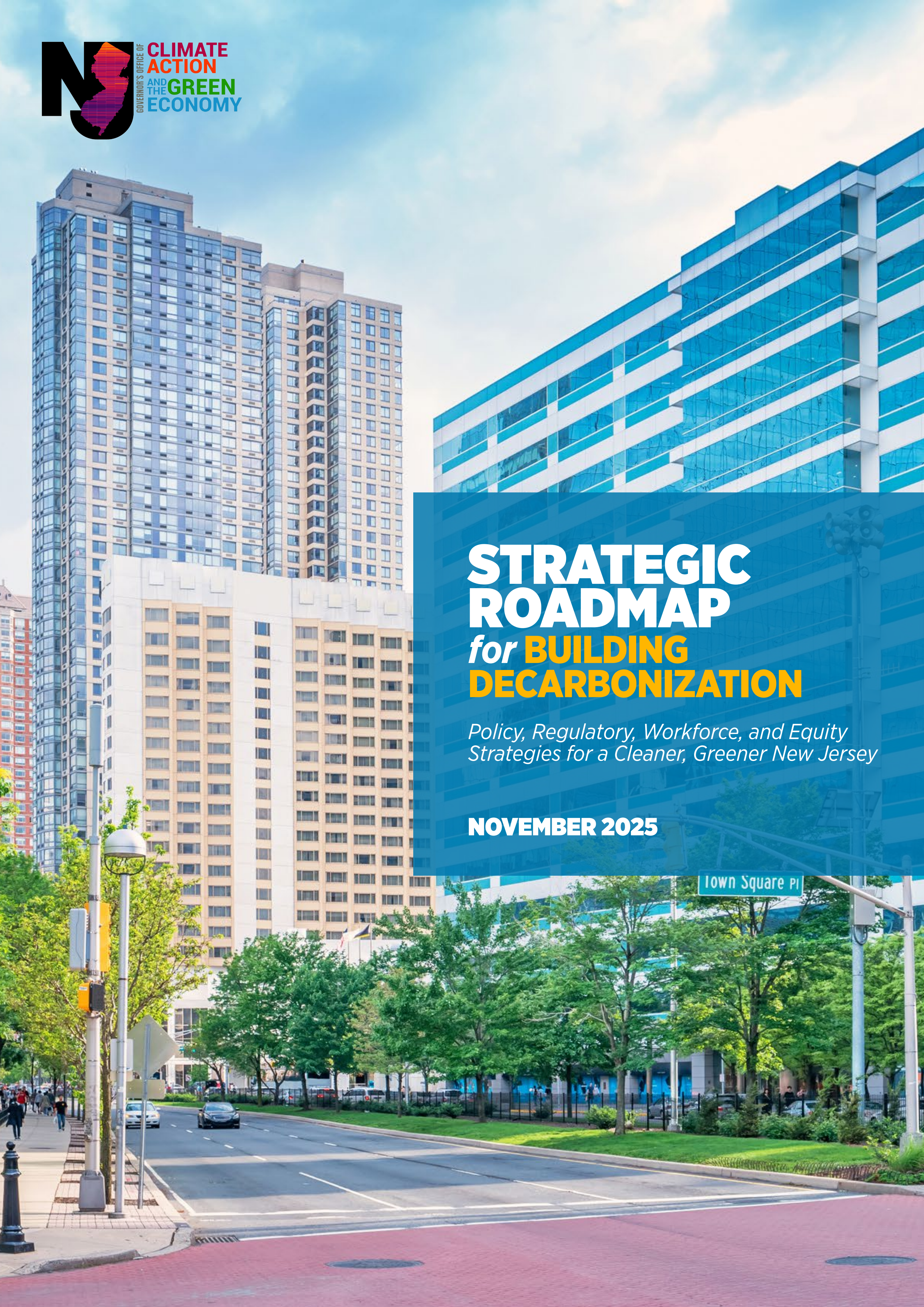
NJ GOVERNOR'S OFFICE OF CLIMATE ACTION AND THE GREEN ECONOMY



STRATEGIC ROADMAP *for* BUILDING DECARBONIZATION

Policy, Regulatory, Workforce, and Equity Strategies for a Cleaner, Greener New Jersey

NOVEMBER 2025

ACKNOWLEDGMENTS

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LIST OF ABBREVIATIONS

Abbreviation	Full Form
80x50 Report	Global Warming Response Act 80x50 Report
ACE	Atlantic City Electric Company
ACEEE	American Council for an Energy-Efficient Economy
AMI	Area Median Income
ASHP	Air-Source Heat Pump
BD	Building Decarbonization
CBWG	Clean Buildings Working Group
CEA	Clean Energy Act of 2018
COP	Coefficient of Performance
CPRG	Climate Pollution Reduction Grants
DMSHP	Ductless Mini-Split Heat Pump
DOE	United States Department of Energy
EE	Energy Efficiency
EV	Electric Vehicle
EIA	United States Energy Information Administration
EPA	United States Environmental Protection Agency
GHG	Greenhouse Gas
GHP	Gas Heat Pump
GSHP	Ground-Source Heat Pump
GWP 100	Global Warming Potential (over a 100-year period)
GWRA	Global Warming Response Act
HER and HEAR	Federal IRA Home Energy Rebates
HPWH	Heat Pump Water Heater
IRA	Inflation Reduction Act
ISO-NE	Independent System Operator - New England
JCP&L	Jersey Central Power & Light Company
LCFS	Low-Carbon Fuel Standard
LIHEAP	Low-Income Home Energy Assistance Program
LMI	Low- and Moderate-income
MMT CO_2e	Million Metric Tons of Carbon Dioxide Equivalent
NJBPU	New Jersey Board of Public Utilities
NJCEP	New Jersey's Clean Energy Program
NJDCA	New Jersey Department of Community Affairs
NJDEP	New Jersey Department of Environmental Protection
NJDOL	New Jersey Department of Labor
NJEDA	New Jersey Economic Development Authority
NESCAUM	Northeast States for Coordinated Air Use Management
NJNG	New Jersey Natural Gas
NPAs	Non-pipeline Alternatives
NWAs	Non-wires Alternatives

Abbreviation	Full Form
NYISO	New York Independent System Operator
OCAGE	Governor's Office of Climate Action and the Green Economy
PCAP	New Jersey's Priority Climate Action Plan
PJM	PJM Interconnection, Regional Transmission Operator
PSE&G	Public Service Electric and Gas Company
RGGI	Regional Greenhouse Gas Initiative
RFS	Renewable Fuel Standard
RNG	Renewable Natural Gas
RTU	Rooftop Unit
SBC	Societal Benefits Charge
Solar PV	Solar Photovoltaics
UEF	Uniform Energy Factor
USCA	United States Climate Alliance
VRF	Variable Refrigerant Flow
WAP	Weatherization Assistance Program

LETTER FROM THE EXECUTIVE DIRECTOR

Dear Colleagues,

In 2023 Governor Murphy directed my office, the Office of Climate Action and the Green Economy, to develop and release a strategic roadmap for building decarbonization that includes recommendations for policy, legislative, regulatory, workforce development, and funding strategies to reduce emissions from the buildings sector — the second largest source of greenhouse gas emissions in New Jersey.

To accomplish this goal, the Office of Climate Action convened the Clean Buildings Working Group — made up of experts from the NJ Board of Public Utilities, NJ Department of Environmental Protection, NJ Department of Community Affairs, NJ Economic Development Authority, NJ Department of Labor and Workforce Development, and NJ Housing and Mortgage Finance Agency, as well as experts from industry, government, building science, organized labor, and workforce development. For more than a year, the Clean Buildings Working Group convened several sub-groups to identify solutions for numerous barriers related to building decarbonization. Upon the completion of the Working Group, key staff members from across New Jersey government, as well as Synapse Energy Economics, worked diligently to refine and expand upon those recommendations to produce this report: *New Jersey's Strategic Roadmap for Building Decarbonization*.

This report provides a well-reasoned and actionable pathway to decarbonize New Jersey's building sector and achieve New Jersey's climate goals while providing cleaner air and new job opportunities for our residents. It is a whole-of-government approach that is laser focused on embracing best practices for program design, equity, and affordability. Additionally, this report provides a comprehensive set of recommendations that touch policy, utility regulation, equity and environmental justice, workforce development, and data collection and performance tracking. Together, the content of this report represents a comprehensive blueprint to reach New Jersey's ambitious climate goals when it comes to buildings, and it is one I am proud to share with the public.

I would like to offer my profound thanks to all the individuals listed in the Acknowledgements, especially the report leadership team who put in countless hours to make this report possible.

Eric Miller
Executive Director
NJ Governor's Office of Climate Action and the Green Economy

EXECUTIVE SUMMARY

Introduction

New Jersey is at the forefront of building decarbonization, setting ambitious emissions reduction targets and implementing a comprehensive strategy to transition away from fossil fuels. With buildings accounting for a significant share of the state's greenhouse gas emissions, the State of New Jersey (State) has adopted policies and programs aimed at reducing energy consumption, expanding electrification, and ensuring an equitable clean energy transition. From legislative mandates such as the Global Warming Response Act (GWRA) and Clean Energy Act of 2018 (CEA) to executive orders accelerating clean electricity adoption and electrification goals, New Jersey's approach reflects a unified, all-agency commitment to comprehensive climate action. This Strategic Roadmap outlines the State's policy framework, challenges and opportunities, and key strategies in building decarbonization, highlighting the role of technology, policy, regulatory, workforce development, and equity considerations in achieving a low-carbon future.

New Jersey State Context and Targets for Emissions Reduction

In New Jersey, buildings contribute 25 percent of the state's total emissions, with residential and commercial space and water heating responsible for most of the sector's energy use. Natural gas dominates space heating (75 percent) and water heating (70 percent) in homes, making it the primary source of emissions. New Jersey has set ambitious targets for reducing greenhouse gas emissions from the building sector. The State aims to cut emissions 80 percent below 2006 levels by 2050 ("80x50 goal") under the GWRA. Additional milestones include the CEA, which mandates annual reductions in natural gas and electricity consumption, and the 2019 Energy Master Plan, which sets a goal for 100 percent clean energy by 2050. New Jersey's Global Warming Response Act 80x50 Report (80x50 Report) further targets a 90 percent transition of buildings to zero-emission heating systems. More recently, Executive Orders 315, 316, and 317 accelerated these efforts by advancing clean electricity goals, setting electrification mandates, and calling for development of natural gas utility emission reduction plans. New Jersey also joined multi-state agreements to increase heat pump adoption.

Multiple state agencies play critical roles in this transition. The NJ Department of Environmental Protection (NJDEP) leads greenhouse gas reduction efforts, the NJ Economic Development Authority (NJEDA) supports clean energy workforce and industry development, and the NJ Board of Public Utilities (NJBPU) regulates utilities and energy efficiency programs. The NJ Department of Community Affairs (NJDCA) oversees building codes and tracks electrification efforts, and the NJ Department of Labor and Workforce Development (NJDOL) oversees workforce development initiatives in energy efficiency and building decarbonization. These agencies collectively drive policies and programs to meet New Jersey's decarbonization goals while fostering economic growth and environmental benefits.

NEW JERSEY'S BUILDING DECARBONIZATION INITIATIVES since 2018

2018

- ☑ **The Clean Energy Act** mandates utilities to implement programs to reduce natural gas usage by at least 0.75% annually and electricity usage by at least 2% annually

2020

- ☑ **2019 Energy Master Plan (EMP)** outlined key strategies to achieve 100% clean energy by 2050, as directed by Executive Order 28
- ☑ New Jersey's **Global Warming Response Act 80X50 Report** built on the 2019 EMP and presented pathways for achieving an 80% reduction in greenhouse gas emissions by 2050

2021

- ☑ Governor Murphy signed **Executive Order 274**, which established an interim goal of reducing emissions to 50% below 2006 levels by 2030

2022

- ☑ **Clean Buildings Working Group** was launched to help guide the State's strategic roadmap to clean buildings

2023

- ☑ **Executive Order 315** directed the State to accelerate the target of 100% clean electricity by 2050 to 2035
- ☑ **Executive Order 316** established several electrification targets, including the electrification of 400,000 homes and 20,000 commercial properties by 2030
- ☑ Through **Executive Order 317**, Governor Murphy directed the NJBPU to work with stakeholders to begin a formal proceeding to develop natural gas utility emission reduction plans
- ☑ New Jersey became a signatory to the **2023 United States Climate Alliance MOU**, which set a target to install 20 million heat pumps across participating states by 2030

2024

- ☑ New Jersey became a signatory to the **Northeast States for Coordinated Air Use MOU**, which set a target of transitioning 65% of residential heating and cooling equipment to heat pumps across participating states by 2030 and 90% by 2040

Policy Vision for State of New Jersey

To meet the goals of the GWRA and EO316, the State will take a whole-of-government approach that primarily focuses on:

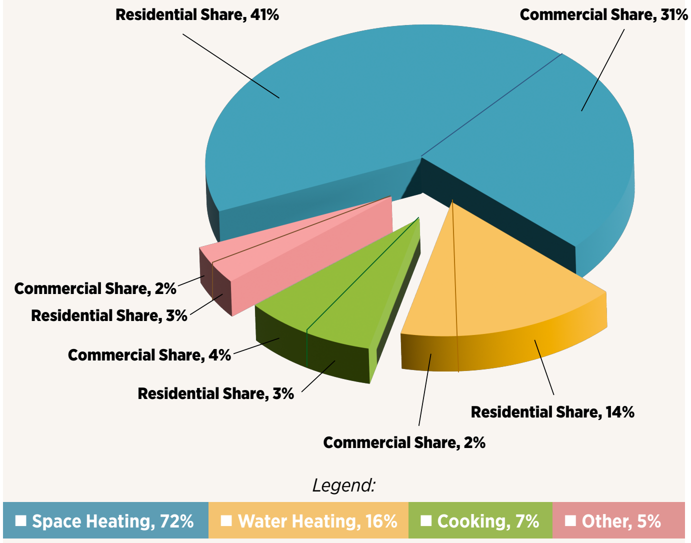
- Installing zero-carbon end use equipment for space and water heating in buildings, primarily through the use of highly efficient heat pumps and other high-efficiency heating equipment.
- Leveraging existing and forthcoming energy efficiency programming to reduce overall energy demand in buildings and provide bill savings to customers, as well as to improve the health and safety of the buildings served.
- Continuing progress on the State's commitment to achieving 100 percent clean electricity by 2035 to ensure that the electricity powering buildings is from zero-carbon sources, thereby reducing source emissions in addition to on-site emissions.
- Advancing equity in program design and implementation to ensure that New Jersey's overburdened communities benefit from reduced air pollution and energy bills associated with building decarbonization, as well as provide new employment opportunities in the clean energy economy.

New Jersey's policy vision and approach to building decarbonization aligns with those of other leading states, such as Massachusetts, New York, Maryland, Colorado, and Washington. These states prioritize enhancing energy efficiency and electrifying residential and commercial buildings to significantly reduce greenhouse gas emissions from the building sector.

Building Decarbonization Technologies

Among on-site greenhouse gas emissions in the buildings in New Jersey, space heating accounts for the largest share (72 percent), with 41 percent from residential and 31 percent from commercial sectors, as shown in the figure (right). Water heating contributes 16 percent (14 percent residential, 2 percent commercial), cooking adds 7 percent (3 percent residential, 4 percent commercial), and other uses account for 5 percent (3 percent residential, 2 percent commercial). Electrification replaces fossil fuel-based equipment with electric alternatives for these key end uses. The following figure (right) provides an overview of the primary building decarbonization technologies by end use, along with an approximate breakdown of current greenhouse gas emissions in residential and commercial buildings.

GHG EMISSIONS BY END USE AND SECTOR[1]



PRIMARY DECARBONIZATION TECHNOLOGIES

Space Heating	Heat Pumps - Heat Source: Air-source (ASHP), Water-source (WSHP), Ground-source (GSHP), Air-to-water (AWHP) Residential Heat Distribution: Ducted, Ductless Minisplit, Packaged Terminal (PTHP), Window, Radiator, Baseboard Heat Commercial Heat Distribution: Ducted, Ductless Minisplit, Radiator, Baseboard Heater, PTHP, Rooftop Unit (RTU), Variable Refrigerant Flow (VRF)
Water Heating	Heat pump water heaters, solar hot water heaters
Cooking	Induction cooking, and electric ovens and fryers
Other	Conventional electric clothes dryers and heat pump dryers

Energy efficiency plays a crucial role in supporting electrification by reducing total energy demand, lowering grid strain, and minimizing the need for costly infrastructure upgrades. Measures such as insulation, air sealing, and high-efficiency appliances directly decrease emissions and enhance the affordability of electrification. Without strategic efficiency improvements, some consumers—particularly low- and moderate-income (LMI) households—may face increased energy costs post-electrification. New Jersey's Priority Climate Action Plan (PCAP) incorporates Executive Order 316's goal of making 10 percent of LMI properties electrification-ready by 2030 through expanded efficiency programs.

Alternative fuels like renewable natural gas (RNG), green hydrogen, and biodiesel face significant limitations in cost, resource availability, and integration with existing infrastructure, making them insufficient for widespread building decarbonization in New Jersey. Even optimistic

1 U.S. EIA. 2023. *2020 Residential Energy Consumption Survey (RECS)*. Available at: https://www.eia.gov/consumption/residential/data/2020/. U.S. EIA. 2022. 2018 Commercial Building Energy Consumption Survey (CBECS). Available at: https://www.eia.gov/consumption/commercial/data/2018/. New Jersey Department of Environmental Protection. 2024. *NJ Greenhouse Gas Emissions Inventory Report: Years 1990-2021*. Available at: https://dep.nj.gov/wp-content/uploads/ghg/2024-ghg-inventory-report.pdf.
U.S. EPA. 2024. *Emissions Factors for Greenhouse Gas Inventories*. Table 1: Stationary Combustion. Available at: https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf

estimates of RNG production potential in New Jersey could replace only about 1 percent of the state's natural gas consumption, while hydrogen and biodiesel are constrained by efficiency and technical challenges. New Jersey's 2019 Energy Master Plan prioritizes electrification as the primary decarbonization strategy, as relying on alternative fuels would increase energy demand and require costly out-of-state fuel purchases. As a result, New Jersey's policy direction focuses on accelerating electrification for the building sector while reserving alternative fuels for hard-to-decarbonize sectors such as heavy industry and long-haul transportation.

Barriers and Opportunities

The transition to decarbonized buildings in New Jersey presents numerous challenges and opportunities. Effectively addressing these factors will be critical for achieving the State's climate and energy goals while ensuring affordability, reliability, and equitable benefits for all residents.

Future of Natural Gas

New Jersey's natural gas infrastructure, serving over 3 million customers, faces significant challenges as the state transitions to full building electrification by 2050. Declining gas demand threatens utilities with stranded assets and rising rates for remaining customers, particularly straining low-income households. Without intervention, declining gas sales will accelerate rate increases, further burdening those unable to electrify. To address these concerns, the State has initiated regulatory proceedings to explore alternative utility business models, minimize new gas infrastructure investments, and evaluate district heating and geothermal network options. Other states' approaches, such as Clean Heat Standards and non-pipeline alternatives, provide models for managing this transition.

Grid impacts

Building electrification will increase New Jersey's electricity demand, particularly in winter, potentially shifting the peak demand from summer to winter. Managing this transition will require proactive grid planning, capacity upgrades, and investment in distributed energy resources such as energy efficiency, demand response, and battery storage. Several states have adopted advanced distribution planning measures, such as grid hosting capacity maps and non-wires alternatives, to mitigate the need for costly infrastructure expansion. New Jersey can adopt similar strategies to optimize investments and prevent bottlenecks in electrification adoption.

Bill and Rate impacts

Electrification will shift household and business energy consumption from gas to electricity, impacting energy bills. While heat pumps are more efficient than gas heating systems, the current cost disparity between gas and electricity could lead to higher energy bills for some consumers. Targeted energy efficiency measures, time-varying electric rates, and seasonal rate discounts can help mitigate cost increases. Regulatory changes, such as modifying gas depreciation schedules and integrating electrification incentives, can further manage rate impacts and prevent inequities in the energy transition.

Building Upgrade Constraints

Physical and structural barriers can hinder electrification, including outdated electrical panels, space constraints for heat pumps, inadequate ventilation, and pre-existing health hazards such as lead-based paint, mold, and asbestos in older buildings. Many low-income households disproportionately face these barriers, which must be addressed before efficiency upgrades can proceed. Programs that bundle efficiency and electrification with health and safety improvements can help overcome these challenges. Emerging technologies, such as smart panels and load-sharing devices, can also reduce the need for costly electrical upgrades.

Consumer Adoption

Widespread adoption of electrification technologies faces barriers such as lack of consumer awareness, high upfront costs, limited financing options, and split incentives between landlords and tenants. Many residents are unfamiliar with heat pumps and induction cooking. Expanding incentives, providing low-cost financing, and enhancing public education efforts can accelerate adoption. Midstream incentives, which provide rebates to distributors and retailers, have proven effective in increasing heat pump availability and affordability. A centralized "one-stop shop" for building decarbonization information can streamline consumer decision-making and program access.

Workforce Development

A successful transition to decarbonized buildings requires a skilled workforce, including electricians, HVAC technicians, and energy auditors. Existing labor shortages in these fields highlight the need for expanded workforce training and apprenticeship programs. Equitable workforce development efforts can ensure job opportunities reach underrepresented communities. Initiatives like New Jersey's Builders Utilization Initiative for Labor Diversity (BUILD) program and Massachusetts' Clean Energy Workforce Equity programs offer models for increasing diversity in green jobs. Training and engaging gas workers for roles in electrification, such as installing networked geothermal systems, can further facilitate the transition.

Health Benefits

Building electrification offers substantial public health benefits by reducing indoor and outdoor air pollution from fossil fuel combustion. Gas appliances release pollutants linked to respiratory illnesses, cardiovascular disease, and premature mortality, disproportionately affecting low-income and minority communities. Heat pumps and induction cooking eliminate these emissions, improving indoor air quality and reducing health disparities. Electrification can also enhance climate resilience by expanding access to air conditioning, a growing necessity as New Jersey's climate warms. Targeted programs, such as the Priority Climate Action Plan's healthy homes initiatives, can further integrate health considerations into building decarbonization efforts.

Equity and Environmental Justice

Low-income and historically marginalized communities face the greatest barriers to electrification while also bearing the highest energy burdens and pollution exposure. Without targeted intervention, wealthier households will electrify first, leaving vulnerable customers to shoulder rising gas costs. To promote equity, New Jersey aims to electrify 10 percent of low-income homes by 2030 through expanded efficiency programs. Targeted incentives, renter protections, and multi-agency coordination can ensure that disadvantaged communities benefit from the clean energy transition. Additionally, improving access to decision-making processes and incorporating equity metrics into program design will help track progress and address systemic disparities. By addressing these barriers and leveraging opportunities, New Jersey can achieve a cost-effective and equitable transition to a decarbonized building sector.

Current Building Decarbonization Efforts

New Jersey has been implementing a range of programs—including incentives, financing, technical assistance, and workforce development—to decarbonize its building sector. Recently, the State has strengthened its efforts by placing a clear emphasis on electrification. The State's energy efficiency and decarbonization programs are funded through the societal benefits charge (SBC), Regional Greenhouse Gas Initiative (RGGI) proceeds, and federal funding, including the Inflation Reduction Act (IRA). Public utilities manage multi-year energy efficiency plans, with the second Triennium (2025-2027) aiming to increase electric and gas savings while offering building decarbonization incentives for the first time. A total of $3.8 billion is approved to be invested, with $172 million allocated to building decarbonization start-up programs, including incentives for heat pumps, electric appliances, and electric panel and wiring upgrades.

In parallel, New Jersey's Clean Energy Program (NJCEP) and NJEDA support energy efficiency efforts for commercial, residential, and institutional buildings. Programs such as Comfort Partners provide free efficiency upgrades for low-income households, while initiatives like NJ Cool and the NJ Green Bank facilitate financing for clean energy projects.

Federal initiatives also play a key role. The IRA's Home Energy Rebates (HER and HEAR) provide funding for residential efficiency upgrades, with additional support from the Weatherization Assistance Program and the Low-Income Home Energy Assistance Program (LIHEAP).

To support workforce development, New Jersey has launched several training initiatives, such as the Green Workforce Training Grant Challenge. Utilities like PSE&G are also expanding clean energy job training, particularly in heat pump installation. Ensuring an equitable transition, the State prioritizes workforce diversity, job quality, and access for disadvantaged communities.

KEY STRATEGIES AND RECOMMENDATIONS

While the State has implemented a comprehensive set of programs, they are not sufficient to address all barriers to building decarbonization to fully achieve its greenhouse gas emission reduction goals. This Strategic Roadmap outlines key strategies and recommendations to address critical challenges across multiple areas. Specifically, the Roadmap provides a comprehensive set of recommendations across five themes:

1. **Decarbonization Policies:** New Jersey must accelerate electrification through innovative regulatory measures, enhanced financial incentives, and consumer education while phasing out incentives for fossil fuel equipment to drive its retirement.
2. **Utility Regulatory Evolution:** Reforms in gas and electric utility regulations are necessary to align investments with decarbonization goals while ensuring affordability and reliability.
3. **Equity and Environmental Justice:** Policies and funding initiatives must prioritize underserved communities to ensure equitable access to clean energy benefits and protections.
4. **Workforce Development:** Expanding technical training and certification programs and job pathways is essential to preparing a diverse workforce for the growing demand for clean energy jobs.
5. **Data Collection and Performance Tracking:** Robust data collection and performance tracking mechanisms are crucial for informed decision-making and sustained progress toward climate goals.

A detailed list of the recommendations is provided in the following section.

Through these strategic initiatives, New Jersey aims to lead the way in building decarbonization, fostering innovation, and ensuring that all communities benefit equitably from the clean energy transition. Strong collaboration between government agencies, utilities, businesses, and residents will be key to their successful implementation, helping the State achieve its ambitious greenhouse gas reduction targets while promoting economic and environmental resilience.

DECARBONIZATION POLICIES

1. Establish long-term statewide heat pump targets to meet the State's emissions reduction targets
2. Modify the design of the energy efficiency programs to promote building electrification
3. Create an information clearinghouse to provide comprehensive information on building decarbonization technologies and available programs
4. Continue advancing the State's lead by example initiative
5. Deploy market transformation, pilot, and demonstration projects
6. Adopt leading building energy codes for residential and commercial buildings
7. Develop an optional statewide stretch code which promotes building electrification and achieves net-zero emissions
8. Explore the development of a statewide building performance standard
9. Explore the development of a clean heat standard
10. Explore the development of zero-emission standards for space and water heating equipment

UTILITY REGULATORY EVOLUTION

1. Continue Future of Gas proceedings and implement policy outcomes
2. Evaluate pipeline replacement practices and implement non-pipeline alternatives
3. Consider ratemaking and incentive structures
4. Develop a framework for proactive electric distribution planning to accommodate electrification
5. Develop a distribution hosting capacity map for building electrification
6. Consider alternative cost recovery approaches

EQUITY AND ENVIRONMENTAL JUSTICE

1. Embed robust community engagement, representation, and partnership in decision-making processes across all initiatives
2. Address programmatic barriers to electrification and energy efficiency
3. Continue to prioritize underserved and disadvantaged communities
4. Ensure energy affordability

WORKFORCE

1. Establish a Clean Buildings Hub to promote technical training, education, and awareness of clean building technologies and best practices
2. Establish a Career Pathways Tool to provide a comprehensive resource of career opportunities, programs, and apprenticeships in the building decarbonization industry
3. Conduct a building decarbonization workforce needs and gap assessment
4. Expand existing apprenticeship and training opportunities and specifically target overburdened communities
5. Expand or establish funding for financial assistance for participation in training programs and connect trainees with other wraparound services (e.g., transportation, child-care)

DATA COLLECTION AND PROGRESS TRACKING

1. Improve data gathering for ongoing development and evaluation of New Jersey's building decarbonization strategies

01.

NEW JERSEY STATE CONTEXT

AND TARGETS FOR EMISSIONS REDUCTION

1.1 GOALS AND REQUIREMENTS

The State has established ambitious targets and taken significant steps toward reducing greenhouse gas (GHG) emissions from the buildings sector. Figure 1 (next page) presents a series of plans and executive orders representing these steps.

In 2007, the New Jersey legislature passed the New Jersey Global Warming Response Act (GWRA) which set a statewide GHG emissions limit of 80 percent below 2006 levels by 2050 (known as the "80x50 goal"). The Act also established a 2020 emissions limit at 1990 levels (or 20 percent below 2006 levels).

In 2018, the New Jersey Legislature enacted the Clean Energy Act, mandating utilities to implement energy efficiency measures aimed at reducing natural gas consumption by at least 0.75 percent annually and electricity consumption by at least 2 percent annually until all full economic, cost-effective potential is reached. Following this, NJBPU set the initial targets at 1.10 percent for natural gas reductions and 2.15 percent for electricity reductions.[2]

In January 2020, New Jersey released the 2019 Energy Master Plan outlining key strategies to achieve 100 percent clean energy by 2050, as directed by Executive Order 28.

The 80x50 Report, released in 2020, builds on the 2019 Energy Master Plan and presents pathways for achieving the 80x50 goal. The report summarizes New Jersey's current emissions and the emission reduction potential of existing programs and compares emissions reductions pathways for seven sectors. The 80x50 Report includes a target of 89 percent reduction of building-related emissions, achieved by transitioning 90 percent of buildings to zero-emission heating systems by 2050.

In 2021, Governor Murphy signed Executive Order 274, which established an interim goal of reducing emissions to 50 percent below 2006 levels by 2030. The Governor also directed the Governor's Office of Climate Action and Green Economy (OCAGE) to coordinate the efforts of Executive Branch agencies and implement the objectives and strategies in the EMP, the 80x50 Report, and elsewhere in the order.

2 NJBPU. 2020. "NJBPU Approves Comprehensive Energy Efficiency Program." June 10. Available at: https://www.nj.gov/bpu/newsroom/2020/approved/20200610.html.

Figure 1. New Jersey's building decarbonization initiatives since 2018

2018

- **The Clean Energy Act** mandates utilities to implement programs to reduce natural gas usage by at least 0.75% annually and electricity usage by at least 2% annually

2020

- **2019 Energy Master Plan (EMP)** outlined key strategies to achieve 100% clean energy by 2050, as directed by Executive Order 28
- New Jersey's **Global Warming Response Act 80X50 Report** built on the 2019 EMP and presented pathways for achieving an 80% reduction in greenhouse gas emissions by 2050

2021

- Governor Murphy signed **Executive Order 274**, which established an interim goal of reducing emissions to 50% below 2006 levels by 2030

2022

- **Clean Buildings Working Group** was launched to help guide the State's strategic roadmap to clean buildings

2023

- **Executive Order 315** directed the State to accelerate the target of 100% clean electricity by 2050 to 2035
- **Executive Order 316** established several electrification targets, including the electrification of 400,000 homes and 20,000 commercial properties by 2030
- Through **Executive Order 317**, Governor Murphy directed the NJBPU to work with stakeholders to begin a formal proceeding to develop natural gas utility emission reduction plans
- New Jersey became a signatory to the **2023 United States Climate Alliance MOU**, which set a target to install 20 million heat pumps across participating states by 2030

2024

- New Jersey became a signatory to the **Northeast States for Coordinated Air Use MOU**, which set a target of transitioning 65% of residential heating and cooling equipment to heat pumps across participating states by 2030 and 90% by 2040

In 2022, Governor Murphy announced the launch of the Clean Buildings Working Group (CBWG). The CBWG is a collaboration between OCAGE and NJBPU, NJDEP, NJDCA, and NJEDA and serves as a cross-sector collaboration of stakeholders and experts in industry, government, building science, organized labor, environmental justice, and workforce development. Their collective insights informed the recommendations in this report.

In 2023 and 2024, Governor Murphy announced a series of commitments to support New Jersey's clean buildings sector as follows:

- **Executive Order 315:** directs the State to accelerate the timeframe to meet the target of 100% clean electricity from 2050 to 2035.
- **Executive Order 316:** defines electrification as the "retrofitting or construction of a building with electric space heating and cooling and electric water heating systems." EO 316 establishes several electrification targets, including the electrification of 400,000 homes and 20,000 commercial and public properties by 2030. Moreover, EO316 sets a target that 10 percent of LMI properties be electrification-ready by 2030. Additionally, the order directs OCAGE to develop and release a strategic roadmap for building decarbonization which should include recommendations for policy, legislative, regulatory, workforce development, and funding strategies to achieve the aforementioned goals for building electrification and requires NJBPU to track and annually report on statewide building decarbonization efforts. The order also directs NJDCA to develop systems to track projects that incorporate electric building space heating and cooling and water heating systems and report on a regular basis.
- **Executive Order 317:** directs NJBPU to work with stakeholders to develop natural gas utility emission reduction plans. The order also directs NJBPU to consider a Clean Heat Standard, which would require natural gas utilities to meet emissions reduction standards through a suite of measures, such as accelerated energy efficiency or enhanced building electrification targets.
- **Memorandums of Understanding (MOU):** New Jersey recently signed two MOUs to accelerate heat pump adoption, including a 2023 United States Climate Alliance (USCA) MOU, which set a target to install 20 million heat pumps across participating states by 2030, and a Northeast States for Coordinated Air Use Management (NESCAUM) MOU, which set a target of transitioning 65 percent of residential heating and cooling equipment to heat pumps across participating states by 2030 and 90 percent by 2040.[3, 4] Both MOUs aim to ensure that 40 percent of the benefits of investment go to low-income households.

3 NESCAUM. 2024. "Nine States Pledge Joint Action to Accelerate Transition to Clean Buildings." Available at: https://www.nescaum.org/documents/2.7.24-nescaum-mou-press-release.pdf.

4 USCA. 2023. "U.S. Climate Alliance Announces New Commitments to Decarbonize BuildingsAcross America, Quadruple Heat Pump Installations by 2030." Available at: https://usclimatealliance.org/press-releases/decarbonizing-americas-buildings-sep-2023/.

1.2 BUILDING EMISSIONS AND ENERGY PROFILES

The building sector is responsible for approximately 25 percent of total net statewide emissions and is the second-largest contributing sector to GHG emissions.[5] In 2021, New Jersey's residential and commercial buildings contributed 24.8 million metric tons of carbon dioxide equivalent (MMT CO_2e) global warming potential over a 100-year period (GWP100).[6] Residential buildings contributed 14.9 MMT CO_2e, or 60 percent of total building emissions.[7,8] In comparison, New Jersey has a goal of reducing building sector emissions to 2.7 MMT CO_2e by 2050, which represents an approximately 89 percent reduction in GHG emissions from 2018 levels.[9]

Space heating is by far the largest source of on-site GHG emissions from buildings in New Jersey. As shown in Figure 2, approximately 72 percent of residential and commercial end-use emissions were from space heating, followed by water heating at 16 percent. Cooking and other end uses account for only 7 and 5 percent of total end-use emissions in buildings, respectively. Among all fuel combustion in buildings, natural gas is the largest contributor to building emissions: in 2021, natural gas contributed 86 percent and 83 percent of the total emissions from residential and commercial buildings, respectively.[10]

Figure 2. Share of building sector GHG emissions by sector and end use in New Jersey

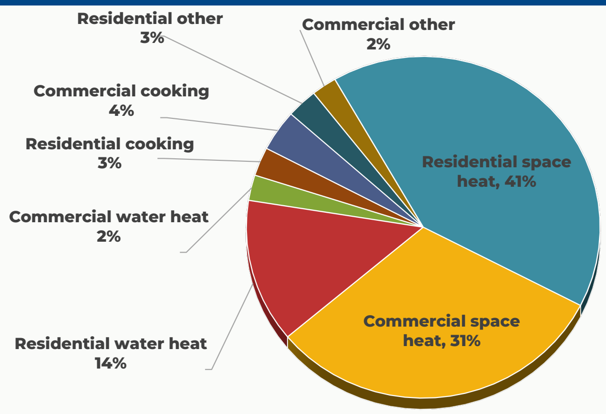


Figure data sources: NJ Greenhouse Gas Emissions Inventory Report. End-use breakdown estimated from: U.S. EIA. 2020 Residential Energy Consumption Survey (RECS). Available at: https://www.eia.gov/consumption/residential/data/2020/, and U.S. EIA. 2018 Commercial Energy Consumption Survey (CBECS). Available at: https://www.eia.gov/consumption/commercial/data/2018/.

Space heating accounts for approximately half of all energy usage in residential buildings, and water heating makes up approximately one-fifth.[11] Together, space and water heating account for 70 percent of total residential energy consumption (Figure 3).

Figure 3. Residential energy consumption by end use in New Jersey (%)

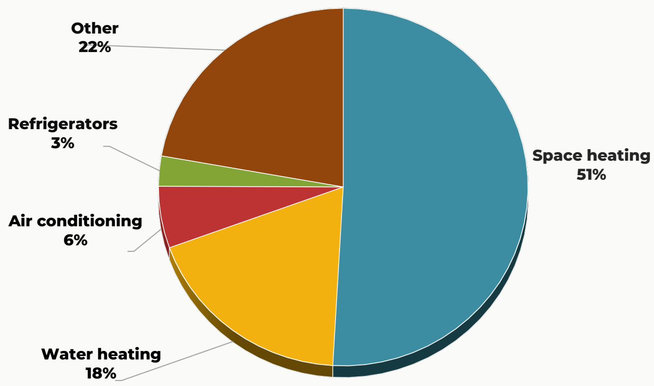


Figure data source: U.S. EIA. 2020 Residential Energy Consumption Survey (RECS). CE3.1ST Available at: https://www.eia.gov/consumption/residential/data/2020/; Note: "Other" category includes various other end uses provided in the CE5 tables in EIA RECS.

For space heating, natural gas is the dominant energy source in New Jersey, accounting for 75 percent of the total usage, while electricity contributes 16 percent, and oil/kerosene makes up 7 percent as shown in Figure 4.[12] For water heating, natural gas remains the primary source, providing 70 percent of the energy, with electricity accounting for 26 percent and oil/kerosene contributing 3 percent. Together, approximately 82 percent of homes in New Jersey heat their spaces by burning fossil fuels on site, while 73 percent use fossil fuels for water heating. Considering the overall energy usage share for space and water heating as shown in Figure 3 above, approximately 42 percent of all residential energy consumption is from on-site fossil fuels combustion for space heating[13] and 14 percent for water heating.[14] In total, approximately 56 percent of residential energy use comes from on-site fuel combustion for heating purposes in New Jersey.

5 New Jersey Department of Environmental Protection (NJ DEP). 2024. *NJ Greenhouse Gas Emissions Inventory Report Years 1990-2021*. p. 60. Available at: https://dep.nj.gov/wp-content/uploads/ghg/2024-ghg-inventory-report.pdf.

6 Ibid.

7 Ibid.

8 NJDEP released a new GHG inventory report in April 2025, shortly after analysis was completed for this report. Available at: https://dep.nj.gov/wp-content/uploads/ghg/ghg-inventory-mcu-2025-1.pdf.

9 NJ DEP. 2020. *New Jersey's Global Warming Response Act 80x50 Report*. p. xi; Available at: https://dep.nj.gov/wp-content/uploads/climatechange/nj-gwra-80x50-report-2020.pdf.

10 NJ DEP and Rutgers Climate Change Resource Center. 2024. *New Jersey's Priority Climate Action Plan*. March 2024. p. 28. Available at: https://www.epa.gov/system/files/documents/2024-03/nj-pcap.pdf.

11 EIA. 2020. 2020 RECS. Table CE3.1.

12 These exclude vacant housing units, seasonal units, second homes, military houses, and group Quarters.

13 51 percent of residential consumption for space heating * 82 percent of households using fossil fuels for space heating = 42 percent of residential consumption from burning fossil fuels for space heating.

14 19 percent of residential consumption for water heating * 73 percent of households using fossil fuels for water heating = 14 percent of residential consumption from burning fossil fuels for water heating.

Figure 4. Residential space and water heating by fuel type in New Jersey (% of homes)

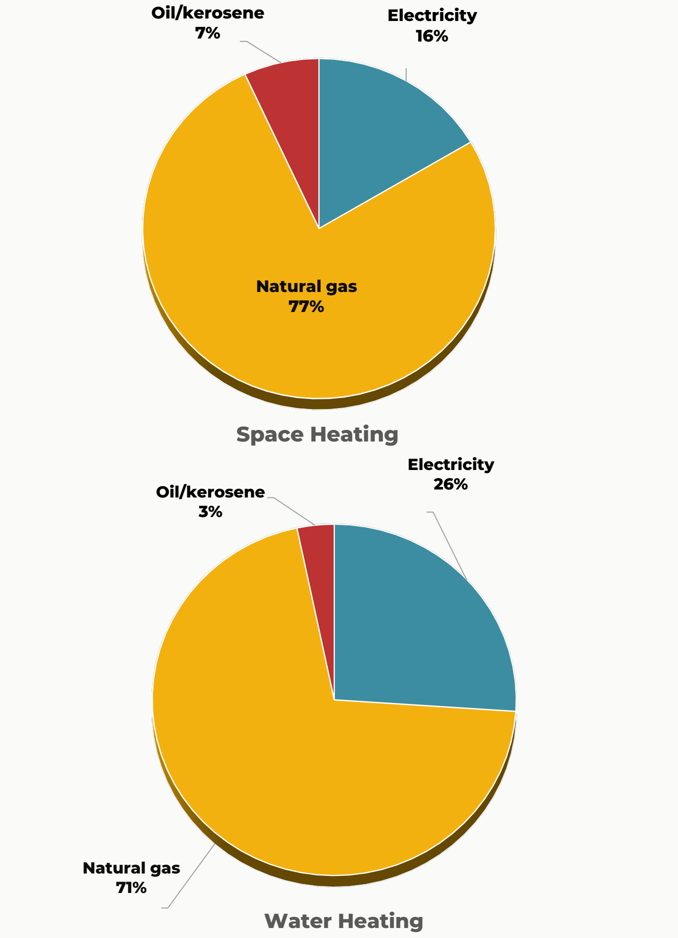


Figure data source: U.S. EIA. 2020 Residential Energy Consumption Survey (RECS). "Highlights for space heating fuel in U.S. homes by state, 2020" and "Highlights for water heating in U.S. homes by state, 2020." Available at: https://www.eia.gov/consumption/residential/data/2020/.

Over half (61 percent) of New Jersey homes use a furnace as their primary space heating equipment, and 25 percent use a boiler (Figure 5). Both heating system types can use gas, oil, propane, or electricity. Only 3 percent of New Jersey homes have a central heat pump.

Figure 5. Residential primary space heating equipment in New Jersey (% of homes)

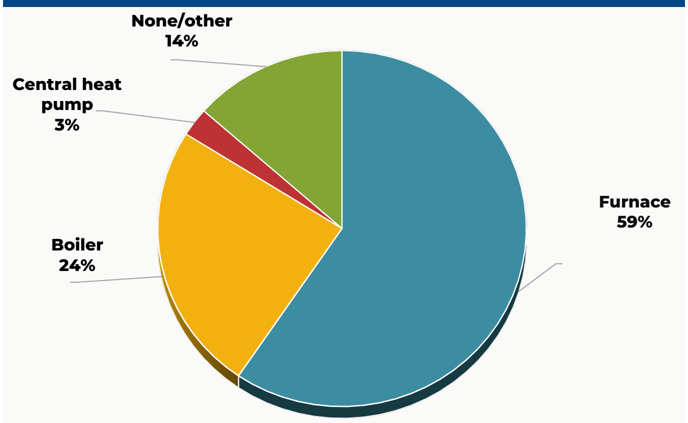


Figure data source: U.S. EIA. 2020 Residential Energy Consumption Survey (RECS). "Highlights for space heating in U.S. homes by state, 2020." Available at: https://www.eia.gov/consumption/residential/data/2020/.

When looking at commercial buildings in the Mid-Atlantic region (New Jersey, New York, and Pennsylvania), electricity accounts for approximately half of total energy consumption, while natural gas accounts for a little over a third (Figure 6).

Figure 6. Commercial energy consumption by fuel type in the Mid-Atlantic region (% of total energy consumption)

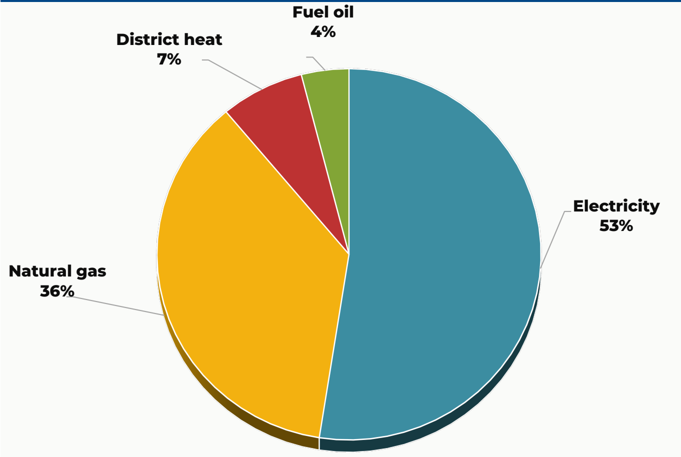


Figure data source: U.S. EIA. 2018 Commercial Energy Consumption Survey (CBECS). Table C1. Available at: https://www.eia.gov/consumption/commercial/data/2018/.

Space and water heating make up a smaller portion of commercial buildings' total energy consumption compared to residential buildings; approximately 45 percent of total energy consumption is attributed to space and water heating (Figure 7). However, space and water heating account for the majority of fossil fuel consumption in commercial buildings and are responsible for 84 percent of total natural gas and fuel oil consumption in those buildings.[15] This means that nearly 40 percent of total energy use in commercial buildings[16] is from burning fossil fuels on site for space and water heating.

Figure 7. Commercial energy consumption by end use in the Mid-Atlantic region (% of total energy consumption)

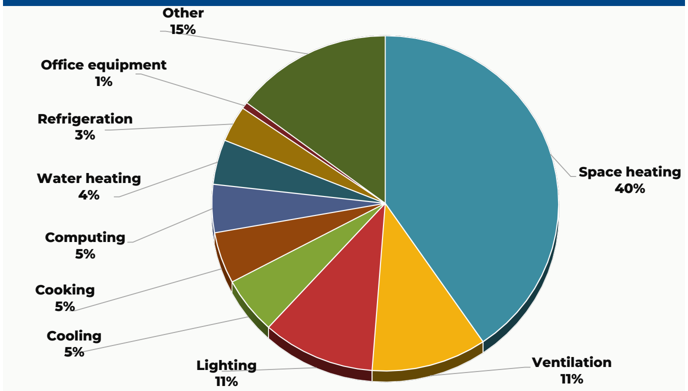


Figure data source: U.S. EIA. 2018 Commercial Energy Consumption Survey (CBECS). Table E1 Note: "Other" category includes various other end uses and is not defined by EIA.

15 U.S. EIA. 2018. 2018 Commercial Energy Consumption Survey (CBECS). Tables E7 and E9.

16 45 percent of total energy used for space and water heating multiplied by 84 percent of total gas and fuel oil used for these end uses equals approximately 38 percent.

Natural gas makes up 70 percent and 54 percent of commercial space and water heating energy consumption, respectively (Figure 8). Electricity makes up just 2 percent of space heating and 3 percent of water heating.

Figure 8. Commercial space and water heating by fuel type in the Mid-Atlantic (% of total energy consumption)

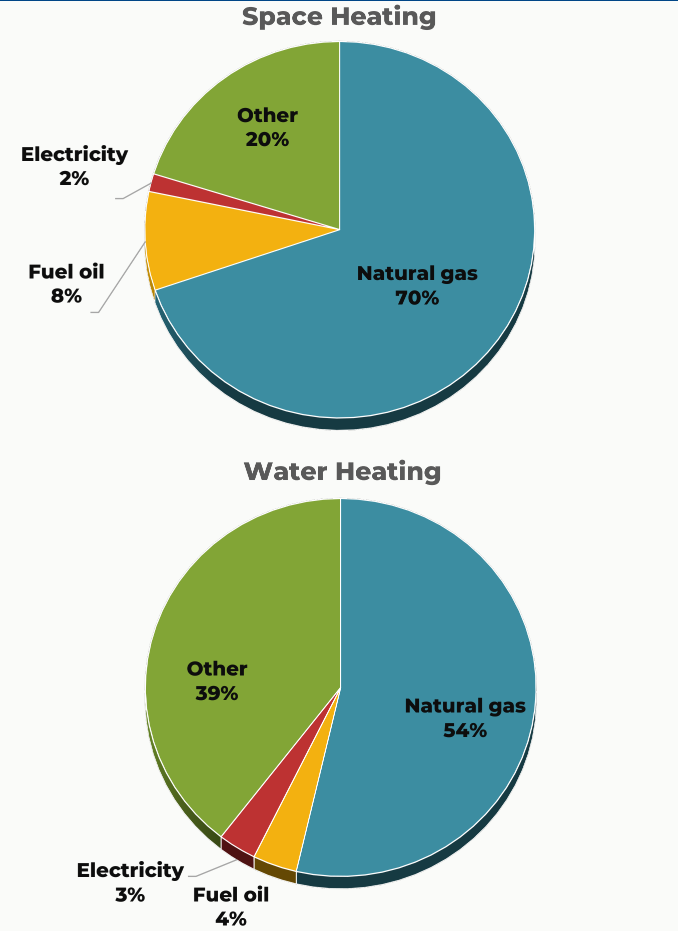


Figure data source: U.S. EIA. 2018 Commercial Energy Consumption Survey (CBECS). Tables E1, E4, E7, and E9. Note: "Other" category includes district heating, propane, wood, coal, solar, and all other energy sources.

Because most energy use in both residential and commercial buildings relies on natural gas, natural gas combustion is responsible for most of the emissions from the building sector. To meet its emissions goals, both economy-wide and specifically within the building sector, New Jersey must prioritize the electrification of natural-gas-fired equipment in buildings, such as space and water heating. In parallel, State programs will need to support the decarbonization of other fossil fuels, particularly fuel oil, which emit more pollution per site and tend to be more expensive than natural gas.

The primary method New Jersey should pursue to meet its emissions reduction goals in the building sector is the installation of high-efficiency electric equipment, such as space heat pumps and heat pump water heaters. These technologies provide the best pathway to reduce the total energy consumption of buildings and will help the State achieve its emissions goals.[17]

1.3 ROLE OF STATE AGENCIES

At the state level, multiple agencies are critical to facilitating the work needed to meet climate goals around building decarbonization. Each agency plays a vital role in ensuring consistent and effective building decarbonization policy.

NJDEP is dedicated to improving and protecting public health and the environment throughout the state. NJDEP uses the best available science to guide the conservation of natural and historical resources; ensure a stable climate and resilient communities; and secure clean and healthy air, water, and lands for all New Jerseyans. The agency plays a leadership role in implementing the GWRA, which is a cornerstone of the State's strategy to combat climate change. NJDEP is tasked with monitoring the state's GHG reduction progress and developing and implementing climate action plans to achieve GHG reductions. Building decarbonization is one of the necessary strategies for achieving the GWRA's mandates.

NJDEP will take a comprehensive approach to reduce emissions from the building sector. NJDEP will utilize its various regulatory powers, funding resources, programs, and public outreach initiatives to promote decarbonization in buildings. This includes evaluating regulatory solutions to encourage the transition to clean energy sources; developing and disseminating guidance documents, technical manuals, and best practice case studies to help building owners and operators implement decarbonization strategies; and working collaboratively with peer agencies to dedicate funding to the adoption of clean heating and cooling systems. NJDEP will continue to monitor the progress of building decarbonization and advocate for policies and programs that not only help reduce GHG emissions from buildings but also achieve energy savings, improve air quality, and enhance the overall sustainability and resilience of communities.

As the State's principal government entity for economic development, NJEDA helps grow the state's economy and increases equitable access to opportunity by supporting high-quality job creation, catalyzing investment, and fostering vibrant, inclusive community development. There is a significant opportunity for economic growth within the challenge of both decarbonizing the state's existing building stock and incorporating building decarbonization practices into new construction projects. Prioritizing building decarbonization will not only reduce critical statewide GHG and pollutant emissions, but also provide new in-state employment opportunities and center technological innovation within the building industry in New Jersey.

NJEDA will use its various funding resources, programs, and economic development tools to advance building decarbonization across the commercial, multifamily residential, and industrial sectors. This includes providing financial incentives that encourage the adoption of clean

17 2019 New Jersey Energy Master Plan: Pathway to 2050. pp. 137, 161.

heating and cooling systems, offering loans and other financial vehicles to enable building construction projects, delivering industry support for relevant companies working within the built environment, and facilitating the training of building sector workforce members in utilizing clean energy technologies and green construction practices. NJEDA will collaborate closely with both its government peers and private sector partners to accomplish these goals, helping to foster connections across the clean energy industry.

NJBPU regulates the State's gas and electric utilities, ensuring that adequate, affordable, and reliable utility services are provided to all participating members of the public. NJBPU is the lead agency committed to developing and regulating competitive and cost-effective energy policies that promote energy efficiency in the built environment, as well as the responsible growth of clean, renewable energy sources across the state. NJBPU oversees the utility-run energy efficiency and building decarbonization programs, which run on triennial cycles governed by the CEA. NJBPU also has authorized electric and gas utilities to offer new building decarbonization programs that will promote fuel-switching to electric space and water heating in single-family homes and multifamily and commercial buildings.

NJDOL is dedicated to protecting our workforce, strengthening our businesses, and promoting the dignity of work. To meet the demands of a decarbonized building sector, NJDOL facilitaites apprenticeships and vocational training focused on green technologies, energy efficiency, renewable energy installation, and sustainable construction techniques. NJDOL partners with educational institutions, state agencies, and industry experts to identify skills gaps and incorporate the latest technologies into training programs. Additionally, NJDOL works to promote equitable job opportunities within the green economy, ensuring that all communities in New Jersey benefit from the transition to sustainable building practices.

NJDCA is responsible for providing administrative guidance, financial support, and technical assistance to local governments, community development organizations, businesses and individuals to improve the quality of life in New Jersey. In this role, NJDCA is responsible for facilitating the adoption of building codes—a regulatory mechanism critical to establishing minimum energy standards around all building construction. To promote building decarbonization specifically, NJDCA will be responsible for the implementation of any optional stretch codes that encourage enhanced energy efficiency and emissions reductions, instituting tracking systems for evaluating statewide building electrification efforts, and working with communities to support building decarbonization adoption in local construction practices and municipal building approvals.

Working together, these state agencies enable a comprehensive response to the complex challenges posed by building decarbonization.

02.

POLICY VISION

FOR THE STATE OF NEW JERSEY

2.1 OVERVIEW

To meet the goals of the GWRA and EO316, the State will take a whole-of-government approach that primarily focuses on:

- Installing zero-carbon end-use equipment for space and water heating in buildings, primarily using highly efficient heat pumps and other high-efficiency heating equipment;
- Leveraging existing and forthcoming energy efficiency programming to reduce overall energy demand in buildings and provide bill savings to customers, as well as improve the health and safety of the buildings served;
- Continuing progress on the State's commitment to achieving 100 percent clean electricity by 2035 to ensure that the electricity powering buildings is from zero-carbon sources, thereby reducing source emissions in addition to on-site emissions; and
- Centering equity in program design and implementation to ensure that New Jersey's overburdened communities benefit from reduced air pollution and energy bills associated with building decarbonization, as well as providing new employment opportunities in the clean energy economy.

2.2 POLICY IN OTHER JURISDICTIONS

New Jersey's policy vision and chosen approach to building decarbonization aligns with many other leading states. Table 1 presents language from other states and federal policy documents outlining strategies to achieve building decarbonization goals. Policy actions from these other states emphasize the importance of improving energy efficiency and electrifying commercial and residential buildings to reduce GHG emissions from the building sector.

Table 1. Summary of other jurisdictions' policy visions for building decarbonization

JURISDICTION	VISION FOR BUILDING DECARBONIZATION
FEDERAL[18]	"...Four strategic objectives necessary for decarbonization: 1. Increase building energy efficiency to reduce overall building energy demand while delivering customer energy bill savings and strengthening building resilience. 2. Accelerate on-site emissions reductions by electrifying space and water heating and reducing fugitive equipment refrigerant emissions. 3. Transform the grid edge where building efficiency and electrification solutions, electric vehicle (EV) charging, and on-site renewable energy generation and storage connect to the power grid to shrink the scale of electrical infrastructure required for a 100% clean electricity system. 4. Minimize embodied life-cycle emissions from the construction of every new building and renovation." pp. iii-iv.
MASSACHUSETTS[19]	"The Commonwealth's primary strategies to reduce emissions from buildings are to improve the energy efficiency of buildings and convert the heating systems for homes and businesses to electric heat pumps." Executive Summary, p. xiii. "Massachusetts' approach to achieving its emissions limits and sublimits is based on three basic principles: (1) electrify non-electric energy uses, (2) decarbonize the electric grid, and (3) reduce energy costs and the costs of transition by increasing the efficiency of transportation and energy systems. These principles must be pursued in parallel, as one will not achieve the emissions limits and sublimits without the others." p. 2.
MARYLAND[20]	"Robust federal and state incentives, paired with education, technical assistance, and training for building owners, contractors, automobile dealers, and other market actors, can help ensure that everyone can transition from fossil fuels and become part of the clean energy economy." Executive Summary, p. 9. "The transition to a clean energy economy requires millions of fuel-burning devices to be replaced with efficient, zero-emission alternatives." p. 12.
NEW YORK[21]	"By 2030 heat pumps will be the majority of new purchases for space and water heating, with one to two million homes and 10% to 20% of commercial space using heat pumps by 2030, and hundreds of thousands of additional homes and commercial buildings becoming efficiently electrified each year. The 2050 vision for the buildings sector sees 85% of homes and commercial building space statewide electrified with a diverse mix of energy-efficient heat pump technologies and thermal energy networks." p. 11. "Integrated planning will ensure the transition is equitable and cost-effective for consumers without compromising reliability, safety, energy affordability, and resiliency." p. 20.
COLORADO[22]	"To advance near term GHG goals, Colorado needs to reduce fuel use in buildings and industrial processes through increasing energy efficiency, transitioning water and home heating and industrial operations to electricity where it is cost-effective, and reducing the GHG intensity of the gas that serves these uses." p. XIII. "In the buildings sector, the 1261 Targets Scenario for full decarbonization by 2050 is based on a large-scale shift to the use of electric heat pumps, powered by zero carbon electricity, for space and water heating. There may be other pathways, depending on technological developments, which is why the near-term actions support a wide variety of strategies for the buildings sector." p. XXVI.
WASHINGTON[23]	"Buildings, with 23% of the state's emissions, require a 10-year market transformation approach that combines transitioning from fossil gas to electrification, with deep levels of efficiency for new and existing buildings, and smart building demand management." p. 15.

18 U.S. Department of Energy. 2024. *Decarbonizing the U.S. Economy by 2050: A National Blueprint for the Buildings Sector*. https://www.energy.gov/eere/articles/decarbonizing-us-economy-2050.

19 Massachusetts Clean Energy and Climate Plan for 2025 and 2030. 2022. Available at: https://www.mass.gov/doc/clean-energy-and-climate-plan-for-2025-and-2030/download.

20 Maryland's Climate Pollution Reduction Plan: Policies to Reduce Statewide Greenhouse Gas Emissions 60% by 2031 and Create a Path to Net-Zero by 2045. December 28, 2023. Available at: https://mde.maryland.gov/programs/air/ClimateChange/Maryland%20Climate%20Reduction%20Plan/Maryland%27s%20Climate%20Pollution%20Reduction%20Plan%20-%20Final%20-%20Dec%2028%202023.pdf.

21 New York State Climate Action Council. 2022. "New York State Climate Action Council Scoping Plan." Available at: https://climate.ny.gov/resources/scoping-plan/.

22 Colorado Energy Office. 2021. *Colorado Greenhouse Gas Pollution Reduction Roadmap*. Available at: https://energyoffice.colorado.gov/climate-energy.

23 Washington State Department of Commerce. 2020. *Washington 2021 State Energy Strategy: Transitioning to an Equitable Clean Energy Future*. Available at: https://www.commerce.wa.gov/wp-content/uploads/2020/12/Washington-2021-State-Energy-Strategy-December-2020.pdf.

03.

BUILDING DECARBONIZATION TECHNOLOGIES

3.1 ELECTRIFICATION

Overview

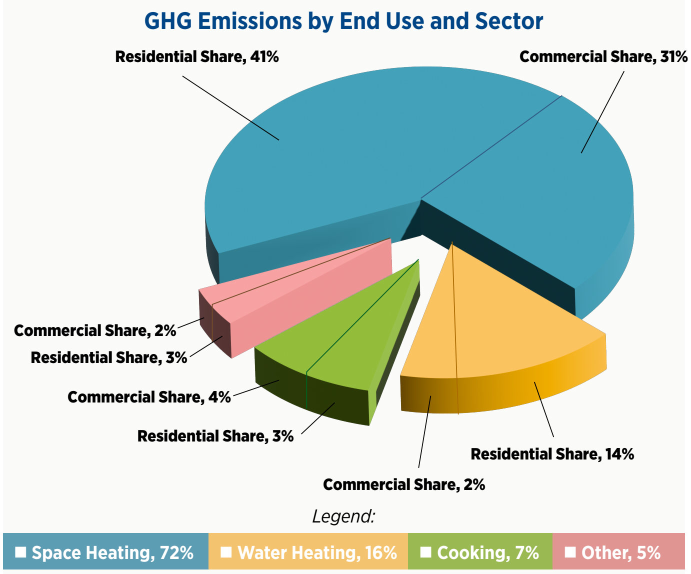
Building electrification efforts encompass the goal of replacing fossil fuel equipment with electric equipment across prominent building end uses, including space and water heating, cooking, and laundry. The 2019 Energy Master Plan identified building electrification as the most cost-effective strategy to decarbonize buildings and set a goal of transitioning to a fully electrified building sector by 2050.[24] As discussed in Section 1.2, the buildings sector contributed 25 percent of total net statewide GHG emissions in New Jersey, with natural gas use making up 86 percent—and 83 percent of that for residential and commercial buildings, respectively.[25] Not only can the replacement of fossil-fuel-burning equipment with electric alternatives reduce GHG emissions, but it can also improve indoor air quality and save energy.

Figure 9 provides an overview of the primary building decarbonization technologies by end use, along with an approximate breakdown of current GHG emissions in residential and commercial buildings.

The rest of this section describes the building decarbonization technologies that exist within each end use, their prevalence in the market, and the current state of the technologies. Building decarbonization technologies, such as heat pumps, may require upgrades to existing electrical panels or wiring, particularly in older buildings with limited panel capacity (e.g., 60 amps). This issue is discussed in detail in Section 4.4.

24 2019 New Jersey Energy Master Plan: Pathway to 2050. pp. 161, 168.
25 New Jersey Department of Environmental Protection and Rutgers Climate Change Resource Center. 2024/ *New Jersey's Priority Climate Action Plan*. p. 28. Available at: https://www.epa.gov/system/files/documents/2024-03/nj-pcap.pdf.

Figure 9. Potential decarbonization technologies by end use[26]



Primary Decarbonization Technologies

Space Heating	Heat Pumps - Heat Source: Air-source (ASHP), Water-source (WSHP), Ground-source (GSHP), Air-to-water (AWHP) Residential Heat Distribution: Ducted, Ductless Minisplit, Packaged Terminal (PTHP), Window, Radiator, Baseboard Heat Commercial Heat Distribution: Ducted, Ductless Minisplit, Radiator, Baseboard Heater, PTHP, Rooftop Unit (RTU), Variable Refrigerant Flow (VRF)
Water Heating	Heat pump water heaters, solar hot water heaters
Cooking	Induction cooking, and electric ovens and fryers
Other	Conventional electric clothes dryers and heat pump dryers

Space Heating

There are substantial opportunities to replace fossil fuel space heating equipment with electric alternatives, with approximately 75 percent of homes in New Jersey relying on natural gas and 7 percent relying on fuel oil for space heating, as outlined in Section 1.2. Electric heat pumps are highly efficient and versatile technologies capable of providing space heating, cooling, and water heating. They are among the most critical technologies for building electrification, as they can significantly reduce fossil fuel usage—particularly natural gas—in buildings that currently rely on them for space and water heating. An electric heat pump works by moving heat—rather than generating it—in or out of a building using vaper-compression cycles. The efficiency of electric heat pumps is measured by the coefficient of performance (COP), which is the ratio of useful heating or cooling output to the total energy input. Because heat pumps transfer heat rather than generate it, their efficiency can exceed 100 percent, typically averaging over 250 percent (represented by a COP of 2.5) for heating and 400 percent (or a COP of 4) for cooling. In addition, heat pumps that extract heat from the ground (i.e., ground-source heat pumps) can achieve even higher efficiency due to the relatively stable ground temperatures—warmer in winter and cooler in summer as opposed to ambient air temperatures.

Air-Source Heat Pumps

The most common type of heat pump is the air-source heat pump (ASHP), which works by transferring heat between indoor and outdoor air. The efficiency of the heat pump works as a function of this temperature differential. In months when cooling is required, rising outdoor temperatures reduce the efficiency and cooling capacity of ASHPs. Similarly, in months when heating is required, falling outdoor temperatures decrease the efficiency and heating capacity of ASHPs. Some conventional ASHPs may be paired with backup or supplemental heating systems (e.g., electric resistance heating or a pre-existing fossil fuel equipment). However, cold-climate ASHPs that are readily available in the market can maintain comfortable indoor temperatures well under-freezing temperatures without backup or supplemental heat.[27] These systems have refrigerants with a lower boiling point than those used in conventional ASHPs and use variable-speed compressors and compressors with larger capacities to achieve these higher performances at cold temperatures.[28, 29]

Cold-climate ASHPs designed for outdoor air temperatures below 5°F have been commercially available in the Northeast for over 10 years.[30] They deliver exceptional performance even in extremely cold temperatures, achieving a COP of 1.5 to 2 (150 to 200 percent efficiency) even at -10°F.[31] While the capacity of ASHPs decreases as temperatures drop, particularly in extremely cold conditions, cold-climate ASHP models are designed to maintain sufficient capacity down to 5°F, with some models

26 U.S. EIA. 2023. *2020 Residential Energy Consumption Survey (RECS)*. Available at: https://www.eia.gov/consumption/residential/data/2020/. U.S. EIA. 2022. *2018 Commercial Building Energy Consumption Survey (CBECS)*. Available at: https://www.eia.gov/consumption/commercial/data/2018/. New Jersey Department of Environmental Protection. 2024. *NJ Greenhouse Gas Emissions Inventory Report: Years 1990-2021*. Available at: https://dep.nj.gov/wp-content/uploads/ghg/2024-ghg-inventory-report.pdf. U.S. EPA. 2024. *Emissions Factors for Greenhouse Gas Inventories*. Table 1: Stationary Combustion. Available at: https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf

27 Cadmus. 2017. *Evaluation of Cold Climate Heat Pumps in Vermont*. Prepared for the Vermont Public Service Department. p. 24. Available at: https://publicservice.vermont.gov/sites/dps/files/documents/Energy_Efficiency/Reports/Evaluation%20of%20Cold%20Climate%20Heat%20Pumps%20in%20Vermont.pdf.

28 BlocPower. 2024. *Heat Pumps in Cold Climates: 2024 Edition*. Accessed June 19, 2024. Available at: https://www.blocpower.io/posts/cold-climate-heat-pumps.

29 American Council for an Energy-Efficient Economy. 2022. *Building Electrification: Programs and Best Practices*. p. 9. Available at: https://www.aceee.org/sites/default/files/pdfs/b2201.pdf.

30 Massachusetts Executive Office of Energy and Environmental Affairs. 2022. *Massachusetts Clean Energy and Climate Plan for 2025 and 2030*. p. 47. Available at: https://www.mass.gov/doc/clean-energy-and-climate-plan-for-2025-and-2030/download.

31 Guidehouse and Ridgeline Energy Analytics. 2024. *Massachusetts and Connecticut Heat Pump Metering Study*. Figure 3-2. Available at: https://ma-eeac.org/wp-content/uploads/MA-HPMS-CT-R2246-Heat-Pump-Metering-Study-Updated-Final-Report_2024-05-30-1.pdf; Ridgeline Energy Analytics and Guidehouse. 2024. *Efficiency Maine Residential Heat Pump Impact Evaluation*. Figure 54. Available at: https://www.efficiencymaine.com/docs/Efficiency_Maine_Residential_Heat_Pump_Impact_Evaluation_Report-2024.pdf.

capable of meeting 100 percent of the heating load at that temperature or even lower.[32] For example, Mitsubishi's cold-climate ASHP Hyper-Heat can deliver 100 percent heating capacity as low as -5°F and maintain 90 percent heating capacity down to -13°F.[33] Over the last 30 years, the coldest monthly average minimum temperature recorded in New Jersey was 12.3°F in February 2015.[34] Additionally, design temperatures—the minimum temperatures contractors use to size heating system capacities—range from 9°F in Sussex County, New Jersey to 15.7°F in Trenton. These climate conditions make New Jersey a suitable region for cold-climate ASHPs to provide sufficient heating year-round.

AIR-SOURCE HEAT PUMP CONFIGURATIONS

1. **Ducted split-system heat pumps (or ducted ASHPs)** have an outdoor condenser and an air handling unit in the building to deliver heating or cooling through ducts similar to forced-air gas furnaces. Ducted ASHPs are often a suitable replacement for the aging gas furnaces prevalent in residential and small-to-medium commercial buildings.

2. **Packaged or rooftop unit (RTU) heat pumps** have all the components necessary for heating, cooling, and air circulation combined into a single system—usually mounted directly onto the building. RTUs can serve as a one-to-one replacement for gas-fired RTUs, which are the most common type of space heating technology for commercial buildings in the United States, serving 33 percent of the heated commercial floor space in the country.[35] These systems are readily available on the market in the United States, and the market is expected to grow over the coming years as the industry develops more efficient cold-climate heat pump RTUs.[36]

3. **Ductless mini-split heat pumps (DMSHPs)** use outdoor condensers and refrigerant pipes to deliver heating or cooling to each room where an indoor unit is installed. Because they use small refrigerant pipes and are relatively easy to install, they are suitable for space heating system retrofits where other heating systems (e.g., boilers) are currently used and ducts are not available. They also use variable speed compressors, which allow them to operate more efficiently and quietly than standard ducted ASHPs and to provide superior temperature controls.

4. **Packaged terminal heat pumps** are all-in-one systems installed on an exterior wall. They are often installed in hotels and small apartment units. Compared to other heat pump systems, packaged terminal heat pumps are less efficient.

5. **Window heat pumps** are a recent innovation in the market, offering compact and efficient heating and cooling solutions. They are well-suited for apartments and rental units in large buildings including public housing complexes. Designed for easy installation in standard windows, these units do not require electrical panel upgrades, as they can simply plug into a standard 120-volt outlet. Utilizing advanced heat pump technology, they deliver high energy efficiency, even in cold climates.[37]

6. **Variable refrigerant flow (VRF) heat pumps** distribute heating and cooling to numerous indoor units through a main refrigerant line from a single outdoor system. VRFs can be air-source or water-source and configured to provide heating and cooling simultaneously in different rooms by adding a heat recovery system. They can also vary the flow of refrigerant to meet the different demands of multiple spaces.[38] This makes VRF heat pumps an ideal electric option for buildings with varying zonal loads, including mid- and high-rise multifamily buildings, hotels, medical offices, and schools.

32 Quinnell et al. 2022. "It's All About the Envelope: Prioritizing Envelope Upgrades for Electrification of Cold Climate Homes." Proceeding of 2022 Summer Study on Energy Efficiency in Buildings. Available at: https://www.mncee.org/paper-its-all-about-envelope-prioritizing-envelope-upgrades-electrification-cold-climate-homes.

33 Go Ductless. 2023. "Mitsubishi Hyper Heat vs. Mitsubishi Standard Heat Pump: Which One Should I Choose?" Available at: https://gotductless.com/blogs/mitsubishi-mini-splits/mitsubishi-hyper-heat-vs-mitsubishi-standard-heat-pump-which-should-i-choose.

34 NOAA National Centers for Environmental Information, filtered for minimum monthly temperatures in New Jersey from 1994 to 2024. NOAA. "Climate at a Glance: Statewide Time Series." July 2024. Accessed July 26, 2024. Available at: https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/statewide/time-series.

35 U.S. Energy Information Administration. 2022. Commercial Building Energy Consumption Survey, 2018. Available at: https://www.eia.gov/consumption/commercial/data/2018/index.php?view=characteristics.

36 Fathollahzadeh, M. H. and A. Tilak. 2022. *The Economics of Electrifying Buildings: Medium-Size Commercial Retrofits*. RMI. Available at: https://rmi.org/insight/economics-of-electrifying-buildings-medium-size-commercial-retrofits/.

37 New York State Energy Research and Development Authority. 2023. "Window Heat Pump Units Installed in Public Housing as Part of Clean Heat Challenge." Available at: https://www.nyserda.ny.gov/About/Newsroom/2023-Announcements/2023-09-20-Governor-Hochul-Announces-Installation-Of-Window-Heat-Pumps-For-New-York-City; WIRED. 2024. "The Next Heat Pump Frontier? NYC Apartment Windows." March 29. Available at: https://www.wired.com/story/the-next-heat-pump-frontier-nyc-apartment-windows/.

38 American Council for an Energy-Efficient Economy. *Electrifying Space Heating in Existing Commercial Buildings: Opportunities and Challenges*. 2020. p. 13. Available at: https://www.aceee.org/sites/default/files/pdfs/b2004.pdf.

Ground-Source Heat Pumps

Ground-source heat pumps (GSHP) are one of the more expensive heat pump types to install but offer some of the highest efficiencies. Rather than using ambient air, GSHPs exchange heat with the ground, which maintains more stable temperatures year-round relative to air.[39] The ground holds warmer temperatures than the air in the winter and cooler temperatures than the air in the summer, allowing GSHPs to reach average COPs of 3.5 or greater.[40] Due to its superior performance relative to ASHPs, GSHPs cost less to operate and can reduce the winter peak load impacts and the associated grid costs in comparison to ASHPs. However, installing GSHPs is a more labor- and capital-intensive process than installing other types of heat pumps, because they require boring, excavation, or both to install underground piping. In general, GHSPs are roughly twice as expensive as ASHPs to install, per ton of heating capacity.[41]

According to NJDEP's 2023 *New Jersey Ground Source Heat Pump Baseline* report, through the end of 2022, a total of 3,136 well-based GSHPs (with a combined capacity of approximately 52,900 tons) were installed in the state—including 1,772 open-loop systems and 1,364 closed-loop systems. Annual installations of open-loop systems peaked in the mid-1990s, while closed-loop system installations peaked in 2010.[42] The report estimates that under a conservative, business-as-usual adoption scenario, the total installed capacity of GSHPs will grow by more than 44,000 tons by 2050, representing an 83 percent increase in GSHP capacity. To assist with identifying optimal locations for GSHP installations, NJDEP and NJBPU plan to develop a GSHP siting tool for New Jersey stakeholders.[43] Finally, a few select states including Massachusetts, New York, and California are exploring the use of networked geothermal heat pump systems, by which a centralized GSHP system serves a cluster of buildings. While these systems have significant installation costs and city or district planning considerations, these systems can reach average COP ratings upwards of 5.0 or 6.0.[44] As part of New Jersey's PCAP, NJDEP with NJBPU plans to pilot networked geothermal heat pump systems in the state.[45]

NJBPU is working with NJDEP to advance commercial-scale geothermal systems in the state through the design and installation of GSHP HVAC demonstration projects.[46] These projects will target selected building types including multifamily housing, properties with multiple buildings, commercial office buildings, and state buildings. The site selection and projects are expected to be identified by the end of 2025.

NJBPU is responsible for implementing P.L. 2023, c. 328, which directs NJBPU to conduct a study to determine the feasibility, marketability, benefits and costs of implementing large-scale geothermal heat pump systems in the state. The report is due in January 2026, and the scope of the study is as follows:

- Determine the feasibility: challenges, obstacles, benefits and costs of GSHPs versus ASHPs, natural gas, propane, and fuel oil. Evaluate the costs and savings to ratepayers, government entities, electric public utilities, and the State.
- Consult with the U.S. Department of Energy (DOE), other states, experts, and utilities.
- Assess efficiency measures that can be employed, and the costs of using geothermal energy and implementing large-scale geothermal heat pump systems, in building construction.
- Evaluate incentives and utility involvement.
- Develop a marketing program.
- Evaluate the need for a pilot program.
- Identify needs for statutory and regulatory changes

Water-Source Heat Pumps

Water-source heat pumps (WSHP) use water, such as wastewater or well water, as a heat exchange reservoir instead of the air or ground. In commercial buildings, water-loop heat pump systems can provide heating and cooling simultaneously to different parts of the building.[47] WSHPs consist of multiple heat pump units inside a building that exchange heat with a single water loop; they are most

39 U.S. Department of Energy. "Geothermal Heat Pumps." Accessed July 22, 2024. Available at: https://www.energy.gov/energysaver/geothermal-heat-pumps.

40 NYSERDA. 2017. *Analysis of Water Furnace Geothermal Heat Pump Sites in New York State with Symphony Monitoring Systems*. Available at: https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Research/Other-Technical-Reports/18-03-Water-Furnace-Geothermal-Heat-Pump-Sites.pdf; U.S. Environmental Protection Agency. "ENERGY STAR Most Efficient 2024 Geothermal Heat Pumps." Accessed July 19, 2024. Available at: https://www.energystar.gov/productfinder/product/certified-geothermal-heat-pumps/results; NYSERDA. 2019. *New Efficiency: New York Analysis of Residential Heat Pump Potential and Economics*. Table 6-1. Available at: https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/PPSER/NYSERDA/18-44-HeatPump.pdf.

41 NYSERDA. 2019. *New Efficiency: New York – Analysis of Residential Heat Pump Potential and Economics*. Table 5-1. Available at: https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/PPSER/NYSERDA/18-44-HeatPump.pdf.

42 New Jersey Department of Environmental Protection. 2023. *New Jersey Ground Source Heat Pump Baseline Report*. Available at: https://dep.nj.gov/wp-content/uploads/cleanenergy/new-jersey-ground-source-heat-pump-baseline-report_final.pdf.

43 New Jersey Department of Environmental Protection and Rutgers Climate Change Resource Center. 2024. *New Jersey's Priority Climate Action Plan*. p. 35. Available at: https://www.epa.gov/system/files/documents/2024-03/nj-pcap.pdf.

44 Buro Happold Engineering. 2019. *Geo Micro District: Feasibility Study.* Prepared for HEET. Available at: https://uploads-ssl.webflow.com/649aeb5aaa8188e00cea66bb/656f8ad67bbc7df081e3fe17_Buro-Happold-Geothermal-Network-Feasibility-Study.pdf.

45 New Jersey Department of Environmental Protection and Rutgers Climate Change Resource Center. 2024. *New Jersey's Priority Climate Action Plan*. p. 35. Available at: https://www.epa.gov/system/files/documents/2024-03/nj-pcap.pdf.

46 Memorandum of Understanding between NJBPU and NJDEP to New Jersey Corporation of Advanced technology Ground-Source Heat Pump Funding (Docket Numbers QO23030158 and QO24060469).

47 American Council for an Energy-Efficient Economy. 2020. *Electrifying Space Heating in Existing Commercial Buildings: Opportunities and Challenges*. p. 14. Available at: https://www.aceee.org/sites/default/files/pdfs/b2004.pdf.

appropriate for large buildings. While WSHP system retrofits on existing buildings are currently limited due to the capital- and labor-intensive installation process, they are becoming increasingly common in large commercial new construction buildings, particularly in California and New York City.[48]

Air-to-Water Heat Pumps

As with other ASHPs, air-to-water heat pumps (AWHP) exchange heat between a building and the outdoor air, but AWHPs circulate that heat within the building using a water-based system. AWHPs can also be paired with a storage tank to provide domestic water heating.[49] AWHPs have been shown to be able to transfer heat in the winter from outdoor temperatures as low as -22°F, while still producing hot water up to 180°F.[50] Though the AWHP market is well established in China and Europe, it is currently small in the United States.[51] AWHPs can play an important role in decarbonizing both space and water heating in existing residential and commercial buildings with circulating hot water heating systems (such as gas or fuel oil boilers) because the AWHP can connect into the hot water distribution system, avoiding costly system replacement.

Gas Heat Pumps

Gas heat pumps (GHP) use natural gas, propane, or other gases as their primary energy source instead of electricity. While GHPs are more efficient than traditional gas heating systems, they still rely on the combustion of natural gas, producing carbon dioxide (CO_2) emissions along with associated pollutants such as nitrogen oxides and carbon monoxide. As a result, GHPs are not aligned with the State's GHG reduction targets.

Recent evaluations of GHP performance revealed efficiencies ranging from a COP of 0.73 to 1.05, with nameplate ratings between 1.2 and 1.4. By comparison, high-efficiency electric heat pumps can achieve COPs of 3 or higher.[52] A recent study conducted for Washington Gas Light (WGL) compared the lifetime emissions of GHPs, electric ASHPs, and gas furnaces, using various sources of avoided emission data. This study found that GHPs installed today, even with a nameplate efficiency of 1.4 COP, are expected to produce approximately twice the GHG emissions of efficient electric heat pumps over their lifetime in Maryland.[53]

While WGL's pilot study clearly indicates that GHPs are not helpful for reducing emissions, GHPs pose additional challenges for decarbonizing the building sector nationwide. They represent a significant obstacle to achieving full building sector decarbonization due to limited opportunities for heating system replacements before 2050. Most buildings will have only one opportunity to replace their heating systems by mid-century, and installing a gas heat pump effectively forfeits this critical chance to adopt cleaner, electric alternatives.

GHPs also pose other challenges. Although the technology has been around for a few decades,[54] they are still considered as emerging technologies and are not yet available for residential applications. Furthermore, they are significantly more expensive than electric ASHPs. According to WGL's GHP pilot study, the cost of installing a GHP including the cost of a central air conditioner ranges from $24,000 to $28,400 per home—two to three times higher than the cost of a high-efficiency ASHP.[55]

Refrigerants

While heat pumps offer significant potential in decarbonizing the space heating sector, many of the current models rely on refrigerants with high global warming potential (GWP). However, it is important to note that heat pumps still reduce GHG emissions substantially relative to gas heating, even considering refrigerant leaks. For example, a 2022 study by researchers from U.C. Davis comprehensively examined emissions impacts from heat pumps and gas furnaces including refrigerant leaks and methane leaks from gas pipeline systems across the country and found that heat pumps could cut emissions approximately 66 to 78 percent relative to gas furnaces in the Northeast.[56] Nonetheless, this U.C. study, as analyzed by the national laboratories found that refrigerant emissions would be expected to increase 0.7 t CO_2e each year for the 16-year life of the air-to-air heat pump equipment analyzed.[57] As a result, it is still important to reduce the impact of refrigerant leaks to maximize the climate benefits

48 Ibid.

49 U.S. Energy Information Administration. 2020. "2019-2020 Air-to-Water Heat Pumps." Available at: https://www.energystar.gov/partner_resources/products_partner_resources/brand-owner/eta-consumers/air-water-heat-pumps-2019#_ftn3.

50 Ark Heat. "The world's first future-proof HVAC platform product suite." Accessed July 26, 2024. Available at: https://arkheat.com/our-products/.

51 Sigenthaler, John. 2022. "Hydronics for Low Energy & Net Zero Homes." Presented at the Minnesota Power Energy Design Conference, February 22. Available at: https://www.duluthenergydesign.com/GeneralInfo/PastMaterials.

52 Guidehouse. 2024. *Evaluation Plan for Washington Gas Maryland Gas Heat Pump Pilot (update)*. Appendix C to Washington Gas Light. 2024. *Final Report: Gas Heat Pump Pilot*. Case No. 9705 (ML 312273). Available at: https://webpscxb.psc.state.md.us/DMS/case/9705; Northwest Energy Efficiency Alliance. 2020. *Robur Heat Pump Field Trial*. Available at: https://neea.org/img/documents/Robur-Heat-Pump-Field-Trial.pdf.

53 Gas Technology Institute. 2024. *EHP vs GHP Methodology for Washington Gas Maryland Gas Heat Pump Pilot*. Table 4. Appendix C to Washington Gas Light. 2024. *Final Report: Gas Heat Pump Pilot*. Case No. 9705 (ML 312273). Available at: https://webpscxb.psc.state.md.us/DMS/case/9705.

54 The first gas heat pump for commercial applications entered the U.S. market in 1997. See Energy Solutions Center. 2019. *Brief History of Utility Support for Gas Cooling and Gas Heat Pumps*. Available at: https://consortia.myescenter.com/CBC/History_of_Gas_Heat_Pumps_and_Gas_Cooling-Burgis-022119.pdf.

55 Gas Technology Institute. 2024. *EHP vs GHP Methodology for Washington Gas Maryland Gas Heat Pump Pilot*. Table 4. Appendix C to Washington Gas Light. 2024. *Final Report: Gas Heat Pump Pilot*.

56 Hillbrand, Alex. 2022. "The Climate Math of Home Heating Electrification." March 3. NRDC. Available at: https://www.nrdc.org/bio/alex-hillbrand/climate-math-home-heating-electrification-0.

57 Pistochini, T., Dichter, M., Chakraborty, S., Dichter, N., and Aboud, A. 2022. "Greenhouse gas emission forecasts for electrification of space heating in residential homes in the US." *Energy Policy*, Volume 163, 112813, ISSN 0301-4215. Available at https://doi.org/10.1016/j.enpol.2022.112813.

of heat pump technology.

Nearly all heat pumps installed to date use high-GWP refrigerants, but they still cut GHG emissions significantly relative to gas heating—by 66–78 percent in the Northeast—even with refrigerant leaks. To further reduce emissions, New Jersey is phasing out high-GWP refrigerants through incentive programs like NJEDA's NJ Cool Program and regulatory actions in the 2024 Priority Climate Action Plan. Federal restrictions under the AIM Act will also limit high-GWP refrigerant systems starting in 2025. Advances in low-GWP refrigerants, leak detection, and recycling will help maximize the climate benefits of heat pumps as electrification expands.

Low- or zero-GWP refrigerants such as propane, ammonia, hydrofluoroolefins (HFO), and CO_2 have started to become available in commercial products, and they continue to be under active consideration by manufacturers for new products. The 2024 New Jersey PCAP estimates that phasing out high-GWP refrigerant systems could reduce CO_2e emissions by 0.7 MMT by 2030, and 8.8 MMT CO_2e by 2050.[58] To this end, in the PCAP, NJDEP proposes piloting an incentive program specifically for systems that use low-GWP refrigerants and working to promote the complete replacement of high-GWP refrigerants.[59] One such pilot program that already exists in the state is NJEDA's $15 million NJ Cool Program (discussed further in Section 5.2, which provides grants for the replacement of high-GWP (GWP100 of 700 or higher) refrigerants with lower GWP alternatives, as well as for other heating electrification, energy efficiency, and renewable energy generation projects.[60] Additionally, under the federal American Innovation and Manufacturing (AIM) Act of 2020, over the next few years companies will be prohibited from manufacturing and importing high-GWP refrigerant systems and heat pump products and from installing high-GWP refrigeration and heat pump systems in the United States.[61] The earliest restrictions took effect on January 1, 2025, and more restrictions will continue to roll out through January 1, 2028. Furthermore, NJDEP has been partnering with the U.S. Environmental Protection Agency's (EPA) GreenChill program to educate New Jersey facilities on voluntarily reducing refrigerant leaks and switching to lower GWP refrigerants to reduce climate impacts and save money. NJDEP, via its GHG monitoring and reporting rule, also requires facilities with refrigeration systems or chillers requiring 50 pounds or more of one or more high-GWP refrigerants to register their facility, keep records and report on refrigerant usage.[62]

Advances in refrigerant leak detection capabilities, refrigerant recycling, and the development of refrigerant-free systems will also help ensure that the avoided emissions from electrifying space heating are not outweighed by emissions incurred from refrigerants.[63] For example, the University of Bologna, Italy conducted a case study of a residence using both ground-source and air-source electric heat pumps, switching from using a higher-GWP refrigerant, R-410A (GWP100 of 2,090) to using a lower-GWP refrigerant, R-454B (GWP100 of 470).[64] They found a slight, 2 to 3 percent decrease in energy performance but a significant reduction in total emissions—approximately 25 percent over the life of the heat pump's lifespan based on the current Italian electric grid, with potential reductions of up to 89 percent as the grid incorporates more carbon-free energy in the future.

WATER HEATING

Heat pump water heaters (HPWH) are an electric alternative to gas or other fossil-fuel-fired water heating technologies. Similar to heat pumps used for space heating and cooling, HPWH work not by generating heat but by moving it, in this case from outside air to inside a water storage tank. For this reason, HPWHs can similarly have efficiencies of over 100 percent. Their efficiency is measured using a Uniform Energy Factor (UEF), which presents an efficiency rating based on certain testing conditions.[65] A UEF of 1 means 100 percent efficient. Electric resistance water heaters can achieve up to a UEF of 1. In contrast, most available HPWHs have an efficiency rating between 3.0 and 4.0.[66] These systems are widely available in the United States.

HPWHs can offer load flexibility and work as demand response resources by storing additional thermal energy when electricity rates are low to avoid or reduce energy usage during peak hours. A 2018 study by Ecotope, Inc. found that using a HPWH's load flexibility capability can result in customer bill savings of 15 to 20 percent, with

58 NJ PCAP, p. 71.
59 New Jersey Department of Environmental Protection and Rutgers Climate Change Resource Center. *New Jersey's Priority Climate Action Plan*. March 2024. p. 71. Available at: https://www.epa.gov/system/files/documents/2024-03/nj-pcap.pdf.
60 New Jersey Economic Development Authority. "NJ Cool Program." Accessed October 15, 2024. Available at: https://www.njeda.gov/njcool/.
61 United States Environmental Protection Agency. "Fact Sheet: Final Rule - Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons under Subsection (i) of the American Innovation and Manufacturing Act of 2020." December 2023. Available at: https://www.epa.gov/system/files/documents/2023-10/technology-transitions-final-rule-fact-sheet-2023.pdf.
62 NJDEP. "Greenhouse Gas Monitoring and Reporting Rule." Available at: https://dep.nj.gov/ghg/ghgmr-rule/refrigeration/
63 U.S. Department of Energy. 2024. *Decarbonizing the U.S. Economy by 2050: A National Blueprint for the Buildings Sector*. p. 35. Available at: https://www.energy.gov/eere/articles/decarbonizing-us-economy-2050.
64 Dongellini, M. et al. 2023. "Energy and Environmental Performance Comparison of Heat Pump Systems Working with Alternative Refrigerants." *Applied Science*. Volume 13. Issue 12. Available at: https://www.mdpi.com/2076-3417/13/12/7238?utm_source=chatgpt.com.
65 UEF is comparable to coefficient of performance: it measures the ratio of the energy service output to the energy input. It is not exactly equal to the coefficient of performance for a water heater's heating element because it incorporates heat losses from the water storage tank.
66 U.S. Environmental Protection Agency. "ENERGY STAR Certified Heat Pump Water Heaters." Accessed July 22, 2024. Available at: https://www.energystar.gov/productfinder/product/certified-heat-pump-water-heaters/.

about 35 percent utility marginal cost savings in California.[67] The load flexibility of HPWHs can help mitigate the grid impacts associated with the electrification of water heating.

Solar water heaters are another low-carbon water heating technology. However, deployment levels of solar water heating systems are currently low in the United States, with less than 400,000 systems operating as of 2021.[68] These systems typically consist of tubes of liquid installed on a rooftop, which are heated by the thermal energy of the sun. That liquid is then circulated from the rooftop to a water storage tank to provide hot water throughout the building.[69] While these systems offer a great source of passive solar heat, in most parts of the United States they are not able to supply all of a building's water heating load year-round, and must be paired with a supplemental heating source.

Cooking

While space heating and water heating make up the largest shares of building energy consumption, the electrification of all building end uses will play an important role in fully decarbonizing the building sector. Cooking is a small contributor to building energy consumption relative to space heating and water heating, yet it plays a critical role in building decarbonization because it affects whether a building still requires a gas connection, even if a home has already switched to an electric space or water heating system. There are several available all-electric cooking appliances that can replace their gas counterparts, including electric resistance and induction cooktops, as well as electric ovens, griddles, and fryers. Induction cooktops use magnetic fields to directly heat pots and pans, with no waste heat lost to the room, making them more efficient than older electric cooktop technologies. Installing electric cooking equipment also offers health benefits, as it can improve indoor air quality significantly by eliminating the indoor air pollutants produced by natural gas equipment.[70] Additionally, induction cooktops specifically offer numerous other benefits, including reduced burn risk and reduced cleaning time, and produce roughly half as much waste heat as natural gas stoves.[71]

Laundry

Laundry also offers opportunities for electrification and efficiency improvements. Electric resistance clothes dryers and heat pump dryers are two alternatives to natural gas or propane dryers. While 88 percent of laundry dryers sold in the United States are already electric, heat pump dryers in particular use roughly half the electricity of electric resistance dryers.[72] These dryers work by pumping heat directly into the drum, and condensing the water removed from the drum using the cool side of the heat pump. A key consideration when installing a heat pump dryer is that these systems are ventless and generate condensate, meaning they must be sited where they can be tied into a drain.[73] These systems typically take longer to dry a load of laundry than traditional clothes dryers, but they are also gentler on clothes.

Costs of Building Electrification

A few recent studies investigated the cost of building electrification for space heating and water heating. In general, these studies find that among residential homes, the upfront costs of installing a heat pump may be higher than installing a new gas furnace. However, since heat pumps can provide both heating and cooling, they are comparably cheaper when considering the costs of installing both a new furnace and an air conditioner. For commercial buildings, studies show that the total installed costs of heating electrification can be more expensive, especially for HPWHs, but the operational costs of heating electrification can be more affordable than gas alternatives depending on the situation, such as regional characteristics and whether the project is paired with other energy efficiency upgrades.

Below is a summary of these studies:

- A 2021 study by the Lawrence Berkeley National Laboratory (LBNL) found the median cost of installing a new residential heat pump in the United States to be $8,027, while the median cost of a new gas furnace is $5,025. However, the right comparison should include the cost of a central air conditioner as part of the cost of gas furnace because heat pumps provide both space heating and cooling. The study found that the combined cost of a new gas furnace and a new central air conditioner is $10,955.[74] LBNL found residential GSHPs to be the most expensive, with a median cost of $9,770 per ton compared with $2,481 per ton for ducted ASHPs and $4,421 per ton for DMSHPs. While GSHPs are substantially more expensive, they typically have much higher efficiencies than ASHPs (e.g., COP of 4). Further, GSHPs can maintain high efficiencies in freezing temperatures, which means the benefits of GSHPs increase in colder climates as they could avoid adding winter peak loads relative to ASHPs.
- In 2018, the Rocky Mountain Institute (RMI) published

67 Carew, Nick. Et al. 2018. Heat Pump Water Heater Electric Load Shifting: A Modeling Study. Ecotope, Inc. Available at: https://ecotope-publications-database.ecotope.com/2018_001_HPWHLoadShiftingModelingStudy.pdf.

68 International Energy Agency and AEE – Institute for Sustainable Technologies. 2023. *Solar Heat Worldwide: Edition 2023*. Available at: https://www.iea-shc.org/Data/Sites/1/publications/Solar-Heat-Worldwide-2023.pdf.

69 Gearino, D. 2023. "A New Solar Water Heating System Goes Online as Its Developer Enters the US Market." Inside Climate News. November. Available at: https://insideclimatenews.org/news/23112023/solar-thermal-heat/.

70 Redwood Energy. 2022. *A Pocket Guide to All-Electric Retrofits of Single-Family Homes*. Available at: https://www.redwoodenergy.net/research/a-pocket-guide-to-all-electric-retrofits-of-single-family-homes.

71 Ibid.

72 Ibid.

73 U.S. Environmental Protection Agency. "ENERGY STAR Certified Clothes Dryers: Buying Guidance." *energystar.gov*. Accessed July 23, 2024. Available at: https://www.energystar.gov/productfinder/product/certified-clothes-dryers/.

74 Lawrence Berkeley National Laboratory. 2021. *The Cost of Decarbonization and Energy Upgrade Retrofits for US Homes*. Available at: https://escholarship.org/content/qt0818n68p/qt0818n68p.pdf?t=r1551m.

its report entitled *The Economics of Electrifying Buildings*, evaluating the economics of space and water heating electrification in residential homes across four representative cities around the United States.[75] RMI found that in Providence, Rhode Island, the city studied with a climate most similar to New Jersey, installing a standard heat pump in an existing home on average costs $7,522, compared with $3,323 to install a new natural gas furnace. However, similar to LBNL, RMI found that a heat pump installation is less in comparison to a natural gas furnace and a new central air conditioner, which has a combined average cost of $9,853. The study also found that the cost of installing a heat pump is less in new construction homes, at $4,752 on average, than in retrofit scenarios. Finally, RMI found that installing an HPWH costs an average of $2,132 in an existing home, more expensive than installing a natural gas water heater ($1,306), but comparable to an oil-heated water heater ($2,175).

- The 2018 RMI study also assessed operation costs of electrification measures and estimated the lifecycle costs. The net present value lifecycle costs for a retrofit in an existing building in Providence are estimated to be $25,600 on average for a standard heat pump, lower than the lifecycle costs for a retrofit heating oil system ($26,900) or propane system ($39,200). Only natural gas retrofits have a lower lifecycle cost, estimated to be $17,900 for a new natural gas furnace and existing air conditioning, and $24,100 for a natural gas furnace and new air conditioning. When comparing lifecycle costs in Providence for new construction, costs are lowest for a standard heat pump ($14,300), compared with natural gas, heating oil, and propane systems.
- RMI also conducted a study in 2022 investigating the economics of commercial electrification of gas-fired space and water heating systems in Washington D.C., Las Vegas, Seattle, and Chicago by comparing operational costs of those systems.[76] In this study, RMI found that regional climate and utility rates heavily affect the cost-effectiveness of space and water heating electrification in medium-sized (50,000 square foot) commercial buildings, and that projects are most cost-effective when paired with other energy efficiency improvements. The study recommended pairing heat pump RTU retrofits with energy recovery ventilators (ERV) and demand management controls or rooftop solar in cold climates such as Washington D.C. (most similar to New Jersey of the cities studied), to achieve a positive 20-year net present value. A 2023 study conducted by Synapse Energy Economics estimated the incremental capital cost to electrify commercial buildings, using cost data from the California Electronic Technical Reference Manual. This study shows national average costs and found that the median incremental costs of electrification measures are 24 percent for space heating and 99 percent for heat pump water heating.[77]

3.2 ENERGY EFFICIENCY

Overview

Energy efficiency is a crucial strategy to reduce GHG emissions in the building sector and to improve energy affordability. New Jersey has a long history of cost-effectively conserving energy in residential and commercial buildings by deploying efficiency measures such as air sealing, insulation, high-efficiency appliances, duct sealing, and HVAC tune-ups. The decarbonization benefit of energy efficiency measures is twofold: decreasing building sector emissions directly by reducing onsite combustion of fossil fuels—which accounted for 64.6 percent of New Jersey building energy use in 2022[78]—and indirectly by reducing demand for electricity generated from fossil fuels.

Deploying efficiency measures is essential to a least-cost, strategic transition to zero-carbon buildings in New Jersey. In addition to providing emissions reductions, energy efficiency reduces system, societal, and owner costs associated with building electrification.[79, 80, 81] Bundling building envelope improvements and heat recovery with electrification reduces peak demand from space heating and mitigates the need for costly upgrades to the electric grid. Further, strategic approaches to efficiency also reduce the required capacity of all-electric equipment, lowering upfront installation costs for owners and reducing the cost of electric panel and utility service upgrades.[82, 83] For example, insulating and air-sealing a building will reduce its heating demand in the winter, allowing for a smaller heat pump which will require less power. Improving the efficiency of electric appliances and lighting can offer similar benefits.

75 Billimoria, S., Henchen, M., Guccione, L., and Louis-Prescott, L. 2018. *The Economics of Electrifying Buildings: How Electric Space and Water Heating Supports Decarbonization of Residential Buildings*. Rocky Mountain Institute. Available at: https://rmi.org/insight/the-economics-of-electrifying-buildings/.

76 Fathollahzadeh, M. H. and Tilak, A. 2022. *The Economics of Electrifying Buildings: Medium-Size Commercial Retrofits*. Rocky Mountain Institute. Available at: https://rmi.org/insight/economics-of-electrifying-buildings-medium-size-commercial-retrofits/.

77 Synapse Energy Economics. 2023. *Building Decarbonization Strategies for the Southwest: Analysis of the costs and emissions reduction potential of space and water heating decarbonization*. Available at: https://www.synapse-energy.com/building-decarbonization-strategies-southwest.

78 U.S. Energy Information Administration. 2024. State Energy Data System: Tables CT4 and CT5. Residential and Commercial sector energy consumption estimates, 1960-2022, New Jersey." Accessed July 26, 2024. Available at: https://www.eia.gov/state/.

79 RMI. 2018. *The Economics of Electrifying Buildings*. Available at: https://rmi.org/insight/the-economics-of-electrifying-buildings/.

80 ACEEE, 2022. *Building Electrification: Programs and Best Practices*. Available at: https://www.aceee.org/sites/default/files/pdfs/b2201.pdf.

81 RMI. 2020. *Regulatory Solutions for Building Decarbonization: Tools for Commissions and Other Government Agencies*. Available at: https://rmi.org/insight/regulatory-solutions-for-building-decarbonization/.

82 Redwood Energy. 2022. *A Pocket Guide to All-Electric Retrofits of Commercial Buildings*, pp. 18, 26, 27, 38, 45. Available at: https://www.redwoodenergy.net/research/redwood-energys-pocket-guide-to-all-electric-commercial-retrofits.

83 Redwood Energy. 2022. *A Pocket Guide to All-Electric Retrofits of Single-Family Homes*, pp. 7, 20, 21. Available at: https://www.redwoodenergy.net/research/a-pocket-guide-to-all-electric-retrofits-of-single-family-homes. pp. 7, 20, 21.

Energy affordability is another reason to pursue efficiency in tandem with electrification. While a 2022 study by the Acadia Center[84] found that the average New Jersey household could save $50 on annual energy costs through electrification, in isolation, building electrification could increase energy costs for some consumers. Natural gas is currently the dominant energy source for space heating in New Jersey, used by 72.8 percent of households.[85] In 2022, the residential price of electricity in New Jersey was 4.1 times the price of natural gas on a per-Btu basis, compared to a national average price ratio of 3.1.[86] The economics of electrification is somewhat better for commercial buildings due to a lower ratio between commercial electricity rates and gas rates.[87] Even though typical heat pumps can use three-to-four times less energy to deliver an equal amount of heat as natural gas furnaces and boilers, as mentioned in the previous section, energy costs may increase post-electrification without modest energy efficiency improvements (assuming the current electricity and gas rates). To ensure costs do not rise, building decarbonization programs should pursue complementary efficiency and electrification, especially for LMI households. New Jersey's PCAP prioritizes making at least 10 percent of all LMI properties electrification-ready by the year 2030 by expanding three existing income-eligible energy efficiency programs.[88] The forthcoming 2025 Energy Master Plan will provide additional information regarding the operational costs of electrification.

Finally, energy efficiency provides a range of non-energy benefits, such as economic development, resiliency, and improved thermal comfort. Investment in building efficiency strengthens New Jersey's economy by supporting jobs and producing bill savings for customers, which can be reinvested into other needs. In 2023, energy efficiency accounted for 38,270 jobs throughout the state.[89] Energy efficiency can also improve grid resiliency, preventing outages by reducing the stress on the grid during extreme weather events. Efficient and well-insulated homes are passively resilient and have a greater ability to maintain livable temperatures during outages.[90]

Reducing combustion of fossil fuels and electricity use through energy efficiency is a critical first step; however, efficiency alone is insufficient to achieve New Jersey's climate goals. Rather, the customer bill savings benefits of energy efficiency are essential to achieving the GWRA decarbonization requirements by making them more affordable.

3.3 ALTERNATIVE FUELS

Overview

Alternative fuels, such as renewable natural gas (RNG), green hydrogen, and biodiesel may be used in place of conventional fossil fuels such as natural gas and heating oil and may reduce lifecycle GHG emissions. However, there is considerable uncertainty about the extent of emission reductions from alternative fuels and whether they can achieve net-zero emissions. Further, alternative fuels present additional challenges in terms of their resource availability, costs, and other technical issues.

RNG, also known as biomethane, is produced by upgrading biogas produced through the anaerobic digestion or thermal gasification from a variety of feedstocks, including organic waste (e.g., food waste, manure), agricultural residues, energy crops (i.e., crops grown for the production of RNG), and non-biogenic waste (e.g., construction debris).[91], [92] RNG can replace pipeline fossil natural gas, can be used in electricity production, or can be compressed and used as a vehicle fuel in place of compressed natural gas.

Growing interest in low- and zero-carbon fuels has generated conversation around the use of hydrogen as an alternative to fossil fuels. Hydrogen is a versatile energy carrier that produces no direct GHG emissions; the only emissions are associated with the production of hydrogen. Today, hydrogen is most commonly used in petroleum refining and fertilizer production and is produced through steam methane reformation which relies on fossil fuels.[93] Hydrogen can also be produced via electrolysis, wherein water is split into hydrogen and oxygen using electricity. The only emissions from production of hydrogen via

84 Acadia Center. 2022. *The Future Is Electric: Helping New Jersey Live in Cleaner, Healthier and More Affordable Homes*. Available at: https://acadiacenter.org/resource/the-future-is-electric/.

85 U.S. Energy Information Administration. 2024. "State Energy Data System: New Jersey Overview". Accessed July 26, 2024. Available at: https://www.eia.gov/state/.

86 U.S. Energy Information Administration. 2024. "State Energy Data System: Table E3. Residential sector energy price estimates, 2022". Accessed July 26, 2024. Available at: https://www.eia.gov/state/seds/sep_sum/html/sum_pr_res.html.

87 In 2022, the price of electricity in New Jersey for the commercial sector was 3.2 times the price of natural gas on a per-Btu basis, which is equal to the national average price ratio.
U.S. Energy Information Administration. 2024. "State Energy Data System: Table E4. Commercial sector energy price estimates, 2022". Accessed July 26, 2024. Available at: https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/sum_pr_com.html&sid=US.

88 New Jersey Department of Environmental Protection. 2024. *New Jersey Priority Climate Action Plan*. Available at: https://dep.nj.gov/climatechange/mitigation/cprg/.

89 U.S. Department of Energy. 2024. *U.S. Energy and Employment Report 2023*. Available at: https://www.energy.gov/policy/us-energy-employment-jobs-report-useer.

90 U.S. Department of Energy. 2024. "Better Buildings: Resilience." Accessed July 26, 2024. Available at: https://betterbuildingssolutioncenter.energy.gov/resilience/about.

91 U.S. EPA. 2022. "Renewable Natural Gas". *Landfill Methane Outreach Program (LMOP)*. Available at: https://www.epa.gov/lmop/renewable-natural-gas.

92 ICF. 2019. *Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment*. Prepared for American Gas Foundation. Available at: https://gasfoundation.org/wp-content/uploads/2019/12/AGF-2019-RNG-Study-Full-Report-FINAL-12-18-19.pdf.

93 U.S. Department of Energy. 2017. "Hydrogen: A Clean, Flexible Energy Carrier." *Office of Energy Efficiency & Renewable Energy*. February 21. Available at: https://www.energy.gov/eere/articles/hydrogen-clean-flexible-energy-carrier.

electrolysis are associated with the generation of the electricity used in the process. Therefore, hydrogen produced through electrolysis powered by zero-carbon energy is called "green hydrogen" and is considered a zero-emission fuel.[94] However, heating with hydrogen produced via hydrolysis is a relatively energy-intensive process and is less efficient than some alternatives. Accounting for an 80-percent electrolysis efficiency and a standard furnace efficiency of 80 percent, the overall efficiency of heating with hydrogen is about 65 percent.[95] Even with a 98-percent high-efficiency gas furnace, the overall efficiency of hydrogen-powered heating is about 78 percent. In comparison, the average efficiency of a cold-climate, high-efficiency heat pump typically ranges from 200 to 300 percent even in cold climates such as Massachusetts.[96]

Biodiesel is a biofuel produced from biomass feedstocks such as plant oils, recycled cooking oil or greases, or animal fats.[97] Biodiesel is similar to fuel oil in many ways but has slightly different chemical properties and is therefore frequently blended with fossil diesel. Renewable diesel is another alternative to fossil fuel oil and is produced from the same feedstocks as biodiesel. Unlike biodiesel, renewable diesel is chemically identical to fossil fuel oil and does not require blending. Biodiesel and renewable diesel can be used as a replacement for fossil heating oil in the building sector and as a replacement for diesel fuel in the transportation sector.

Availability and Technical Barriers

The potential for alternative fuels to decarbonize buildings is constrained by their availability and competition from other sectors. The current supply of RNG is limited, both due to limited infrastructure to produce RNG and the amount of biomass that can be sustainably produced. Even optimistic estimates of RNG production potential result in a potential of less than 1 percent of current New Jersey natural gas consumption. A report by NJDEP's Science Advisory Board estimates that the total production potential of RNG in New Jersey from current production methods is around 40 million cubic meters, or 1.4 billion cubic feet, which could be used to generate between 0.27 and 0.33 TWh of electricity per year.[98] The report also estimates that up to 182 million cubic meters, or 6.54 billion cubic feet, could be produced annually if there was expanded collection of methane from landfills and wastewater treatment plants. This amount of RNG potential is only about 1.3 percent of New Jersey's total natural gas consumption of 468 billion cubic feet that was consumed by residential, commercial, and industrial customers in 2022.[99]

Biodiesel and renewable diesel face similar biomass and infrastructure constraints. Further, while renewable diesel production capacity is increasing,[100] production is unlikely to meet demand; the U.S. Energy Information Administration estimates that renewable diesel and biodiesel will account for less than 8 percent of U.S. diesel production in 2050.[101] Additionally, there is likely to be significant competing demand in the transportation sector, driven by policies such as the federal Renewable Fuel Standard (RFS) and California Low-Carbon Fuel Standard (LCFS).

While several hydrogen pilot and demonstration projects have been announced in New Jersey,[102] the clean hydrogen economy is still nascent, making the future prices and availability of green hydrogen uncertain.[103] Furthermore, in the short term, there is likely to be competition for green hydrogen from industries currently using hydrogen (e.g., refining and fertilizer industries) or other industries with hard-to-decarbonize industrial processing needs (e.g., iron and steel, chemical, cement, and refining), as these industries look to decarbonize.

Beyond the uncertainty around hydrogen cost and availability, there are considerable challenges and risks associated with hydrogen usage in gas transmission and distribution networks. First, without major retrofits to the natural gas system, hydrogen cannot replace natural gas one-to-one and must be blended with natural gas. The literature suggests that the maximum blending limit is around 10 percent hydrogen by volume, thus limiting the

94 New Jersey Department of Environmental Protection. 2022. "Hydrogen Energy." *Clean Hydrogen in New Jersey*. Available at: https://dep.nj.gov/hydrogen/hydrogen-energy/.

95 Rosenow, Jan. 2022. *Is heating homes with hydrogen all but a pipe dream? An evidence review*. Joule, 6 (10) (2022), pp. 2225-2228. Available at: https://www.sciencedirect.com/science/article/pii/S2542435122004160.

96 Cadmus 2016. *Ductless Mini-Split Heat Pump Impact Evaluation*. Figure ES-4 and ES-5. Available at: https://ripuc.ri.gov/sites/g/files/xkgbur841/files/eventsactions/docket/4755-TRM-DMSHP-Evaluation-Report-12-30-2016.pdf; Guidehouse. 2024. *Massachusetts and Connecticut Heat Pump Metering Study*, p. 5. Available at: https://ma-eeac.org/wp-content/uploads/MA-HPMS-CT-R2246-Heat-Pump-Metering-Study-Updated-Final-Report_2024-05-30-1.pdf.

97 U.S. DOE Alternative Fuels Data Center. "Biodiesel Fuel Basics." available at https://afdc.energy.gov/fuels/biodiesel-basics.

98 New Jersey Department of Environmental Protection Science Advisory Board. 2023. *Final Report: Biofuels*. Available at: https://dep.nj.gov/wp-content/uploads/sab/sab-biofuels-final.pdf.

99 U.S. Energy Information Administration (EIA). "Natural Gas Consumption by End Use." Available at: https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_SNJ_a.htm.

100 U.S. EIA. 2023. "Domestic renewable diesel capacity could more than double through 2025." February 2. Available at: https://www.eia.gov/todayinenergy/detail.php?id=55399.

101 U.S. EIA. 2022. "EIA projects U.S. renewable diesel supply to surpass biodiesel in AEO2022." March 2022. Available at: https://www.eia.gov/todayinenergy/detail.php?id=51778.

102 Holland, B., et al. 2021. "Hydrogen pilot projects advance, evolve at gas utilities." August 10. Available at: https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/hydrogen-pilot-projects-advance-evolve-at-gas-utilities-65942022.

103 Synapse Energy Economics. 2023. *Building Decarbonization Strategies for the Southwest*. Prepared for Western Resource Advocates. p. 17. Available at: https://www.synapse-energy.com/sites/default/files/Synapse%20WRA%20BD%20strategy%20report%20%28Final%29%2022-136%20new.pdf.

GHG reduction potential of hydrogen.[104] There are several properties of hydrogen that create risks associated with blending hydrogen into the existing gas system. These include the potential for increased pipeline leakage due to the small molecular size of hydrogen compared to methane, increased risk of fire hazard from leaks due to the broader flammability range and lower ignition energy compared to methane, and increased volume of hydrogen required to deliver the same amount of energy compared to methane—and thus increased operating pressures—due to the lower energy content of hydrogen. [105] Furthermore, blending even 1 percent hydrogen by volume can exacerbate the risks of fire hazard by increasing pipeline embrittlement, fatigue, and fracture.[106]

Finally, while green hydrogen does not face feedstock constraints, producing sufficient green hydrogen to replace even 10 percent of the total residential natural gas usage by New Jersey buildings would require a substantial amount of zero-carbon energy. Ten percent of the current residential gas usage is approximately 25 TBtu.[107] With an approximate energy conversion efficiency of 80 percent for producing green hydrogen, replacing this amount of natural gas with green hydrogen would require approximately 30 TBtu of electricity, which would increase residential electricity consumption by approximately 30 percent.[108, 109] However, electric heat pumps that are expected to be 300 percent efficient or more in New Jersey's climate[110] would require only about 9.5 TBtu of electricity or less to meet 10 percent of existing gas heating demand.[111]

Uncertainty

The extent to which alternative fuels will reduce GHG emissions relative to fossil fuels is uncertain and depends on the fuel produced, feedstocks used, and production pathway, among other factors. The lifecycle emissions reductions associated with biodiesel and renewable diesel is highly dependent on feedstocks and their associated land use.[112] The emission reduction potential of RNG is also highly uncertain, and in some cases, RNG may increase emissions relative to fossil fuels.[113] Potential pipeline leakage of RNG produced from intentionally produced methane (as opposed to waste-methane) can have significant climate impacts.[114] Finally, although green hydrogen is often considered a zero-emission fuel, hydrogen has significant short-term indirect climate warming impacts if released into the atmosphere; pipeline leakage of hydrogen would significantly reduce the emissions reduction impact of green hydrogen.[115]

There is also considerable uncertainty around the cost of alternative fuels. Achieving New Jersey's climate goals with the use of alternative fuels would require heavy scaling up of current production levels, which involves multiple and differing challenges depending on the fuel type. The costs of biodiesel, renewable diesel, and RNG will likely vary based on feedstock availability, demand for fuels, and costs to build new production and distribution infrastructure. A study for a District of Columbia gas utility estimated that RNG will be available for between $12 and $18 per MMBtu, about three times the cost of fossil natural gas.[116] Similarly, because the green hydrogen economy is still nascent, there are many uncertainties associated with the cost of hydrogen production.[117]

Alternative Fuels in New Jersey Buildings

Given the uncertainties around the availability, cost, and greenhouse reduction potential of alternative fuels, they are unlikely to play a large role in the decarbonization of New Jersey's buildings. Instead, New Jersey's policy

104 University of California, Riverside and Gas Technology Institute for The California Public Utilities Commission (CPUC). 2022. *Hydrogen Blending Impacts Study*. pp. 107-108. Available at: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M493/K760/493760600.PDF.

105 Id. p. 37.

106 Id. p. 67.

107 In 2022, the residential sector in New Jersey consumed 248 TBtu of natural gas. Source: U.S. EIA. Table C5. Residential sector energy consumption estimates, 2022 (trillion Btu). State Energy Data System. Available at: https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/sum_btu_res.html&sid=NJ.

108 Calculations based on an assumed 85-percent hydrogen production efficiency and 5-percent loss due to pipeline compression. Source: Pashchenko, Dmitry. 2024. "Green hydrogen as a power plant fuel: What is energy efficiency from production to utilization?" *Renewable Energy*, Volume 223,120033. Available at: https://doi.org/10.1016/j.renene.2024.120033.

109 In 2022, the residential sector in New Jersey consumed 102.6 TBtu of electricity.
Source: U.S. EIA. Table C5. Residential sector energy consumption estimates, 2022 (trillion Btu). State Energy Data System. Available at: https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/sum_btu_res.html&sid=NJ.

110 As mentioned above in the Overview section, the efficiency of a cold-climate, high-efficiency heat pump typically ranges from 200 to 300 percent even in cold climates. This means that we expect at least 300 percent efficiency for cold-climate heat pumps in a warmer climate like New Jersey.

111 Assuming an average gas heating system efficiency of 85 percent, 24 TBtu of gas demand (which is 10 percent of the total residential gas consumption) represents about 28 TBtu of heating service demand. Assuming a 300 percent efficiency for heat pumps, heat pumps would require just about 9.5 TBtu of energy to replace the 10 percent gas consumption.

112 Xu, Hui, Longwen Ou, Yuan Li, Troy R. Hawkins, and Michael Wang. 2022. "Life Cycle Greenhouse Gas Emissions of Biodiesel and Renewable Diesel Production in the United States." *Environmental Science & Technology*, Volume 56, no. 12: 7512–21. Available at: https://doi.org/10.1021/acs.est.2c00289.

113 Rai, S., Hage, D., Littlefield, J., Yanai, G., and Skone, T. 2022. "Comparative Life Cycle Evaluation of the Global Warming Potential (GWP) Impacts of Renewable Natural Gas Production Pathways." *Environmental Science & Technology*, Volume 56, no. 12L 8581-8589. https://doi.org/10.1021/acs.est.2c00093.

114 Grubert, Emily. 2020. "At scale, renewable natural gas systems could be climate intensive: the influence of methane feedstock and leakage rates." *Environmental Research Letters*, Volume 15, No. 18. https://doi.org/10.1088/1748-9326/ab9335.

115 Ocko, I and Hamburg, S. 2022. Climate consequences of hydrogen emissions. Atmos. Chem. Phys., 22, 9349–9368. https://doi.org/10.5194/acp-22-9349-2022.

116 ICF. 2020. Technical Study Report: Opportunities for Evolving the Natural Gas Distribution Business to Support the District of Columbia's Climate Goals. Prepared for AltaGas, pp. TS-7, 13. Available at: https://washingtongasdcclimatebusinessplan.com/wp-content/uploads/2020/04/Technical-Study-Report- Opportunities-for-Evolving-the-Natural-Gas-Distribution-Business-to-Support-DCs-Climate-Goals-April-2.pdf.

117 Synapse Energy Economics. 2024. *Avoided Energy Supply Components in New England: 2024 Report*. pp. 42-43.

regarding alternative fuels supports using them for hard-to-decarbonize sectors of the economy, such as heavy industry and long-haul transportation. Moreover, the policy of New Jersey prioritizes the production of those fuels in a manner that is consistent with the "three pillars" approach: prioritize additionality, deliverability, and hourly-matching outlined by the U.S. Treasury in its final rule on credits for production of clean hydrogen.[118]

The State's policy for building decarbonization focuses on electrification, not alternative fuels, as the primary pathway for building decarbonization. The 2019 Energy Master Plan identified building electrification as the most cost-effective strategy to decarbonize buildings and established a goal of transitioning to a fully electrified building sector by 2050.[119] Additionally, the 2019 Energy Master Plan found that relying on alternative fuels to decarbonize New Jersey's building sector instead of electrification would result in a final energy demand approximately 20 percent higher than the least-cost scenario (electrification) and would require the state to purchase higher amounts of relatively expensive fuels from out-of-state.[120] Further, the 80x50 Report states that achievement of the 80x50 goal will require the state to aggressively pursue electrification of heating, cooking, and hot water in the commercial and residential sectors.[121]

118 U.S. Department of Treasury. 2025. *Credit for Production of Clean Hydrogen and Energy Credit*. Available at: https://www.federalregister.gov/documents/2025/01/10/2024-31513/credit-for-production-of-clean-hydrogen-and-energy-credit.

119 2019 New Jersey Energy Master Plan: Pathway to 2050. At. pp. 161, 168.

120 Id. p. 270.

121 New Jersey Department of Environmental Protection. 2020. "New Jersey's Global Warming Response Act 80x50 Report."

04.

BUILDING DECARBONIZATION

BARRIERS, ISSUES & OPPORTUNITIES

This section explores the barriers, issues, and opportunities related to the decarbonization of New Jersey's building sector. Specifically, it provides a comprehensive analysis of the following key topics:

- **The Future of Natural Gas:** Exploring the shift away from fossil fuels and its implications for gas utilities and infrastructure.
- **Grid Impacts:** Assessing the challenges and opportunities for the electric grid in supporting increased electrification.
- **Bill and Rate Impacts:** Examining the financial implications of electrification for consumers and strategies to ensure affordability.
- **Building Upgrade Constraints:** Identifying physical and technical barriers to decarbonizing buildings and strategies to overcome them.
- **Consumer Adoption:** Addressing the challenges consumers face in adopting decarbonization solutions, including high upfront costs, limited awareness, and misaligned incentives.
- **Workforce Development:** Highlighting the need for skilled labor and equitable workforce opportunities to support decarbonization.
- **Health Benefits:** Discussing the potential for improved indoor and outdoor air quality and overall public health outcomes.
- **Equity and Environmental Justice:** Ensuring decarbonization efforts prioritize low-income and overburdened communities to address systemic disparities.

4.1 FUTURE OF GAS

Overview

Most of the GHG emissions from New Jersey's residential and commercial buildings sector come from the combustion of natural gas, as discussed in Section 1.2. The current natural gas distribution system serves over 3 million residential and commercial customers across the state.[122] New Jersey has identified electrification as the primary strategy to decarbonize Its buildings, aiming to supply all electricity with zero-carbon energy by 2035. This raises important questions about the future of the natural gas distribution system in light of the State's climate goals.

The relative share of electricity and natural gas used in buildings is expected to shift as the state replaces fossil natural gas end uses with clean electric ones. Under the least-cost scenario in the 2019 Energy Master Plan modeling, New Jersey's natural gas demand should decrease by 75 percent over the next few decades.[123] The 2019 Energy Master Plan identified building electrification as the most cost-effective method to decarbonize buildings. High levels of electrification are not consistent with the current gas utility business model, which depends on spreading the cost of the gas delivery system across many units of gas sales in order to provide affordable energy.

As discussed in the previous section on Alternative Fuels, the use of alternative fuels to decarbonize the gas system—and thus residential and commercial building sector gas use—is limited by the cost and availability of those fuels, and in the case of hydrogen, their compatibility with existing pipelines and natural gas appliances. The 2019 Energy Master Plan found that a scenario with continued fuel use in buildings and a higher use of alternative fuels limits the state's options for further emissions reductions and poses higher costs than a scenario with higher levels of electrification.[124]

The State, natural gas distribution utilities, and their regulators, must prepare for a future where the gas system has declining throughput and is used very differently from today. This shift will require proactive and innovative strategies to navigate this changing landscape.

Barriers and Issues

An unmanaged transition away from gas over the next several decades has the potential for negative impacts on gas utilities and their customers. As households and businesses electrify, those residential and commercial gas customers will depart from the gas system. Many studies have analyzed this transition and found that gas rates and bills are expected to increase as gas sales decrease, holding all else equal, as gas utilities must recover the costs of the system over fewer sales to customers.[125] High gas rates may then push more customers to use electricity instead of natural gas to lower their energy bills, accelerating a decline in sales and further escalating rates and bills for remaining customers. This poses a major equity concern: customers who can afford the upfront costs of electrification will do so first. Without policy intervention, LMI customers and renters with less access to capital will be left to shoulder an increasing share of the costs of the gas system.

Departures from the gas system and declining gas consumption in buildings will mean that many gas utility assets will be increasingly underused as 2050 approaches. Natural gas infrastructure assets have long lifetimes over which their capital costs are recovered through rates, generally over decades. Gas distribution utilities set the gas distribution rates by depreciating the cost of their assets over many years (e.g., 50 years) that reflect the service life of the assets. If depreciation rates are not changed, many assets will retire (or no longer be used and useful) before they are fully depreciated. These would be stranded assets. If the utility cannot recover the remaining costs associated with those assets, it will face stranded costs. Stranded costs will be borne by ratepayers, taxpayers, or the utility's investors, thus creating hardship.[126] While some may argue for placing all such costs on utility investors, New Jersey benefits from having a utility that is financially healthy enough to bear the costs of maintenance to avoid catastrophic risks and reduce methane leakage.

Finally, existing energy policies and regulatory structures risk exacerbating rather than resolving these issues. Current line extension cost recovery policies, pipeline replacement programs, and the "obligation to serve" encourage gas infrastructure investment and system expansion.[127] It is risky to incur substantial infrastructure costs to extend the life of a gas system that may need to be downsized in the near future. While these frameworks may have worked well in the past, they have the potential to continue the status quo of gas system investment and planning, which would increase future costs and risks. Regulators, gas utilities, and

122 As of 2022. Source: U.S. Energy Information Administration. "Number of Natural Gas Customers" Form EIA-176. Available at: https://www.eia.gov/dnav/ng/NG_CONS_NUM_DCU_SNJ_A.htm.

123 2019 New Jersey Energy Master Plan, p. 189.

124 2019 New Jersey Energy Master Plan, pp. 270-271.

125 Steven Nadel. 2023. *Impact of Electrification and Decarbonization on Gas Distribution Costs*. American Council for an Energy Efficient Economy. Available at: https://www.aceee.org/sites/default/files/pdfs/U2302.pdf; The Brattle Group. 2022. *New Jersey Energy Master Plan: Ratepayer Impact Study*. Prepared for the New Jersey Board of Public Utilities. Available at: https://www.nj.gov/bpu/pdf/reports/2022-08-13%20-%20BPU,%20EMP%20Ratepayer%20Impact%20Study%20Report_PUBLIC_Brattle.pdf; Synapse Energy Economics. 2022. Climate Policy for Maryland's Gas Utilities: Financial Implications. Prepared for the Maryland Office of the People's Counsel. Available at: https://opc.maryland.gov/Portals/0/Files/Publications/Reports/MDFutureGasReport%20FINAL.pdf?ver=IKcLN0p_148NtsVsj2A0Og%3d%3d.

126 Synapse Energy Economics. 2020. *Gas Regulation for a Decarbonized New York*. Prepared for Natural Resources Defense Council. Available at: https://www.synapse-energy.com/sites/default/files/Gas_Regulation_Decarbonized_NY_19-082.pdf.

127 Regulatory Assistance Policy and Synapse Energy Economics. 2021. *Regulating Renovation to Electrify Buildings: A Guide for the Handy Regulator*. https://www.synapse-energy.com/sites/default/files/rap-shipley-hopkins-takahashi-farnsworth-renovating-regulation-electrify-buildings-2021-january.pdf.

possibly their customers will increasingly face challenges associated with balancing the need to serve new customer demand, replace aging and leaking pipes, and maintain safety and reliability, with the need to prudently downsize the gas system and maintain reasonable rates to avoid unmanaged defection away from gas service and stranding vulnerable customers with unaffordable rates.[128]

All these points emphasize the need for clear policy leading to regulatory action. As many studies have concluded, delaying this transition will only cause higher costs for customers.[129] In order to successfully achieve decarbonization of the building sector, New Jersey will need to address these issues raised in gas system transition. New Jersey cannot afford to delay.

Opportunities

New Jersey is poised to tackle some of these issues head on. In March 2023, NJBPU opened a proceeding to address some of these limitations of the existing gas utility regulatory process, as directed by EO 317.[130] The proceeding will investigate the development of natural gas utility plans to reduce emissions consistent with the State's GHG emissions goals. EO 317 required NJBPU to consider a variety of policies, regulatory structures, and impacts, including:

- "Lowest cost mechanisms to reduce natural gas sector emissions, including a clean heat standard;
- Reliability and long-term financial viability of the natural gas utility business model;
- Minimizing investment in new infrastructure to reduce the risk of stranded costs, and eliminating subsidies encouraging natural gas infrastructure;
- Alternative business models such as converting existing pipeline infrastructure to district geothermal heating and cooling;
- Long-term impacts on residential and industrial customers unable to convert from gas to electric, specifically low-income customers; and
- Electric grid preparations to handle increased load."[131]

Numerous other states and jurisdictions have initiated similar future of gas proceedings to address many of these issues.[132, 133, 134, 135]

From an affordability lens, while gas rates will inevitably rise with large-scale building decarbonization, many studies have found that electric rates are not expected to increase as much as gas rates even with electrification, and that full electrification can mitigate total energy bill increases.[136],[137] The New Jersey Ratepayer Impact Study found that customers who adopt energy efficiency and electrification measures will have lower energy costs in 2030 than they do today, and they will have lower energy costs than households who continue to use fossil fuels in their homes and vehicles.[138] Strong electrification policies and programs targeting low-income communities can mitigate inequitable energy cost increases. Many states are prioritizing electrification programs for low-income households so they can benefit from these programs. See Section 4.8 for more information on low-income electrification programs.

Utility-specific decarbonization policies can re-orient gas utility priorities towards electrification. As noted above, EO 317 directed NJBPU to consider a Clean Heat Standard, which would require emissions reductions from heating energy utilities by requiring them to replace fossil fuel heating with clean heat measures, including energy efficiency, building electrification, and leak minimization.[139] A handful of other states have implemented or plan to implement Clean Heat Standards.[140, 141] For example, gas utilities in Colorado are required to file Clean Heat Plans

128 Synapse Energy Economics. 2020. *Gas Regulation for a Decarbonized New York*. Prepared for Natural Resources Defense Council. Available at: https://www.synapse-energy.com/sites/default/files/Gas_Regulation_Decarbonized_NY_19-082.pdf.

129 For example, a study for California found that a managed, proactive pathway is less costly and more equitable than an unmanaged "reactive" path. See: Gridworks. California's Gas System in Transition: Equitable, Affordable, Decarbonized and Smaller. September 2019. Available at: https://gridworks.org/wp-content/uploads/2019/09/CA_Gas_System_in_Transition.pdf.

130 NJBPU. 2023. "NJBPU Opens Proceeding on Natural Gas." March 6. Available at: https://www.nj.gov/bpu/newsroom/2023/approved/20230306b.html.

131 State of New Jersey Executive Order #317. February 15, 2023. Available at: https://nj.gov/infobank/eo/056murphy/pdf/EO-317.pdf.

132 New York State Public Service Commission. *Case 20-G-0131: Proceeding on Motion of the Commission in Regard to Gas Planning Procedures*. Available at: http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=20-g-0131&submit=Search.

133 California Public Utilities Commission. 2025. Order Instituting Rulemaking to Establish Policies, Processes, and Rules to Ensure Safe and Reliable Gas Systems in California and Perform Long-Term Gas System Planning. February 26. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M322/K522/322522999.pdf.

134 Massachusetts Department of Public Utilities. 2020. *Vote and Order Opening Investigation*. D.P.U. 20-80. October 29. Available at: https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/12820821.

135 Colorado Public Utilities Commission. *Docket No. 20M-0439G: Investigation into Retail Natural Gas Utility Greenhouse Gas Emissions in Accordance with House Bill 19-1261*. Available at: https://www.dora.state.co.us/pls/efi/EFI.Show_Docket?p_session_id=&p_docket_id=20M-0439G.

136 The Brattle Group. 2022. *New Jersey Energy Master Plan: Ratepayer Impact Study*. Prepared for the New Jersey Board of Public Utilities. Available at: https://www.nj.gov/bpu/pdf/reports/2022-08-13%20-%20BPU,%20EMP%20Ratepayer%20Impact%20Study%20Report_PUBLIC_Brattle.pdf.

137 Gridworks. California's Gas System in Transition: Equitable, Affordable, Decarbonized and Smaller. September 2019. Available at: https://gridworks.org/wp-content/uploads/2019/09/CA_Gas_System_in_Transition.pdf.

138 The Brattle Group. 2022. *New Jersey Energy Master Plan: Ratepayer Impact Study*. August 2022. Prepared for the New Jersey Board of Public Utilities. Available at: https://www.nj.gov/bpu/pdf/reports/2022-08-13%20-%20BPU,%20EMP%20Ratepayer%20Impact%20Study%20Report_PUBLIC_Brattle.pdf.

139 State of New Jersey Executive Order #317. February 15, 2023. Available at: https://nj.gov/infobank/eo/056murphy/pdf/EO-317.pdf.

140 State of Vermont Public Utility Commission. "Clean Heat Standard." 2024. Available at: https://puc.vermont.gov/clean-heat-standard.

141 In Maryland, the Department of Environment is required to propose both a zero-emission heating equipment standard and a clean heat standard. See "Governor Wes Moore Signs Executive Order to Advance Maryland's Pollution Reduction Plan." June 6, 2024. Available at: https://governor.maryland.gov/news/press/pages/governor-moore-signs-executive-order-to-advance-maryland%E2%80%99s-pollution-reduction-plan.aspx.

every five years that include analysis of portfolios reflecting different clean heat trajectories and resources to meet the required emissions reduction targets. The Colorado Public Utilities Commission recently ruled on Xcel Energy's Clean Heat Plan filing, approving $440 million in clean heat expenditures (most of which is directed toward energy efficiency and electrification) and rejecting proposed spending on hydrogen and certified gas.[142, 143]

New regulatory structures and proactive planning can ease the transition away from the gas system. There is increasing focus on gas non-pipeline alternatives (NPA). Of particular value for the gas transition are NPAs that allow the gas utility to retire assets rather than replace them.[144] These NPAs are based on electrifying buildings that would otherwise be served by the replaced gas assets. Where NPAs of this sort have been piloted, voluntary participation in such NPAs has not been high. Stronger regulatory action, along with planning processes that look further ahead, may be necessary. For example, Zurich, Switzerland, has retired portions of its gas system, and the City and utility have given building owners 10 years of notice for the transition, providing ample time to plan and acquire electric equipment.[145] In California, Pacific Gas & Electric Company (PG&E) developed an analysis tool to prioritize areas that are good candidates for zonal electrification, which takes into account risk, GHG reductions, equity, and costs.[146]

NPAs and targeted electrification can be implemented at a neighborhood level, as in Zurich. Some states such as Massachusetts require gas utilities to prove they considered NPAs before replacing pipes or investing in new gas system capital.[147] Other jurisdictions are reconsidering the gas utility's obligation to serve, such as by implementing moratoria on new gas customer connections. For example, Massachusetts allows up to 10 municipalities to opt in to a pilot program that bans fossil fuels in new construction.[148]

Some states are considering or have implemented modified depreciation approaches to mitigate future rate increases and stranded assets. For example, New York required its gas utilities to submit studies on the effects of alternative depreciation scenarios, including a case where all utility assets are fully depreciated by 2050.[149] Some jurisdictions are also developing integrated gas-electric utility and energy planning. For example, the State of Washington passed HB. 1589 in March 2024, which requires Puget Sound Energy, the state's largest utility, to create an integrated plan for both electric and gas operations that will achieve Washington's climate goals.[150]

4.2 GRID IMPACTS

Overview

The electrification of building end uses, particularly space heating, is expected to increase New Jersey's winter electric peak loads. This rise poses challenges and potential barriers due to the need for the electric grid to be able to support these higher loads reliably and affordably. However, it also presents opportunities to mitigate these challenges through cost-effective distributed energy resources, such as energy efficiency, load flexibility measures, solar panels, and batteries. Additionally, these challenges offer an opportunity to reform electric utilities' load forecasts and distribution planning to control costs. Potential improvements include better use of energy efficiency and load flexibility measures such as non-wires alternatives (NWA) and proactively identifying and planning for future distribution upgrade needs.

Barriers and Issues

Building electrification, along with other emerging loads such as EVs and data centers, is posing a considerable challenge for the electric grid. New Jersey's 2019 Energy Master Plan estimates that a least-cost scenario meeting GWRA's GHG reduction targets would roughly double the state's annual electric load by 2050.[151] While the 2019 Energy Master Plan does not provide peak load or annual energy increases due to building electrification, recent load forecasts incorporating the impact of aggressive building electrification reveal that winter peak loads will rise significantly, likely surpassing summer peaks in the next decade. For example, the New York Independent System Operator (NYISO) recently developed load forecasts aligned with the state's climate policy, concluding that winter peak loads are expected to increase by at least 80 percent, potentially rising to as high as 180 percent by 2050 (Figure 10). NYISO projects that while peak load impacts from building electrification will be less significant than those from EVs in the next several years, they will surpass EV impacts by the early 2030s. As a result, NYISO forecasts that winter peak loads will surpass summer peak loads between 2035 and 2038, depending on the

142 Colorado Public Utilities Commission Decision No. C24-0397, Adopted May 1, 2024, Proceeding No. 23A-0392EG.

143 Certified gas is fossil gas that has been certified to have reduced or limited upstream or midstream methane emissions.

144 2019 New Jersey Energy Master Plan, p. 36.

145 Rocky Mountain Institute and National Grid. 2024. *Non-Pipeline Alternatives: Emerging Opportunities in Planning for U.S. Gas System Decarbonization*. Available at: https://www.nationalgridus.com/media/pdfs/other/CM9904-RMI_NG-May-2024.pdf.

146 Energy and Environmental Economics, Inc., Gridworks, and East Bay Community Energy. 2023. *Strategic Pathways and Analytics for Tactical Decommissioning of Portions of Gas Infrastructure in Northern California*. Interim Report. Available at: https://gridworks.org/wp-content/uploads/2023/06/Evaluation-Framework-for-Strategic-Gas-Decommissioning-in-Northern-California-Interim-Report-for-CEC-PIR-20-009.pdf.

147 Massachusetts Department of Public Utilities. *Order on Regulatory Principles and Framework*. DPU-20-80-B. December 6, 2023. pp. 97-98. Available at: https://www.mass.gov/news/department-of-public-utilities-issues-order-20-80.

148 Massachusetts Department of Energy Resources. 2022. "Municipal Fossil Fuel Free Building Demonstration Program." Available at: https://www.mass.gov/info-details/municipal-fossil-fuel-free-building-demonstration-program.

149 New York Public Service Commission. 2022. *Order Adopting Gas System Planning Process*. May 12, Case 20-G-0131 and Case 12-G-0297. Available at: https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={130B05B5-00B4-44CE-BBDF-B206A4528EE1}.

150 HB 1589. Available at: https://app.leg.wa.gov/billsummary?BillNumber=1589&Initiative=false&Year=2023.

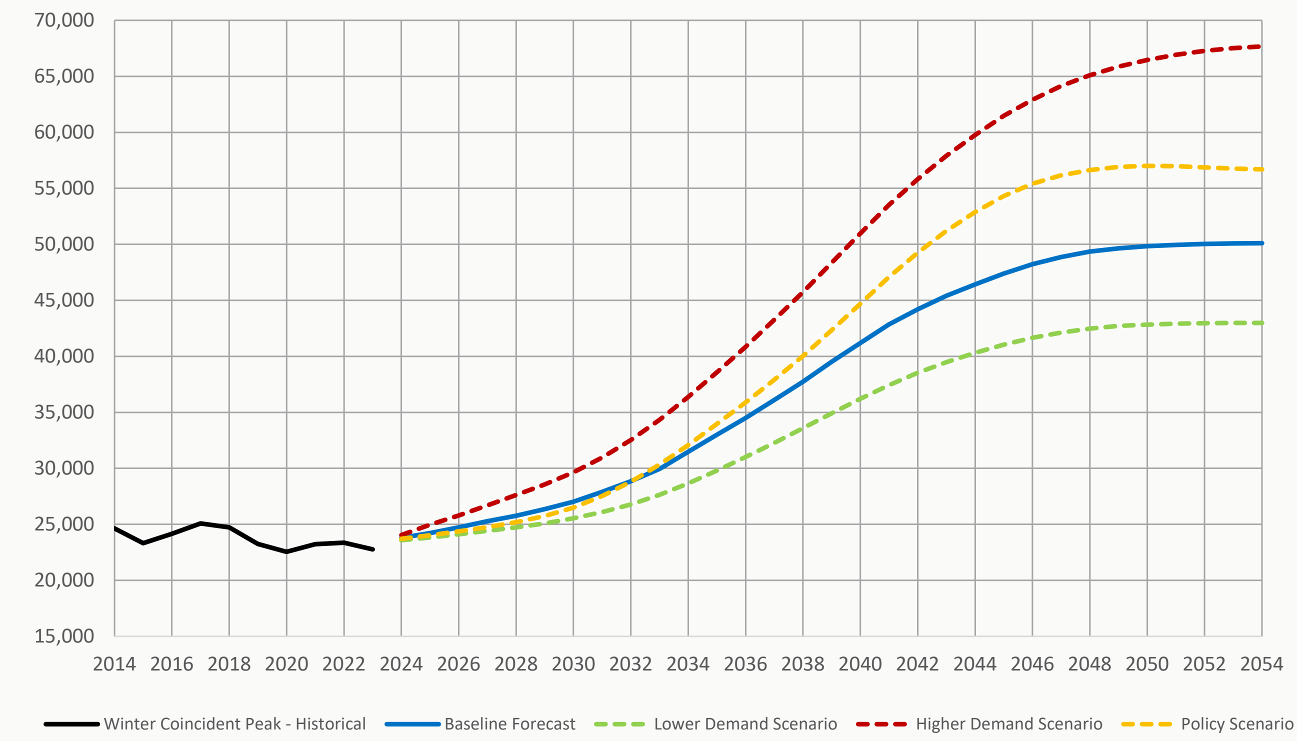
151 2019 New Jersey Energy Master Plan: Pathway to 2050. p. 49. Available at: https://nj.gov/bpu/pdf/publicnotice/NJBPU_EMP.pdf.

scenario.[152] In its baseline scenario, NYISO projects that building electrification will account for approximately 35 percent of total load in 2040 and 44 percent in 2050. As a result, peak energy demand is expected to shift from traditional summer peaks, driven by air conditioning use, to winter peaks, primarily due to increased heating demand in New York.[153] On the other hand, some jurisdictions are anticipating significant load growth driven largely by data centers—an emerging load distinct from building electrification. For example, PJM projects that the projected load increase could be substantial, with certain jurisdictions, such as Virginia Electric and Power Company (Dominion Energy Virginia) and PPL Electric, potentially seeing their total load double within the next decade due to data center growth.[154] The extent of potential data center load growth in New Jersey is uncertain, and the state may see the largest impact on the bulk power and transmission systems due to data center growth in other states.

Accommodating these new peak loads presents challenges due to the limitations of current grid infrastructure. The capacity of existing distribution—including distribution circuits, transformers, and substations—may not be sufficient to accommodate full electrification, and assets may need upgrades. Meeting this load growth could require investments in the distribution system.

The process to review and approve grid investments is inherently complex and time-consuming. It involves multiple stakeholders, including government agencies, utility companies, and affected communities. Delays in this process could significantly impede the progress towards full building decarbonization. If not managed and planned efficiently, these delays could also hinder New Jersey's ability to meet Its GHG reduction targets. Proactive planning and streamlined approval processes are essential to avoiding delays and ensuring a smooth transition to a decarbonized building sector.

Figure 10. NYISO 2024 winter peak forecasts by scenario (MW)



Source: NYISO. 2024. Gold Book: Load & Capacity Data. Figure I-3. Available at: https://www.nyiso.com/documents/20142/2226333/2024-Gold-Book-Public.pdf.

152 New York Independent System Operator (NYISO). 2024. Gold Book: Load & Capacity Data. Available at: https://www.nyiso.com/documents/20142/2226333/2024-Gold-Book-Public.pdf.

153 For example, see Table I-1d of NYISO's 2024 load forecast, available at: https://www.nyiso.com/documents/20142/2226333/2024-Gold-Book-Public.pdf.

154 PJM. 2024. "2025 Preliminary PJM Load Forecast." Available at: https://www.pjm.com/-/media/DotCom/committees-groups/subcommittees/las/2024/20241209/20241209-item-03---2025-preliminary-pjm-load-forecast.ashx; Howland, E. 2024. "PJM expects summer peak load to grow 2% a year on average, driven by data centers." December 10. *UtilityDive*. Available at: https://www.utilitydive.com/news/pjm-load-forecast-data-center-dominion-virginia/735056/.

Opportunities

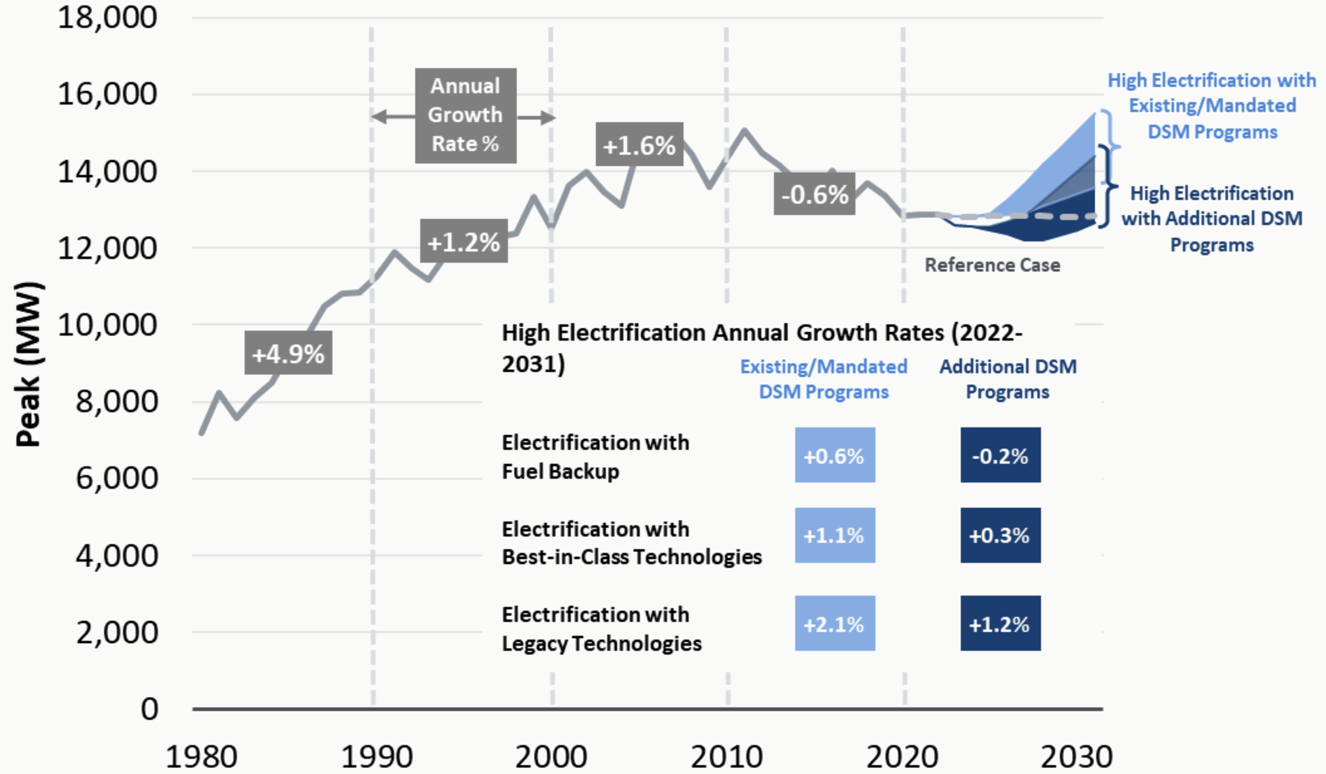
While the anticipated load growth due to building electrification is significant, it is not unprecedented—many states including New Jersey experienced equal or more significant load growth in the 1970s and 1980s. In New Jersey, peak loads in Atlantic City Electric Company (ACE) and Jersey Central Power & Light Company (JCP&L) territories rose by 60 percent and 100 percent from 1971 to 1990, respectively. On an annual basis, this corresponds to growth rates of 2.5 percent per year for ACE and 3.7 percent for JCP&L.[155] Maryland and New York's planners estimate annual compound peak demand growth rates around 2 to 3 percent to accommodate building and transportation electrification, so New Jersey has seen similar rates before.

Despite the challenges posed by this anticipated load growth, it presents various opportunities to reduce peak loads cost-effectively through low-cost demand-side measures such as energy efficiency and load flexibility measures (See Section 5.2 for details of energy efficiency measures and programs). For example, a recent study conducted for the Maryland Public Service Commission analyzed the potential peak load impacts of building electrification towards the state's 60 percent GHG reduction targets by 2031 and concluded that the projected growth rates align with historical trends seen in past periods of grid expansion.[156] Importantly, the study found that peak load increases can be mitigated considerably through energy efficiency and demand response/load flexibility measures (see the text box below).

Electrification Impacts on the Maryland Electric Grid

A recent study by Brattle Group conducted for Maryland Public Service Commission examined the electric system impacts of building electrification towards the statewide GHG reduction requirements of 60 percent by 2031. The study modeled various scenarios and found annual growth rates of 0.6 to 2.1 percent through 2031 in scenarios where utilities implement mandated minimum demand-side management programs. The lowest growth rate represents a scenario assuming a "hybrid solution" to space heating where fossil backup heating is used during the coldest hours of the year, and the highest growth rate represents a scenario where legacy heat pump technologies are assumed (instead of advanced cold-climate heat pumps). The study further found that the load growth could be mitigated to -0.2 to 1.2 percent per year if utilities implement additional energy efficiency and load flexibility measures (e.g., time-varying rates, smart thermostat load controls, smart water heating, managed EV charging, battery storage). The study concludes that these projected peak growth rates are consistent or lower than historical levels of Maryland load growth.

Figure 11. Historical and projected Maryland annual load growth



Source: Brattle Group. 2023. An Assessment of Electrification Impacts on the Maryland Electric Grid. https://www.psc.state.md.us/wp-content/uploads/Corrected-MDPSC-Electrification-Study-Report-2.pdf.

155 New Jersey 1991 Energy Master Plan. Chapter 8. Figure 8-5 and Figure 8-8. Available at: https://www.nj.gov/emp/home/docs/pdf/1991empch8-11.pdf.

156 Brattle Group. 2023. *An Assessment of Electrification Impacts on the Maryland Electric Grid*. https://www.psc.state.md.us/wp-content/uploads/Corrected-MDPSC-Electrification-Study-Report-2.pdf.

As another example, a 2021 study from the American Council for an Energy-Efficient Economy (ACEEE) examined various demand-side measures in an electrification scenario for the Independent System Operator-New England (ISO-NE) and found substantial winter peak load reduction potential.[157] The study found that a standard package of energy efficiency measures, including thermal envelope improvements and better performance of cold-climate heat pumps, could reduce peak residential and commercial load by 7%, equivalent to the output of about 10 peaker plants. Additionally, load flexibility measures including smart thermostats, load controls of water heaters, and managed EV charging and battery storage could reduce peak loads by 12%. In the most ambitious scenario, the study concluded that an "ambitious but plausible" set of demand-side retrofits including deep retrofits, advanced rooftop HVAC system controls, and energy information management systems could achieve a peak reduction of 34%.

Demand-side technologies are evolving, offering new load flexibility measures to manage electric system loads. U.S. DOE has been assessing the potential of such measures along with distributed energy resources and advanced meter infrastructure (e.g., smart meters)[158] over the past several years. They released the reports "A National Roadmap for Grid-Interactive Efficient Buildings" in 2021[159] and another report "Decarbonizing the U.S. Economy by 2050: A National Blueprint for the Buildings Sector" in 2024.[160] In addition to the measures mentioned above (e.g., smart thermostats, EV managed charging), these reports identified several new load flexibility measures[161] and found approximately three to four times greater peak reduction potential from load flexibility measures compared to current demand response capabilities.[162]

The expected load increases also provide New Jersey with the opportunity to improve the existing distribution planning process so that distribution utilities can more accurately forecast the expected load growth from building electrification and other new loads (e.g., EVs and data centers), incorporate distributed energy resources such as NWAs (which avoid or defer distribution and transmission wire investments) and develop optimized grid investment plans. More specifically, such improvements in distribution planning could proactively assess:

1. How much of the expected electrification the existing distribution systems (e.g., circuits and substations) can accommodate, which is called distribution headroom analysis;[163]
2. How many NWAs the existing distribution systems can accommodate and reduce the needs for capacity upgrades; and
3. Determine when and how much additional capacity is needed to meet the long-term peak load increases.

Several states, including Colorado and Massachusetts, recently adopted holistic legislation that requires electric distribution companies to develop proactive distribution plans that upgrade distribution systems to accommodate electrification and distributed energy resources to meet the states' long-term climate targets.[164]

Furthermore, proactive distribution planning will make the process more transparent by developing and sharing hosting capacity maps for electrification and distributed energy resources, such as solar photovoltaics (PV). This will inform interested parties (e.g., developers, building owners) where they can install electrification technologies or distributed energy resources without straining the grid.

A growing number of utilities, including those in New Jersey, have developed hosting capacity maps.[165] Utilities initially started developing hosting capacity maps for solar installations, and many of them now have hosting capacity maps for EVs. Among them, New York is a step ahead of other states; the investor-owned electric utilities in the state recently expanded their existing EV hosting capacity maps and created electrification hosting capacity maps, which include building electrification. This was done in compliance with the New York Public Service Commission's "Order Directing Energy Efficiency and Building Electrification Proposals" issued on July 20, 2023, in Case No. 18-M-0084.[166]

Proactive grid planning will enable faster electrification and optimal grid investments, reducing the unit costs of the investments by taking advantage of economies of scale. However, utilities, regulators, and consumers need to be diligent about examining a reasonable level of prudent, proactive grid investment.[167]

157 Specian, M. Cohn. C., and York. D. 2021. *Demand-Side Solutions to Winter Peaks and Constraints*. ACEEE. Available at: https://www.aceee.org/sites/default/files/pdfs/u2101.pdf.

158 U.S. DOE called technologies together "grid-edge" technologies or "grid-interactive efficient building (GEB)" technologies.

159 U.S. DOE. 2021. *A National Roadmap for Grid-Interactive Efficient Buildings*. Available at: https://gebroadmap.lbl.gov/.

160 U.S. DOE. 2024. *Decarbonizing the U.S. Economy by 2050: A National Blueprint for the Buildings Sector*. https://www.energy.gov/eere/articles/decarbonizing-us-economy-2050.

161 Including HVAC integrated and add-on module thermal storage, thermal storage integrated with equipment or envelop materials, and bi-directional EV charging.

162 U.S. DOE. 2021. *A National Roadmap for Grid-Interactive Efficient Buildings*. p. 72. Available at: https://gebroadmap.lbl.gov/.

163 See a high-level headroom analysis of distribution utilities in New York "Assessment of Electric Grid Headroom for Accommodating Building Electrification" recently conducted by Synapse Energy Economics, available at: https://nyforcleanpower.org/headroom-assessment/.

164 Massachusetts's Act Driving Clean Energy and Offshore Wind. Available at: https://malegislature.gov/Laws/SessionLaws/Acts/2022/Chapter179; Colorado's SB24-218 - Modernize Energy Distribution Systems. Available at: https://leg.colorado.gov/bills/sb24-218.

165 U.S. DOE. " U.S. Atlas of Electric Distribution System Hosting Capacity Maps." Available at: https://www.energy.gov/eere/us-atlas-electric-distribution-system-hosting-capacity-maps.

166 New York Public Service Commission. 2023. *Order Directing Energy Efficiency and Building Electrification Proposals*. Case No. 18-M-0084, issued July 20, 2023. Available at: https://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?Mattercaseno=18-M-0084.

167 For detailed discussion on this topic, see Energy Systems Integration Group. 2024. *Grid Planning for Building Electrification*. page 43-46. Available at: https://www.esig.energy/grid-planning-for-building-electrification/.

4.3 BILL AND RATE IMPACTS

Overview

Energy service affordability is a key priority for the State. Energy rates and bills are deeply intertwined with New Jersey's energy landscape, state programs and policies, and the feasibility of decarbonization strategies. Electrification of New Jersey's buildings will shift energy consumption away from natural gas and towards electricity. This will change the fuel share of energy consumed by building end uses, and thus the energy bills paid by residents and businesses. Furthermore, building decarbonization will have an impact on the electric and gas rates charged by New Jersey's utilities. Rate and bill impacts are a cross-cutting issue tied to many topics discussed in this chapter. This section provides a summary of the key drivers and potential barriers to building decarbonization specific to utility rates and energy bills. The section then discusses opportunities for addressing those barriers.

Barriers and Issues

Today, gas bills can be lower than electric bills for space and water heating, depending on the region, particularly where electricity prices are relatively higher or gas prices are relatively lower. While heat pump technologies are several times more efficient than combustion-based gas equipment, the price differential between electricity and gas can sometimes be a barrier to converting customers from gas to electricity (in addition to the upfront cost barrier, discussed in Section 3.1). Existing literature indicates that energy bills could increase or decrease after switching a building from natural gas to electrification, depending on price differentials between gas and electricity prices and heating and cooling loads. A 2022 analysis by the Acadia Center found that switching to efficient heat pumps for space and water heating could result in slightly lower annual utility bills for a typical New Jersey home and slightly higher bills for a drafty home.[168] The study also found that weatherization could reduce utility bills by 7 percent for an average home and by up to 45 percent for a drafty home. Further, the study highlighted differences in bill impacts from heating electrification across utility jurisdictions, with typical homes in New Jersey Natural Gas (NJNG) territory achieving 30 percent savings, whereas those in Public Service Electric and Gas Company (PSE&G) territory experienced no cost reductions. A 2024 study by Lawrence Berkeley National Laboratory included a comprehensive analysis of customer bill impacts for building electrification retrofits across the country and found that approximately half of the households in the Northeast that switch from gas to electricity could see their energy bills increase.[169]

The potential for higher bills from electrification is a significant concern for low-income households. Low-income customers may face higher barriers to electrification because they often pay higher energy bills relative to their income than higher-income households.[170] Without intentional actions to mitigate potential bill increases due to electrification of gas end uses, building decarbonization initiatives risk exacerbating already high energy burdens among low-income households.

As discussed in Section 4.1, gas rates are likely to increase substantially in the future as gas customers use less gas and leave the gas system as a result of building electrification. The New Jersey Ratepayer Impact Study estimated that volumetric gas rates would increase by over a third by 2030 compared to 2020 levels.[171] This raises important equity and affordability concerns. Low-income and disadvantaged communities are more likely to not have the resources to electrify and thus may be left on the gas system and paying for increasingly expensive gas to heat their homes.

Opportunities

In the long term, electric rates are expected to remain relatively stable, in real terms. The New Jersey Ratepayer Impact Study estimated that electric rates would be only 4 percent higher by 2030 compared to 2020 levels.[172] This is in part because the downward rate pressure resulting from increased electricity sales for building and transportation electrification is expected to counterbalance the upward rate pressure from increased transmission and distribution investments required to support the electric grid.

As a result, there is a great opportunity to electrify building end-uses to reduce total energy bills in the long term. Decarbonization strategy modeling from New Jersey and several other jurisdictions has found that electrification is the least-cost pathway, and building decarbonization will not dramatically impact households' energy bills.[173] The Rate Impact Study for the New Jersey's 2019 Energy Master Plan found that, under the least-cost pathway, total energy costs will decrease in 2030 from today for customers who adopt energy efficiency, EVs, and electric heating.[174] The

168 The Acadia Center. 2022. *The Future is Electric: Helping New Jersey Live in Cleaner, Healthier and More Affordable Homes*. Available at: https://acadiacenter.wpenginepowered.com/wp-content/uploads/2022/02/AC_PH_NJ_R8.pdf.

169 Miller, Cesca et al. 2024. *The Customer Bill Impacts of Efficient Building Electrification*. Lawrence Berkely National Laboratory. Available at: https://emp.lbl.gov/publications/customer-bill-impacts-efficient.

170 Drehobl, A., L. Ross, and R. Ayala. September 2020. *How High Are Household Energy Burdens? An Assessment of National and Metropolitan Energy Burden across the United States*. American Council for an Energy Efficient Economy. Available at: https://www.aceee.org/sites/default/files/pdfs/u2006.pdf.

171 Under the Energy Master Plan Achievement Pathway. The Brattle Group. 2022. New Jersey Energy Master Plan: Ratepayer Impact Study. p. 22. Prepared for the New Jersey Board of Public Utilities. Available at: https://www.nj.gov/bpu/pdf/reports/2022-08-13%20-%20BPU,%20EMP%20Ratepayer%20Impact%20Study%20Report_PUBLIC_Brattle.pdf

172 Under the Energy Master Plan Achievement Pathway. The Brattle Group. 2022. New Jersey Energy Master Plan: Ratepayer Impact Study. p. 23. Prepared for the New Jersey Board of Public Utilities. Available at: https://www.nj.gov/bpu/pdf/reports/2022-08-13%20-%20BPU,%20EMP%20Ratepayer%20Impact%20Study%20Report_PUBLIC_Brattle.pdf

173 2019 New Jersey Energy Master Plan.

174 New Jersey Energy Master Plan: Ratepayer Impact Study. Prepared for the New Jersey Board of Public Utilities. Available at: https://www.nj.gov/bpu/pdf/reports/2022-08-13%20-%20BPU,%20EMP%20Ratepayer%20Impact%20Study%20Report_PUBLIC_Brattle.pdf

study emphasized the importance of programs targeting LMI customers to ensure that those customers can adopt energy efficiency and electrification equipment.

In addition, efficient, flexible and grid-interactive buildings can provide energy savings and reduce system and customer costs.[175] Energy efficiency and demand response programs can provide customers opportunities to manage bills by using less energy and at non-peak times. The 2022 Acadia study mentioned above found that weatherization can reduce energy bills for space heating by 20 to over 60 percent.[176] Similarly, time-varying rates or other innovative rate designs can be an effective way to incentivize customers to use energy more efficiently.[177] If these kinds of flexible rate structures are offered, households might find ways to reduce the bills they pay by consuming energy at off-peak times. And when many customers alter their demand through these types of programs, it can reduce overall electric system costs for all customers.

Programs or policies can also be implemented to improve the economics of electrification relative to continued gas use. For example, a seasonal discount on electricity in the winter, which is currently the peak gas season, would help reduce bill increases faced by customers who switch to electric from gas heating. In some states such as California, utilities are adopting different rate designs (such as income-based fixed charges) to address equity issues while also lowering volumetric electric rates.[178]

4.4 BUILDING UPGRADE CONSTRAINTS

A range of physical constraints can act as barriers to building decarbonization. Examples include health and safety barriers, electrical service restrictions, equipment system compatibility issues, and space limitations.[179,180] Overcoming these constraints may increase retrofit costs and exacerbate affordability issues with building decarbonization.[181] For most combustion appliances and equipment, there will be exactly one opportunity for end-of-life replacement before New Jersey must meet its 2050 GWRA decarbonization requirements. Addressing technical barriers takes time and planning and should be initiated before existing equipment fails, lest building owners default to like-for-like replacement of existing systems.[182]

Acknowledging this, the State of New Jersey seeks to make at least 10 percent of all LMI properties electrification-ready by the year 2030.

This section reviews the leading barriers and constraints to building electrification and energy efficiency, as well as potential opportunities associated with addressing them. Notably, overcoming such constraints can provide a range of non-energy benefits and clear the way for other energy upgrades such as on-site solar photovoltaics and vehicle electrification. Section 6.1 discusses strategic policy and programmatic planning approaches to overcome building upgrade constraints.

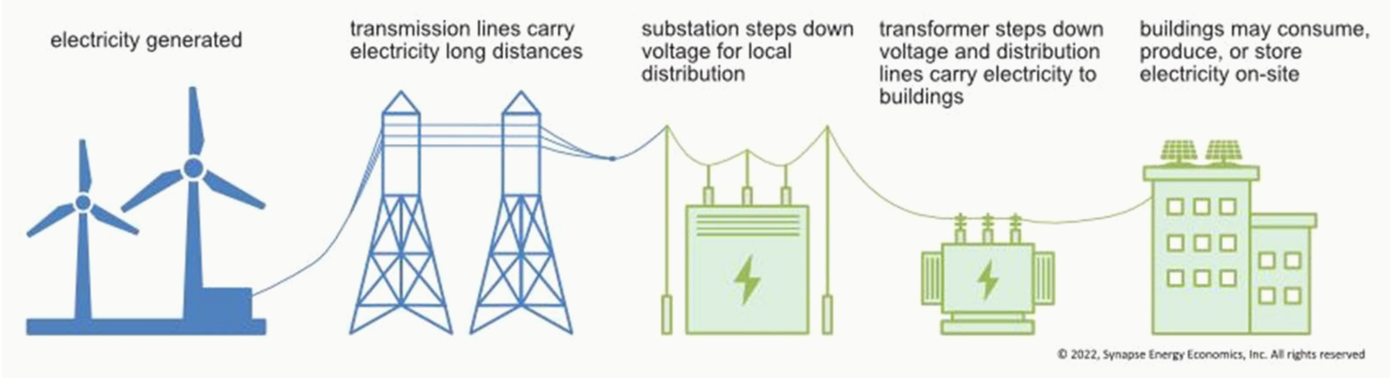
Barriers and Issues

Health and safety risks. Building safety hazards not only pose a risk to occupants, but such hazards also may preclude energy efficiency and electrification measures.[183] New Jersey's PCAP identifies several types of safety hazards to address: water intrusion, mold, asthma triggers, asbestos, radon, slip-and-fall risks, pests, electrical deficiencies, lead-based paint, lead service lines, and other existing toxins and contaminants. These challenges can pertain to commercial and residential buildings alike. Regulations on building materials and construction practices have eliminated certain hazards in newer construction, but older buildings may still contain lead-based paint, knob-and-tube wiring, and asbestos. Under-resourced communities are more likely to face such barriers[184] and are simultaneously less able to afford the mitigation measures that would enable weatherization to proceed. Buildings that require substantial health and safety upgrades are often deemed ineligible for ratepayer- or grant-funded retrofit programs.[185]

Electrical infrastructure. Conveying electricity from power plants to end-use equipment in buildings is a multi-stage process, with electrical infrastructure at each step (Figure 12). Each piece of infrastructure is designed with a maximum capacity, from the transmission lines that carry bulk power to the electric service panels inside a building.

175 RAP and Synapse. 2021. *Regulating Renovation to Electrify Buildings: A Guide for the Handy Regulator*. https://www.synapse-energy.com/sites/default/files/rap-shipley-hopkins-takahashi-farnsworth-renovating-regulation-electrify-buildings-2021-january.pdf.
176 Acadia Center. 2022. *The Future Is Electric: Helping New Jersey Live in Cleaner, Healthier and More Affordable Homes*. Available at: https://acadiacenter.org/resource/the-future-is-electric/.
177 RAP and Synapse. 2021.
178 Yim, E., and S. Subramanian. 2023. *Equity and Electrification-Driven Rate Policy Options*. American Council for an Energy-Efficient Economy. Available at: https://www.aceee.org/sites/default/files/pdfs/equity_and_electrification-driven_rate_policy_options_-_encrypt.pdf.
179 Bastian, H., and C. Cohn. 2022. *Ready to Upgrade: Barriers and Strategies for Residential Electrification*. Washington, DC: American Council for an Energy-Efficient Economy. www.aceee.org/research-report/b2206.
180 Nadel, S., and C. Perry. 2020. *Electrifying Space Heating in Existing Commercial Buildings: Opportunities and Challenges*. Washington, DC: American Council for an Energy-Efficient Economy. www.aceee.org/research-report/b2004.
181 U.S. Department of Energy. 2024. *Decarbonizing the U.S. Economy by 2050 A National Blueprint for the Buildings Sector*. Available at: https://www.energy.gov/eere/decarbonizing-us-economy-2050-national-blueprint-buildings-sector.
182 In absence of solutions to technical barriers, the need to quickly restore energy services (e.g., heating and hot water) when an existing equipment system fails may preclude installing all-electric systems.
183 Building Electrification Institute. 2024. *Boston Funding Gap Analysis for Residential Building Decarbonization*. Available at: https://www.beicities.org/boston-fga.
184 Energy Futures Group. 2020. *Overcoming Weatherization Barriers*. Available at: https://e4thefuture.org/wp-content/uploads/2021/01/Weatherization-Barriers-White-Paper-1-6-21.pdf.
185 U.S. Department of Energy. 2024. "Weatherization Health and Safety." Available at https://www.energy.gov/scep/wap/weatherization-health-safety.

Figure 12. Diagram of the Electric Grid



Building decarbonization solutions must be adaptable to the constraints and opportunities of the electric grid, while interacting sensibly with the electrical equipment within the building, including other building systems. Through strategic planning, buildings can be decarbonized in a way that works within existing constraints and balances costs against potential benefits to the owner, occupants, and society. Many of the costs of maintaining and upgrading the power grid to serve increasing load are typically socialized across utility customers; however, building owners who request increased service capacity (e.g., to meet increased loads from electrification) may be responsible for the cost of incremental upgrades to the electric distribution system. Key electrical components that may constrain building electrification include the following: [186, 187]

- **Existing panel electrical capacity**, typically measured in amps, may be insufficient to meet the building electrical load post-electrification.
- **Existing panel breaker space** may preclude adding dedicated circuits for new electric equipment and appliances.
- **Utility service capacity** to the building may be insufficient to carry additional load. This can be true for service conductors (wires), transformers, or both.
- **Distribution system capacity** may also be limited, particularly in dense, urban settings with older infrastructure. Capacity constraints may exist at substation transformers, distribution feeders, and distribution lines.

Inadequate ventilation. Ventilation standards are minimum requirements in modern codes that specify how much outside ventilation air must be supplied to a building or portion of a building.[188] These standards are important for ensuring indoor air quality. Building equipment systems installed prior to the advent of modern building codes may lack adequate ventilation and can be grandfathered under the codes in place at the time the system was installed. Buildings that convert HVAC systems to all-electric technologies may trigger code requirements, particularly when such alterations are substantial (e.g., replacing the existing heating distribution system),[189] and compliance can be costly.

Historic buildings. Owners of historic buildings may face challenges to decarbonization due to special limitations on changes to appearance and historic features. Approaches to eliminating emissions from such properties will vary on a building-by-building basis according to the existing characteristics of the building as well as the specific historic preservation requirements that pertain. Historic provisions may require moving the retrofit equipment to locations that are less visible from the public right-of-way.

Space constraints for heat pumps. Like most code-regulated building equipment systems, heat pumps have space requirements that must be met. ASHPs and AWHPs, like most air conditioning equipment, need to be installed in a location with adequate airflow for the outdoor heat exchanger.[190] Equipment clearance requirements, property setback requirements, and space limitations in dense, urban areas may pose a challenge to installation. Similarly, GSHPs and WSHPs require access to sufficient land or water area, for installing vertical wells or boreholes, horizontal trenches, or coiled piping heat exchange loops. Airflow issues can be problematic for HPWHs, particularly when installed in utility closets or other small rooms.

Opportunities

Co-benefits to addressing building upgrade constraints. In addition to preparing buildings for electrification and energy efficiency, addressing the technical barriers discussed above can help prevent disease and injury, increase the quality of life for residents, and protect

186 Wamburu, J., Bashir, N., Irwin, D. and Shenoy, P., 2023. "Analyzing the Impact of Decarbonizing Residential Heating on the Electric Distribution Grid." *ACM SIGENERGY Energy Informatics Review*, 3(2), pp. 47-60. Available at: https://dl.acm.org/doi/10.1145/3607114.3607119.

187 Opinion Dynamics. 2024. *Fuel Substitution Behind the Meter Infrastructure Market Study: Equity Segment*. Available at: https://pda.energydataweb.com/api/view/3967/Fuel%20Substitution%20Behind%20the%20Meter%20Infrastructure%20Market%20Study%20Equity%20Segment%20DRAFT%202024-05-08.pdf.

188 See, for example: *ANSI/ASHRAE Standard 62.1, Ventilation and Acceptable Indoor Air Quality*. Available at: https://www.ashrae.org/technical-resources/bookstore/standards-62-1-62-2.

189 Mass Save. 2021. "Existing Building Energy Code FAQ – Residential." Available at: https://www.masssave.com/-/media/Files/PDFs/Partners/Tool-and-Resources/Residential-Existing-Building-Energy-Code-FAQ.pdf.

190 Rosenberg, J. 2021. *Electrify Everything In Your Home: A Guide To Comfy, Healthy, Carbon-Free Living*. Available at: https://www.rewiringamerica.org/electrify-home-guide.

vulnerable individuals such as people with asthma, children, the elderly, and immunocompromised individuals.

Eliminating pre-existing issues through electrification. In certain circumstances, electrification can avert the need for costly upgrades to address existing building deficiencies. For example:

- Panel and wiring upgrades made to enable electrification can also clear the way for adding other decarbonization strategies that require dedicated panel capacity, such as solar PV or EV charging.
- Gas and propane appliances and customer-owned pipes are prone to leaks, which can be eliminated by removing the associated equipment through electrification.
- Electrifying combustion equipment that is improperly vented or lacks makeup air[191] obviates the need to re-vent or supply makeup air.
- Combustion appliances and equipment can also contribute to moisture issues (water vapor is a byproduct of combustion) and replacing these with heat pumps helps reduce related problems.
- Most types of HPWHs blow indoor air across cold refrigerant coils to extract the heat. As the air cools, water vapor in the air condenses, a process which can help remove moisture from overly humid spaces. Mechanical closets, basements, and laundry rooms can be a fortuitous place for HPWHs if such rooms are currently too hot or too humid.

Programs to address barriers. Some jurisdictions have created successful programs to remove health and safety barriers to enable energy efficiency and electrification work for income-eligible households, such as Connecticut's Residential Energy Preparation Services (REPS) program.[192] New Jersey also recently launched the Whole House Pilot, a holistic housing intervention program aiming to address health, safety, and housing quality issues that prevent households from participating in the State's income-eligible energy efficiency program called Comfort Partners (See Section 5.2 for more information about this pilot program).

Electrical load management strategies. Strategic approaches to load management at the building level, however, can avert the need for replacing electrical equipment and infrastructure in many cases. These include adding sub-panels, load-sharing, smart circuit breakers, circuit pausers, meter collars, smart panels, and more.[193] In addition, energy efficiency measures, particularly weatherization, are highly effective in significantly reducing building energy loads during the winter season.[194] Further, a recent survey found that most households use only a fraction of their total panel capacity—35 percent on average—with 86 percent of households having peak load under 50 amps.[195]

Resources for addressing barriers to building upgrades. There is a preponderance of publicly available resources to address barriers to building upgrades. Useful reference guides include the Building America Solution Center,[196] Whole Building Design Guide,[197] Redwood Energy all-electric retrofit pocket guides,[198, 199] Rewiring America home electrification guide,[200] and more. Additionally, federal funds, including new sources under the IRA, could be used to address barriers to building upgrades; for example, states can use Home Electrification and Appliance Rebates program funds for panels and wiring.[201]

4.5 CONSUMER ADOPTION

Overview

An important part of reaching New Jersey's building decarbonization goals will include the electrification of building end uses, or the replacement of fossil-fuel-fired equipment with electric alternatives. Making this transition happen will require consumers to be on board with adopting these technologies, as well as for them to be accessible and affordable. Financial barriers, such as high upfront costs and misaligned incentives among different market actors (e.g., renter vs. owner), as well as a lack of information around electrification technologies

191 Makeup air, as the name suggests, "makes up" the air exhausted from a building for combustion appliances or other sources of indoor air pollutants. Where exhaust fans, clothes dryers, and kitchen ventilation systems interfere with the operation of appliances, by code, makeup air must be provided.

192 Connecticut Department of Energy and Environmental Protection. 2024. "Residential Energy Preparation Services (REPS)." Available at: https://portal.ct.gov/deep/energy/conservation-and-load-management/weatherization-barrier-mitigation.

193 Redwood Energy. 2022. *A Pocket Guide to All-Electric Retrofits of Single-Family Homes*. Available at: https://www.redwoodenergy.net/research/a-pocket-guide-to-all-electric-retrofits-of-single-family-homes; Walker, Iain and B. Less. 2023. "Low-Power Home Electrification: the Key to Avoiding Electric Panel Upgrades." *2023 National Home Performance Conference*. Available at: https://homes.lbl.gov/sites/default/files/2023-04/BPA_NHPC23-LowPowerElectrification.pdf.

194 Quinnell et al. 2022. "It's All About the Envelope: Prioritizing Envelope Upgrades for Electrification of Cold Climate Homes." Proceeding of 2022 Summer Study on Energy Efficiency in Buildings. Available at: https://www.mncee.org/paper-its-all-about-envelope-prioritizing-envelope-upgrades-electrification-cold-climate-homes.

195 Home Energy Analytics. 2024. *Determining Electrical Panel Utilization with Smart Meter Data*. Available at: https://corp.hea.com/electricpanel.

196 U.S. Department of Energy. 2024. "Building America Solution Center." Available at: https://basc.pnnl.gov.

197 National Institute of Building Sciences. 2024. "Whole Building Design Guide." Available at: https://wbdg.org.

198 Redwood Energy. 2022. *A Pocket Guide to All-Electric Retrofits of Commercial Buildings*. Available at: https://www.redwoodenergy.net/research/redwood-energys-pocket-guide-to-all-electric-commercial-retrofits. pp. 18, 26, 27, 38, 45.

199 Redwood Energy. 2022. *A Pocket Guide to All-Electric Retrofits of Single-Family Homes*. Available at: https://www.redwoodenergy.net/research/a-pocket-guide-to-all-electric-retrofits-of-single-family-homes. pp. 7, 20, 21.

200 Rosenberg, J. 2021. Electrify Everything In Your Home: A Guide To Comfy, Healthy, Carbon-Free Living. Available at: https://www.rewiringamerica.org/research/electrify-home-guide.

201 U.S. Department of Energy. 2024. "Home Electrification and Appliance Rebates." Available at: https://www.energy.gov/scep/home-electrification-and-appliance-rebates.

and building energy performance, can hinder customers from electrifying their homes or buildings. Through NJCEP and utility programs, New Jersey is working to improve adoption and make these technologies more accessible and affordable. Federal funding could also help to fund incentives and training programs to lower the customer costs of efficient electric equipment and support contractor education around these technologies. Section 5 discusses current building decarbonization efforts being led in the state in further detail.

The rest of this section discusses some of the barriers to adoption, as well as opportunities to overcome these challenges.

Barriers and Issues

There are several factors that a homeowner or building manager may consider when purchasing a new system, such as a heat pump or electric cooktop.

One major barrier is the upfront cost and a lack of access to capital for some customers. According to the *Decarbonizing the U.S. Economy by 2050* report by the U.S. DOE, "One in five American adults lives in a household that was behind on energy bill payments for at least one month in 2023," and "three in five Americans live paycheck to paycheck."[202] This, coupled with the steep rise in housing costs relative to income between 2019 and 2023, may make grappling with the high capital costs of high-performing electric equipment infeasible.[203] Low-income customers in particular may not pay income tax, rendering them ineligible for electrification or energy efficiency tax credits.[204] An ASHP (before including any available incentives) can cost over twice as much as a new natural gas or delivered fuel-based space heating system, and the average incentive for a heat pump is not always able to make up the difference.[205] Jurisdictions with high electricity rates may also yield higher operating costs than natural gas equivalent systems.

Customers with functional existing fossil fuel equipment may also be unmotivated to replace their equipment before the end of its lifetime. In the case of sudden failures of fossil fuel space heating or water heating equipment, replacement of such equipment can be an emergency, and customers may not have enough time to fully search for appropriate electric heat pump options or for contractors who are well-informed about the technologies. Customers or contractors may also not find appropriate heat pump options available and end up installing a similar gas heating system because they lack sufficient time to wait for the products to come in stock.[206] In such emergencies, customers may also not have the luxury of taking the time to have panel upgrades done or upgrade their electric service in cases where that would be necessary in order to switch to an electric system.[207]

Renters face other types of obstacles to building decarbonization. Specifically, renters and building owners have split incentive issues, where building owners do not typically have financial incentives to install energy efficient equipment because they do not pay for energy bills and therefore would not see a personal return on their investment in the form of energy savings.[208] Renters are unable to take advantage of many such incentives or rebates themselves because they do not own their own equipment.

A lack of knowledge (or familiarity) about electrification and energy efficiency technologies including their benefits poses another major barrier to the adoption of those technologies. For example, the U.S. DOE assesses that, "Heat pumps are not extensively marketed to consumers in regions where they are currently less common and the decarbonization potential is greatest, such as the Northeast, Mid-Atlantic, and Great Lakes."[209] Regions with lower heat pump adoption are typically those with cold winter climates, where the need for cold-climate performance poses challenges for achieving efficient building decarbonization. The continued adoption of partial heat pump replacements, where a heat pump is installed with the existing fossil-fired heating system as a supplemental or backup heating system, make complete building decarbonization difficult—particularly in large commercial buildings.[210] Misinformation about the ability of heat pump technology to provide sufficient heating contributes to this — highlighting the need for greater awareness of heat pump performance and cold-climate heat pumps, particularly as advancements in heat pump technologies regularly occur. As another example, consumers are often not aware of induction cooking technologies and their benefits: induction cooktops are very energy efficient technologies and produce no emissions and thus pose no risk of indoor air pollution and health issues; they also pose little-to-no fire-related risk as they don't need to burn fossil fuels for cooking. Raising awareness of this kind

202 U.S. Department of Energy. 2024. *Decarbonizing the U.S. Economy by 2050: A National Blueprint for the Buildings Sector*. Available at: https://www.energy.gov/eere/articles/decarbonizing-us-economy-2050.
203 Ibid.
204 Cohn, C., and N. W. Esram. 2022. *Building Electrification: Programs and Best Practices*. American Council for an Energy-Efficient Economy. Available at: aceee.org/researchreport/b2201.
205 Ibid.
206 U.S. Department of Energy. 2024. *Decarbonizing the U.S. Economy by 2050: A National Blueprint for the Buildings Sector*. Available at: https://www.energy.gov/eere/articles/decarbonizing-us-economy-2050.
207 Pacific Gas and Electric Company. 2022. *Service Upgrades for Electrification Retrofits Final Study Report*. Available at: https://pda.energydataweb.com/api/view/2635/Service%20Upgrades%20for%20Electrification%20Retrofits%20Study%20FINAL.pdf.
208 Cohn, C., and N. W. Esram. 2022. *Building Electrification: Programs and Best Practices*. American Council for an Energy-Efficient Economy. Available at: aceee.org/researchreport/b2201.
209 United States Department of Energy. 2024. *Decarbonizing the U.S. Economy by 2050: A National Blueprint for the Buildings Sector*. Available at: https://www.energy.gov/eere/articles/decarbonizing-us-economy-2050.
210 Ibid.

of information about induction cooking is important to promote electrification.[211]

A lack of proper knowledge about energy usage can also be a major barrier to building decarbonization. This includes information about a building's energy performance and how its energy usage compares to other buildings. Without proper information about building energy usage, (a) homeowners or commercial property owners or managers cannot make informed decisions on cost-effective energy retrofits; (b) actors in the real estate market (i.e., buyers, tenants and lenders) cannot correctly value properties and thus cannot make informed decisions when purchasing or renting a new property; and (c) policymakers cannot develop the right building performance standards or other policies that can be used to promote energy efficiency and reduce emissions from homes and buildings.

Finally, another barrier to adoption is an overall lack of availability of technologies. Shortages of heat pumps in the supply chain and the higher manufacturing costs of heat pumps compared to air conditioners both contribute to this.[212]

Opportunities

Incentives are an important and effective way to make the adoption of efficient and electric equipment more affordable for consumers and to assist their transition away from fossil-fuel-based heating or other end uses. In tandem, on-site, zero-carbon energy generation such as rooftop solar can effectively reduce electric energy bills as people electrify their buildings.[213] As will be discussed in Section 5.2, NJCEP and the utilities' energy efficiency programs are now offering incentives and financing for building electrification in their second Triennium plans, which began in January 2025. Federal programs like the IRA could also support this effort. As the largest investment in clean energy and climate action in U.S. history, the IRA could provide rebates, tax credits, and financing options towards energy efficiency and building decarbonization technologies, with increased incentives for underserved communities.[214] More information on state and federal financial incentives can be found in Section 5.3.

When retailers or distributors do not have enough stock or appropriate products in stock, simply providing more incentives may not work for some customers who cannot afford to wait (e.g., in emergency situations). To address such situations, programs can offer midstream incentives to retailers or distributors to incentivize market transformation. Distributors or retailers can then pass on discounts to contractors or venders, who in turn pass down discounts to customers. This circumvents the need for customers to apply for and claim a rebate, which can take time and may require the customer to supply the entire cost of the product before receiving reimbursement. Midstream incentives also encourage distributors or retailers to keep enough or appropriate products in stock. A study on electrification through heat pump adoption in the northeast found that of the 10 programs analyzed, most of which were downstream programs, Efficiency Vermont's midstream program achieves the highest annual heat pump installation rates.[215]

For customers for whom the upfront costs of efficient electric equipment still pose a barrier even after factoring in incentives, offering financing will be critical for making purchases less burdensome. A recent study from the Harvard Kennedy School estimated that "approximately $100 billion to $150 billion per year of financing will be needed over the next 30 years to retrofit existing buildings in the United States alone, if their operational emissions are to be reduced significantly to contribute toward reaching net-zero emissions economy-wide by 2050."[216] New Jersey is already addressing this barrier through some of the State's initiatives. The recently created New Jersey Green Bank will offer financing options to aid in the transition towards energy efficiency and zero-carbon energy supply in the commercial, industrial, and institutional sectors.[217, 218] NJEDA's New Jersey Clean Energy Loans program offers co-lending for small businesses (under 750 employees) for clean energy projects through reduced interest rate financing.[219] The Garden State Commercial Property Assessed Clean Energy Program is another such state financing option for commercial property owners. Section 5.2 describes these and other programs. All public electric and gas utilities in the state also currently offer financing.

211 William J Worthen Foundation. *The Building Decarbonization Practice Guide – A Zero Carbon Future for the Built Environment*. Volume 5: All-Electric Kitchen: Residential + Commercial. Available at: https://worthenfoundation.org/get-the-guide-bdpg.

212 Cohn, C., and N. W. Esram. 2022. *Building Electrification: Programs and Best Practices*. American Council for an Energy-Efficient Economy. Available at: https://www.aceee.org/research-report/b2201.

213 U.S. Department of Energy. 2024. *Decarbonizing the U.S. Economy by 2050: A National Blueprint for the Buildings Sector*. Available at: https://www.energy.gov/eere/articles/decarbonizing-us-economy-2050.

214 The White House. 2023. "Fact Sheet: One Year in, President Biden's Inflation Reduction Act Is Driving Historic Climate Action and Investing in America to Create Good Paying Jobs and Reduce Costs." Available at: https://www.whitehouse.gov/briefing-room/statements-releases/2023/08/16/fact-sheet-one-year-in-president-bidens-inflation-reduction-act-is-driving-historic-climate-action-and-investing-in-america-to-create-good-paying-jobs-and-reduce-costs/.

215 Vermont Energy Investment Corporation (VEIC). 2018. *Driving the Heat Pump Market: Lessons Learned from the Northeast*. Prepared for the Natural Resources Defense Council (NRDC). Available at: https://www.veic.org/Media/default/documents/resources/reports/veic-heat-pumps-in-the-northeast.pdf.

216 Chang, J., Fornara, M., & Sanghvi, R. 2024. *Financing Building Decarbonization: The Roles of Government and Private Sector Investors*. January 22. Available at: https://www.belfercenter.org/sites/default/files/pantheon_files/files/publication/Chang%20Fornara%20Rushabh_Building%20Decarbonization_Final_1.pdf.

217 State of New Jersey, Office of Governor. 2024. "ICYMI: NJEDA Establishes New Jersey Green Bank to Advance Climate Goals." April 15. Available at: https://www.nj.gov/governor/news/news/562024/approved/20240415a.shtml.

218 Coalition for Green Capital. "New Jersey Announces Funding for a Green Bank". Available at: https://coalitionforgreencapital.com/new-jersey-announces-funding-for-a-green-bank/.

219 New Jersey Economic Development Authority. 2024. "New Jersey Clean Energy Loans (NJ CELs)." Available at: https://www.njeda.gov/njcels/.

PSE&G, for example, offers up to $25,000 per household with zero interest for 10 years.[220] Finally, Massachusetts's Mass Save HEAT Loan offers an exemplary example of financing offerings for residential customers, providing up to $50,000 per household with zero-percent interest for seven years for energy efficient home upgrades.[221]

Education about available technologies can benefit building owners and tenants as well as contractors. In particular, focusing education in LMI communities can help prioritize customers who can benefit the most from low-carbon equipment.[222] A study by Cornell University found that state-level education programs can help residential customers reduce their energy use by up to 20 percent.[223] Within these programs, strong educational messaging promotes not only the emission reduction potential of electric technologies, but focuses on the economic and health benefits as well. For instance, switching to electric resistance or induction cooktops can eliminate the air pollution and respiratory risks associated with gas stoves.[224] Homeowners and building owners often rely on contractors for suggesting appropriate space or water heating systems. So, it is also important for program administrators to reach out to contractors and share critical information about new technologies including installation best practices. For example, program administrators can share information about emerging technologies such as lower-power heat pumps (e.g., 120 volt plug-in heat pump water heater),[225] induction stoves with built-in batteries,[226] smart circuit switches (that allow switching between two high-voltage devices such as an induction range and an EV charger), and smart panels[227] as these technologies can circumvent the need for panel upgrades and accelerate consumer adoption for building electrification, although these may take time to gain traction in the market.[228]

Setting up a clearinghouse, or "one-stop shop" for consumers to access information on building decarbonization, can make the process of researching and obtaining new equipment and incentives easier to access and navigate. In 2022, the Massachusetts Commission on Clean Heat recommended that Mass Save, the state's program to advance cost-effective energy efficiency, establish a Clearinghouse to "'connect the dots' between Massachusetts' programs, helping contractors, residents, commercial and industrial building owners, and other businesses assess possible building interventions, understand and access benefits, optimize project sequencing, and leverage funding resources in a more straightforward and streamlined manner than is possible today."[229] Providing a central point of contact and administration will help facilitate the coordination of all building decarbonization programs across the state as well as the coordination across different entities from the planning stage to the installation stage for consumers.

To most effectively overcome barriers to adoption, states will need to come at them from all angles. A new program in New England will aim to do just that, putting many of these opportunities into practice. On July 22, 2024, New England was awarded $450 million in funding from the Climate Pollution Reduction Grants (CPRG), a $4.6 billion program created by the IRA.[230] With this funding, a coalition consisting of Massachusetts, Connecticut, Maine, New Hampshire, and Rhode Island will create a program called the New England Heat Pump Accelerator ("Accelerator"), aimed at having 65 percent of residential space heating, cooling, and water heating sales be for heat pumps by 2035. The Accelerator will consist of a Market Hub, Resource Hub, and Innovation Hub, each aimed at targeting a unique barrier to heat pump adoption. The Market Hub will aim to "engag[e] manufacturers, distributors, and contractors to drive the sales, stocking, and quality installation of heat pumps suited to New England's climate and housing stock."[231] This initiative will also include mid-stream incentives for distributors and contractors to draw the market forward and will provide training and education to contractors on cold-climate heat pumps and whole-

220 PSE&G. "HVAC Instant Rebates Program." Available at: https://homeenergy.pseg.com/heatingandcooling.
221 Mass Save. "0% Interest Financing." Available at: https://www.masssave.com/residential/programs-and-services/financing.
222 United States Climate Alliance. 2021. *Building Decarbonization Roadmap*. Available at: https://usclimatealliance.org/wp-content/uploads/2023/04/USClimateAlliance_Guide_BuildingDecarbonizationRoadmap_2021.pdf.
223 Laquarta, J., Pierce, M. R., & Helmholdt, N. 2009. The Consumer Education Program for Residential Energy Efficiency. The Journal of Extension, 47(6), Article 6. https://tigerprints.clemson.edu/joe/vol47/iss6/6.
224 According to the Rocky Mountain Institute, gas stoves can emit carbon monoxide and levels of nitrogen dioxide that exceed both indoor guidelines and outdoor standards. See: Seals, B. and Krasner, A. 2020. *Health Effects from Gas Stove Pollution*. Rocky Mountain Institute, Physicians for Social Responsibility, Mothers Out Front, and Sierra Club. Available at: https://rmi.org/insight/gasstoves-pollution-health.
225 Hot Water Solutions. "120V Heat Pump Water Heater Product Overview." Available at: https://hotwatersolutionsnw.org/partners/news/120-volt-heat-pump-water-heater-productoverview; Jeff St. John. 2022. "Finally, a heat-pump water heater that plugs into a standard outlet." Available at: Canary Media (August 29, 2022). https://www.canarymedia.com/articles/heat-pumps/finally-a-heat-pump-water-heater-that-plugs-into-a-standard-outlet.
226 Maria Virginia Olano. 2022. "This startup is adding a battery to induction stoves." Canary Media. Available at: https://www.canarymedia.com/articles/electrification/this-startup-is-adding-a-battery-to-induction-stoves.
227 Redwood Energy. 2022. *A Pocket Guide to All-Electric Retrofits of Single-Family Homes*. p. 76, Available at: https://www.redwoodenergy.net/research/a-pocket-guide-to-all-electric-retrofits-of-single-family-homes; Walker, Iain and B. Less. 2023. "Low-Power Home Electrification: the Key to Avoiding Electric Panel Upgrades." *2023 National Home Performance Conference*. Available at: https://homes.lbl.gov/sites/default/files/2023-04/BPA_NHPC23-LowPowerElectrification.pdf.
228 United States Department of Energy. 2024. *Decarbonizing the U.S. Economy by 2050: A National Blueprint for the Buildings Sector*. Available at: https://www.energy.gov/eere/articles/decarbonizing-us-economy-2050.
229 Massachusetts Commission on Clean Heat. 2022. *Massachusetts Commission on Clean Heat: Final Report*. Available at: https://www.mass.gov/doc/massachusetts-commission-on-clean-heat-final-report-november-30-2022/download.
230 Mass.gov. "Healey-Driscoll Administration Celebrates $450 Million EPA Award to Rapidly Accelerate Adoption of Heat Pumps". Press Release, offered by Governor Maura Healy and Lt. Governor Kim Driscoll, Executive Office of Energy and Environmental Affairs. July 22, 2024. Available at: https://www.mass.gov/news/healey-driscoll-administration-celebrates-450-million-epa-award-to-rapidly-accelerate-adoption-of-heat-pumps.
231 Ibid.

home electrification. The Resource Hub, on the other hand, will serve as a central clearinghouse for all stakeholders in the heat pump supply chain, from distributors to contractors and program implementers, to access consistent and relevant data and information.[232] Finally, the Innovation Hub will specifically target LMI customers, with each state completing up to two large-scale projects, such as networked geothermal heat pump systems and other large heat pump projects.[233]

Besides financial incentives and customer and contractor outreach efforts, regulations can be very effective in overcoming consumer adoption barriers. Regulations such as energy disclosure and benchmarking regulations provide valuable insights about building energy usage compared to similar buildings, allowing building owners to identify the magnitude of potential energy and cost savings and make informed decisions about energy system improvements.[234] New Jersey is one of six states that have statewide energy benchmarking policies for large public and commercial buildings. Some other jurisdictions also require additional actions for these buildings such as imposing fines for non-compliance.[235] Some jurisdictions, such as Massachusetts, have benchmarking requirements with a lower threshold for the size of building floor space compared to New Jersey (e.g., 20,000 sq. ft. gross floor area in Massachusetts, versus 25,000 sq. ft in New Jersey).[236]

Advanced building codes and appliance/equipment standards could also help address customer adoption issues because such policies could be designed to make electrification a requirement, which would lead to a substantial increase in customer adoption of electrification and a cost reduction due to the economies of scale. For example, Massachusetts recently developed and put in place a voluntary energy code called the "specialized stretch energy code" that promotes the construction of all-electric and net-zero energy buildings.[237] This voluntary code will become a mandate once municipalities choose to adopt it. Appliance standards can be used to promote electrification in a different way. For example, in its Climate Pollution Reduction Plan, Maryland recently proposed a new policy called Zero-Emission Heating Equipment Standard (ZEHES), which would require building owners to install zero-emission heating systems (e.g., heat pumps) when replacing the pre-existing heating systems. Maryland will start a rulemaking process for the ZEHES this year and propose draft regulations in 2025.[238]

4.6 WORKFORCE

Overview

Achievement of New Jersey's building decarbonization goals will require significant growth and investment in its building decarbonization workforce. Put differently, the current level and size of skilled workforce in the industry will not be able to support the State's building decarbonization goals. Building decarbonization often includes electrification and energy efficiency, such as installation of heat pump space and water heating technologies. Therefore, as demand for building decarbonization increases, so will the demand for jobs to support energy efficiency and electrification, such as electricians, HVAC contractors, architects, and energy auditors. In 2020, there were approximately 32,000 energy efficiency jobs in New Jersey, including jobs in the HVAC, ENERGY STAR and efficient lighting, advanced materials, and other energy efficiency technologies sectors.[239] Energy-efficiency-related jobs have grown to approximately 38,270 jobs as of 2023, representing a 20 percent increase over the past four years, with an annual average growth rate of 6.5 percent.[240] According to the *Green Jobs for a Sustainable Future* report published by the NJ Council on the Green Economy, the number of jobs in the energy efficiency industry is projected to more than triple in New Jersey by 2031 relative to 2020. Current green policies and investments in New Jersey will drive the creation of nearly 70,000 additional job-years in the energy efficiency industry by 2031.[241, 242] The growth in demand for energy efficiency and building decarbonization services offers the opportunity to transform the New Jersey economy and improve equity through targeted creation of high-quality[243] local jobs that can't be outsourced or automated, such

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232 Ibid.
233 Ibid.
234 Institute for Market Transformation (IMT). *Energy Benchmarking and Transparency – Benefits*. Available at: https://imt.org/resources/fact-sheet-energy-benchmarking-and-transparency-benefits/.
235 Institute for Market Transformation (IMT). "Building Performance Policies You Should Know." Available at: https://imt.org/public-policy/maps-and-comparisons/; IMT. 2024. *Comparison of U.S. Commercial Building Energy Benchmarking and Transparency Policies*. Available at: https://imt.org/resources/comparison-of-commercial-building-benchmarking-policies/.
236 IMT. 2024; Massachusetts Department of Energy Resources. "Large Building Energy Reporting." Available at: https://www.mass.gov/info-details/large-building-energy-reporting.
237 Massachusetts Department of Energy Resources. "Energy Efficiency Provisions of the State Building Code." Available at: https://www.mass.gov/info-details/building-energy-code.
238 Northeast Energy Efficiency Partnerships. 2024. "Maryland Releases Comprehensive Climate Pollution Reduction Plan." Available at: https://neep.org/blog/maryland-releases-comprehensive-climate-pollution-reduction-plan.
239 New Jersey Council on the Green Economy. 2022. *Green Jobs for a Sustainable Future*. Leveraging Our Strengths to Grow and Inclusive Green Economy, p. 6. Available at: https://www.nj.gov/governor/climateaction/documents/CGE%20Roadmap.pdf.
240 U.S. Department of Energy. 2024. *Energy Employment By State 2024*. Available at: https://www.energy.gov/sites/default/files/2024-09/USEER%202024%20States_0913.pdf.
241 New Jersey Council on the Green Economy. 2022. p. 7.
242 A job-year represents one year of employment for one person. For example, a construction job that lasts five years would be equivalent to five job-years.
243 The NJ Green Jobs Report defines high-quality jobs as those that are family-sustaining, high-wage, safe, and with a pathway to a full-time career.

as energy auditors and HVAC installers.[244, 245] However, growing the building decarbonization industry at the rate necessary to achieve New Jersey's goals is unprecedented and thus will require targeted efforts from the State and from within the industry. Lack of knowledgeable or skilled workers could inhibit progress towards achieving building decarbonization goals. Other potential challenges include enabling workers to transition from careers in legacy (i.e., fossil-fuel-based) energy systems to new positions in the building decarbonization industry and ensuring that members of overburdened communities can access new jobs and workforce development training and apprenticeship programs. These issues and potential opportunities are discussed more below.

Barriers and Issues

Given the forecasted increase in jobs for building decarbonization, it is important to ensure there are workers available to meet demand. A Massachusetts workforce needs assessment identified the type of occupations that will be at the highest risk of becoming bottlenecks in the state's decarbonization efforts due to potential labor shortages relative to future demand.[246] Many of these include building decarbonization occupations, such as electricians, HVAC installers and mechanics, construction laborers, and construction and building inspectors. New Jersey is likely to experience similar constraints, and the unavailability of skilled workers could limit progress towards New Jersey's building decarbonization goals.

An assessment of New Jersey's energy efficiency workforce needs and Business Industry Leadership Team (BILT) meetings, as covered in Section 5.4, identified several challenges related to training, hiring, and recruiting new energy efficiency workers. These include a lack of qualified candidates to fill instructor positions, an absence of clearly defined pathways and career trajectories, and a misalignment of education and training programs with industry needs.[247] Additionally, as part of the PCAP development process, stakeholders mentioned difficulty accessing information regarding workforce opportunities as a barrier to building GHG reduction measures.[248]

Among existing workers, a lack of knowledge of building decarbonization technologies (such as cold-climate heat pumps, 120 Volt plug-in heat pump water heaters, and smart circuits), or lack of familiarity with installation best practices (such as how to properly size and install heat pumps or how to avoid expensive panel upgrades) can hinder building decarbonization progress. A national study conducted by ACEEE reported that many program administrators and experts emphasized lack of qualified contractors as a barrier to heat pump adoption and electrification.[249]

The PCAP notes that skill gaps and licensing barriers can set back decarbonization efforts. For example, if HVAC technicians are unfamiliar with the latest heat pump technologies and how to install them, they are unlikely to recommend this technology to customers or install them. Further, counties in New Jersey have different building and construction requirements, which can create licensing barriers and thus limit the availability of workers who can install decarbonization technologies.[250] The 2019 Energy Master Plan discusses how a lack of training or awareness can create barriers to implementing building decarbonization technologies:

> The growth of building electrification and energy efficiency is dependent upon a community of builders, trades professionals, installers, energy managers, real estate agents, and customers who are knowledgeable about the different technologies available to them. Lack of awareness, education, training, and accessibility of recently developed and emerging-market technologies and appliances creates barriers to both the implementation of building efficiency measures and building electrification.
>
> Currently, professionals and customers are sometimes unaware of the costs and benefits associated with electrification and energy efficiency technologies. This makes builders unlikely to implement them in their construction, and customers unlikely to ask about them for their homes or businesses. Increased awareness of these technologies can lead to greater implementation in the state's building sector and growth of New Jersey's energy efficiency market.[251]

Additionally, without targeted intervention, it is likely that members of historically underrepresented and overburdened communities will not benefit from the growing building decarbonization economy. The *Green Jobs for a Sustainable Future* report finds that there is no guarantee that all New Jersey residents will have the same

244 State of New Jersey. 2020. 2019 New Jersey Energy Master Plan: Pathway to 2050, p. 204. Available at: https://nj.gov/emp/docs/pdf/2020_NJBPU_EMP.pdf.
245 U.S. Department of Energy. 2024. *Decarbonizing the U.S. Economy by 2050*. A National Blueprint for the Buildings Sector, p. 9. Available at: https://www.energy.gov/eere/articles/decarbonizing-us-economy-2050.
246 Massachusetts Clean Energy Center. 2023. *Powering the Future: A Massachusetts Clean Energy Workforce Needs Assessment*. Available at: https://www.masscec.com/resources/massachusetts-clean-energy-workforce-needs-assessment.
247 Donovan, Brittney, Maruska, Grace, Sherwani, Sahar, and Walsh, Stephanie. 2024. *New Jersey's Energy-Efficiency Workforce Needs, Infrastructure, and Equity Assessment*. Heldrich Center for Workforce Development. Available at: https://njcepfiles.s3.amazonaws.com/New_Jerseys_Energy_Efficiency_Workforce_Needs_Infrastructure_+and_Equity_Assessment.pdf.
248 NJ Department of Environmental Protection and Rutgers Climate Change Resource Center. 2024. *New Jersey's Priority Climate Action Plan*. (NJ PCAP), p. 138. Available at: https://dep.nj.gov/wp-content/uploads/climatechange/nj_pcap_final-1.pdf.
249 York, Dan, Marti Shoemaker, and Grace Relf. 2022. *Building Electrification: Programs and Best Practices*. ACEEE. Page 57. Available at: https://www.aceee.org/sites/default/files/pdfs/b2201.pdf.
250 NJ PCAP, p. 260.
251 2019 New Jersey Energy Master Plan p. 226.

level of access to new green jobs.[252] It also finds that absent specific programs to promote diversity, it is likely that the benefits of a growing green economy will not equitably reach members of underserved communities and the workforce will continue to under-represent New Jersey's racial and gender diversity. Although women make up half of New Jersey's labor market, they account for only 5 percent of the energy efficiency workforce.[253] Black workers are also underrepresented: they make up nearly 16 percent of the statewide workforce but only 6 percent of the energy efficiency workforce.[254] Underrepresented or underserved populations face multiple barriers, such as a lack of early awareness of the industry, unequal access to training opportunities, and inequities in hiring processes and work experiences.[255] A 2024 assessment of New Jersey's energy efficiency workforce needs, infrastructure and equity discusses a survey of energy efficiency students, trainers, workers, and business owners and finds:

> [M]any women, individuals of color, and/or individuals with disabilities are treated as less competent or valuable, denied advancement and promotion opportunities, and hear or read comments, insults, or slurs directed at them by managers, supervisors, and co-workers at their current or previous job(s). These negative experiences harm students, trainees, and workers, and have the potential to undermine efforts to create more equitable workforce development infrastructure.[256]

Other potential barriers often experienced by overburdened communities include a lack of transportation access to better quality jobs, a lack of access to affordable childcare, a lack of community representation in policy and/or decision-making, historical disinvestment that leads to poorer education systems, lower awareness about jobs and job training, and fewer opportunities for career and vocational-technical education.[257]

Another obstacle to building decarbonization is potential resistance from workers in the fossil fuel industry because the transition is likely to mean a significant decline in the number of workers employed in fossil-fuel-based businesses, such as natural gas companies and propane and oil dealers. Ensuring these workers have the knowledge and skillset necessary to transition to good-quality jobs will be important to equitable achievement of New Jersey's building decarbonization goals.

Opportunities

Expanding the building decarbonization workforce to meet New Jersey's future needs provides an opportunity to create high-quality local jobs. Energy efficiency has higher average wages compared to other industries—energy efficiency workers in New Jersey on average earn $32.38 per hour—so the growth of the building decarbonization industry means a growth in good-paying jobs in New Jersey.[258] Additionally, a 2023 national study of energy efficiency jobs found that about 70 percent of energy efficiency companies in New Jersey are small businesses with fewer than 20 employees, which offers the opportunity to ensure local and disadvantaged communities benefit from future increased demand for jobs.[259] Small local businesses tend to employ workers that spend their wages locally, which creates both direct and induced economic benefits.[260]

To fully capture the opportunity of building decarbonization for Its workforce, New Jersey must be intentional about job creation to ensure that new decarbonization jobs are good-quality jobs. Ways to promote equitable job growth in the building decarbonization industry include job quality standards, such as prevailing wage and wage floor requirements for contracts that use taxpayer or ratepayer funds, project labor and community workforce agreements, and support for unionization.[261] New Jersey can continue to build on existing prevailing wage and benefits laws. For example, the Prevailing Wage Act ensures that public works projects (i.e., projects connected to or receiving state and municipal funding) pay prevailing wages as established by the collective bargaining agreements specific to each trade or craft and locality.[262] Other states and local governments have included job quality standards within clean energy legislation. For example, Washington's Clean Energy Transformation Act (CETA) includes tax incentives for using labor standards such as a 100 percent tax exemption for projects "developed under a community workforce agreement or project labor agreement."[263] Additionally, the NJ Emerge program promotes local job creation in priority sectors and targeted communities by providing tax credits to projects that create at least 35 new full-time jobs, or 25 full-time jobs if the project is in a priority industry such as clean energy; are located within an eligible area; and ensure

252 New Jersey Council on the Green Economy. September 2022. "Green Jobs for a Sustainable Future. Leveraging Our Strengths to Grow and Inclusive Green Economy." p. 25. https://www.nj.gov/governor/climateaction/documents/CGE%20Roadmap.pdf

253 Heldrich Center for Workforce Development. 2024. New Jersey's Energy-Efficiency Workforce Needs, Infrastructure, and Equity Assessment. p. 27.

254 Ibid.

255 Massachusetts Clean Energy Center. July 2023. "Powering the Future: A Massachusetts Clean Energy Workforce Needs Assessment." p. 12.

256 Heldrich Center for Workforce Development. 2024. *New Jersey's Energy-Efficiency Workforce Needs, Infrastructure, and Equity Assessment*. p. 39.

257 NJ Department of Environmental Protection and Rutgers Climate Change Resource Center. March 2024. "New Jersey's Priority Climate Action Plan." (NJ PCAP) At pp. 242-247.

258 Heldrich Center for Workforce Development. 2024. *New Jersey's Energy-Efficiency Workforce Needs, Infrastructure, and Equity Assessment*, p. 22.

259 E4TheFuture and Environmental Entrepreneurs. 2023. *Energy Efficiency Jobs in America*. Available at:

260 New Jersey Council on the Green Economy. September 2022. *Green Jobs for a Sustainable Future*. *Leveraging Our Strengths to Grow and Inclusive Green Economy*, p. 34. Available at: https://www.nj.gov/governor/climateaction/documents/CGE%20Roadmap.pdf.

261 New Jersey Council on the Green Economy. September 2022. *Green Jobs for a Sustainable Future*. *Leveraging Our Strengths to Grow and Inclusive Green Economy*. Available at: https://www.nj.gov/governor/climateaction/documents/CGE%20Roadmap.pdf.

262 New Jersey Department of Labor and Workforce Development. "Prevailing Wage Rates on Construction-Related Public Works Projects." Available at: https://www.nj.gov/labor/wageandhour/prevailing-rates/public-works/.

263 American Council for an Energy Efficient Economy, "State and Local Policy Database: Washington." Available at https://database.aceee.org/state/washington.

that at least 80 percent of incentivized employees' time is spent within New Jersey.[264]

Some of the need for additional building decarbonization workers may be met by the transition of existing workers employed in the fossil-fuel-powered buildings sector who can transition with little to no additional training. For example, existing gas furnace or boiler service workers could transition to HVAC service jobs which focus on installing and maintaining electric heat pumps. Additionally, deployment of networked geothermal systems and GSHPs represent opportunities for existing natural gas and pipeline workers to maintain similar jobs by using their existing skills in a new way. Gas utilities could also leverage their existing rights of way to install geothermal systems, thus providing a new opportunity for utilities to transition their business to providing thermal energy rather than natural gas, and subsequently, preserving the jobs of utility employees. Because pipes for networked heating systems are made of the same materials as gas pipes, existing workers can transition with minimal additional training.[265] To tap into these opportunities, utilities in some states such as Massachusetts and New York are currently implementing networked geothermal pilot programs.[266] Similarly, as discussed in Section 5.2, two New Jersey utilities recently received approval from NJBPU to conduct feasibility studies for networked geothermal pilot programs as part of their building decarbonization start-up programs.

In contrast, other building decarbonization jobs (e.g., electricians) require significantly more training or retraining. New Jersey has the opportunity to pursue a just transition from a fossil fuel economy to a green energy economy which includes ensuring legacy workers can transition to building decarbonization jobs. In Massachusetts, the Department of Public Utilities recently ordered gas utilities to collaborate with stakeholders to establish a transition framework for gas industry workers and other people who have been left out of the clean energy transition to begin training these workers for electrification and decarbonization jobs.[267]

Finally, New Jersey has an opportunity to ensure an equitable sharing of the benefits of building decarbonization industry growth. One example of programs that specifically focus on increasing equity and diversity in the building decarbonization workforce is the New Jersey Builders Utilization Initiative for Labor Diversity (BUILD) program, which provides training opportunities for women and minorities in construction and construction-related trades.[268] In Massachusetts, the Massachusetts Clean Energy Center offers over $12 million in funding annually for Workforce Equity programs, including equity workforce training grants for organizations that offer training programs for underrepresented populations in the clean energy sector and grants for organizations supporting the minority- and women-owned businesses that focus in areas critical to the achievement of the Commonwealth's climate goals.[269]

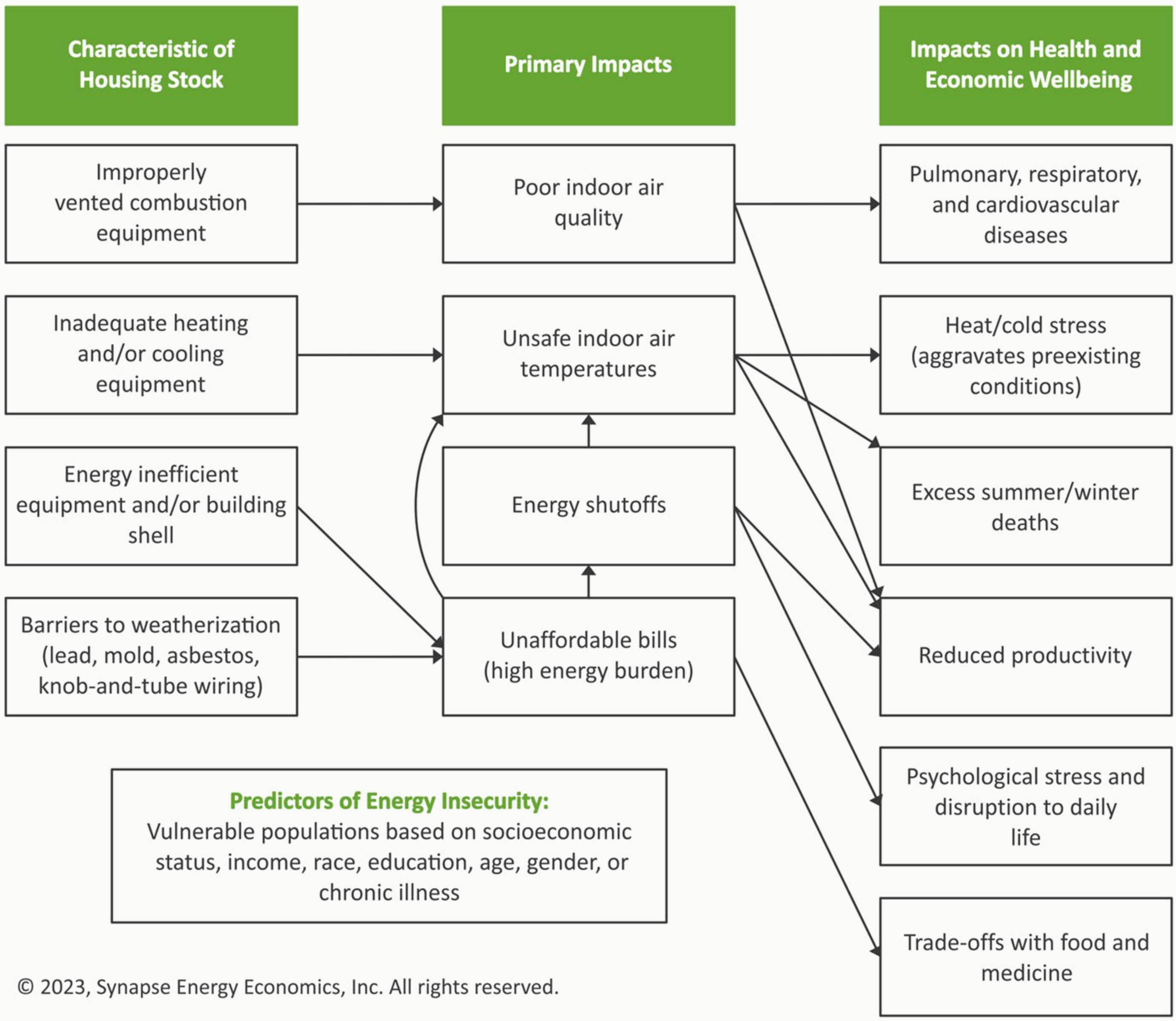
4.7 HEALTH BENEFITS

Overview

Buildings that are inefficient, highly polluting, or inadequately maintained can affect human health and wellbeing. These adverse impacts can result from poor air quality, inadequate thermal comfort, and issues with building safety (Figure 13.). Notably, the harmful health effects of fossil fuel combustion disproportionately affect low-income and minority communities. Section 4.8 provides an in-depth review of these inequities and opportunities to overcome them. Furthermore, Section 4.4 separately discusses health- and safety-related building upgrade constraints that can pose a barrier to decarbonization. In addition to reducing GHG emissions, decarbonizing buildings creates an opportunity to improve health outcomes, ensuring that people from all backgrounds have access to clean air and can afford adequate heating and cooling.

264 New Jersey Economic Development Authority (NJEDA). "Emerge Program". Available at: https://www.njeda.gov/emerge/.
265 HEET. "Workforce Transition." https://www.heet.org/workforce-transition.
266 Eversource. "Geothermal Pilot Project in Framingham." Available at: https://www.eversource.com/content/residential/about/transmission-distribution/projects/massachusetts-projects/geothermal-pilot-project; Upgrade NY. "Utility Thermal Energy Networks in action across New York." Available at: https://www.upgradeny.org/about-thermal-energy-networks.
267 Massachusetts Department of Public Utilities. *Order on Regulatory Principles and Framework*. DPU-20-80-B. December 6, 2023. Available at: https://www.mass.gov/news/department-of-public-utilities-issues-order-20-80.
268 Department of Labor and Workforce Development. "NJ BUILD (Builders Utilization Initiative for Labor Diversity)". Available at: https://www.nj.gov/labor/myunemployment/employers/njbuild.shtml.
269 Massachusetts Clean Energy Center. "Workforce Equity Programs". Available at: https://www.masscec.com/workforce/workforce-equity-programs.

Figure 13. Impacts and Outcomes of Energy Insecurity



Notes: Energy insecurity is broadly defined as the inability to adequately meet household energy needs. Adapted from: Jessel, S., Sawyer, S., and Hernandez, D. 2019. "Energy, Poverty, and Health in Climate change: A Comprehensive Review of an Emerging Literature." Front. Public Health. https://doi.org/10.3389/fpubh.2019.00357.

Barriers and Issues

Fossil fuel use in buildings is a major cause of poor indoor and outdoor air quality in the United States. Combustion appliances used for cooking and heating release a variety of air pollutants, including nitrogen oxides, carbon monoxide, methane, nitrous oxide, volatile organic compounds, trace amounts of sulfur dioxide, and particulate matter. Further, these combustion byproducts include precursors of ground-level ozone and photochemical smog, which have serious health impacts in urban areas. Emissions from fossil fuel combustion are linked to adverse health outcomes, including respiratory irritation and illnesses; cardiovascular disease; fatigue; hospitalizations; and damage to the kidneys, liver, and central nervous system.[270, 271, 272] Combustion byproducts from residential and commercial buildings contribute to an estimated 28,000 premature deaths from outdoor air pollution annually, more than any other sector, including power plants and transportation.[273] In 2018, buildings were responsible for an estimated 37 percent of early deaths attributable to combustion pollutants in the United States. Fossil fuel appliances can also create unsafe indoor conditions. Indoor air pollution can be equally or more harmful than outdoor air pollution—especially if combustion equipment is improperly vented—

270 Tran, V, Park, D, and Lee, Y-C. 2020. "Indoor Air Pollution, Related Human Diseases, and Recent Trends in the Control and Improvement of Indoor Air Quality." *Int J Environ Res Public Health*, 17(8): 2927. https://doi.org/10.3390/ijerph17082927.

271 Seals, B., Krasner, A. 2020. Health Effects from Gas Stove Pollution. Rocky Mountain Institute, Physicians for Social Responsibility, Mothers Out Front, and Sierra Club. Available at: https://rmi.org/insight/gas-stoves-pollution-health/.

272 Lin, W., Brunekreef, B. and U. Gehring. 2013. Meta-analysis of the effects of indoor nitrogen dioxide and gas cooking on asthma and wheeze in children. *International journal of epidemiology*, 42(6), pp.1724-1737.

273 Dedoussi, I.C., Eastham, S.D., Monier, E. and Barrett, S.R., 2020. Premature mortality related to United States cross-state air pollution. Nature, 578(7794), pp. 261-265.

and studies have shown median indoor concentrations are two to five times higher than outdoor pollution.[274, 275]

Multifamily apartment buildings pose particular health challenges because indoor air pollutants may move among housing units and because tenants have limited ability to change the building structure itself since they do not own it.[276] Low-income multifamily housing are especially likely to have improper ventilation for onsite fossil fuel combustion and may be more likely to use unvented heating sources due to substandard housing conditions.[277]

New Jersey is the fastest warming state in the Northeast region and average annual temperatures are expected to rise by 4.1–5.7°F by 2050.[278] As climate change continues to make extreme weather more frequent, access to cooling will become increasingly important for health outcomes. Exposure to high indoor temperatures increases the frequency of workplace accidents;[279] inhibits learning in schools;[280] and exacerbates risks of cardiovascular, respiratory, and cerebrovascular diseases.[281] According to U.S. Energy Information Administration (EIA), approximately 4 percent of housing units in New Jersey and 13 percent of commercial buildings in the region lack air conditioning.[282, 283] In 2020, an estimated 20,700 New Jersey households required medical attention because the home was too hot.[284]

High energy costs can be another cause of unhealthy conditions in buildings. Energy represents a meaningful portion of household expenditures, and households burdened by high energy bills often must choose between energy use and other necessities. A survey by the U.S. EIA found that in 2020, 18 percent of New Jersey households forwent food or medicine to pay energy costs, 9 percent reported leaving their home at an unhealthy temperature, and 8 percent received at least one disconnect notice in the past year.[285]

Energy efficiency retrofits can help alleviate high energy costs, but the associated building materials can be another source of toxic pollutants in buildings. Insulation and sealants are common sources of toxins that can harm building occupants, installation contractors, and manufacturing workers.[286] Notably, healthier alternative building materials are available, often at equal or lower cost, and can be prioritized within decarbonization programs to avoid introducing harmful pollutants.

Opportunities

Reducing the use of fossil fuels in buildings not only lowers GHG emissions; it also provides health co-benefits. Importantly, switching away from combustion reduces indoor and outdoor air pollutants that contribute to and exacerbate a variety of negative health and environmental impacts.[287, 288] Benefits include lower rates of mortality, cardiovascular disease, respiratory disease, emergency room visits, restricted physical activity, and lost work. Health benefits accrue especially for vulnerable populations with heightened susceptibility to air pollution, including children, pregnant women, older adults, and those with asthma and pre-existing heart and lung conditions.[289]

Replacing existing gas heating equipment with heat pumps can improve health outcomes by adding air conditioning to buildings that do not already have cooling

274 U.S. Environmental Protection Agency. 2022. "Why Indoor Air Quality is Important to Schools." Available at: https://www.epa.gov/iaq-schools/why-indoor-air-quality-important-schools.
275 Wallace, L.A., Pellizzari, E.D., Hartwell, T.D., Whitmore, R., Sparacino, C. and Zelon, H., 1986. Total Exposure Assessment Methodology (TEAM) Study: personal exposures, indoor-outdoor relationships, and breath levels of volatile organic compounds in New Jersey. *Environment International*, 12(1-4), pp. 369-387.
276 U.S. Environmental Protection Agency. 2022. "Indoor Air Quality in Multifamily Housing." Available at: https://www.epa.gov/indoor-air-quality-iaq/indoor-air-quality-multifamily-housing.
277 Zota, A, Adamkiewicz, G, Levy, J, and Spengler, J. 2005. "Ventilation in public housing: implications for indoor nitrogen dioxide concentrations." *Indoor Air*, 15(6):393–401. Available at: https://pubmed.ncbi.nlm.nih.gov/16268829/.
278 New Jersey Department of Environmental Protection. 2020. 2020 New Jersey – Scientific Report on Climate Change. Available at: https://dep.nj.gov/wp-content/uploads/climatechange/nj-scientific-report-2020.pdf#page=50.
279 Park, J, Pankratz, N, and Behrer, A. 2021. *Temperature, Workplace Safety, and Labor market Inequality*. Institute of Labor Economics. IZA DP No. 14560. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3892588.
280 Goodman, J, Hurwitz, M, Park, J, and Smith, J. 2018. *Heat and Learning*. National Bureau of Economic Research. Working Paper 24639. Available at: https://www.nber.org/papers/w24639.
281 U.S. Centers for Disease Control and Prevention. 2022. "Climate and Health: Temperature Extremes." Available at: https://www.cdc.gov/climateandhealth/effects/temperature_extremes.htm.
282 U.S. EIA. 2023. *Commercial Buildings Energy Consumption Survey (CBECS) 2018 Survey Data*. Accessed September 3, 2023. Available at: https://www.eia.gov/consumption/commercial/data/2018/.
283 U.S. EIA. 2023. *Residential Energy Consumption Survey (RECS) 2020 Survey Data*. Accessed September 3, 2023. Available at: https://www.eia.gov/consumption/residential/.
284 Ibid.
285 U.S. Energy Information Administration. 2023. "Table HC11.1 Household energy insecurity, 2020." Residential Energy Consumption Survey. Available at: https://www.eia.gov/consumption/residential/data/2020/hc/pdf/HC%2011.1.pdf.
286 Energy Efficiency For All. 2018. "Making Affordable Multifamily Housing More Energy Efficient: A Guide to Healthier Upgrade Materials." Available at: https://www.energyefficiencyforall.org/resources/making-affordable-multifamily-housing-more-energy-efficient-guide-healthier-upgrade/.
287 Lin, W., Brunekreef, B. and U. Gehring. 2013. "Meta-analysis of the effects of indoor nitrogen dioxide and gas cooking on asthma and wheeze in children." *International journal of epidemiology*, 42(6), pp. 1724-1737.
288 Buonocore, J.J., Salimifard, P., Michanowicz, D.R. and J.G. Allen. 2021. "A decade of the US energy mix transitioning away from coal: historical reconstruction of the reductions in the public health burden of energy." *Environmental Research Letters*, 16(5), p. 054030.
289 U.S. Environmental Protection Agency. 2023. "Research on Health Effects from Air Pollution." Available at: https://www.epa.gov/air-research/research-health-effects-air-pollution.

equipment. Similarly, HPWHs can provide free cooling and dehumidification to interior spaces.[290] Building envelope upgrades also provide an opportunity to improve the overall quality and healthfulness of the building stock. Weatherization is beneficial for reducing energy bills, enabling electrification, and increasing the comfort of living spaces. However, to prevent problems with indoor air quality, envelope upgrades must be paired with adequate ventilation and elimination or isolation of pollutant sources.[291] For example, retrofits should be designed and installed in a manner that avoids trapping moisture that can cause mold or structural damage. In addition, by reducing natural ventilation, measures that tighten building envelopes by sealing leaks may also lead to the buildup of indoor toxins. Ensuring proper ventilation and eliminating sources of pollutants is key to avoiding these risks.

The health-related benefits of building electrification are part and parcel of the New Jersey PCAP's holistic approach to healthy housing, energy efficiency, and decarbonization.[292] Further, as discussed in detail in Section 5, New Jersey has a tapestry of clean energy and efficiency programs that incentivize building decarbonization and reduce fossil fuel use.

4.8 EQUITY AND ENVIRONMENTAL JUSTICE

Overview

Recently, a growing number of states are taking steps to recognize and remediate the disproportionate social, health, and economic burdens of the energy system on low-income communities, communities of color, and disinvested communities. New Jersey has centered environmental justice and equity throughout government agencies, programs and priorities. In September 2020, New Jersey passed its Environmental Justice Law (EJ Law), which states that "all New Jersey residents, regardless of income, race, ethnicity, color, or national origin, have a right to live, work, and recreate in a clean and healthy environment; that, historically, New Jersey's low-income communities and communities of color have been subject to a disproportionately high number of environmental and public health stressors."[293]

As stated in the EJ Law, the impacts of climate change do not fall equally across all residents of New Jersey. Low-income and environmental justice communities are disproportionately impacted by air pollution and other environmental and climate-change-related stressors. To advance equity and environmental justice, building electrification strategies will need to prioritize low-income, overburdened, and underserved communities to avoid reinforcing existing socioeconomic disparities in New Jersey.

New Jersey has taken steps to identify disadvantaged communities and enact policies to reduce harm to them. As set forth in New Jersey's Environmental Justice Rules (N.J.A.C. 7:1C-1.1 to -10.3), regulated facilities seeking permits or permit renewals in "overburdened communities" must analyze their existing and potential contributions to environmental and public health stressors. Permit applications for new facilities will be denied if they cannot avoid disproportionate impacts on overburdened communities or serve a compelling public interest. New Jersey's Environmental Justice Law (N.J.S.A. 13:1D-158) defines overburdened communities as census block groups that meet the following criteria:

- At least 35 percent low-income households; or
- At least 40 percent of the residents identify as a minority or as members of a State-recognized tribal community; or
- At least 40 percent of the households have limited English proficiency.

The State must ensure that these communities reap the environmental, energy, and climate benefits of the building decarbonization transition, and minimize harm to its most vulnerable populations.

Barriers and Issues

As stated in the 2019 Energy Master Plan, New Jersey has a "responsibility to facilitate equal access to and representation in the clean energy economy and all the opportunities and benefits it provides."[294] Numerous studies have found that communities of color, low-income communities, and indigenous populations are disproportionately impacted by climate change, harmed by fossil fuel combustion byproducts, occupy residences with existing health and safety issues, and face high energy burdens when compared to other communities.[295, 296, 297] These communities have faced historical inequities and discriminatory practices that reduce their ability to overcome these burdens.[298]

290 Redwood Energy. 2022. *A Pocket Guide to All-Electric Retrofits of Commercial Buildings*. Available at: https://www.redwoodenergy.net/research/redwood-energys-pocket-guide-to-all-electric-commercial-retrofits.

291 U.S. Environmental Protection Agency. 2022. "Energy, Weatherization and Indoor Air Quality." Available at: https://www.epa.gov/indoor-air-quality-iaq/energy-weatherization-and-indoor-air-quality.

292 NJ DEP and Rutgers Climate Change Resource Center. 2024. *New Jersey's Priority Climate Action Plan*. March 2024. p. 28. Available at: https://www.epa.gov/system/files/documents/2024-03/nj-pcap.pdf.

293 New Jersey Environmental Justice Law, N.J.S.A. 12:1D-157. Available at: https://dep.nj.gov/wp-content/uploads/ej/docs/ej-law.pdf.

294 2019 New Jersey Energy Master Plan, p. 198.

295 Jbaily, A., Zhou, X., Liu, J. et al., "Air pollution Exposure Disparities Across U.S. Population and Income Groups," Nature 601, 228–233 (2022). Available at: https://doi.org/10.1038/s41586-021-04190-y.

296 Tessum, Christopher W., et al. "Inequity in Consumption of Goods and Services Adds to Racial–Ethnic Disparities in Air Pollution Exposure." March 11, 2019. Available at: https://www.pnas.org/doi/full/10.1073/pnas.1818859116.

297 J. Lewis, D. Hernandez, and A. Geronimus. March 2019. "Energy Efficiency as Energy Justice: Addressing Racial Inequities through Investments in People and Places." Energy Efficiency 13(3): 419–432. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7966972/.

298 New Jersey Department of Environmental Protection. 2024. *New Jersey Priority Climate Action Plan*, p. 85. Available at: https://dep.nj.gov/climatechange/mitigation/cprg/.

LMI households bear a higher energy burden (the percentage of income spent on energy bills) than higher-income households.[299] In 2022, 16 percent of New Jersey residents had a "high" energy burden (greater than 6 percent).[300] Statewide, the average energy burden for low-income households[301] is 9 percent, compared to 2 percent for non-low-income households. Nationally, Black, Hispanic, indigenous households, and families in low-income multifamily housing and older buildings experience disproportionately higher energy burdens.[302] This emphasizes the importance of ensuring that the building decarbonization transition does not increase energy costs for low-income and energy-burdened households.

LMI households bear a higher energy burden (the percentage of income spent on energy bills) than higher-income households. In 2022, 16 percent of New Jersey residents had a "high" energy burden (greater than 6 percent). Statewide, the average energy burden for low-income households is 9 percent, compared to 2 percent for non-low-income households.

Many of these communities who bear the greatest health, environmental, and economic hardships face the most barriers to electrification. The high cost of new technologies and a lack of access to upfront capital is a key barrier. Wealthier households can pay the upfront costs of switching to electric equipment, leaving those without those resources to pay for gas bills that are expected to increase as more and more gas customers electrify their end-use equipment and leave the system. As discussed in Section 4.1, the households who are the last to electrify will face the highest gas costs, as the fixed costs of the gas system are spread over fewer and fewer customers. In addition to financial barriers, there are physical barriers to electrification for low-income and EJ communities. Health and safety issues in buildings can be a barrier to installing energy efficiency or electrification building upgrades, as required health and safety repairs may add significant costs or result in deferral from energy efficiency or weatherization programs, and programs may not provide sufficient incentives or funding to address necessary repairs.[303] Examples include lead-based paint, mold, asbestos, roof leaks, and knob-and-tube wiring.[304] These challenges are more often experienced by renters and LMI communities.[305] Also, equipment systems and the structure of multifamily housing can pose limitations to electrification. For example, space and location constraints for electric appliances and equipment may be a challenge for multifamily building retrofits.

The so-called "split incentive" between renters and property owners poses a challenge for implementing energy efficiency or electrification building upgrades.[306, 307] Many utility-run energy efficiency programs typically target homeowners, rather than property owners or renters. If a renter pays the energy bill, the property owner does not necessarily have an incentive to invest in energy efficiency, and vice versa—if the building owners pays for energy bills, the renter may not have an incentive to reduce their energy consumption.

Finally, there are programmatic and procedural barriers to electrification. As stated in the 2019 EMP, "whether due to lack of information, opportunity, or funding, LMI communities are often unable to benefit from energy efficiency initiatives and upgrades that can reduce energy bills and improve air quality."[308] Barriers to customer engagement with these programs include lack of computer or internet access, language barriers, and lack of knowledge or awareness of the programs.[309] These barriers can make it difficult for customers to navigate programs offered by different agencies, with different eligibility requirements.

There is also a lack of representation and participation in decision-making regarding clean energy. Historically, low-income communities, rural communities and communities of color are underrepresented in regulatory processes and distributed energy resource programs decision-making.[310] These procedural barriers limit opportunities for marginalized and under-resourced communities to participate and play an active role in shaping building energy programs and policies.

299 Drehobl, A., L. Ross, and R. Ayala. September 2020. How High Are Household Energy Burdens? An Assessment of National and Metropolitan Energy Burden across the United States. American Council for an Energy Efficient Economy. Available at: https://www.aceee.org/sites/default/files/pdfs/u2006.pdf.

300 U.S. Department of Energy. Low-Income Energy Affordability Data (LEAD) Tool. Available at: https://www.energy.gov/scep/slsc/lead-tool.

301 Defined as less than 200 percent of the Federal Poverty Level.

302 Drehobl, A., L. Ross, and R. Ayala. September 2020. How High Are Household Energy Burdens? An Assessment of National and Metropolitan Energy Burden across the United States. American Council for an Energy Efficient Economy. Available at: https://www.aceee.org/sites/default/files/pdfs/u2006.pdf.

303 Residential Retrofits for Energy Equity. May 31, 2024. "The Residential Retrofits for Energy Equity Playbook." Available at: https://r2e2playbook.org/.

304 Green & Healthy Homes Initiative. 2022. *New Jersey Whole House Pilot Design Project: Asset and Gap Analysis*. Prepared for the New Jersey Board of Public Utilities. Available at: https://www.njcleanenergy.com/files/file/Library/6_17_22_GHH-NJ-Report-Final-revised.pdf.

305 Ibid.

306 Amann, J., C. Tolentino, and D. York. *Toward More Equitable Energy Efficiency Programs for Underserved Households*. May 2023. American Council for an Energy Efficient Economy. Available at: https://www.aceee.org/sites/default/files/pdfs/B2301.pdf.

307 Bird S, Hernández D. 2012. "Policy options for the split incentive: Increasing energy efficiency for low-income renters." *Energy Policy*. *Energy Policy* 48: 506–514. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0301421512004661.

308 2019 New Jersey Energy Master Plan, p. 198.

309 Amann, J., C. Tolentino, and D. York. *Toward More Equitable Energy Efficiency Programs for Underserved Households*. May 2023. American Council for an Energy Efficient Economy. Available at: https://www.aceee.org/sites/default/files/pdfs/B2301.pdf.

310 Lawrence Berkeley National Laboratory. 2021. Advancing Equity in Utility Regulation, Future Electric Utility Regulation Report. No.12, L. Schwartz, C. Farley, J. Howatt, J. Bosco, N. Thaker, J. Wise, J. Su. Available at: https://emp.lbl.gov/publications/advancing-equity-utility-regulation.

Opportunities

New Jersey has already enacted policies to prioritize environmental justice and support overburdened and LMI communities in the building electrification transition. Decarbonization actions can build upon the foundation laid by the 2019 Energy Master Plan, which set strategies to "encourage, support and enable LMI and environmental justice communities" to benefit from building decarbonization, such as by ensuring that "new and existing clean energy and bill assistance programs are widely marketed and easily accessible to LMI ratepayers and environmental justice communities."[311]

New Jersey has a goal of electrifying 10 percent of LMI households by 2030.[312] Efficient building electrification can reduce overall energy bills, as the economics of electrification will improve over time relative to natural gas use.[313] In addition, building electrification can help reduce environmental and pollution burdens. Pairing weatherization and health and safety repairs with electrification offerings can improve living conditions and occupant health (e.g., improved indoor air quality or greater thermal comfort). Efforts to decarbonize buildings can also support household and community resilience.[314]

As discussed in detail in Section 5.2, New Jersey already has clean energy and efficiency programs targeting low-income households and communities, such as the Comfort Partners Program and a Whole House pilot program.[315] The Comfort Partners program seeks to improve long-term energy affordability by providing financial assistance, energy education, and installation of energy efficient products to income-eligible customers.[316] The Whole House pilot program provides holistic health, safety, and energy efficiency interventions in low-income households in Trenton, New Jersey.[317]

Ensuring an equitable and efficient building decarbonization pathway will require multi-agency coordination and collaboration. As noted in a recent report titled *New Jersey Whole House Pilot Design Project*, successful building upgrade programs utilize a one-stop-shop model for housing, health, and energy services; establish a "robust referral network;" and incorporate customer education.[318] Other states have established 'clearinghouse' programs for energy-related assistance programs which can reduce barriers and improve access to multiple programs. As part of the statewide program called Mass Save in Massachusetts, the Low-Income Energy Affordability Network (LEAN) administers and implements a one-stop-shop program for owners and operators of multifamily low-income and affordable housing, implemented by a network of utilities, community organizations, and state agencies.[319]

As the State reinforces and expands its offerings for low-income and underserved populations, there are opportunities to modify and improve existing processes and build community partnerships. Program administrators and regulators can coordinate with trusted community organizations to support program offerings or provide program outreach and education.[320] For example, the Connecticut Department of Energy and Environmental Protection (DEEP) has proposed establishing "Community Resource Hubs" in environmental justice communities throughout the state to undertake a range of activities, including facilitating community input and participation in DEEP programs, providing technical assistance, and increasing access to federal and state funding and financial assistance.[321] In addition, many states are working to facilitate greater input and participation in existing programs and regulatory policies, such as by providing funding for intervenor training or compensation, or conducting energy education and outreach.[322] It will also be important to track equity metrics (e.g., energy burden, frequency of energy shutoffs, or health impacts) to ensure decarbonization efforts help correct systemic equity issues and ensure progress toward program goals. For example, many states such as Illinois have implemented equity tracking metrics for the utility energy efficiency programs based on stakeholder advisory group discussions.[323]

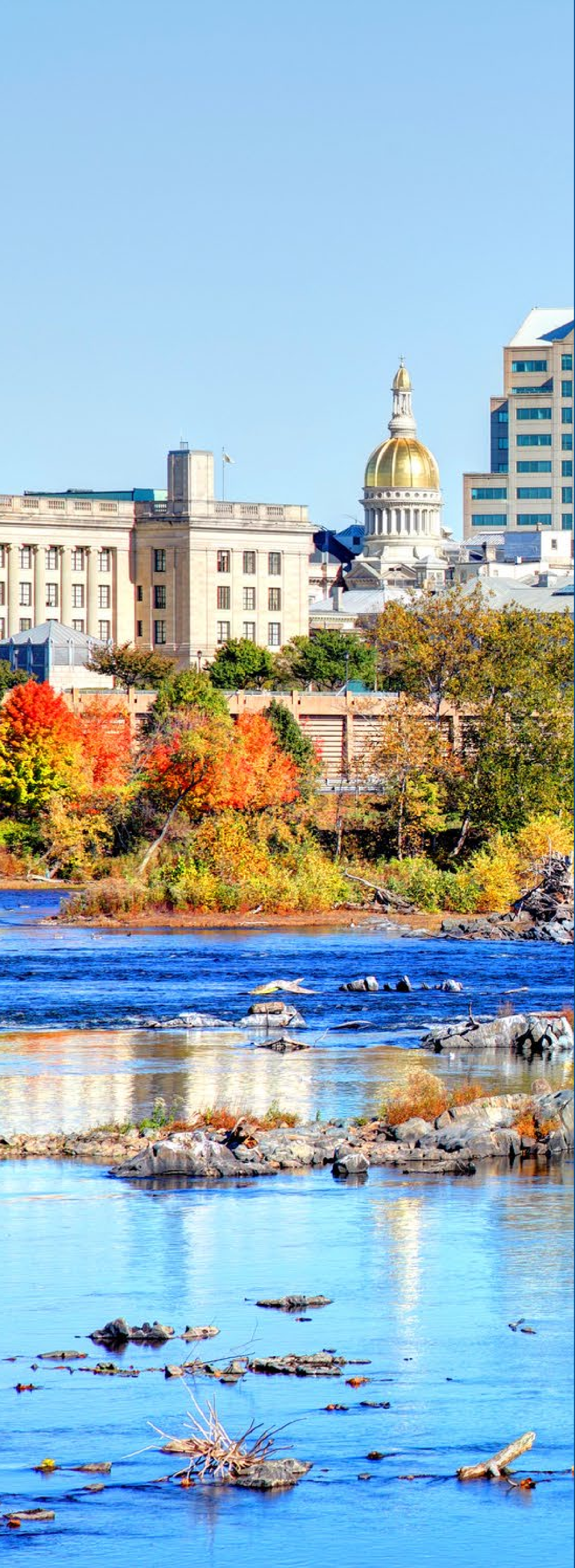
There are numerous funding opportunities to support these programs and actions. Leveraging and combining these funding sources can help ensure the successful implementation of building energy upgrade programs

311 2019 New Jersey Energy Master Plan, p. 198.
312 2019 New Jersey Energy Master Plan, p. 39.
313 Yim, E., and S. Subramanian. 2023. Equity and Electrification-Driven Rate Policy Options. ACEEE. aceee.org/white-paper/2023/09/equity-and-electrification-driven-rate-policy-options.
314 U.S. DOE. Decarbonizing the U.S. Economy by 2050. p. 17 Available at: https://www.energy.gov/eere/articles/decarbonizing-us-economy-2050.
315 NJ Clean Energy Program. "Comfort Partners." https://njcleanenergy.com/residential/programs/comfort-partners/comfort-partners.
316 2019 New Jersey Energy Master Plan, p. 209.
317 Green & Healthy Homes Initiative. 2022. *New Jersey Whole House Pilot Design Project: Asset and Gap Analysis*. Prepared for the New Jersey Board of Public Utilities. p. 4. Available at: https://www.njcleanenergy.com/files/file/Library/6_17_22_GHH-NJ-Report-Final-revised.pdf.
318 Green & Healthy Homes Initiative. 2022. *New Jersey Whole House Pilot Design Project: Asset and Gap Analysis*. Prepared for the New Jersey Board of Public Utilities. Available at: https://www.njcleanenergy.com/files/file/Library/6_17_22_GHH-NJ-Report-Final-revised.pdf.
319 LEAN Residential. Available at: https://masslean.org/.
320 Synapse Energy Economics, Regulatory Assistance Project, and Community Action Partnership. 2020. *Energy Infrastructure: Sources of Inequities and Policy Solutions for Improving Community Health and Wellbeing*. Available at: https://www.synapse-energy.com/sites/default/files/Equity-in-Energy-Report-19-037-0.pdf.
321 Connecticut Department of Energy & Environmental Protection. "Community Resource Hubs." 2024. Available at: https://portal.ct.gov/deep/environmental-justice/community-resource-hubs.
322 For example, California and Michigan both provide funding for intervenor compensation in utility commission proceedings. See: https://www.cpuc.ca.gov/proceedings-and-rulemaking/intervenor-compensation.
323 For example, see the Equity and Affordability Reporting Metrics from the Illinois Energy Efficiency Stakeholder Advisory Group: https://www.ilsag.info/reporting-working-group/.

for LMI and disadvantaged communities. Combining multiple sources of funding can help expand programs by offering additional measures, covering a greater share of the measure costs, or serving more households.[324] Federal funding, including programs offered under the IRA, and state funding have offered grants and programs targeted towards disadvantaged and low-income communities. For example, the New York State Energy Research and Development Authority (NYSERDA) EmPower+ program offers no-cost home energy assessments and energy efficiency upgrades to LMI residents. EmPower+ has multiple funding sources including proceeds from RGGI, ratepayer funding, state-legislature-enacted budget, and IRA funding.[325] See Section 5.3 for more information on federal funding opportunities.

324 Residential Retrofits for Energy Equity. 2024. "The Residential Retrofits for Energy Equity Playbook." Available at: https://r2e2playbook.org/.

325 NYSERDA. "EmPower+." Available at: https://www.nyserda.ny.gov/All-Programs/EmPower-New-York-Program; U.S. Environmental Protection Agency. 2024. "NYSERDA EmPower+ Program Profile." Available at: https://www.epa.gov/system/files/documents/2024-01/empower-program-profile-draft_revised_2024-01-15_508.pdf.



05.

CURRENT STATE BUILDING DECARBONIZATION EFFORTS

5.1 PHASED STRATEGY APPROACH

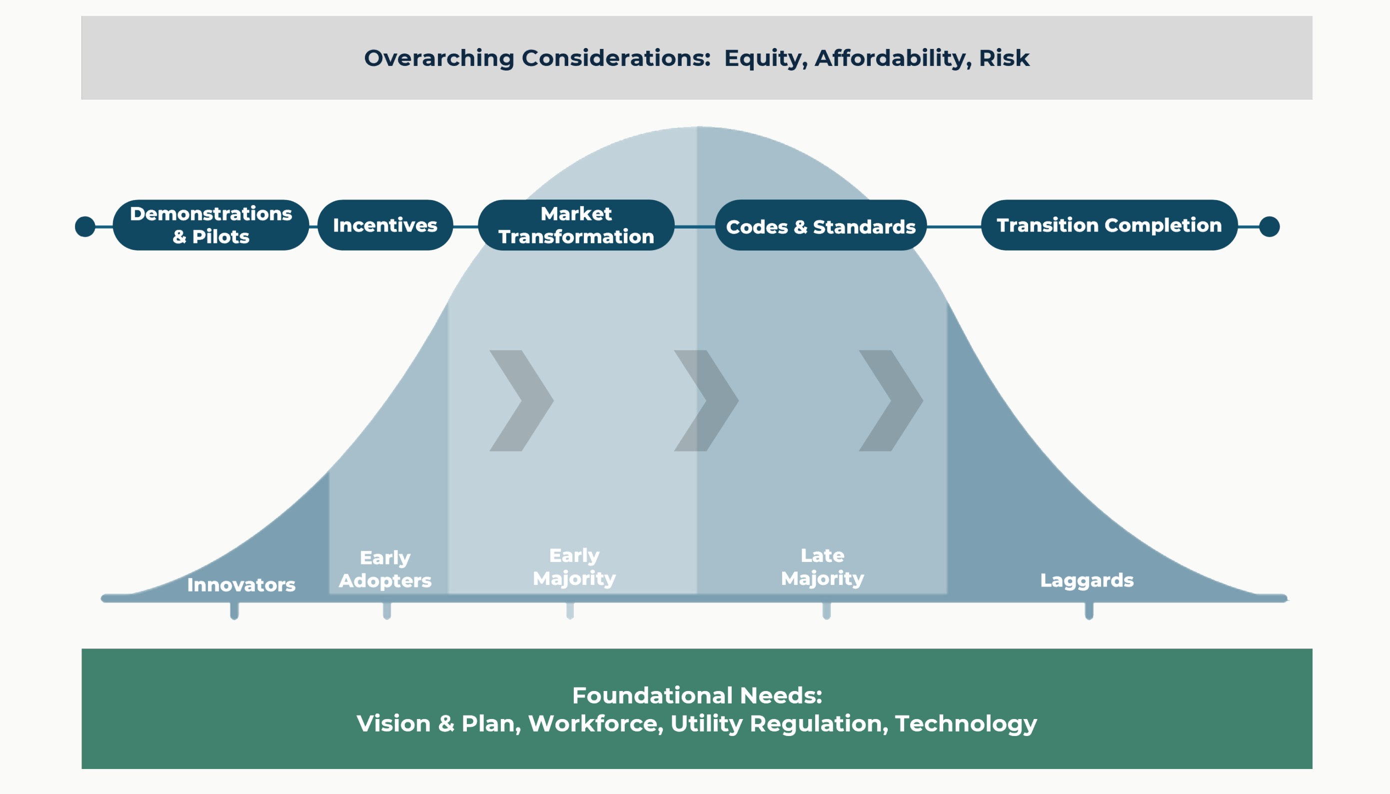
The most effective policies reflect the state of technology and market development, including building owner and workforce readiness. Policy choices are informed by the potential to mitigate or exacerbate equity concerns. When developing a policy portfolio, the appropriate policies to implement in each market or sector will depend on this context, which itself shifts over time.

For example, where the State's pathway identifies a promising option to use a relatively new or underutilized technology to decarbonize a given end use—such as networked geothermal heat pump systems—it is most appropriate to begin with actions that test and prove out the technology, such as pilots and demonstration projects. Pilots allow market players, regulators, and workers to engage with and learn from deploying the new technology, to better plan how to bring it to scale. And if the pilot or demonstration shows serious problems, the State can pivot to different approaches without too much time or money lost. In the contrasting case of a more mature technology and market, such as ASHPs for single-family homes, incentive programs can help grow the market. Codes and standards can be integrated at a later date to require the use of technology that meets a certain level of performance and can help drive technology deployment at a scale beyond the budgetary reach of incentive programs. In parallel, policies aimed at associated workforce development are required throughout the maturation and growth of a given market (although the details of training programs and needs may shift as the market develops).

The graphic shown in Figure 14 illustrates how policies and programs can be aimed at different levels of market development, including some that are cross-cutting.

The remainder of this chapter summarizes existing New Jersey state policies and programs, and places them in this framework. Most existing funding goes to support incentive programs, because this step along the market development curve has the greatest combination of scale and cost. However, the State also engages in pilots and demonstrations and uses codes and standards. The following chapter makes recommendations for key strategies, policies, and programs to expand upon this foundation and meet the State's decarbonization objectives.

Figure 14. Policy Development Framework



5.2 STATE AND LOCAL PROGRAMS AND PILOTS

Energy Efficiency Programs

State energy efficiency programs are funded primarily by the SBC and are implemented by the public gas and electric utilities and by NJBPUs' Division of Clean Energy, which runs NJCEP. Other funding for energy efficiency measures, including building decarbonization, comes from proceeds from RGGI and federal sources. These include the U.S. DOE State Energy Program (SEP), which provides both funding and technical assistance to states, and the federal Weatherization Assistance Program (WAP), which supports home weatherization efforts for low-income households. For new energy efficiency programs including building decarbonization, New Jersey has tapped into other sources of federal funding such as the IRA. Section 5.3 details programs using federal funds.

Utility-Run Programs – Previous Programs

Pursuant to the requirements of the CEA, public gas and electric utilities administer energy efficiency programs within their service territories.[326] The utilities implemented the first Triennium plans from July 2021 to December 2024.[327] Under the first Triennium plans, the utilities offered programs for existing buildings for residential, multifamily, commercial, and industrial customers. Residential offerings included incentives for energy efficient products such as lighting, HVAC equipment, smart thermostats, and refrigerators, access to zero-percent financing for energy efficient equipment, and appliance recycling rebates, among other resources. Commercial customers can also receive prescriptive incentives for energy-saving equipment, such as heating and cooling equipment, HVAC controls, and lighting and lighting controls. Additionally, utilities offered custom incentives for energy efficiency measures designed for customers' facilities, and an energy management program which provided solutions and incentives for optimizing the performance of existing buildings.[328]

During the FY23 plan year, from July 1, 2022, to June 30, 2023, the electric and gas utilities spent $651 million in the implementation of energy efficiency programs and avoided approximately 0.94 million tons of annual CO_2 emissions and 11.3 million metric tons of lifetime CO_2 emissions.[329] The utilities achieved FY2023 annual electric savings of 1,285 GWh, or approximately 1.7 percent of statewide 2022 electricity sales,[330] and annual gas savings of 3.07 trillion Btu, or approximately 0.6 percent of 2022 statewide natural gas consumption for residential, commercial, and industrial

326 Specifically, CEA directed NJBPU to require each electric utility to achieve reductions of at least 2 percent of the average annual electricity usage by customers within its service territory in the prior three years within five years of energy efficiency program implementation and to require each natural gas public utility to achieve annual reductions in the use of natural gas of at least 0.75 percent average annual gas usage by customers within its service territory in the prior three years within five years of energy efficiency program implementation.

327 NJBPU approved the first three-year cycle of New Jersey's EE programs (Triennium 1) for July 1, 2021–June 30, 2024. In October 2023, NJBPU extended program year 3 through December 31, 2024, and ordered the start of Triennium 2 programs to commence on January 1, 2025.

328 New Jersey Clean Energy Program. "Find a Program" Available at: https://cepfindaprogram.com/.

329 4Q FY23 Statewide Report- PUBLIC. Available at: https://www.njcleanenergy.com/files/file/UTILITY%20REPORTING/4Q%20FY23/4Q%20FY23%20Statewide%20Report%20-%20PUBLIC.pdf

330 U.S. EIA. 2023. "State Electricity Profiles," New Jersey Electricity Profile 2022. Available at: https://www.eia.gov/electricity/state/newjersey/.

customers.[331]

Utility-Run Programs – New Programs

NJBPU directed the state and electric utilities to propose a second three-year cycle of energy efficiency programs (Triennium 2) for January 1, 2025, through June 31, 2027.[332] NJBPU also established annual savings targets for utility programs based on the utilities' share of the CEA energy reduction requirements. For Program Year (PY) 2025 through 2027, NJBPU established annual electric savings targets between 1.28 and 1.57 percent of retail sales and established annual gas savings targets between 0.49 and 0.55 percent of retail sales.[333]

Additionally, NJBPU ordered electric utilities to propose building decarbonization (BD) programs as part of their portfolio of Triennium 2 energy efficiency programs. NJBPU highlighted New Jersey's goals for energy usage reductions, building decarbonization, and GHG emissions reductions, and directed the utilities to propose building decarbonization start-up programs at a scale large enough in Triennium 2 to set the foundation for significant progress in Triennium 3 (2027–2030) with a specific focus on achieving the 2030 goals for building electrification established by Executive Order 316. In the same order, NJBPU specified that the building decarbonization programs should be designed to ensure that all projects result in net source energy savings on a fuel-neutral MMBtu basis, prioritize customer incentives for space and water heating in residential and multifamily buildings, and specifically focus on switching from delivered fuels to heat pumps and making buildings electrification-ready while supporting participation by LMI and multifamily unit customers who are not eligible for Comfort Partners.[334]

NJBPU approved the utilities' Triennium 2 program filings in October 2024.[335] A complete list of the current energy efficiency programs offered by the electric and gas utilities is available at cepfindaprogram.com. Combined, the utilities plan to spend approximately $3.8 billion over the 2.5-year Triennium 2 period from January 1, 2025, through June 2027 (Table 2). The total program budget represents an average annual budget of $1.52 billion, a significant increase from the $0.65 billion spent on the FY23 programs. Building decarbonization programs account for nearly $172.3 million, or 4.5 percent of the total Triennium 2 program budget of $3.8 billion.

Table 2. Triennium 2 energy efficiency program budgets

Utility	Total budget ($M)	BD Program Budget ($M)
Public Service Electric and Gas Company	2,193	101.2
Jersey Central Power & Light Company	597	27
Atlantic City Electric Company	400	32.6
New Jersey Natural Gas	225	7.3
South Jersey Gas Company	182	0
Elizabethtown Gas Company	148	0
Rockland Electric Company	51	4.3
All Utilities	**3,797**	**172.3**

Pursuant to NJBPU directives, as part of their Triennium 2 programs, the utilities proposed programs that provide incentives for building decarbonization measures. For example, PSE&G will provide incentives for building decarbonization measures for residential, commercial, and industrial customers. Table 3 provides a summary of building decarbonization measure incentives offered by PSE&G. Additionally, PSE&G will conduct a Network Geo-Exchange study to assess the feasibility of a networked geothermal project for PSE&G customers and identify options for potential sites.[336] Other electric utilities are offering similar levels of incentives for building decarbonization measures.

331 U.S. EIA. 2023. "New Jersey State Profile and Energy Estimates," Table F21: Natural gas consumption estimates, 2022. Available at: https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_fuel/html/fuel_use_ng.html&sid=US&sid=NJ.

332 New Jersey Board of Public Utilities. 2023. Order Directing the Utilities to Propose Second Triennium Energy Efficiency and Peak Demand Reduction Programs. Docket Nos. QO19010040, QO23030150, and QO17091004. May 24, 2023.Available at: NJBPU. Available at https://www.nj.gov/bpu/.

333 New Jersey Board of Public Utilities. 2023. *In the Matter of the Implementation of P.L. 2018, C. 17, The New Jersey Clean Energy Act of 2018, Regarding the Second Triennium of Energy Efficiency and Peak Demand Reduction Programs, Order*. Docket No. QO23030150. October 25, 2023. Available at https://www.nj.gov/bpu/pdf/boardorders/2023/20231025/8G%20ORDER%20EE%20Triennium%202.pdf.

334 July 26, 2023. *Order Directing the Utilities to Propose Second Triennium Energy Efficiency and Peak Demand Reduction Programs*. "Triennium II Framework Order pt. 2" New Jersey Board of Public Utilities (NJBPU) Docket QO19010040, QO23030150, and QO17091004.

335 State of New Jersey Board of Public Utilities. "Board Agenda Business," October 30, 2024. Available at: https://www.nj.gov/bpu/agenda/2024calendar/approved/20241030.html.

336 NJBPU. 2024. *Order Adopting Stipulation. In the Mater of the Petition of Public Service Electric and Gas Company for Approval of its Clean Energy Future-Energy Efficiency II (CEF-EE II) Program on a Regulated Basis*. Docket QO23120874.

Table 3. PSE&G building decarbonization incentives

Measure Type	Description
ASHP	Residential customers can receive the lesser of $10,000 or 50 percent of the installation cost of a cold-climate ASHP that fully displaces their fossil fuel heating system. Incentives are also available for full displacement in a dual-fuel-heated home (the lesser of $5,000 or 50 percent of project cost) and for non-cold-climate ASHPs that partially displace the existing heating system (the lesser of $2,000 or 30 percent of project cost). Moderate-income customers are eligible for higher incentive levels; for example, moderate-income customers can receive up to $12,000 or 60 percent of project cost for cold-climate ASHP that can fully replace their existing heating systems.
GSHP	Delivered fuels customers who want to install a GSHP can receive the lesser of $5,000 or 50 percent of project cost and natural gas customers can receive the lesser of $4,000 or 50 percent of project cost.
Appliances	PSE&G will also offer incentives for other electric appliances, such as heat pump water heaters, electric lawn equipment (e.g., snow blowers, leaf blowers), induction stoves, and heat pump pool heaters.
Circuit and Panel Upgrades	Customers installing building decarbonization measures can receive incentives for circuit and panel upgrades. Non-income-qualified customers can receive up to $300 per measure requiring a 240V circuit, up to four circuits, or $300 for a panel upgrade. Income-qualified customers can receive significantly higher incentives and are eligible for up to $4,000 for a panel upgrade plus $2,500 for wiring upgrades.

New Jersey Natural Gas (NJNG) will also offer incentives for building decarbonization measures that reduce reliance on natural gas. Specifically, NJNG will provide incentives to residential customers for installing heat pumps that partially displace natural gas heating. Customers who wish to fully electrify are not eligible to receive incentives from NJNG but can receive incentives through their electric utility. Customers can receive the lesser of $2,000 or 30 percent of project cost, and moderate-income customers are eligible for the lesser of $3,000 or 40 percent of project cost. To be eligible for incentives, the heat pump must include integrated controls and NJNG may require a specific thermostat switchover point. NJNG also plans to conduct a network geothermal feasibility study which will be used to inform future potential projects, support future policy discussions, and support future district geothermal projects.[337] NJNG is the only gas utility in the state offering rebates for electric heat pumps, while other gas utilities provide financing for dual-fuel heat pumps that use gas heating as a backup.

New Jersey's Clean Energy Programs – Existing Programs

NJBPU administers energy efficiency offerings that are complementary to the utility-run programs through NJCEP. Table 4 summarizes current NJCEP programs.

NJBPU partners with the utilities to run the Comfort Partners program for income-eligible households. Participants receive energy education services and installation of energy efficiency measures such as lighting, insulation upgrades, and hot water conservation measures at no cost. NJBPU provides funding for the program and programmatic guidelines, while the utilities are responsible for program management and implementation.

During the FY23 plan year, NJCEP spent $43 million in the implementation of energy efficiency programs and avoided approximately 94,000 tons of annual CO_2 emissions and 1.7 million metric tons of lifetime CO_2 emissions.[338] FY2023 electric savings were 139 GWh, or approximately 0.2 percent of 2023 electricity sales,[339] and annual gas savings of approximately 247,000 Btu, or 0.1 percent of 2022 statewide natural gas consumption for residential, commercial, and industrial customers.[340]

337 NJBPU. 2024. Order Adopting Stipulation. *In the Matter of the Petition of New Jersey Natural Gas Company for Approval of New Energy Efficiency, Building Decarbonization Start-Up, and Demand Response Programs and the Associated Cost Recovery Mechanism Pursuant to the Clean Energy Act, N.J.S.A. 48:3-87.8 et seq. and 48:3-98.1 et seq. Second Triennium.* Docket QO23120868.

338 4Q FY23 Statewide Report- PUBLIC. Available at: https://www.njcleanenergy.com/files/file/UTILITY%20REPORTING/4Q%20FY23/4Q%20FY23%20Statewide%20Report%20-%20PUBLIC.pdf

339 U.S. EIA. 2023. "State Electricity Profiles," New Jersey Electricity Profile 2022. Available at: https://www.eia.gov/electricity/state/newjersey/

340 U.S. EIA. 2023. "New Jersey State Profile and Energy Estimates," Table F21: Natural gas consumption estimates, 2022. Available at: https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_fuel/html/fuel_use_ng.html&sid=US&sid=NJ

Table 4. NJCEP Energy Efficiency Programs

Program Name	Description	Customers Served
New Construction Programs	Incentives to increase energy efficiency and environmental performance of new construction residential, multifamily, and commercial and industrial buildings. Incentives provided to achieve above-code compliant efficiency standards, such as ENERGY STAR® and Zero Energy Ready Home (ZERH) standards.	Residential Commercial Multifamily Industrial Local Governments
Combined Heat & Power and Fuel Cells	Incentives for Combined Heat and Power and Fuel Cell installations.	Commercial Industrial Local Governments
Large Energy Users Program (LEUP)	Designed to promote investment in energy efficiency among large energy users who have paid a minimum in $5 million in annual energy costs to NJ utilities.	Commercial Industrial Local Governments
Higher Education Decarbonization Pilot	An enhancement to the LEUP, the pilot incentivizes existing colleges and universities to implement decarbonization strategies such as energy efficiency, beneficial electrification, EV chargers, storage, and combined heat and power.	Higher Education
Community Energy Plan Grant (CEPG) Program and Community Energy Plan Implementation (CEPI) Grant Program	CEPG provides grants of up to $10,000 to support municipalities to develop climate action plans at the local level based on their assessment of which Energy Master Plan strategies are most applicable in their respective communities. Overburdened communities are eligible to receive a $25,000 grant. The CEPI Grant Program provides municipalities with up to $250,000 to implement clean energy projects supporting energy resilience, renewable energy, and energy efficiency.	Local Governments
Local Government Energy Audit (LGEA)	Free energy audits for local government agencies, state contracting agencies, public agencies, state colleges and state universities, and select non-profit agencies.	Local Governments 501(c)(3) Non-Profits
Financing for Local Government Equipment Upgrades (ESIP)	Energy Savings Improvement Program (ESIP) is a financing mechanism used to pay for energy efficiency projects for all public entities and allows participants to make energy-related improvements to their facilities using the value of energy savings that result from the improvements.	Local Governments
Comfort Partners	NJBPU partners with the utilities to run the Comfort Partners program which offers free energy efficiency upgrades to low-income households.	Eligible Residential

Notes: Local government includes public K-12 schools, higher education, state and local governments facilities. Source: NJ CEP. "Energy Efficiency Programs." Available at: https://njcleanenergy.com/EEP.

New Jersey's Clean Energy Programs – New Programs

The Triennium 2 plan (Plan) — developed by the NJCEP program administrator, TRC Companies, Inc. — comprises the framework and initiatives recommended to support, enhance, and/or expand NJCEP Solar Registration, New Construction (NC), Large Energy Users (LEU), Local Government Energy Audit (LGEA), and Combined Heat and Power/Fuel Cell (CHP/FC) Programs.

The **NC Program** launched in May 2025. The new program is designed to: simplify the customer experience and application process, increase energy efficiency and environmental performance of new construction, increase equity and general participation, and inform code development. The long-term goal is to transform the new construction market into one in which most new buildings in the state will be "net zero energy."

For the **Solar Programs**, the designs and modifications are determined by the Board, and TRC implements and supports them once approved. The Plan includes enhancements to increase interaction with the solar industry through trainings and industry meetings as well as improvements to application processing efficiency and customer satisfaction.

For the **LEU Program**, the Plan focuses on collaboration with the utilities regarding customer outreach and engagement since this program overlaps with the utility-offered programs. For the **LEUP Decarbonization Pilot**, the Plan addresses the evaluation of the decarbonization plans submitted and working with customers to move them into the implementation phase.

For the **LGEA Program**, the Plan focuses on offering additional pre-application assistance as well as offering additional scopes to support more in depth solar and electrification options and post-audit assistance to help audit findings result in tangible projects and energy savings.

Based upon guidance from NJBPU, the **CHP/FC program** will remain largely unchanged as TRC works with NJBPU to determine the future policy goals and objectives for this program.

New Jersey Economic Development Authority Programs

NJEDA runs multiple programs that support the implementation of energy efficiency and building decarbonization, as summarized in Table 5. Many programs rely on federal funding, such as the New Jersey Clean Energy Loans program, which is funded by the U.S. Treasury's State Small Business Credit Initiative. Additionally, NJEDA was recently named a sub-awardee of the U.S. EPA's National Clean Investment Fund competition for the establishment of a national green bank.[341]

Table 5. NJEDA energy efficiency and building decarbonization programs

Program	Description	Funding
NJ Green Bank	A subsidiary of NJEDA designed to facilitate an equitable energy transition through climate-related investments and financial assistance that mobilize private capital and provide benefits to the state's Environmental Justice Communities.	RGGI, State
NJ Clean Energy Loans	A $80 million co-lending program for small businesses seeking to finance clean energy projects, including for energy efficiency related technologies and improvements in buildings.	Federal
NJ Cool	A $30 million program that provides grants to commercial, industrial, and institutional building owners and tenants undertaking retrofit construction projects that reduce operating GHG emissions from existing buildings located in New Jersey designated Overburdened and Adjacent census blocks.	RGGI
RETROFIT NJ	A $75 million grant program that will provide grant awards ranging from $2.5 million to $12.5 million to support large-scale building retrofit projects that drastically reduce emissions.	RGGI
Garden State Commercial Property Assessed Clean Energy (C-PACE)	A financing mechanism to facilitate energy efficiency, renewable energy, water conservation, and resiliency improvements for commercial buildings. Lower-interest, longer-term project financing is repaid through a property assessment, similar to a property tax bill, that can transfer between property owners.	Private capital

Source: New Jersey Economic Development Authority's Clean Energy Products. Available at: https://www.njeda.gov/clean-energy.

Other State Programs

New Jersey has also implemented other programs to promote building decarbonization such as building energy benchmarking and a Whole House Pilot program (both implemented by NJBPU), as well as building energy codes.

Building Energy Codes

Building energy codes establish minimum energy efficiency standards for new construction and major building renovations, aiming to cost-effectively reduce energy consumption in buildings. Most states develop and adopt new building codes that are based on "model codes" developed by the International Code Council (ICC) and the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). The most recent model codes are ICC 2021 and ASHRAE 90.1-2019. New Jersey is one of the leading states in implementing building energy codes across the country, with its current standards aligned with these most recent model codes.[342] The State has also adopted the solar-ready and net-zero appendices of the 2021 ICC as optional provisions, allowing municipalities to incentivize these standards in new construction projects.[343]

Building Energy Benchmarking

Building energy benchmarking evaluates a building's energy performance by comparing it to similar buildings with comparable uses. By providing building owners with valuable information about building energy usage, a benchmarking policy allows building owners to identify the magnitude of potential energy and cost savings and make informed decisions about energy system improvements. In New Jersey, NJBPU implements two benchmarking programs: a mandatory program for commercial and public buildings over 25,000 square feet, which launched in spring 2023, and a free, voluntary program available for all other buildings.[344] New Jersey is one of six states that have statewide energy benchmarking policies for large public and commercial buildings. [345]

NJBPU's Whole House Pilot

Many households are deferred from the Comfort Partners Program due to existing housing conditions that would make the process or result of weatherization dangerous. These conditions are often found in older and deteriorating housing and can additionally impact health and financial stability. To address these issues, NJBPU established the Whole House Pilot, a holistic housing intervention program aiming to address health, safety, and housing quality issues that prevent households from participating in the Comfort Partners Program.[346] The goals of the pilot model include demonstrating the viability of a statewide holistic model to provide housing services, streamlining and integrating

341 U.S. EPA. 2024. "NCIF Selected Applicant Details." Available at: https://www.epa.gov/greenhouse-gas-reduction-fund/ncif-selected-applicant-details

342 U.S. DOE. Building Energy Codes Program – State Portal. Available at: https://www.energycodes.gov/state-portal.

343 New Jersey Department of Community Affairs. "Current Construction Codes." Available at: https://www.nj.gov/dca/codes/codreg/current.shtml.

344 New Jersey's Clean Energy Program. "Energy Benchmarking." Available at: https://www.njcleanenergy.com/energy-benchmarking.

345 Institute for Market Transformation (IMT). "Building Performance Policies You Should Know." Available at: https://imt.org/public-policy/maps-and-comparisons/; IMT. 2024. *Comparison of U.S. Commercial Building Energy Benchmarking and Transparency Policies*. Available at: https://imt.org/resources/comparison-of-commercial-building-benchmarking-policies/.

346 Green & Healthy Homes Initiative. 2022. *New Jersey Whole House Pilot Design Project Asset and Gap Analysis*. Prepared for the New Jersey Board of Public Utilities. Available at: https://www.njcleanenergy.com/files/file/Library/6_17_22_GHH-NJ-Report-Final-revised.pdf .

programs that provide health and safety improvements and energy savings, and supporting the State's goal to make 10 percent of LMI housing stock "electrification ready" by 2030.[347] The pilot's goal is to serve 100 homes in Trenton, New Jersey and install electrification or electrification-ready measures in 20 homes.[348]

5.3 FEDERALLY FUNDED PROGRAMS

Inflation Reduction Act Home Energy Rebates (HER and HEAR)

The IRA, signed into law on August 16, 2022, marks one of the largest federal investments in the economy, energy security, and climate change mitigation in U.S. history. The IRA created tax credits for residential energy efficiency technologies and EVs and created numerous programs to invest in energy efficiency and building electrification.[349, 350] Two such programs are the Home Efficiency Rebates (HER) Program and the Home Electrification and Appliance Rebates (HEAR) Program (formally known as the High-Efficiency Electric Home Rebate Program or HEEHR). These programs (collectively, the "Home Energy Rebates") aim to provide funding to lower residential energy bills, support energy efficiency, and reduce indoor and outdoor air pollution.[351] For both programs, all funds must be spent by September 30, 2031.

The HER Program is expected to distribute $4.3 billion to state energy offices, with the goal of delivering residential rebates to support the costs of whole-home efficiency projects. Through the HER Program, New Jersey is eligible to receive up to $91,654,709. Through the HEAR Program, New Jersey is eligible to receive up to $91,307,380. As of March 2024, New Jersey had received Notice of Awards for both the HER and HEAR programs.

HER funding can be used for residential energy efficiency projects, with increased rebates available for households with an income less than 80 percent of the area median income (AMI). Eligible projects must meet minimum percent savings requirements for the household, and include at least one major upgrade, defined as "Energy usage, equipment, technologies, and services related to heating and cooling, envelope, and water heating end uses."[352] States can opt to follow the Modeled or Measured program pathway. Under the Modeled pathway, states can use an approved model to estimate energy savings prior to installation. Under the Measured pathway, states must use an approved method to measure energy savings post-installation. Table 6 and Table 7 provide more details on the rebates available through HER. Under HER, $200 installer incentives would also be provided to contractors for projects completed in disadvantaged communities.

Table 6. HER program maximum rebate amounts, modeled approach

Modeled energy savings	Income level	Maximum rebate amount
Single Family		
20%-34%	Less than 80% AMI	Lesser of $4,000 or 80% of project cost
	80% AMI and greater	Lesser of $2,000 or 50% of project cost
35% or greater	Less than 80% AMI	Lesser of $8,000 or 80% of project cost
	80% AMI and greater	Lesser of $4,000 or 50% of project cost
Multifamily		
20%-34%	A building with at least 50% of households with incomes less than 80% AMI	Lesser of $4,000 per dwelling unit or 80% of project cost
	A building with at least 50% of households with incomes 80% AMI and greater	$2,000 per dwelling unit up to $200,000 per building
35% or greater	A building with at least 50% of households with incomes less than 80% AMI	Lesser of $8,000 per dwelling unit or 80% of project cost
	A building with at least 50% of households with incomes 80% AMI and greater	$4,000 per dwelling unit up to $400,000 per building

Source: U.S. DOE. 2024. Inflation Reduction Act Home Energy Rebates: Program Requirements & Application Instructions.

347 New Jersey Clean Energy Program. 204. "Energy Efficiency Stakeholder Meeting." May 16. Available at: https://www.njcleanenergy.com/files/file/EE/2024/EE%20Stakeholder%20Meeting%202024-05-16%20Final.pdf.

348 Ibid.

349 The White House. 2023. *Building a Clean Energy Economy: A Guidebook to the Inflation Reduction Act's Investments in Clean Energy and Climate Action*. Available at: https://www.whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf.

350 H.R.1, a narrowly passed bill signed into law on July 4, 2025, has added significant uncertainty to federally funded programs, and accelerated the termination and phase-out schedules for some IRA tax credits.

351 U.S. Department of Energy (DOE). 2024. *Inflation Reduction Act Home Energy Rebates: Program Requirements & Application Instructions*. Available at: https://www.energy.gov/sites/default/files/2024-06/program-requirements-and-application-instructions_061324.pdf; U.S. Department of Energy (DOE). "Home Energy Rebates Programs." Available at: https://www.energy.gov/scep/home-energy-rebates-programs.

352 U.S. Department of Energy (DOE). 2024. *Inflation Reduction Act Home Energy Rebates: Program Requirements & Application Instructions*. Available at: https://www.energy.gov/sites/default/files/2024-06/program-requirements-and-application-instructions_061324.pdf.

Table 7. HER program maximum rebate amounts, measured approach

<table>
<tr><th>Measured energy Savings</th><th>Income level</th><th>Maximum rebate amount</th></tr>
<tr><td colspan="3">Single Family</td></tr>
<tr><td rowspan="2">15% or greater</td><td>Less than 80% AMI</td><td>kWh, or kWh equivalent, payment rate equal to $4,000 for a 20% reduction of energy use for the average home in the state or 80% of project cost</td></tr>
<tr><td>80% AMI and greater</td><td>kWh, or kWh equivalent, payment rate equal to $2,000 for a 20% reduction of energy use for the average home in the state or 50% of project cost</td></tr>
<tr><td colspan="3">Multifamily</td></tr>
<tr><td rowspan="2">15% or greater</td><td>A building with at least 50% of households with incomes less than 80% AMI</td><td>kWh, or kWh equivalent, payment rate equal to $4,000 for a 20% reduction of energy use for the average home in the state or 80% of project cost</td></tr>
<tr><td>A building with at least 50% of households with incomes 80% AMI and greater</td><td>kWh, or kWh equivalent, payment rate equal to $2,000 for a 20% reduction of energy use for the average home in the state or 50% of project cost</td></tr>
</table>

Source: U.S. DOE. 2024. Inflation Reduction Act Home Energy Rebates: Program Requirements & Application Instructions.

The HEAR Program is expected to allocate $4.275 billion to states, also to be distributed through state energy offices. HEAR aims to provide rebates for qualified energy efficient electric equipment, electric wiring and panel upgrades, and weatherization measures. Eligible households must not have incomes exceeding 150 percent AMI, with increased total project rebate caps for households with incomes less than 80 percent AMI. Table 8 describes the eligible measures and rebate amounts through the HEAR Program. In addition to these maximum rebate amounts, states may also offer installer incentives of up to $150–$300, depending on the measure, and must offer an incentive of up to $200 per project for contractors installing projects in disadvantaged communities. [353]

Table 8. HEAR program maximum rebate amounts

<table>
<tr><th colspan="3">Product Rebates</th></tr>
<tr><th>Upgrade type</th><th>Qualified product</th><th>Maximum rebate amount</th></tr>
<tr><td rowspan="4">Appliance</td><td>Heat Pump Water Heater</td><td>$1,750</td></tr>
<tr><td>Heat Pump for Space Heating and Cooling</td><td>$8,000</td></tr>
<tr><td>Electric Heat Pump Clothes Dryer</td><td>$840</td></tr>
<tr><td>Electric Stove, Cooktop, Range, or Oven</td><td>$840</td></tr>
<tr><td rowspan="3">Building Materials</td><td>Electric Load Service Center</td><td>$4,000</td></tr>
<tr><td>Insulation, Air Sealing, and Ventilation</td><td>$1,600</td></tr>
<tr><td>Electric Wiring</td><td>$2,500</td></tr>
<tr><td colspan="2">Maximum Rebate</td><td>$14,000</td></tr>
<tr><th colspan="3">Rebate Limitations</th></tr>
<tr><th>Eligible rebate recipient</th><th>Income level</th><th>Maximum rebate amount</th></tr>
<tr><td rowspan="2">LMI Household</td><td>Less than 80% AMI</td><td>100% of qualified project cost</td></tr>
<tr><td>80%-150% AMI</td><td>50% of qualified project cost</td></tr>
<tr><td rowspan="2">Owner of Multifamily building</td><td>At least 50% of residents with incomes less than 80% AMI</td><td>100% of qualified project cost</td></tr>
<tr><td>At least 50% of residents with incomes less than 80%-%150 AMI</td><td>50% of qualified project cost</td></tr>
</table>

Source: U.S. DOE. 2024. Inflation Reduction Act Home Energy Rebates: Program Requirements & Application Instructions.

State Energy Program

The State Energy Program (SEP) is a federal program run by the U.S. DOE with the aim of improving energy security, affordability, and environmental quality. This program has been operating since the 1970s, providing funds and technical assistance to, among other things, "increase energy affordability and efficiency."[354] Specifically, funds from this program can be used to support costs around energy efficiency and renewable energy measures, including equipment, materials, and installation costs. In FY2020, SEP delivered $62.5 million through formula grants, with $1.47 million awarded to New Jersey through NJBPU.[355] In the most recent program year, New Jersey invested these funds into the Whole House Pilot program

353 U.S. Department of Energy (DOE). 2024. *Inflation Reduction Act Home Energy Rebates: Program Requirements & Application Instructions*. Available at: https://www.energy.gov/sites/default/files/2024-06/program-requirements-and-application-instructions_061324.pdf.
354 U.S. DOE. "About the State Energy Program." Available at: https://www.energy.gov/scep/about-state-energy-program.
355 Green & Healthy Homes Initiative. 2022. *New Jersey Whole House Pilot Design Project Asset and Gap Analysis*. Prepared for the New Jersey Board of Public Utilities. Available at: https://www.njcleanenergy.com/files/file/Library/6_17_22_GHH-NJ-Report-Final-revised.pdf.

and the commercial building benchmarking program. For more information on NJCEP, please refer to Section 5.2.

Weatherization Assistance Program

Another federal program administered by the U.S. DOE is the Weatherization Assistance Program (WAP), which provides funding to support weatherization to reduce energy costs for low-income households. According to the U.S. DOE, this program "supports 8,500 jobs and provides weatherization services to approximately 35,000 homes every year using DOE funds" nationally, and has supported weatherization for over 7 million households since 1976.[356] In 2024, New Jersey received over $7 million from WAP, administered by NJDCA.[357] With this funding, in addition to supporting weatherization, up to 15 percent of WAP funds can be used to address health and safety hazards for low-income households in situations where those hazards prevent weatherization.[358]

Low Income Home Energy Assistance Program

The Low-Income Home Energy Assistance Program (LIHEAP) is a federally funded program that provides utility bill assistance for residential households, as well as assistance with costs associated with weatherization and energy crises. The aim of the program is to act as a safety net to support access to heating and cooling for low-income households and reduce risks associated with insufficient heating in the winter or cooling in the summer.[359] Through LIHEAP, households can receive $118 to $1,278 in assistance during the heating season or during cooling season for households requiring cooling to meet certain medical conditions.[360] In FY2020, New Jersey received $121,729,563. As with the WAP, this program is administered by NJDCA. NJDCA aligns its health and safety funds from WAP and LIHEAP in a combined strategy to offer up to $7,000 per household for health and safety interventions.[361]

5.4 GREEN BUILDINGS WORKFORCE PROGRAMS

There are multiple programs and initiatives being implemented or recently proposed in New Jersey to promote workforce development in the building decarbonization sector. State agencies, public utilities, academic institutions, industry organizations, and public-private partnerships fund and support various workforce training and development programs. For example, NJEDA has made $7 million dollars available for the Green Workforce Training Grant Challenge, a competitive funding opportunity that will award grants of up to $1.5 million for implementation of workforce development training programs that bolster the green economy talent pipeline with a particular focus on overburdened communities.[362]

The Training for Residential Energy Contractors (TREC) Program, created through the IRA and administered by the U.S. DOE, is expected to administer up to $200 million, with $150 million to be allocated to state energy offices through a formula, and $40 million offered to states through competitive grants.[363, 364] Through the TREC formula program, New Jersey has been conditionally awarded $3,517,680. The TREC program supports foundational workforce development to enable building decarbonization by (1) reducing the cost of training contractors by providing workforce development tools; (2) providing testing and certifications for contractors to install residential energy efficiency and electrification equipment; and (3) providing states with funding to develop state-sponsored workforce development programs alongside community organizations to be able to deliver energy efficiency and electrification programs.[365] This funding will be available through September 30, 2031.[366]

To prepare for this program, the State has established a Business and Industry Leadership Team (BILT) to brainstorm and develop coordinated approaches to TREC implementation as well as overall workforce development in the state. BILT is co-led by NJDOL and NJBPU in partnership with NJEDA and stakeholders, including industry, employers, training providers, community-based organizations, and more. NJDOL's Industry Partnerships (IP) Model was adopted by NJBPU to adapt and customize the BILT model to address New Jersey's energy efficiency workforce needs. BILT's employer-driven approach makes industry partnerships essential for understanding employers' workforce needs and resolving those challenges by bringing public-private partnerships. The expertise of the NJDOL IP team has been crucial in scaling this partnership model for energy efficiency and ensuring that

356 U.S. DOE. 2024. "Weatherization Assistance Program." Available at: https://www.energy.gov/scep/wap/weatherization-assistance-program.
357 U.S. DOE. 2024. *Weatherization Program Notice 24-2*. Available at: https://www.energy.gov/sites/default/files/2024-04/wap-wpn-24-2_041024.pdf.
358 Green & Healthy Homes Initiative. 2022. *New Jersey Whole House Pilot Design Project Asset and Gap Analysis*. Prepared for the New Jersey Board of Public Utilities. Available at: https://www.njcleanenergy.com/files/file/Library/6_17_22_GHH-NJ-Report-Final-revised.pdf.
359 LIHEAP.org. 2024. "What is LIHEAP? Learn more about the Low Income Home Energy Assistance Program." Available at: https://www.liheap.org/about.
360 Green & Healthy Homes Initiative. 2022. *New Jersey Whole House Pilot Design Project Asset and Gap Analysis*. Prepared for the New Jersey Board of Public Utilities. Available at: https://www.njcleanenergy.com/files/file/Library/6_17_22_GHH-NJ-Report-Final-revised.pdf.
361 Ibid.
362 NJ EDA. 2024. "Green Workforce Training Grant Challenge" Available at: https://www.njeda.gov/green-workforce-grant/
363 U.S. DOE. 2024. "Training for Residential Energy Contractors Grants (Competitive)." Available at: https://www.energy.gov/scep/training-residential-energy-contractors-grants-competitive.
364 U.S. DOE. 2024. "Training for Residential Energy Contractors Grants (Formula)." Available at: https://www.energy.gov/scep/training-residential-energy-contractors-grants-formula.
365 U.S. DOE. 2024. "DE-FOA-0003316: The Inflation Reduction Act (IRA) Section 50123 established the State-Based Home Energy Efficiency Contractor Training Grants, Training for Residential Energy Contractors (TREC)." Available at: https://infrastructure-exchange.energy.gov/Default.aspx#FoaId4f03295b-9ff6-42d2-b3f0-5c1f2ae1d189.
366 U.S. DOE. 2023. *Inflation Reduction Act (IRA) of 2022 - State-Based Home Energy Efficiency Contractor Training Grant Program: Administration and Legal Requirements Document (ALRD)*. Available at: https://www.energy.gov/sites/default/files/2023-10/IRA-50123-ALRD_published-modification_10-12-23.pdf.

energy efficiency training modules remain aligned with industry demands.[367]

In addition, some utilities have developed or proposed workforce development programs. For example, PSE&G partnered with NJDOL to create the Clean Energy Jobs program in Triennium 1. In its Triennium 2 energy efficiency program filing, PSE&G also proposed to continue the program. PSE&G described this program as follows:

> PSE&G has hired industry experts to teach candidates the skills and competencies most needed by New Jersey employers that supply energy efficiency ("EE") services. Training courses offered through the PSE&G Clean Energy Jobs Program are designed to take people in entry level positions and progress their skills to the next level; thereby creating additional opportunities for entry-level candidates to enter in the workforce... The Clean Energy Jobs Program will continue to offer certifications from Building Performance Institute ("BPI"), or similar industry certifications. Initially, the BPI training courses will include Building Analyst, Air Leakage Control Installer, and Heating Professional certifications and others. These certifications are recognized industry-wide and will equip candidates with essential skills in energy auditing, weatherization, and HVAC systems, aligning with the growing demand for energy-efficient and sustainable building practices.[368]

Additionally, PSE&G proposes several program expansions:

> For the second triennium, in addition to BPI training courses, the program will expand its offerings to include technical training to support the State's building decarbonization goals. For example, a specialized curriculum for heat pumps will be developed to support the need for qualified contractors and other courses will be integrated as the demand for additional topics become known. The Company will partner with heat pump manufacturers to build the knowledge base on heat pumps with contractors to build market capacity to scale building decarbonization.[369]

A recent study on energy efficiency workforce needs in New Jersey prepared by the Heldrich Center for Workforce Development summarizes a snapshot of clean energy workforce development programs and initiatives in New Jersey. For additional detail and examples of ongoing initiatives, see Table 4 and B-3 of the 2024 New Jersey's Energy Efficiency Workforce Needs, Infrastructure, and Equity Assessment.[370]

367 For more information about BILT, see National Convergence Technology Center. 2018. *Implementing the BILT Model of Business Engagement*. Available at: https://connectedtech.org/wp-content/uploads/2020/02/BILT-Toolkit-Sept-2018.pdf.

368 Public Service Electric and Gas Company (PSE&G). 2023. *In the Matter of the Petition of Public Service Electric and Gas Company for Approval of its Clean Energy Future-Energy Efficiency II (CEF-EE II) Program on a Regulated Basis*. Docket QO23120874. p. 61. Available at: https://s24.q4cdn.com/601515617/files/doc_downloads/regulatory_activity/2023/12/2023-12-01-PSE-G-CEF-EE-II-Filing.pdf.

369 Ibid.

370 Heldrich Center for Workforce Development. 2024. *New Jersey's Energy-Efficiency Workforce Needs, Infrastructure, and Equity Assessment*. Available at: https://njcepfiles.s3.amazonaws.com/New_Jerseys_Energy_Efficiency_Workforce_Needs_Infrastructure_+and_Equity_Assessment.pdf.

06.

KEY STRATEGIES

AND RECOMMENDATIONS

The transition to clean energy and building decarbonization in New Jersey represents a critical step toward achieving the State's ambitious climate goals, as outlined in the GWRA, New Jersey's 2019 Energy Master Plan, and the forthcoming 2025 Energy Master Plan. Section 6 of this roadmap provides a comprehensive set of strategies and recommendations designed to address key barriers, leverage emerging opportunities, and ensure an equitable and sustainable transition.

This section builds upon existing policies and programs while identifying critical areas for enhancement regarding decarbonization policies, regulatory evolution, and workforce development. It also emphasizes the importance of equity and environmental justice, ensuring that underserved and disadvantaged communities are central to the clean energy transition. Further, the roadmap calls for data-driven approaches and robust stakeholder engagement to set key targets in multiple areas toward the State's GHG reduction goals and track the performance of the State's building decarbonization initiatives.

The recommendations outlined herein are informed by extensive research, stakeholder input, and insights from successful initiatives in other states. Recommendations marked with an asterisk (*) are aligned with those proposed by the Clean Building Working Group. Together, these strategies provide a clear roadmap for achieving decarbonization targets while addressing systemic challenges and fostering innovation in the building energy landscape.

6.1 DECARBONIZATION POLICIES

Overview

New Jersey is implementing robust policies and programs, supporting energy efficiency through incentives, research and development, and targeting early-stage building decarbonization markets and technologies. The next frontier for New Jersey is to build upon and amplify its existing efforts to promote energy efficiency and incorporate electrification as a core strategy.

As markets mature, New Jersey can start using regulatory tools to promote building decarbonization technologies alongside incentive-based approaches. These regulatory tools include building performance standards, electrification/net-zero energy codes, and zero-emission equipment standards. As these regulations come into force, they will make electrification the minimum standard.

Key Strategies

1. Establish long-term statewide heat pump targets to meet the State's emissions reduction targets	
Timeline: Near to medium term	**Implementing Agencies:** NJBPU, NJDEP
Description: • Looking past 2030, develop long-term electric heating and cooling system targets at levels sufficient for the State to meet its 2050 GHG reduction target. Executive Order 316 aims to support all electric space heating and cooling systems in 400,000 homes and 20,000 commercial properties and make 10 percent of all LMI income properties electrification-ready by 2030. This is a crucial state policy but is not sufficient to reach the statewide 80x50 target (including 89 percent GHG reductions from buildings). Establishing long-term heat pump targets will enable market stakeholders to make proactive long-term plans, helping the state to develop its workforce to meet the anticipated demand for heat pump deployment.	
Barriers being addressed: Consumer adoption (lack of knowledge, inadequate stock of equipment), workforce constraints, transition away from gas infrastructure	**Impact:** Space and water heating in existing and new construction residential and commercial buildings
2. Modify the design of the energy efficiency programs to promote building electrification*	
Timeline: Immediate or near term	**Implementing Agencies:** NJBPU, State legislature
Description: • Maintain increased incentive levels for heat pumps, learning from nearby peer states (New York and Massachusetts). New Jersey incentive amounts for building decarbonization measures from energy efficiency programs were much lower than neighboring states. To drive decarbonization and stimulate market adoption of relevant technologies that reduce emissions, incentive amounts for components such as air source and ground source (geothermal) heat pumps should be increased. For the second three-year energy-efficiency plan, Triennium 2 which began in January 2025, electric utilities introduced significantly higher incentives for switching to heat pumps from other fuels, aligning their incentive levels with those offered in peer states. In addition to increasing the relative size of rebates, ensuring consistency of rebate amounts over time is also critical — it signals market stability to contractors and gives confidence to all parties to invest the time to work in the state and participate in state programs. This doesn't mean that incentive levels need to stay the same for the duration of the program; instead it means that there should be adequate notice if there are any planned shifts in the incentive levels, recognizing that project timelines can be lengthy (several months to years) from initial planning stages to completion of installation. • Eliminate incentives for fossil fuel equipment: Continuing incentives for gas equipment will prevent the State from meeting its climate goals in 2050. By continuing to incentivize fossil equipment, the State is locking in additional emissions from the combustion of fossil fuels. Given the expected useful life of new fossil fuel equipment being incentivized and installed today, there will be limited opportunities for replacement of this equipment with zero-emission alternatives before 2050. Gas utilities continue to provide incentives for gas equipment under their Triennium 2. They should eliminate incentives for fossil fuel equipment as soon as possible. • Consider implementing a single statewide midstream incentive program for space and water heating equipment. Midstream incentives can drive market transformation by encouraging retailers and distributors to maintain a stock of efficient electric products. This approach allows retailers and distributors to pass discounts on to contractors and customers, making products more affordable without requiring customers to apply for rebates. A unified statewide midstream incentive program offers several advantages over multiple programs run by different utilities. It streamlines program implementation across the state, reduces administration and implementation costs, and minimizes confusion about varying program offerings among customers and contractors—particularly for businesses managing properties across different areas and contractors operating in multiple utility jurisdictions. • Consider updating the Clean Energy Act of 2018 to allow NJBPU to use GHG emissions as a primary metric for state and utility programs. New Jersey's energy efficiency programs' reliance on MMBtu-based goals rather than GHG reduction targets createsa misalignment with the State's overall clean energy objectives, which include an 89 percent emissions reduction from buildings by 2050 relative to 2006 levels. The current approach could incentivize measures that reduce energy usage but lock in GHG	

emissions long term due to their reliance on fossil fuels, making it challenging for the State to achieve its primary GHG reduction goals. Revising state policy to prioritize emissions reductions over energy savings would appropriately value electrification and clean energy solutions that may have lower MMBtu savings but provide greater GHG reduction potential in the long run.

Barriers being addressed: Consumer adoption (lack of knowledge or awareness, fragmented program offerings, high upfront costs, inadequate stock of equipment, building upgrade constraints), customer equity, transition away from gas infrastructure

Impact: Existing and new construction residential and commercial buildings

3. Create an information clearinghouse to provide comprehensive information on building decarbonization technologies and available programs (including financing offerings from state agencies and utilities) *

Timeline: Immediate or near term

Implementing Agencies: NJBPU

Description:

- Develop a comprehensive "one-stop shop" that provides customers and contractors with education on decarbonization technologies and strategies including options to avoid electrical panel upgrades. A clearinghouse can also serve as a single point to connect customers and contractors to the energy efficiency and building decarbonization programs available to them in the state. Further, this hub should provide insight into how to braid and stack incentive programs for different project and property owners. As part of their Triennium 2 program plans, the electric and gas companies agreed to contribute to the design and coordinate on the scope of a one-stop shop website to provide customers and contractors with a simple and easy-to-understand application process to participate in utility and the state's clean energy programs. NJBPU and the companies should work together and consider establishing a primary information hub for energy efficiency and building decarbonization technologies and programs.

Barriers being addressed: Customer adoption (lack of knowledge or awareness, lack of time to learn new technologies and programs, high upfront costs, limited access to financing or capital, inadequate stock of equipment, building upgrade constraints), customer equity, workforce constraints

Impact: Existing and new construction residential and commercial buildings

4. Continue advancing the State's lead by example initiative

Timeline: Immediate

Implementing Agencies: NJ Treasury, NJBPU, and NJDEP

Description:

- Explore climate goals similar to those set by the U.S. DOE Better Climate Challenge. Other states that have committed to adopting the goal of the initiative include Maine, Maryland and Hawaii. Through this effort the State would pledge to reduce its GHG emissions by 50 percent or more across its buildings and plant portfolio in 10 years. Further, the State should consider committing to powering its operations with 100% clean energy by 2035, in alignment with statewide goals.
- Require every state agency/entity to develop biennial GHG inventories, which also serve to track progress towards established goals.
- Strengthen the Local Government Energy Audit program (which is free for state and local government entities in New Jersey) to prioritize building decarbonization. State agencies should be required to apply for energy audits for each facility.
- Prioritize climate goals within state procurement, such as replacing fossil fuel equipment with electric heat pumps for state buildings and expediting a new solar power purchase agreement (PPA) that state agencies can use to site solar throughout their properties, including options for both remote net metering and net metering.
- Continue funding commitments to the State Buildings Electrification Pilot program.

Barriers being addressed: Customer adoption (lack of knowledge or awareness, lack of time to learn new technologies, high upfront costs, inadequate stock of equipment, building upgrade constraints), workforce constraints

Impact: Existing and new construction residential and commercial buildings

5. Deploy market transformation, pilot, and demonstration projects*

Timeline: Near term

Implementing Agencies: NJBPU

Description:

- Focus on deploying pilot and demonstration projects throughout the state. As suggested in the Clean Building Working Group, some of these innovator pilots and demonstration projects could include carbon capture projects that are currently being designed by New Jersey Resources, thermal energy networks/district heating and cooling utilities, renewable natural gas applications, and clean hydrogen. Pilots are also needed to prove the viability of whole-building and whole-neighborhood decarbonization approaches. Showcasing leading edge projects can inform the design of robust programs across market categories/building types and raise consumer and industry awareness. NJBPU recently approved NJCEP's Garden State Challenge (GSC) pilot that supports the design and development of innovative, low- to zero-carbon new construction buildings.[371] NJBPU and NJCEP should also host building challenges and competitions for building retrofits, similar to New

371 TRC. 2024. *New Jersey's Clean Energy Program Fiscal Year 2024 Program Descriptions and Budget - Energy Efficiency and Renewable Energy Program Plan Filing FY24 Compliance Filing (Draft)*. Available at: https://njcleanenergy.com/main/njcep-policy-updates-request-comments/policy-updates-and-request-comments.

York's RetrofitNY, Empire Building Challenge, Clean Heat for All Challenge, and Induction Stove Challenge. Pilots and demonstration projects should vary by sector, geographic location, and building type/size. The State should also carve out funding to ensure inclusive and equitable pilot programs that include LMI customers. New Jersey should also fund strategies that are most likely to be replicable, while understanding that every building is unique.	
Barriers being addressed: Consumer adoption (lack of knowledge or awareness, lack of time to learn new technologies, high upfront costs, upgrade constraints), workforce constraints and customer equity	**Impact:** Existing and new construction residential and commercial buildings
6. Adopt leading building energy codes for residential and commercial buildings*	
Timeline: Fall 2025	**Implementing Agencies:** NJDCA
Description: • Show leadership in building codes by adopting, without weakening amendments, the 2024 IECC for residential new construction and ASHRAE 90.1-2022 for commercial new construction as the next base codes for the state. Building energy codes serve as key climate mitigation tools, working to reduce building-level energy use, energy related costs, and GHG emissions.[372] They establish minimum standards for energy efficiency across various aspects of building design and technologies, encompassing the building envelope, HVAC systems, lighting, and water heating. These model codes will provide a significant boost towards improved efficiency of the built environment.	
Barriers being addressed: Customer adoption barriers (lack of knowledge or awareness, lack of time to learn new technologies, renter/building owner split incentives, building upgrade constraints), workforce constraints, customer equity	**Impact:** According to estimates from the Pacific Northwest National Laboratory (PNNL), the 2024 IECC alone could reduce energy use intensity, energy costs, and emissions, each by an average of 5 to 7 percent compared to the 2021 IECC.[373]
7. Develop an optional statewide stretch code which promotes building electrification and achieves net-zero emissions	
Timeline: Near term. Develop the code in 2025 and implement by 2027	**Implementing Agencies:** NJDCA, State legislature
Description: • Establish an optional statewide stretch code to promote the construction of all-electric and net-zero-emissions buildings. Municipalities could offer incentives to permit applicants that build to the standards in the stretch code. An optional code would promote building decarbonization in two ways: **(a) enhanced energy efficiency standards:** requiring higher energy efficiency standards for the building envelope (e.g., passive house standards) and appliances compared to the standard building code and **(b) all-electric standards:** either requiring the installation of all electric appliances and equipment (e.g., heat pumps and induction stove) or providing enhanced incentives for all electric appliances and equipment over fossil burning appliances. For example, this could involve setting even stricter energy efficiency requirements for fossil fuel-powered buildings than for all-electric ones, which would steer consumers away from installing fuel appliances and equipment and encourage consumers to construct all-electric buildings. New Jersey should also provide technical and financial support for those municipalities that adopt the statewide all electric stretch code.	
Barriers being addressed: Customer adoption (lack of knowledge or awareness, lack of time to learn new technologies, renter-building owner split incentives, building upgrade constraints), workforce constraints, customer equity, transition away from gas infrastructure	**Impact:** New construction residential and commercial buildings
8. Explore the development of a statewide building performance standard*	
Timeline: Near term	**Implementing Agencies:** NJBPU, NJDEP
Description: • Establish annual emissions targets, set by building type, reaching a net-zero emissions requirement by 2050. Building performance standards are a powerful policy tool for reducing GHG emissions from large commercial buildings. These standards establish progressively stricter limits on emissions over time, ensuring steady progress in reducing emissions from existing buildings. By encouraging compliance with these declining limits, the standards drive the adoption of energy-efficient technologies and promote electrification across various building types. As of July 2024, approximately 14 jurisdictions have adopted building performance standards, including New York City; Boston, Cambridge, and Newton, MA; Washington, D.C.; St. Louis, MO; and the states of Washington, Oregon, Colorado, and Maryland. Over 30 other jurisdictions have also committed to the passage of building performance standards, according to the Institute for Market Transformation.[374] A robust policy also includes technical assistance to ensure that building owners have the information and tools necessary to help decarbonize their buildings and meet targets. New Jersey already has statewide benchmarking policies for large buildings (minimum 25,000 sq. ft), a prerequisite for establishing building performance standard targets. This positions New Jersey well to take the next step and develop annual targets and a building performance standard.	

372 Schwarz, Marius. et al. 2019. "Innovative designs of building energy codes for building decarbonization and their implementation challenges." Journal of Cleaner Production. 248:119260. Available at: https://www.researchgate.net/publication/337152882_Innovative_designs_of_building_energy_codes_for_building_decarbonization_and_their_implementation_challenges.

373 U.S. DOE. 2024. *Energy Savings Analysis: 2024 IECC for Residential Buildings*. Available at: https://www.energycodes.gov/sites/default/files/2024-12/2024_IECC_Determination_TSD.pdf.

374 Institute for Market Transformation (IMT). "Building Performance Standards." Available at: https://imt.org/bps.

Barriers being addressed: Consumer adoption (lack of knowledge or awareness, renter building owner split incentives, lack of time to learn new technologies or program offerings, emergency replacement situations), workforce constraints, transition away from gas infrastructure	**Impact:** Medium to large existing commercial buildings (e.g., at and above 25,000 sq. ft.)
9. Explore the development of a clean heat standard*	
Timeline: Near term	**Implementing Agencies:** NJDEP or NJBPU
Description: • Explore the development of clean heat standards in pursuit of Governor Murphy's EO 317, which requires NJBPU to consider a clean heat standard along with other policies to minimize or eliminate investment in gas technology and infrastructure. A clean heat standard is a performance standard, requiring fossil heat providers to deliver a gradually increasing percentage of clean heat services to customers. Similar to a renewable portfolio standard, it would mandate each heating energy provider (such as providers of natural gas, fuel oil, and propane) to provide a certain percentage of heating energy to come from cleaner sources, such as electricity and zero-carbon fuels.	
Barriers being addressed: Consumer adoption (lack of knowledge or awareness, high upfront costs, renter building owner split incentives, lack of time to learn new technologies or program offerings, emergency replacement situations, inadequate stock of equipment), customer equity, workforce constraints, transition away from gas infrastructure	**Impact:** Space and water heating in existing and new construction residential and commercial buildings
10. Explore the development of zero-emission standards for space and water heating equipment	
Timeline: Near term	**Implementing Agencies:** NJDEP
Description: • Explore zero-emission standards for space and water heating, which would essentially put a moratorium on the sale of new fossil fuel-burning space and water heating equipment. New Jersey's 80x50 Report includes a target of transitioning 90 percent of buildings to zero-emission heating systems by 2050. Zero-emission standards would not only help New Jersey reduce GHG emissions but would reduce indoor air pollution and risks for respiratory illnesses in homes and buildings. Some jurisdictions are already exploring or implementing zero-emission standards, including Denver, Colorado; Maryland; and California. For example, Maryland has recently proposed a Zero-Emission Heating Equipment Standard (ZEHES), which would require building owners to install zero-emission heating systems (e.g., heat pumps) when replacing pre-existing systems. Beginning in 2025, Denver will require heat pumps to be installed when replacing gas-fired furnaces and water heaters. However, Denver will allow exemptions, including new gas furnaces that provide supplementary heat only, and for emergency situations and economic hardship. A model rule is also currently under development by NESCAUM; Maryland, Massachusetts, and New York will likely be early adopters of the regulation. New Jersey should explore limiting emissions of nitrogen oxides and carbon dioxide, methane, and nitrous oxide from certain water heaters, boilers, and furnaces to phase out the sale of fossil fuel-fired space and water heating equipment, and consider ways to ensure equity in customers' ability to afford this transition. For example, New Jersey could pair the policy with incentives or financing support to alleviate the burden of this mandated transition, particularly for low-income homeowners and renters.	
Barriers being addressed: Consumer adoption (lack of information about decarbonization measures, emergency replacement situations), customer equity, workforce constraints, transition away from gas infrastructure	**Impact:** Existing buildings. Reduces nitrogen oxides and other criteria air pollutants to improve public health outcomes. Phasing out fossil fuel residential heating equipment also lowers GHG emissions.

6.2 UTILITY REGULATORY EVOLUTION

Overview

New Jersey is facing a dramatic transition in how buildings consume energy, with far-reaching implications for the utilities that provide energy services. The State must ensure that gas and electric systems are well-planned, programs are implemented cost-effectively, and the utilities continue to provide safe, adequate services that support that transition at just and reasonable rates. Evolving utility regulatory structures should strive to mitigate financial and safety risks stemming from building decarbonization. Strategies for utility regulatory evolution will involve changes to gas infrastructure spending, including consideration of alternatives to pipeline infrastructure, greater coordination and planning between gas and electric systems, and new rate designs and cost recovery structures.

Key Strategies

1. Continue Future of Gas proceedings and implement policy outcomes*	
Timeline: Ongoing	**Implementing Agencies:** NJBPU
Description: • Address barriers to electrification and set plans for a managed transition through a comprehensive Future of Gas proceeding. EO 317 requires NJBPU to consider policies to reduce gas sector GHG emissions and minimize or eliminate investment in gas technology and infrastructure. This includes minimizing new gas infrastructure investment or subsidies to mitigate the risk of stranded asset costs. This proceeding and future efforts by NJBPU should seek to address and mitigate barriers including regulatory and statutory obligations of natural gas utilities, rate design and depreciation methods to recover and allocate costs fairly, and include plans to protect LMI customers from bearing disproportionate costs of the gas system. • As the current Future of Gas docket is ongoing, there may be other docketed matters that come out of this proceeding or other issues for NJBPU to consider not addressed by the proceeding. Future of Gas issues will likely require ongoing discussion and processes in the future to plan for the evolution of the gas business model, integrated gas and electric planning and coordination.	
Barriers being addressed: Regulatory requirements related to gas line extensions, pipeline replacement programs, the obligation to serve, and affordability and stranded asset issues.	**Impact:** All gas customers, particularly focused on LMI
2. Evaluate pipeline replacement practices and implement non-pipeline alternatives*	
Timeline: A framework or screening process for NPAs should be implemented in the near term. Pilot NPA projects could begin in the near term.	**Implementing Agencies:** NJBPU
Description: • Develop and implement a non-pipeline alternative (NPA) screening and implementation process. This should especially include NPAs that reduce demand for pipeline gas or help electrify buildings. EO 317 requires the NJBPU to consider policies to minimize new gas infrastructure investment to mitigate the risk of stranded asset costs. NPAs are measures such as electrification and energy efficiency that reduce or avoid gas use as alternatives to building or expanding gas pipelines. The 2019 Energy Master Plan directs NJBPU to evaluate whether NPAs are a reasonable and prudent alternative to replacing aging or underutilized pipeline.[375] In Docket No. GO19070846, NJBPU ordered gas distribution companies to consider NPAs in efforts to ensure sufficient gas capacity.[376] Other states such as Massachusetts have required gas utilities to prove they have considered NPAs before investing in new gas infrastructure.[377]	
Barriers being addressed: Barriers related to continued gas infrastructure investment and stranded costs	**Impact:** All gas customers
3. Consider ratemaking and incentive structures*	
Timeline: Near to medium term	**Implementing Agencies:** NJBPU
Description: • Review existing utility incentive mechanisms (e.g., rate of return and performance incentive mechanisms, or PIMs), and investigate the effectiveness of PIMs to support building decarbonization, for both electric and gas utilities. For electric utilities, consider how to implement/modify rate designs that encourage demand flexibility and support building electrification in a cost-effective manner. This could include developing and offering lower winter electric rates for heat pumps, which takes advantage of lower marginal system costs during the winter season. One example is new heat pump rates by Unitil Corporation in Massachusetts. Unitil's heat pump rates feature significantly lower volumetric rates paired with a slightly higher monthly fixed charge, which is expected to reduce electric bills for consumers using heat pumps.[378]	
Barriers being addressed: Customer affordability, rates and bill impacts, lack of awareness about decarbonization measures.	**Impact:** All gas and electric customers
4. Develop a framework for proactive electric distribution planning to accommodate electrification*	
Timeline: Immediate	**Implementing Agencies:** NJBPU
Description: • Reform utility distribution planning practices by developing and establishing a framework for proactive electric distribution planning to accommodate the impacts of anticipated customers' decarbonization initiatives in a cost effective and timely manner. Such a framework would enable distribution utilities to accurately forecast load growth from building electrification	

375 2019 New Jersey Energy Master Plan, p. 190.

376 New Jersey Board of Public Utilities. Docket No. GO19070846. In the Matter of the Exploration of Gas Capacity and Related Issues. Order 6-29-22-9A. Available at: https://publicaccess.bpu.state.nj.us/CaseSummary.aspx?case_id=2108126

377 Massachusetts Department of Public Utilities. *Order on Regulatory Principles and Framework. DPU-20-80-B*. December 6, 2023. pp. 97-98. Available at: https://www.mass.gov/news/department-of-public-utilities-issues-order-20-80.

378 Shemkus, S. 2024. "Advocates hope utility's winter heat pump rate discount becomes model for Massachusetts utilities." September 30. Energy News Network. Available at: https://energynews.us/2024/09/30/advocates-hope-utilitys-winter-heat-pump-rate-discount-becomes-model-for-massachusetts-utilities/; Kresowik. M. 2024. "New Electricity Rates Are Needed to Support Equitable Heat Pump Adoption." Available at: https://www.aceee.org/blog-post/2024/07/new-electricity-rates-are-needed-support-equitable-heat-pump-adoption.

and other new loads (e.g., EVs and data centers), incorporate distributed energy resources (e.g., energy efficiency, demand response, solar PV and storage) as non-wires alternatives, and develop optimized grid investment plans. Under this proactive planning framework, electric utilities should:

   a. **Extend their planning horizon** to estimate winter and summer peak load growths over the long-term, aligning with the State's 2050 climate goals;

   b. **Develop a process to evaluate and integrate cost-effective NWAs**, similar to the way gas utilities need to incorporate NPAs;

   c. **Develop a geographically granular distribution system investment plan** (at feeder and substation levels) that accounts for the impacts of NWAs and targeted electrification initiatives (or NPAs), some of which may be supported by local gas utilities.

   d. **Coordinate closely with gas utilities** to align electric distribution system plans with consistent electrification projections across gas and electric planning.

   e. **Evaluate the optimal scale of prudent, "upsized" distribution investments** to meet long-term demand growth while avoiding overinvestment.

- Consider exploring these topics in the ongoing Grid Modernization proceeding (Docket No. QO21010085) or opening a new docket. This proceeding currently focuses on improvements to distributed energy resource interconnection standards and to the existing distributed energy resource hosting capacity maps. However, the scope of the proceeding includes proactive system upgrade plans, integrated distribution and distributed energy resource system planning, as well as increased electrification from EVs. Further, one of the key impetuses to opening this proceeding is one of the seven key strategies of the 2019 EMP: accelerated procurement of renewable energy and distributed energy resources and the electrification of the transportation and building sectors. Thus, the ongoing Grid Modernization proceeding could address the key topics discussed above. Alternatively, NJBPU could open a new proceeding to explore the topics other than interconnection standards and hosting capacity maps.

Barriers being addressed: Current distribution planning and load forecast practices (which do not adequately account for the impacts of electrification and or incorporate NWAs), distribution grid constraints and the complex, time-consuming process of approving distribution investments, fragmented load forecasts and distribution plans between electric and gas utilities.	**Impact:** All gas and electric customers

5. Develop a distribution hosting capacity map for building electrification*

Timeline: Immediate	**Implementing Agencies:** NJBPU and utilities

Description:

- Expand the scope of the hosting capacity maps by requiring utilities to estimate and provide information for distribution grid headroom to accommodate building electrification along with distributed energy resources and EVs. The ongoing grid modernization proceeding (Docket No. QO21010085) is currently in the process of improving the utilities' existing distribution hosting capacity maps for accommodating distributed energy resources. An enhanced hosting capacity map would provide valuable insights to stakeholders—including developers, building owners, utility managers, and policymakers—by identifying locations where electrification technologies or distributed energy resources can be deployed without adversely impacting the grid. Such a tool would advance and accelerate the State's efforts to decarbonize the building sector.

Barriers being addressed: Current distribution planning and load forecast practices (which do not adequately account for the impacts of electrification and/or incorporate NWAs), distribution grid constraints and the complex, time-consuming process of approving distribution investments, fragmented load forecasts and distribution plans between electric and gas utilities.	**Impact:** All gas and electric customers

6. Consider alternative cost recovery approaches

Timeline: Set up proceedings and processes to consider these issues in the near-term, implement in the medium-term.	**Implementing Agencies:** NJBPU

Description:

- Consider ways to ensure the costs of gas distribution systems are equitably spread across customers over time to mitigate stranded cost and safety risks. This can be achieved through utilization-based depreciation or other accelerated depreciation methods that align with the expected useful life of the assets.
- Similarly, consider cost recovery changes on the electric side to make sure that grid upgrade costs do not hinder building electrification.
- For example, Colorado recently enacted legislation requiring electric utilities to recover the costs of distribution upgrades from all customers (rather than only immediately benefitted customers) when those upgrades are necessary to support the State's decarbonization and climate targets.[379]

379 Colorado General Assembly. Senate Bill 24-218. 2024. Available at: https://leg.colorado.gov/sites/default/files/2024a_218_signed.pdf

Barriers being addressed: Affordability, stranded costs, equity issues of customers unable to transition to electricity.	**Impact:** All gas and electric customers

6.3 EQUITY AND ENVIRONMENTAL JUSTICE

Overview

The benefits of building decarbonization must be distributed equitably, especially for New Jersey residents who have suffered disproportionate burdens from pollution and other harms of the energy system. This clean energy transition requires participation and input from all communities. Program and policy implementation and decision-making must incorporate and enhance community involvement and accessibility. To ensure that all communities can benefit from decarbonization programs and policies, New Jersey must continue to address issues relating to affordability and barriers to electrification, and prioritize underserved and disadvantaged communities.

Key Strategies

<table>
<tr><th colspan="2">1. Embed robust community engagement, representation, and partnership in decision-making processes across all initiatives*</th></tr>
<tr><td>Timeline: Immediate and ongoing</td><td>Implementing Agencies: All agencies</td></tr>
<tr><td colspan="2">Description:
Provide meaningful opportunities for engagement and public input in planning and decision-making processes. Reduce barriers to participation and engagement and promote community empowerment, including through technical assistance, stipends, intervenor funding, and other resources that enable community members to participate meaningfully and provide feedback in programs.
Ensure that procedures and processes are clearly designed, streamlined, and implemented effectively to minimize burden on regulators, policymakers, and participants, and avoid unnecessary delays.
Increase community outreach efforts, and especially increase collaboration with nonprofit organizations, community-based organizations (CBOs), and other local community groups. Achieving deep decarbonization at a neighborhood level requires close coordination with communities.
Improve consumer education and awareness to improve participation in incentive programs and decision making, especially in environmental justice communities.</td></tr>
<tr><td>Barriers being addressed: Procedural equity, community engagement and accessibility.</td><td>Impact: All residents of New Jersey, but especially LMI and disadvantaged communities.</td></tr>
<tr><th colspan="2">2. Address programmatic barriers to electrification and energy efficiency*</th></tr>
<tr><td>Timeline: Immediate and ongoing</td><td>Implementing Agencies: All agencies</td></tr>
<tr><td colspan="2">Description:
Address barriers alongside electrification (wiring, health and safety, etc.)<ol type="a">
Programs should be designed to pair electrification with weatherization/building shell improvements and storage/generation to reduce bill impacts
Additionally, programs should incorporate health and safety measures and provide financial assistance to support health and safety repairs and energy efficiency upgrades, such as through the Comfort Partners Program. They should also ensure the use of healthy building materials, particularly for insulation and sealants, while avoiding materials that contain persistent, bio-accumulative, or toxic chemicals that could harm building occupants, installation contractors, and manufacturing workers.
NJBPU's current Whole House Program is piloted in Trenton, New Jersey, and provides coordinated weatherization, energy efficiency, and health and safety improvements, with the goal of serving 100 households. NJBPU should evaluate and explore expanding the Whole House Pilot Program to serve additional LMI communities and customers across the state.
Programs should reduce barriers to participation in programs: streamline services, coordinate across state agencies and community groups, and make program interfaces user-friendly. Streamline and simplify income verification processes to minimize unnecessary data verification and privacy concerns. Implement automatic enrollment in and/or referral to programs where possible to reduce customer effort to participate.</td></tr>
<tr><td>Barriers being addressed: Health and safety barriers, participation and customer engagement barriers.</td><td>Impact: All program participants in clean energy programs, but especially LMI and disadvantaged communities.</td></tr>
<tr><th colspan="2">3. Continue to prioritize underserved and disadvantaged communities*</th></tr>
<tr><td>Timeline: Immediate and ongoing</td><td>Implementing Agencies: All agencies</td></tr>
<tr><td colspan="2">Description:
Continue to pursue the goal to make at least 10 percent of all LMI homes electrification-ready by 2030. Target programs at affordable housing, multifamily housing, housing stock without air conditioning, and populations with heightened susceptibility</td></tr>
</table>

to indoor air pollution (including children, pregnant women, older adults, and those with asthma and pre-existing heart and lung conditions).

- Address the "split incentive" problem in rental properties.
- Building performance standards and net-zero-emissions codes can help ensure that rental properties are not left behind. Another approach that some jurisdictions have taken to address split incentives would be to set minimum energy efficiency standards for rented homes, as done in Burlington, Vermont.[380]
- Programs can include policies to ensure that rents do not become unaffordable as a result of building upgrades.[381] The 4d Affordable Housing Incentive Program in Minneapolis, Minnesota helps owners of affordable housing receive tax reductions in exchange for a commitment to keep at least 20 percent of the units affordable, and support for energy efficiency and solar installations through cost sharing incentives.[382]
- Prioritize LMI and disadvantaged communities for neighborhood electrification efforts and building decarbonization pilots and demonstrations. These communities have historically been excluded from green building investment projects. Additionally, state agencies should provide targeted support for electrification in LI households and disadvantaged communities so they are not left as the only remaining customers on the gas system, thereby avoiding inequitable cost burdens and promoting an inclusive transition to clean energy.
- Evaluate opportunities to further develop, leverage funding for, and expand the Whole House Pilot, which addresses health, safety, and housing quality barriers to New Jersey's income eligible energy efficiency program.
- Coordinate between energy providers, local health departments, building retrofit administrators and community-based groups to simultaneously address building, health, and safety interventions and maximize impact of funding.[383]
- Explore requiring public housing to be built above base code to maximize energy efficiency, thereby reducing bills.

Barriers being addressed: Program accessibility and barriers to participation for low-income and underserved communities and renters.	**Impact:** All program participants in clean energy and/or building decarb programs, but especially LMI and disadvantaged communities.

4. Ensure energy affordability*

Timeline: Immediate and ongoing	**Implementing Agencies:** All agencies

Description:

- Consider energy assistance programs and innovative rate structures like Percentage of Income Payment Plans.
- Cover a large share of upfront costs and maximize use of non-debt funding for program work. Make no-cost, zero-interest, or low-cost or forgivable loans available if using loans, and ensure that there are adequate consumer protections to discourage harmful lending practices.
- Evaluate the existing on-bill financing programs and enhance and expand the programs where necessary to fund energy improvements and building decarbonization projects, especially for LMI customers.
- Carefully design the package of electrification-related building upgrades, incentives, rate designs and measure offerings to not increase operating costs.
- Offer additional programmatic assistance (including direct install measures) for LMI households and ensure that energy affordability and programmatic assistance aligns household and landlord incentives with clean energy and energy efficiency outcomes.

Barriers being addressed: Financial barriers and affordability, especially for customers with limited access to financing or capital.	**Impact:** All program participants in clean energy and/or building decarbonization programs, but especially LMI and disadvantaged communities.

6.4 WORKFORCE

Overview

New Jersey has a strong base of existing workforce development programs that can be built upon to help prepare the workforce for the decarbonization transition, produce good quality jobs, and increase equity. The key strategies focus on filling gaps in the current workforce education ecosystem by providing central training resources for current and future workers, targeting training opportunities to address gaps in knowledge of clean buildings technologies and best

380 RMI. "Rental Efficiency Standards: A Win for Equity and Climate." May 25, 2021. Available at: https://rmi.org/rental-efficiency-standards-a-win-for-equity-and-climate/

381 For more examples, see: ACEEE. 2021. *A New Lease on Energy: Guidance for Improving Rental Housing Efficiency at the Local Level*. Available at: https://www.aceee.org/sites/default/files/pdfs/u2102.pdf

382 City of Minneapolis. "4d Affordable Housing Initiative." Available at: https://www2.minneapolismn.gov/government/programs-initiatives/housing-development-assistance/rental-property/4d/

383 For example, see New York's Healthy Homes Value Based Payment Pilot and other examples: ACEEE. 2021. "Providing Health Services as Part of Residential Energy-Saving Programs." Available at: https://www.aceee.org/sites/default/files/pdfs/Providing_Health_Services_as_Part_of_Residential_Energy_Sep2021_Reformat.pdf

practices, and increasing focus and expanding resources to promote equitable participation in training programs. These key strategies are not exhaustive, and they draw on prior recommendations from work on workforce development, such as from the Clean Buildings Working Group, Energy Efficiency Workforce Needs, Infrastructure, and Equity Assessment,[384] and New Jersey's PCAP.

Key Strategies

<table>
<tr><th colspan="2">1. Establish a Clean Buildings Hub to promote training and awareness of clean building technologies and best practices</th></tr>
<tr><td>Timeline: Near-term</td><td>Implementing agencies: All state agencies</td></tr>
<tr><td colspan="2">Description:
• Establish a Clean Buildings Hub to promote training and awareness of clean building technologies and best practices. This hub would promote the development of a skilled clean buildings workforce and address existing and future workforce demands. By functioning as both a physical, place-based hub and an online resource center, it would offer valuable support to students, trainees, and professionals in the field. Training should include:
a. Training on the proper installation and maintenance of electrification appliances and equipment including space heating heat pumps, heat pump water heaters, and induction stoves.
b. Overcoming barriers to electrification, such as electrical load management strategies (sub-panels, load-sharing, smart circuit breakers, circuit pausers, meter collars, smart panels, and more)
c. Opportunities to address health and safety barriers to energy efficiency through electrification of combustion appliances (eliminating gas and propane leaks, controlling moisture, removing appliances with improper venting or lacking adequate makeup air).
• Evaluate whether to require trainings for contractors participating in state-funded programs.
• Approaches to electrification that preserve the historic character of existing buildings, ideally developed in partnership with the New Jersey Historic Preservation Office and local government historic preservation offices.
• Collaborate with equipment manufacturers to develop and provide training programs and resources.</td></tr>
<tr><td>Barriers being addressed: Lack of qualified building decarbonization workforce; lack of diversity in building decarbonization workforce; inability to access or lack of awareness of career and workforce training opportunities.</td><td>Impact: Current and future workers (e.g., electricians, plumbers, architects, HVAC contractors, trainees, students)</td></tr>
<tr><th colspan="2">2. Establish a Career Pathways Tool to provide a comprehensive resource of career opportunities, programs, and apprenticeships in the building decarbonization industry.</th></tr>
<tr><td>Timeline: Near-term. Could be enacted as soon as agencies create a training and job opportunity inventory and launch the website.</td><td>Implementing agencies: OCAGE, NJBPU, NJDOL</td></tr>
<tr><td colspan="2">Description:
• Establish a Career Pathways Tool to provide a comprehensive resource of career opportunities, programs, and apprenticeships in the building decarbonization industry. The tool could be a part of the Clean Buildings Hub and could be established by a collaboration between the OCAGE, NJBPU, and NJDOL. This resource could expand upon NJDOL's New Jersey Career Network tool which provides information about career pathways. New Jersey offers a variety of building decarbonization training opportunities and programs, but lacks a comprehensive, central resource for job seekers and trainees. The establishment of a career pathways tool would promote the development of a robust clean buildings workforce and address existing and future workforce needs by providing a central resource for students, trainees, and current workers to find training, career opportunities and related wraparound services and support.
• The Career Pathways Tool could provide job seekers with current job opportunities and job requirements. This function could help standardize job offerings and provide information about job requirements. This information could be particularly valuable for people entering the workforce to understand the baseline job requirements for entry level careers in the building decarbonization industry.</td></tr>
<tr><td>Barriers being addressed: Lack of qualified building decarbonization workforce; lack of diversity in building decarbonization workforce; inability to access or lack of awareness of career and workforce training opportunities.</td><td>Impact: Current and future workers (e.g., electricians, plumbers, HVAC contractors, builders, trainees, students). Improved workforce pipeline, more information for job seekers, and increased awareness of training opportunities and support services.</td></tr>
<tr><th colspan="2">3. Conduct a building decarbonization workforce needs and gap assessment</th></tr>
<tr><td>Timeline: Near-term</td><td>Implementing agency: OCAGE, NJBPU, NJDOL, NJEDA</td></tr>
</table>

384 Heldrich Center for Workforce Development. 2024. *New Jersey's Energy-Efficiency Workforce Needs, Infrastructure, and Equity Assessment*. Available at: https://njcepfiles.s3.amazonaws.com/New_Jerseys_Energy_Efficiency_Workforce_Needs_Infrastructure_+and_Equity_Assessment.pdf

Description: • Conduct an additional assessment of the workforce needs and investment needed in the building decarbonization workforce to meet decarbonization goals. New Jersey has begun to inventory and assess its building decarbonization workforce needs but lacks a detailed understanding of the specific needs. This study should focus on understanding the future demand for building decarbonization services (e.g., location, type of services including ancillary supply chain services, required skillsets, and licensing needs), addressing training gaps, achieving and supporting long-term upskilling, anticipating workforce attrition, and understanding barriers to ensure equity in access to training and work opportunities. This study can build upon the 2024 EE workforce needs and equity assessment. Additionally, the assessment could include a survey of employers to understand hiring challenges, gaps in statewide training programs and services, and other related challenges.	
Barriers being addressed: Lack of detailed estimates for building decarbonization workforce, including current workforce status and future needs. Lack of knowledge of current gaps in workforce pipeline.	**Impact:** Increase knowledge and awareness of workforce needs to enable more effective policymaking and decision making
4. Expand existing apprenticeship and training opportunities and specifically target overburdened communities	
Timeline: Near- to mid-term.	**Implementing Agencies:** NJDOL, NJPBU
Description: • Expand current apprenticeship and building decarbonization training opportunities, especially those offered by state agencies (e.g., NJDOL, NJBPU). Expansion of apprenticeship and training opportunities could include financial support to training entities to increase the incentives for experienced workers to participate as instructors, and to incentivize workers who would otherwise retire out of the workforce to become trainers. Increased funding could also go toward increasing the number of apprenticeships available, and increasing the funds available for students, especially for members of overburdened communities who may face financial barriers to participation.	
Barriers being addressed: Lack of qualified building decarbonization workforce, including replacement workers for retiring workforce and upskilling needs for legacy fossil workers. Lack of diversity in building decarbonization workforce. Inequitable participation in building decarbonization workforce and training opportunities, and potential for overburdened communities to not receive equitable benefits from building decarbonization transition.	**Impact:** Current and future building decarbonization workers, especially members of overburdened communities. Increased number of qualified building decarbonization workers and improved workforce pipeline.
5. Expand or establish funding for financial assistance for participation in training programs and connect trainees with other wraparound services (e.g. transportation, child-care)	
Timeline: Near-term and sustained	**Implementing Agencies:** NJEDA, NJDOL, NJDEP, NJBPU
Description: • Increase the amount of dedicated funding to enable potential trainees to participate in training programs. There should be a particular focus on providing support to members of overburdened communities and removing barriers to participation in training programs. Funding could go toward tuition, stipends for trainees, dedicated childcare, providing transportation or transportation reimbursement, counseling, etc. • Ensure wraparound and training services are an allowable cost with any state funding grant opportunities (including NJDOL, NJDCA, NJBPU, NJDEP, etc.)	
Barriers being addressed: Lack of diverse participation in workforce training programs, barriers to participation in training programs	**Impact:** Current and future building decarbonization workers, especially members of overburdened communities. Increase access to workforce training programs by reducing participation barriers. Improve equitable participation in workforce training programs.

6.5 DATA COLLECTION AND PERFORMANCE/PROGRESS TRACKING

Overview

A key action to help drive New Jersey's transition to clean energy is enhancing data collection processes to ensure informed and effective decision-making. Accurate, consistent, and accessible data enables the State to monitor progress toward decarbonization goals set forth by New Jersey's Global Warming Response Act (GWRA) and Energy Master Plan. By establishing a robust framework for data gathering that includes clear metrics, utility cooperation, and inter-agency collaboration, New Jersey can track the performance of its building electrification efforts over time. This data-centric approach will allow policymakers to evaluate the effectiveness of current strategies, address emerging gaps, and refine targets to ensure the State remains on track toward its climate objectives.

Engaging stakeholders, such as the Clean Buildings workgroup, to participate in tracking progress and setting goals toward New Jersey building decarbonization is critical to success. This collaboration will help monitor and assess the State's progress against established targets, providing a platform for continuous improvement and adjustment of policies as needed. Further, it will help align the State's actions to the needs of the community. Through ongoing data-driven assessments and cross-sector engagement, New Jersey can set a precedent for successful, equitable building sector decarbonization, leading to significant reductions in GHG emissions and setting the state on a path to a sustainable energy future.

Key Strategies

1. Improve data gathering for ongoing development and evaluation of New Jersey's building decarbonization strategies	
Timeline: This strategy can be implemented near term and will require sustained effort until goals are achieved.	**Implementing Agencies:** All agencies
Description: • Improve data gathering, which is a low-cost, foundational action for ongoing development and evaluation of New Jersey's building decarbonization strategies.[385] Legislative action may be needed to require utilities to prompt cross-agency coordination and partnership with local governments or other entities to access certain data. This effort also requires a consistent data gathering framework and definitions across agencies and utilities, as well as ensuring utility customer classification codes align with State electrification and climate goals. Appendix: Metrics to Consider provides a list of possible metrics for this data gathering effort. Selection of metrics should prioritize the following: a. Data quality, availability, and ease of collection b. Clearly defined, easily interpretable metrics c. Alignment with policy or equity goals for GWRA, EMP, and other New Jersey initiatives d. Experience with indicators in other states e. Ability of policymakers to impact metric outcomes f. Ability to evaluate and verify g. Geographic specificity h. Availability of demographic variables • Identify existing, time-bounded metric targets aligned to Global Warming Response Act and Energy Master Plan. Identify any gaps in existing targets and establish new targets as needed. • Conduct periodic review of key metrics (b.) against New Jersey targets (c.) to identify successes and shortfalls. • Engage the Clean Buildings workgroup to monitor and assess progress towards New Jersey's decarbonization targets. Solicit recommendations from this group to improve program offerings and policy designs. • As needed, modify programs and policies to help ensure that New Jersey meets its targets.	
Barriers being addressed: Lack of sufficient data and methods to monitor building decarbonization progress and refine State policies.	**Impact:** Provides necessary information to state agencies and policymakers to guide future actions. Informs all stakeholders of progress and target areas for sustained action.

385 For example, see *Massachusetts Clean Energy and Climate Metrics*, available at: https://www.mass.gov/info-details/massachusetts-clean-energy-and-climate-metrics.

CROSS-CUTTING

- ✓ Building energy use
  - Building energy benchmarking and reporting can lay the foundation for building performance standards. The State can lead by example by disclosing energy information for public buildings.
- ✓ Quantities of new, end-use equipment installed (e.g., space heating, water heating systems) by fuel type and building type

EQUITY AND ENVIRONMENTAL JUSTICE

- ✓ Include socioeconomic and demographic information on building occupants/owners when collecting other metrics
  - Investments, incentives, and program benefits received by disadvantaged communities and low-income households; affordable housing
  - Participation in building electrification and energy efficiency programs, cross-participation in energy and bill assistance programs
  - Track stakeholder input, community engagement, and outreach efforts

HEALTH

- ✓ Households with inadequately vented combustion equipment
- ✓ Presence of cooling equipment; frequency of energy shutoffs
- ✓ Presence of barriers to weatherization
- ✓ ER visits for energy-related causes (e.g. heat stroke, asthma)

BUILDING CONSTRAINTS

- ✓ Households rejected from participating in existing building programs due to barriers
- ✓ Electrical panel capacity rating and headroom, electrical panel breaker space
- ✓ Distribution system capacity rating and headroom

ALTERNATIVE FUELS

- ✓ Integration, synergies, and enablement of clean energy technologies

FUTURE OF GAS

- ✓ Geolocational data on natural gas infrastructure, such as mains and service lines
- ✓ Non-pipeline alternatives: number implemented, type, customers served, costs

GRID IMPACTS

- ✓ Current summer and winter peak loads at the distribution circuit, substation and utility jurisdiction levels
- ✓ Capacity ratings for distribution circuits and substations
- ✓ Load forecasts at the distribution circuit, substation and utility jurisdiction levels
- ✓ Heat pump and EV adoption by geographic area

BILL AND RATE IMPACTS

- ✓ Energy burden
- ✓ Number of customers using each rate structure

ECONOMIC IMPACTS

- ✓ Cost of decarbonization measures
- ✓ Cost of mitigating emissions

CONSUMER ADOPTION

- ✓ Reason for replacement (replace-on-fail versus early replacement)
- ✓ Heat pump adoption by geographic area and key market segment (e.g., low income, residential, small business, medium to large commercial)
- ✓ Heat pump product stock at retail shops and distributors
- ✓ Number of and share of trained HVAC contractors on heat pumps and electrification technologies
- ✓ General consumer awareness via periodic surveys

WORKFORCE

- ✓ Employment in the buildings sector, broken out by sub-industry (e.g., HVAC, electrician, lighting, energy auditor)
  - Demographic characteristics of workforce (ethnicity, gender, age, education, language, disability status)
- ✓ Number of licensed HVAC contractors, plumbers, electricians
  - Challenge to understand the number of HVAC installers that are heat pump installers specifically. Consider BPI certification of HP professionals, EPA certification for professionals who work with refrigerants, etc.
- ✓ Average wage by sub-industry and role
- ✓ List of wage/labor policies in place at state and local level (e.g., prevailing wage or wage floor requirements for taxpayer funded projects, hiring incentives, etc.)
- ✓ Number of participants in building decarbonization workforce training programs by geography
- ✓ List of education and training programs (overlap with recommendation for comprehensive workforce training hub tool in workforce development section 6.4)
- ✓ Hiring difficulty via survey with building decarbonization firms or using U.S. DOE's U.S. Energy & Employment Jobs Report (USEER) data
- ✓ Continue collecting, analyzing, and reporting data collected in workforce development reports