The Future Is Electric

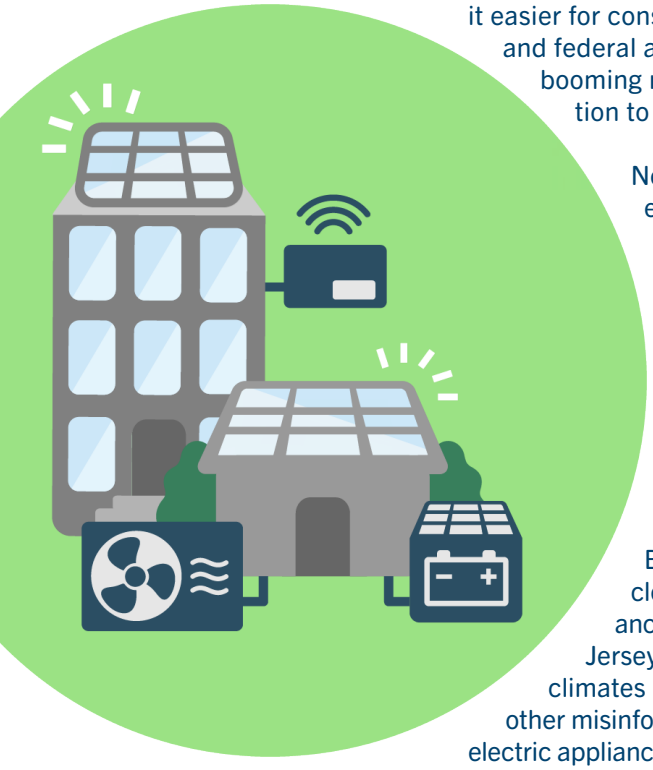
Helping New Jersey Live in Cleaner, Healthier and More Affordable Homes

Executive Summary

Buildings are the second largest source of greenhouse gas emissions in New Jersey.[1] Aggressively reducing emissions from buildings will be instrumental in achieving the Global Warming Response Act's target of an 80% reduction in emissions by 2050. Transitioning off fossil fuels to highly efficient and affordable electric appliances like heat pumps will reduce emissions, improve indoor and outdoor air quality, reduce health disparities in overburdened and underserved communities and communities of color, and help New Jerseyans reduce their energy bills.[2]

Even as New Jersey cleans up its electricity sector, New Jerseyans continue to burn fossil fuels – gas, oil, and propane – directly in their homes, for space and water heating as well as cooking. This produces not only greenhouse gas emissions but also harmful indoor air pollution. Highly efficient clean electric appliances are the clear option for reducing those emissions. As consumers replace appliances that rely on fossil gas, fuel oil, propane, and wood, with highly efficient and affordable electric appliances, these emissions will decline.

The transition to clean, electric buildings is underway throughout the Northeast, in much of the U.S. and globally. Consumers are finding that advanced electric heating systems improve comfort in the winter, provide cooling in the summer, and often reduce energy bills, particularly when combined with weatherization measures. Acadia Center analysis shows that the average household in New Jersey will see annual bill savings, with some reducing their bills by more than 20%. Many households can achieve bill reductions of more than 50% by combining electric appliances with home weatherization measures. New Jersey policies can accelerate the transition to healthy electric buildings by making it easier for consumers to purchase appliances and identify experienced installers. State and federal actions to reduce market barriers, like those that helped establish the now booming market for electric vehicles, should be adopted to accelerate the transition to electric appliances.



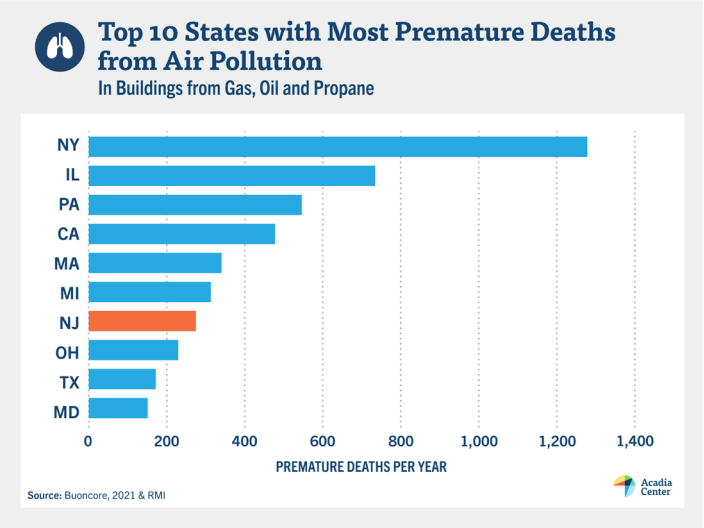
New Jersey consumers show overwhelming support for transitioning to electric heating and cooking – options that create healthier homes, lower energy bills and provide greater comfort from their heating and cooling systems. They strongly support policies that advance the adoption of electric appliances in buildings.[3] As aging gas and oil fueled furnaces, boilers, and water heaters near their end of life, consumers will choose better performing and increasingly affordable electric alternatives, if state policies appropriately support them. State policies are needed to ensure that the many benefits of heat pumps are available to all consumers, especially those in overburdened and underserved communities and communities of color.

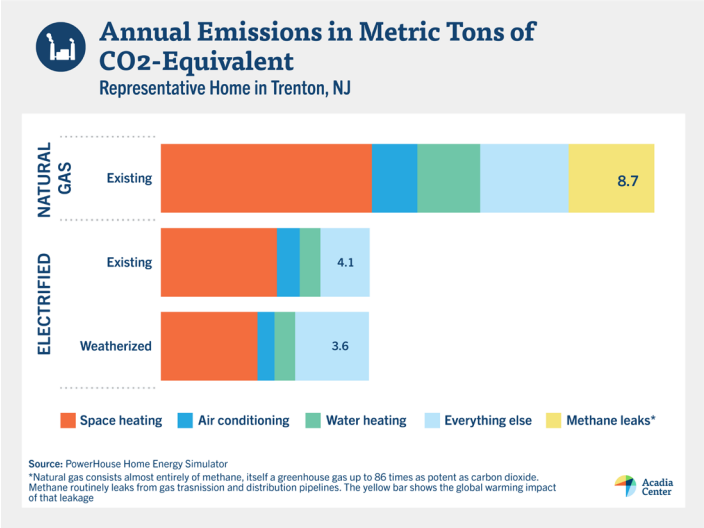
Buildings are the largest market for fossil gas in New Jersey, which is why clean energy opponents are desperate to delay conversion to electric appliances. It is also why they actively tout myths that heat pumps won't heat New Jersey homes effectively – while consumers successfully use them in colder climates including New York, Massachusetts, Vermont and Maine – and promote other misinformation intended to confuse residents. Delaying the transition to efficient electric appliances provides a windfall to fossil fuel interests while unsuspecting New Jersey consumers pay the price. The benefits of a faster transition are overwhelming – making buildings healthier and safer for all New Jerseyans while also reducing greenhouse gas emissions in the state.

Electric Homes Are Healthier Homes

Shifting away from gas and oil fueled furnaces, boilers, and water heaters to high performing and affordable electric appliances will dramatically reduce harmful emissions from buildings, particularly nitrogen dioxide that harms indoor air quality and greenhouse gas emissions that exacerbate climate change. That is why the New Jersey's 2019 Energy Master Plan's least cost scenario calls for converting at least 90% of residential and commercial buildings from natural gas to electric appliances by 2050.[4]

Fossil fuel combustion in buildings is a significant contributor to outdoor air pollution and adverse health outcomes in New Jersey, particularly in low-income communities and communities of color. New research from the Harvard T.H. Chan School of Public Health quantified impacts of outdoor air pollution, including premature mortality from gas and oil burning in residential and commercial buildings.[5] New Jersey had one of the highest health burdens from outdoor air pollution directly related to combustion of fossil fuels in buildings of any state in the country, with over 250 premature deaths and $2.8 billion in monetized health impacts annually.[6]





People with low incomes and people of color are more likely to live in areas with poor outdoor air quality, including neighborhoods near power plants, garbage incinerators, ports, and where bus and truck traffic is especially heavy. Indoor air pollution resulting from burning of fossil fuels in buildings only further degrades air quality, exacerbating the environmental impacts on these communities. Public health experts have increasingly highlighted harms of indoor air pollution from gas stoves. Households with gas stoves regularly exceed safe levels of nitrogen dioxide and carbon monoxide – among other pollutants – and have significantly higher levels of indoor air pollution than those with electric cooking.[7]

A 2013 meta-analysis showed that children in homes with gas stoves have a 42% higher likelihood of asthma incidents and a 24% higher likelihood of asthma prevalence.[8] Fossil fuel combustion in buildings should be considered in forthcoming regulations to implement the landmark 2020 Environmental Justice Law, N.J.S.A. 13:1D-157.[9]

Moreover, low-income households are more likely to live in smaller homes, where concentrations of nitrogen dioxide from cooking with gas have less air volume in which to dissipate. Low-income household residents are more likely to suffer from asthma, chronic obstructive pulmonary disease (COPD), and heart disease due to multiple nearby pollution sources. Additional household air pollution from fossil fuel appliances can have an outsized impact.

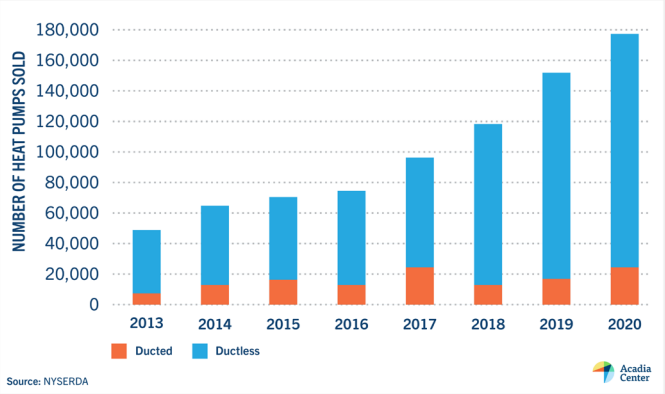
As shown below, shifting to electric appliances today will cut greenhouse gas emissions in a representative home in New Jersey by more than half, while simultaneously improving local health. As renewables produce a larger share of New Jersey's electricity, power sector emissions will decline, further increasing the environmental and health benefits of electric appliances.

Heat Pump Technology is Right for New Jersey

The current generation of cold climate heat pumps can replace gas furnaces or boilers and handle the heating needs of well insulated homes in the northeast without backup systems. An added bonus in an era with ever higher summer temperatures is that heat pumps also provide highly efficient air conditioning. Gas water heaters can be replaced with efficient heat pump water heaters (HPWHs). Heat pump appliances dramatically reduce energy consumption and frequently reduce energy bills. When combined with investments in home weatherization, shifting to electric appliances achieves even greater bill savings, particularly for older, leaky homes.

Better performance is why sales of air-source heat pumps (ASHP) in the northeast are growing rapidly, as shown below. Heat pump sales were catching up to sales of fossil fuel furnaces in 2019 (150,000 heat pumps compared to 235,000 fossil fuel furnaces), and that trend will accelerate due to significant improvements in state incentives since 2019, particularly in Massachusetts and New York.[10]

Air Source Heat Pump Sales in New England & New York
2013-2020



Where Are Heat Pumps Being Used Today?

Heat pumps designed for use in low temperatures are seeing accelerated adoption in the Northeast. For example, Maine, the coldest state in the Northeast, has installed over 100,000 heat pumps in the last seven years, reaching more than 4% of the housing stock each year. Vermont, the region's second coldest state, has installed heat pumps in about 1% of its homes per year since 2015. Both states offer rebates to customers who install heat pumps through their energy efficiency programs, and Vermont further offers a bonus rebate to low- and moderate-income customers. Other states across the Northeast are following the lead of Vermont and Maine and have adopted heat pump incentives in their energy efficiency programs.

Today's heat pump appliances bear little resemblance to the models that were in use 10 or 20 years ago. Some home contractors and installers who have not yet installed new technologies may advise clients against using them. To address this learning gap, state policies are needed to accelerate product training and connect consumers with experienced installers.[12]

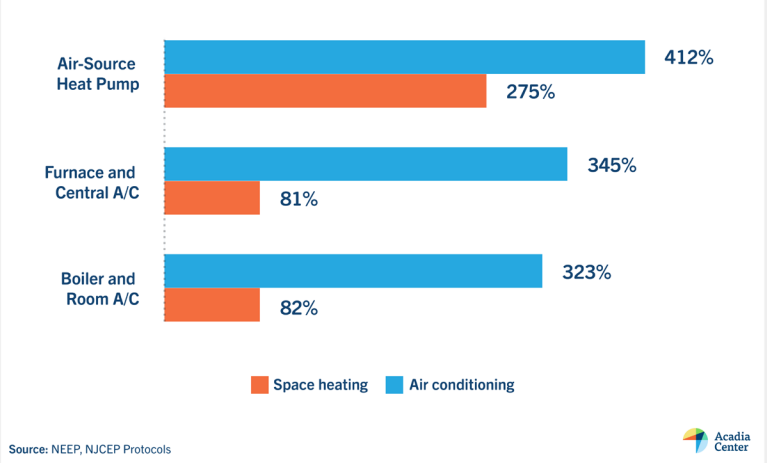
WHAT IS A COLD CLIMATE HEAT PUMP?

A heat pump works by harvesting heat energy. Believe it or not, everything that is warmer than outer space has heat energy in it, and heat pumps are able to push that energy into or out of your home. Even when it's below zero, there's still heat in the air. A heat pump effectively extracts heat from the cold outdoors, concentrates it, and delivers it inside to keep you comfortable all winter. According to the laws of physics, a lot less energy is required to move heat than to create it.

Some people think that heat pumps don't work in below freezing temperatures, but modern technology has improved performance dramatically. Many of today's cold-climate models produce plenty of heat down to outdoor temperatures of 5, -5, or even -15 degrees Fahrenheit.[11]

A heat pump might look like a typical air conditioner. It is actually an air conditioner that's designed to operate in either direction, so it can heat or cool a house as needed. Another big difference from a typical AC is that advanced air-source heat pumps are "variable capacity," which means the motors and fans can speed up or slow down to provide just the right amount of heating or cooling without constantly turning on and off. They are also quieter than most air conditioners and furnaces.

Typical Efficiencyof Heating and Air Conditioning Equipment



IT GETS COLD IN MASSACHUSETTS, TOO

In cold climates, like Massachusetts', high efficiency, cold-climate air-source heat pumps can provide 100% of a home's heating and cooling needs. Two common myths are that air-source heat pumps cannot heat when temperatures are below freezing and that they cannot heat homes without a backup heating source. In fact, cold-climate air-source heat pumps provide heating at below freezing temperatures and do not require a backup in well-insulated homes.[13]

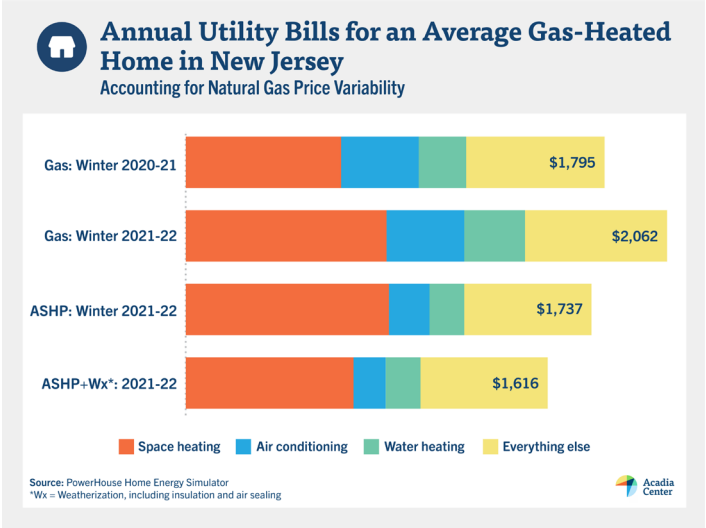
Heat Pumps Reduce Energy Bills Across New Jersey

With supportive state policies, many New Jersey homeowners can dramatically reduce their energy bills by switching away from fossil gas, oil, and propane to highly efficient and affordable electric systems for space and water heating.

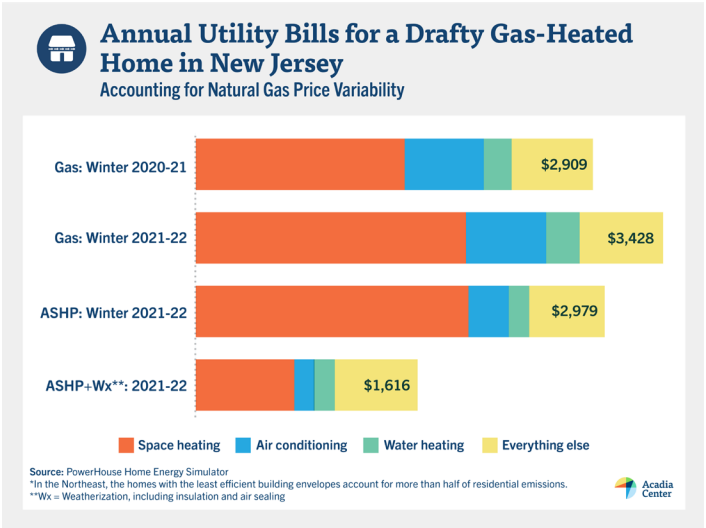
New Jersey's housing stock is older and less energy efficient than the national average and has little insulation to protect against drafts. Not only are drafty homes uncomfortably chilly in the winter and hot in the summer, but homeowners also spend far more to heat and cool these homes than owners of better insulated homes. Weatherization measures reduce the demand on heating and cooling equipment (also known as load). Measures that reduce leakage include adding insulation to exterior walls, attic walls, rim joists, and attic floors, and air sealing in the attic and around exterior windows and doors.[14]

Acadia Center's PowerHouse model uses data about New Jersey housing stock, weather and utility rates and calculates energy consumption and energy costs based on an average level of weatherization.[15] Analysis for New Jersey finds that the installation of new efficient cold climate heat pumps and heat pump water heaters results in lower annual operating costs for a representative New Jersey home with an average level of weatherization.[16] The average home would save about $50 annually, even assuming very low gas prices, such as those from winter 2020- 2021.

Importantly, the model also calculates energy consumption and energy cost based on improved weatherization. If the homeowner chooses to improve weatherization, energy savings for the average New Jersey home that switches from gas to electric appliances increases to about $180 annually. Note that as the price of fossil gas increases, consumers who convert to electric appliances save even more. Current projections show that gas prices increased by 30% in winter 2021-22 from winter 2020-2021. Using these higher gas prices, annual energy savings would increase from $50 to more than $325 annually for the average New Jersey home that shifts from natural gas to electric for heating and cooling. Energy savings reach about $450 annually if the same home also improves weatherization.



In the case of a representative drafty home[17] in New Jersey, using relatively low 2020-2021 gas prices, the model calculates that a drafty home that improves weatherization and switches from gas to electric appliances would reduce annual operating costs by nearly $1,300. Using the higher gas prices from winter 2021-2022, a drafty home would save over $1,800 annually by improving weatherization and converting to electric appliances.



Targeting the most inefficient homes is critical because the EIA's Residential Energy Consumption Survey shows that the leakiest 25% of housing units account for half of residential emissions in Northeast states. Typically, these super-emitting housing units are located in lower-income communities and communities of color and include residents who speak languages other than English. Retrofitting these homes would significantly reduce energy bills for many vulnerable households in the region, improve indoor air quality, and cut

residential sector emissions in half as the electric grid transitions to carbon neutral sources of generation.

While analysis of a representative home in New Jersey based on average gas and electric rates is useful, even more can be learned from examining differences across New Jersey. Gas and electric rates vary across each electric and gas utility in New Jersey and have a significant impact on energy bills. Depending on where they live In New Jersey, many homeowners converting from fossil gas to electric appliances will benefit from substantial annual reductions of their current annual energy bills.

- An average gas-heated home in South Jersey can reduce annual energy bills by 13% by switching to heat pumps for space heating, air conditioning and water heating. A leaky home with improved weatherization and electric appliances can reduce its bills from $3,350 per year to about $1,750, a savings of 48%.

- An average gas-heated home in New Jersey Natural Gas territory could reduce its energy bills by 30% by switching to heat pumps for space heating, air conditioning and water heating. A leaky home with improved weatherization and electric appliances can reduce its bills from about $2,800 per year to about $1,100, a savings of 61%.

- An average gas-heated home in PSE&G territory would spend the same amount on its energy bills each year after switching to heat pumps for space heating, air conditioning and water heating. A leaky home with improved weatherization and electric appliances can reduce its bills from about $2,500 per year to about $1,640, a savings of 35%.

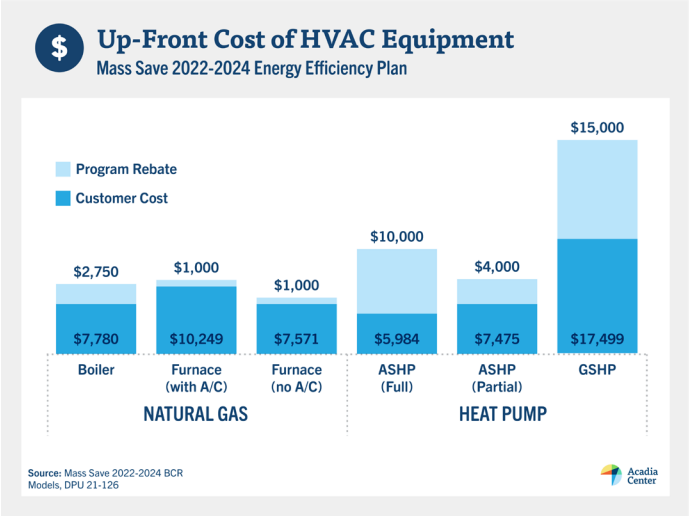
- Consumers using heating oil and propane can achieve even greater savings by switching to electric appliances. An average home using fuel oil spends about $3,000 annually on energy bills and would save more than $1,250 each year, a savings of 58%, by switching to electric for space and water heating.

New Jersey Is Falling Behind

A coordinated electrification strategy is required to improve consumer access to electric appliances and ensure energy savings for all consumers. Building electrification is a critical strategy to reduce a major source of greenhouse gas emissions, as described in New Jersey's 2019 Energy Master Plan. However, New Jersey is now behind in achieving its building decarbonization goals and needs effective policies that remove marketplace obstacles and promote the switch away from fossil fuels.

Unfortunately, New Jersey currently is doing little compared to other states in the northeast to remove market barriers that slow consumer adoption of high performing electric appliances. Low consumer incentives provide a visible example. States throughout the northeast provide substantial rebates that make it attractive to purchase electric appliances. Under new utility-run energy efficiency programs, approved by the New Jersey Board of Public Utilities (NJBPU) in July 2021, New Jersey incentives for highly efficient air-source heat pumps have declined substantially. In prior years, NJBPU offered rebates of $2,000 for a typical 5-ton air-source heat pump. In 2021, those rebates dropped to $1,000 for consumers served by electric utilities JCP&L and ACE, and to a meager $390 for PSE&G consumers.[18]

In contrast, program rebates for Mass Save, a statewide energy efficiency program offered by electric utilities, are provided in the figure below, in light blue. The out-of-pocket



consumer cost in dark blue shows that consumers pay over 40% less for a full (or whole home) cold climate air source heat pump (ASHP) system than for a combination of new furnace and air conditioning system and pay over 20% less than the cost of a furnace alone. Rebates range from $4,000 to $10,000 for cold climate air source heat pumps that provide heating in the winter and cooling in summer months.[19]

Across the Northeast, states are now providing substantial assistance to homeowners to weatherize their homes and to reduce the initial cost of electric appliances – making it a low-cost alternative to fossil gas, propane and oil. Incentives for cold climate air-source heat pumps are far greater in other states compared to New Jersey and are rapidly changing. As of January 2022, state program offerings include:[20]

- Vermont offers up to $2,000 plus a bonus for low-income customers

- Maine offers up to $1,200 plus a bonus of $1,200 for low-income customers

- Connecticut offers between $2,500 and $7,500

- Rhode Island offers up to $1,750

- New York offers up to $1,600

New Jersey's Future Is Electric, Not Fossil Fuels

Cold climate air-source heat pumps and heat pump water heaters provide substantial benefits to New Jersey households and are replacing gas-fired furnaces and boilers throughout the northeast. In New York, Governor Hochul is providing bold leadership to deliver these benefits to New York households. In January 2022, New York announced a plan to achieve 1 million electrified homes and 1 million climate-friendly electrification-ready homes by 2030. Governor Hochul also proposed legislation to ensure that all new building construction reaches zero-emissions by 2027.

New Jersey households demand equally bold leadership in New Jersey, from the Governor, legislators, regulators and government agencies.

- Programs to assist low- and moderate-income households should be a high priority for New Jersey policymakers. The administration and NJBPU should direct substantial investments to assist with building weatherization of low and moderate-income households, along with widespread electric-ready measures and electric appliances.

- NJBPU should direct the Division of Clean Energy and utilities to dramatically improve their support for electric appliances through consumer incentives, workforce training, and supply chain development.

- The building conversion rate described in the 2019 Energy Master Plan – 22% of buildings by 2030 – is not aggressive enough. The opportunity to improve health outcomes and reduce energy bills requires a faster conversion rate. NJBPU together with other agencies should set new goals to convert all homes with costly electric resistance, oil or propane heating to electric heat pumps by 2030, as well as at least 20% of homes with fossil gas heating systems. NJBPU should also develop policies and programs to ensure these goals are met.

- Resist efforts by gas utilities and fossil fuel interests to promote "renewable" natural gas, biofuel, hydrogen, and other high cost, problematic investments as false alternatives to electrification.[21]

- In 2022, develop a Building Electrification Roadmap that achieves at least 90% conversion of buildings to all-electric by 2050, and enact legislation to enable Stretch Codes that allow municipalities to opt-in to all-electric new construction.

- By 2027, adopt a zero-energy building code for new and existing buildings using a public stakeholder process.

- New Jersey must invest in workforce training for proper installation of heat pumps, as experts agree that proper installation ensures that savings and greenhouse gas benefits are achieved.

- NJBPU should begin a gas planning proceeding to establish a strategic and transparent process to plan for the future of gas and protect ratepayers, particularly low- and moderate-income households, from catastrophic gas rate increases as gas consumption declines. NJBPU should move quickly to develop a new approach to approving further investments in gas infrastructure that aligns with New Jersey's climate goals. This will limit future stranded assets, while simultaneously protecting the safety and reliability of the gas distribution system.

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Endnotes

1 Direct, on-site combustion of fossil fuels in buildings is the second largest source of GHG emissions in New Jersey (26% of GHG emissions) after transportation (42%). Space and water heating account for the majority of emissions from these sectors, with 87% of residential buildings and 82% of commercial buildings relying predominantly on natural gas. About 10% of residential households rely on fuel oil or propane.

2 Decarbonizing Homes: Improving Health in Low-Income Communities through Beneficial Electrification, RMI, Nov 2021

3 2021 Attitudes on Clean Energy Poll: https://rethinkenergynj.org/rethink-energy-nj-poll-shows-large-majority-of-nj-voters-support-stronger-action-to-address-climate-change/

4 2019 New Jersey Energy Master Plan: Pathway to 2050, Page 53 https://nj.gov/emp/docs/pdf/2020_NJBPU_EMP.pdf

5 Jonathan J Buonocore (Harvard T.H. Chan School of Public Health) et al., "A decade of the U.S. energy mix transitioning away from coal: historical reconstruction of the reductions in the public health burden of energy," 2021 Environ. Res. Lett. 16 054030, https://doi.org/10.1088/1748-9326/abe74c

6 These values are based on additional analysis from Jonathan Buonocore, Sc.D, the study's lead author. RMI used median estimates from the results of 3 reduced complexity models used in: Jonathan J Buonocore (Harvard T.H. Chan School of Public Health) et al, "A decade of the U.S. energy mix transitioning away from coal: historical reconstruction of the reductions in the public health burden of energy", 2021 Environ. Res. Lett. 16 054030, https://doi.org/10.1088/1748-9326/abe74c

7 See Rocky Mountain Institute, et al, "Gas Stoves: Health and Air Quality Impacts and Solutions", 2020. https://rmi.org/insight/gas-stoves-pollution-health/. In addition a 2022 Stanford study found significant methane emissions even when gas stoves were turned off, https://www.washingtonpost.com/climate-environment/2022/01/27/gas-stoves-kitchens-pose-risk-public-health-planet-research-finds

8 Weiwei Lin, Bert Brunekreef, and Ulrike Gehring, "Meta-analysis of the effects of indoor nitrogen dioxide and gas cooking on asthma and wheeze in children," International Journal of Epidemiology, Volume 42, Issue 6, (December 2013): 1724–1737, https://doi.org/10.1093/ije/dyt150

9 The Environmental Justice Law, signed by Governor Murphy in September 2020, requires the New Jersey Department of Environmental Protection to evaluate the environmental and health impacts of certain facilities on overburdened communities when reviewing certain permit applications. The law is the first in the nation to require mandatory permit denials if an environmental justice analysis determines a new facility will have a disproportionately negative impact on overburdened communities.

10 Chart prepared by Acadia Center using data from 2013-2020 HVAC market reports prepared by D+R International for NYSERDA https://www.nyserda.ny.gov/About/Publications/Program-Planning-Status-and-Evaluation-Reports/Evaluation-Contractor-Reports/2017-Reports & https://data.ny.gov/Energy-Environment/HVAC-Market-Share-by-Efficiency-and-Capacity-Begin/tf22-v9nz

11 In New Jersey, a temperature of zero degrees Fahrenheit with a 16 mile-per-hour wind, equivalent to -6.3 degrees Fahrenheit, is considered a 1-in-90-year event. See Final Report: Analysis of Natural Gas Capacity to Serve New Jersey Firm Customers, London Economics International LLC, November 5, 2021, p. 41. https://www.bpu.state.nj.us/bpu/pdf/boardorders/2021/20211215/9B%20LEI%20Final%20Gas%20Capacity%20Report%2011%2005%202021%20Public%20Redacted.pdf

12 Northeast Energy Efficiency Partnership provides excellent resources for both consumers and installers of cold climate air-source heat pumps, including the "Air-Source Heat Pump Buying Guide," a resource to help consumers ask better questions when planning a new system and obtaining bids. https://neep.org/sites/default/files/resources/ASHP_buyingguide_5.pdf. Also, a new campaign in California, The Switch Is On, provides consumers resources to learn about heat pumps and connect with experienced installers. https://www.switchison.org/

13 See https://goclean.masscec.com/wp-content/uploads/2020/04/ASHP_Tech_Guide-v4.pdf and MassCEC Whole-Home Heat Pump Pilot, https://www.masscec.com/blog/2021/09/13/masscec-pilot-showcases-success-whole-home-heat-pumps. Also see NREL research on whole home heat pumps in Alaska, https://www.nrel.gov/news/features/2021/even-in-frigid-temperatures-air-source-heat-pumps-keep-homes-warm-from-alaska-coast-to-us-mass-market.html

14 For further information, see: https://www.energy.gov/energysaver/air-sealing-your-home

15 All analysis presented in this brief assumes a 2,000 square foot, single-family home, as 63% of housing units in New Jersey are single-family. The default electricity and natural gas rates used in the analysis are an average of the rates that actual New Jersey households pay to their distribution utilities, weighted based on the number of customers that each utility serves. Rates can vary substantially between companies and from year to year.

16 Acadia Center uses conservative assumptions to forecast the utility bill and emissions impacts of weatherization. Potential increases in insulation are limited by the framing depth of the average New Jersey home, which is shallower than what would be required under today's building energy code. Air sealing impacts take account of the locations where energy efficiency programs commonly obtain cost-effective reductions in air leakage, such as in attics, on foundation sills and rim joists, and around exterior doors.

17 A drafty home in this instance is defined as a home with an air infiltration rate of 20 air changes per hour at 50 pascals pressure differential and with below-average levels of insulation in ceilings, walls, and rim joists.

18 PSE&G as of 2/1/2022, https://homeenergy.pseg.com/heatingandcooling

19 Massachusetts offers up to $15,000 for a ground source heat pump (GSHP). While ground source heat pumps have higher efficiency and cost less to operate than ASHP, they have substantially higher upfront costs.

20 For details by state, see https://neep.org/sites/default/files/media-files/2021_ashp_program_summary_-_july_2021_update.pdf. Note that these rates are from early 2021, so current New Jersey rates differ.

21 See "A Pipe Dream or a Climate Solution - Issue Brief," Merrian Borgeson, NRDC, June, 2020, https://www.nrdc.org/resources/pipe-dream-or-climate-solution