, October 4, 2024.
[245] Mass Save, "The Massachusetts 2025-2027 Energy Efficiency and Building Decarbonization Plan," October 31, 2024.
[246] MassSave, "2024 Discontinuation of Rebates and Incentives for Natural Gas, Oil, and Propane Heating Equipment," April 12, 2024.
[247] Berg, W., "State Policies and Rules to Enable Beneficial Electrification in Buildings through Fuel Switching," ACEEE, July 21, 2022.

3) **Target oil, propane, and electric resistance customers** for heat pump and HPWH installation and rebates, as these residents will experience the greatest lifetime savings from making the switch.[248]
    - EXAMPLE: New Jersey's Building Decarbonization Program offers generous incentives and financing for fuel switching, including a bonus incentive to decommission a delivered fuels system.[249]
4) **Design incentives and rebates to reduce or eliminate the need for large out-of-pocket expenses**, particularly for LMI residents. 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 paid after the customer has filed a tax return.
5) **Bundle information and incentives for electrification and weatherization** with other programs that can lower operating costs for customers and support a clean and resilient electricity system, including:
    - Community solar, which allows homeowners and renters to purchase a share in a solar project and receive monthly electricity savings without installing their own solar array.[250]
    - Distributed capacity procurement (DCP) programs, where utilities own and deploy distributed energy resources like rooftop solar or residential storage, rather than having residents own and install their own. These programs can increase energy affordability by efficiently and rapidly meeting increasing electrical capacity needs without shifting costs to non-participating ratepayers.[251]
    - Demand response and virtual power plant (VPP) programs, where utilities or aggregators pay customers to participate in programs that temporarily shift their energy consumption through smart thermostats, batteries, and electric vehicles.[252] These programs can directly compensate residents and lower overall grid costs by reducing peak electricity use and the need for expensive and polluting power from peaker plants.[253]

E. Midstream and Upstream Incentives and Programs

The following recommendations 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, expanding the

[248] Gartman, M., et al., "What a 20 million heat pump commitment means for the U.S.," RMI, September 21, 2023.
[249] He, Y., "New Jersey Approves Second Triennium Energy Efficiency Program Filings," NEEP, December 17, 2024.
[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] Takemura, A., "The power grid explained – plus demand response, virtual power plants and more," Canary Media, June 2, 2022.
[253] U.S. DOE, "Virtual Power Plants Projects," accessed January 14, 2025.

number of skilled workers,[254] and increasing contractor education on and comfort with zero-emission technology, can all decrease the costs ultimately passed down to consumers. The following recommendations highlight program approaches that target market actors to achieve these goals.

1) **Design and implement midstream and upstream incentive programs.** These programs apply incentives higher up the supply chain via contractors, retailers, and wholesale distributors (midstream incentives) or manufacturers (upstream incentives), in contrast to rebates paid to end-use customers (downstream incentives). Midstream incentives can also be passed through, in whole or in part, to customers through instant discounts at the point-of-sale. This approach reduces the upfront cost of zero-emission equipment, eliminating the need for customers to pay more upfront and wait for a rebate payment on the back end. While additional oversight and rebate transparency may be needed to ensure rebates are passing through to consumers, well-designed midstream incentive programs can result in enduring changes to the market while delivering the following benefits:[255]
    - Increased program participation: By offering upfront rebates combined with prompt payments to contractors and distributors, these programs capture greater customer participation. Midstream incentives also 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.
    - Faster market transition to zero-emission technologies: Midstream programs that effectively engage the supply chain with collaborative sales and marketing strategies can encourage contractors to recommend heat pumps to potential customers and improve their 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.
    - EXAMPLE: 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 over 50% of the state's electric water heater sales going to HPWHs (compared to 3-4% nationally).[257]
2) **Pilot innovative incentive and procurement strategies that engage market actors in new ways.** Ideas include:

[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.

- Offering incentives to builders through utility energy efficiency programs for all-electric or electric-ready new construction, to avoid future costs of 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.
    - EXAMPLE: California renewable energy provider and public agency MCE offers contractors an incentive of $1,500 per unit to install a heat pump water heater after installing (and removing) an emergency loaner).
- Encouraging manufacturers to increase heat pump sales through programs that provide incentives based on achievement of targets for percentage-of-sales or truckloads-of-shipments of zero-emissions equipment.
- Facilitating bulk heat pump purchasing from manufacturers to reduce costs for consumers, through state procurement or by supporting community group-buy programs that make upfront costs more transparent, reduce contractor and customer acquisition costs, and facilitate economies of scale.

F. 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 electrification, while providing a compelling value proposition that spurs the heat pump market. These financing strategies should be targeted to middle- and upper-income households to avoid increasing 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 a range of situations including renters, single-family and multifamily properties, middle-income homeowners, renters, and situations where bills increase (e.g., when AC is installed in a home that did not previously have cooling). Financing is included in this section because many utility energy efficiency and building decarbonization programs include financing options, 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.

1) **Design financing to work for unplanned equipment replacements,** which represent the vast majority of HVAC and hot water heater installations. Homeowners are unlikely to utilize financing in these situations if it requires a multi-day application and approval process, a detailed energy audit, and/or engaging a third party (e.g. navigating to a program website).
2) **Work with utilities to offer on-bill financing** that enables customers to pay for energy efficiency and electrification measures through their energy bills. Tariffed on-bill programs, also known as inclusive utility investment, 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 to 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, cost recovery is associated with the meter rather than an individual, and payments can be structured so that customers pay for the measures out of the energy cost savings without increasing utility bills.[258,259] 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.[260]

3) **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 further defray the upfront costs of electrification and building upgrades. Residential financing options should be designed with the following best practices:[261,262,263]
    - 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, such as: limiting eligibility to contractors verified by utility or state programs, a fraud reporting and cost recovery process, cost-effectiveness screening or targeting efficiency measures most likely to yield tangible long-term savings and non-monetary comfort and health benefits, a utility disconnection and/or arrearage management program to prevent utility shutoffs, enhanced disclosure practices, and/or a third party navigator program.
4) **Attach energy efficiency and electrification requirements to existing lending programs administered by housing finance agencies**. This may require coordinating or consolidating a variety of existing financing options and programs serving affordable housing and multifamily buildings. Where feasible, incorporating energy standards into financing programs can encourage or require multifamily building owners to consider energy upgrades they might not consider otherwise when applying for funding.

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[258] U.S. DOE, "Issue Brief: Low-income Energy Efficiency Financing through On-Bill Tariff Programs," accessed January 17, 2025.
[259] U.S. EPA, "Inclusive Utility Investments: Tariffed On-Bill Programs," last updated January 24, 2025.
[260] U.S. EPA, "On-Bill Loan Programs," last updated January 24, 2025.
[261] U.S. EPA, "Inclusive Utility Investments: Tariffed On-Bill Programs," last updated January 24, 2025.
[262] Hayes, S., et al., "What Have We Learned from Energy Efficiency Financing Programs?" ACEEE, September 2011.
[263] Prieto, O. and Unger, R., "Making Decarbonization Financing Work for Homeowners and Contractors," RMI, 2024.

G. Gas 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 ratepayers. Proactive planning for the future of gas utilities is crucial to the transition to zero-emission residential buildings; if not addressed, the stranded costs associated with long-term maintenance of the gas network will present a major challenge to affordability. This section recommends gas system planning requirements and processes that states and PUCs can put in place.

1) **Require integrated methane gas and electric utility planning** to optimize investments in electrical and gas infrastructure, improve reliability, and reduce energy bills.[264] 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.
2) **Eliminate methane gas line extension subsidies** to decrease costs passed to ratepayers and encourage electric new construction.[265] 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 may encourage electrification.
    - EXAMPLE: In 2024, the Oregon PUC instructed the state's largest methane gas utility to start phasing down gas extension allowances, with full discontinuation of allowances by 2027.[266]
3) **Require gas utilities to conduct non-pipeline alternative (NPA) assessments** when considering gas infrastructure upgrades, such as gas line replacement and repair, without sacrificing safety of the gas system. NPAs could include energy efficiency, demand response, and electrification, including through thermal energy networks, which can eliminate the need for additional gas infrastructure and reduce long-term cost-recovery borne by ratepayers.[267]
        - EXAMPLE: The Massachusetts Department of Public Utilities requires gas utilities to demonstrate that they considered NPAs and found them to be cost-prohibitive to maintain eligibility for full cost recovery on methane gas infrastructure investments.[268]

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[264] Lebel, M., et al., "Opportunities for Integrating Electric and Gas Planning," Regulatory Assistance Project and Lawrence Berkeley National Laboratory, January 2025.
[265] Alter, A., Billimoria, S., Henchen, M., "Overextended: It's Time to Rethink Subsidized Gas Line Extensions," RMI, December 2021.
[266] Oregon PUC, "Northwest Natural Gas Company Request for a General Rate Revision," entered October 25, 2024.
[267] Nelson, R., et al., "Non-Pipeline Alternatives to Natural Gas Utility Infrastructure: An Examination of Existing Regulatory Approaches," Strategen, November 2023.
[268] Massachusetts Department of Public Utilities, "Order on Regulatory Principles and Framework," DPU 20-0-B, December 6, 2023.

4) **Promote thermal energy networks (TENs)** as an emerging approach to decarbonize communities while offering a viable business model for gas utilities and workers. TEN construction can repurpose skills such as pipefitting and laying from the existing gas workforce, creating an ideal workforce transition opportunity.[269] 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 serve gas to any customer in their territory who asks for it and can be served at a reasonable cost, which can hinder neighborhood-scale decarbonization by enabling a single resident to veto a project for their entire neighborhood by continuing to ask for gas.[270] Changing the obligation from providing "gas" to providing "heat" can clear the path for neighborhood-level thermal energy networks or electrification upgrades if a majority of residents agree to the upgrade.
   - Funding stakeholder committees representing utilities, labor, consumers, climate and environmental advocates, and regulators to initiate feasibility studies that incorporate diverse expertise and interests.
   - Funding TEN pilot projects to demonstrate their efficacy and affordability and to help with community energy mapping and planning.
   - Providing incentives for utilities to develop gas system planning tools that enable TEN site selection, design, and development.
     - EXAMPLE: In California, PG&E developed a Gas Asset Analysis Tool including data on gas pipeline segments, gas meters, and customer gas consumption. These types of planning tools are not widely available – particularly for external stakeholder use – and can support TEN planning and stakeholder engagement.[271]
   - Establishing labor standards for TEN construction, operation, and maintenance, and offer retraining programs to help the methane gas workforce transition to TEN installation, maintenance, and operation.
     - EXAMPLE: The New York Utility Thermal Energy Network and Jobs Act directs the state public utility commission to develop a regulatory framework for TENs, redefines "gas corporation" as a company that delivers gas or thermal energy, and requires the seven largest energy utility companies to propose at least one TEN pilot in a disadvantaged community for potential implementation. The bill also includes strong labor standards for TEN projects such as prevailing wages,

[269] 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.
[270] Bagdanov, K.G., "Decarbonizing the Obligation to Serve," Building Decarbonization Coalition, March 2024.
[271] 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.

apprenticeship and pre-apprenticeship requirements, and labor peace agreements between unions and utilities.[272]

VI. CONCLUSION

[PENDING]

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

VII. APPENDIX

A. 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.[273] In the Northeast, cold-climate ASHPs, designed to operate in temperatures below 5°F, are often the most energy-efficient option. Standard-efficiency and cold-climate ASHPs can take the following forms:

- **Ducted ASHP:** Ducted ASHPs can take many forms, 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 be "drop-in" replacements for homes with central furnaces or AC.[274] Types of ducted ASHPs include:
  1) Split unitary ASHPs, which separate the compressor (responsible for cycling refrigerant) and air handler into separate indoor and outdoor units connected by refrigerant lines.
  2) Packaged unitary ASHPs, which contain the compressor and air handler in a single outdoor unit.
  3) Ducted multi-splits, which connect the outdoor unit to one or multiple indoor air handlers that deliver heat through short duct runs.[275,276]
- **Ductless Minisplit ASHP:** Minisplit heat pumps connect outdoor units to one or multiple indoor "heads," 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.[277] An average residential home would require multiple indoor units to provide heating and cooling for the whole home.
- **Air-to-Water Heat Pump (AWHP):** AWHPs are a type of ductless ASHP common in Europe and emerging on the U.S. market, made to replace hydronic heating. They use 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. Packaged monobloc AWHPs have the entire refrigeration cycle contained in the outdoor unit and circulate heated or cooled water 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

[273] U.S. DOE, "Air-Source Heat Pumps," accessed February 5, 2025.
[274] U.S. EPA ENERGY STAR, "Air-Source Heat Pumps," accessed December 24, 2024.
[275] Booth, K., et al., "Heat Pumps in the Northeast and Mid-Atlantic: Costs and Market Trends," Energy Solutions, October 30, 2024.
[276] Turpin, J.R., "Ducted Mini Splits Offer Hidden Benefits," ACHR News, May 29, 2017.
[277] U.S. EPA ENERGY STAR, "Ductless Heating & Cooling," accessed December 24, 2024.

and air conditioning by running heated or cooled water through an air handler or fan coils.[278]

- **Window Heat Pump:** Window heat pumps are an emerging technology that can provide zero-emission heating and cooling in multifamily buildings by inserting into a window and plugging into a standard electrical outlet like a baseline window AC unit. Window heat pumps can operate down to below 0°F, have reduced risk of refrigerant leaks, and do not require drainage or plumbing for condensation management.[279]

Ground-Source Heat Pump (GSHP): GSHPs (also called geothermal heat pumps) use the ground as a heat source. Since the ground maintains a more consistent temperature than air, GSHPs are more efficient than ASHPs – particularly in cold climates – but cost significantly more to install because they involve drilling vertical boreholes or horizontal trenches into the earth and installing underground piping.[280] Like ASHPs, GSHPs can be ducted and ductless, and/or provide hot water for space or water heating. GSHPs can heat and cool individual homes, or can also service multiple buildings through a thermal energy network (TEN).

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, waste heat from building systems, wastewater, and bodies of water. Given their ability to transfer heat between buildings and draw from warmer heat sources than ambient air, heat pump-based TENs can be a highly efficient zero-emission heating measure and are currently being piloted in several states.[281] In addition, TEN construction leverages skills often used in the gas system, such as installing and maintaining pipes, which can provide employment opportunities for gas utility workers.[282]

B. Zero-Emission Water Heating

Like AWHPs, heat pump water heaters (HPWHs) produce hot water by transferring heat from the air into 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 installed in conditioned or semi-conditioned spaces (for example, basements) that maintain temperatures above 40°F,[283] and are available in two configurations:

- **240-Volt Heat Pump Water Heater (HPWH):** 240V HPWHs require a higher-voltage electrical outlet, which is typically present in homes with existing electric resistance water heaters. Other households may need to add a dedicated electrical circuit or

[278] U.S. EPA ENERGY STAR, "2019-2020 Air-to-Water Heat Pumps," accessed December 24, 2024.
[279] U.S. EPA ENERGY STAR, "Window of Opportunity: New Room Heat Pumps," ENERGY STAR Products Partner Meeting, 2024.
[280] U.S. DOE, "Heat Pump Systems," accessed December 24, 2024.
[281] Building Decarbonization Coalition, "Thermal Energy Networks (TENs)," accessed January 23, 2025.
[282] Building Decarbonization Coalition, "Thermal Energy Networks (TENs)," accessed January 23, 2025.
[283] U.S. DOE, "Heat Pump Water Heaters," accessed March 11, 2025.

optimize or upgrade their electrical panel to support a 240V HPWH, which can increase installation costs.[284]

120-Volt HPWH: 120V HPWHs are a more recent innovation that can plug into standard electrical outlets. As such, they can be less expensive to install than a 240V HPWH that needs an electrical upgrade.[285] While not every household can "plug and play" 120V HPWHs, they can offer a smoother and more affordable installation by reducing electrical service requirements.[286]

Rarer split-type HPWHs have two units: an indoor storage tank and an outdoor compressor. As such, they can work efficiently in temperatures down to -25°F, and offer more flexibility for residents who do cannot fit the full packaged unit indoors.

[284] NYSERDA, "All About Heat Pump Water Heaters," accessed October 1, 2024.
[285] Advanced Water Heating Initiative, "2024 State of the Heat Pump Water Heater: Market Report," New Buildings Institute, 2025.
[286] Bay Area Air Quality Management District (BAAQMD), "Final Staff Report: Proposed Amendments to Building Appliance Rules," March 2023.