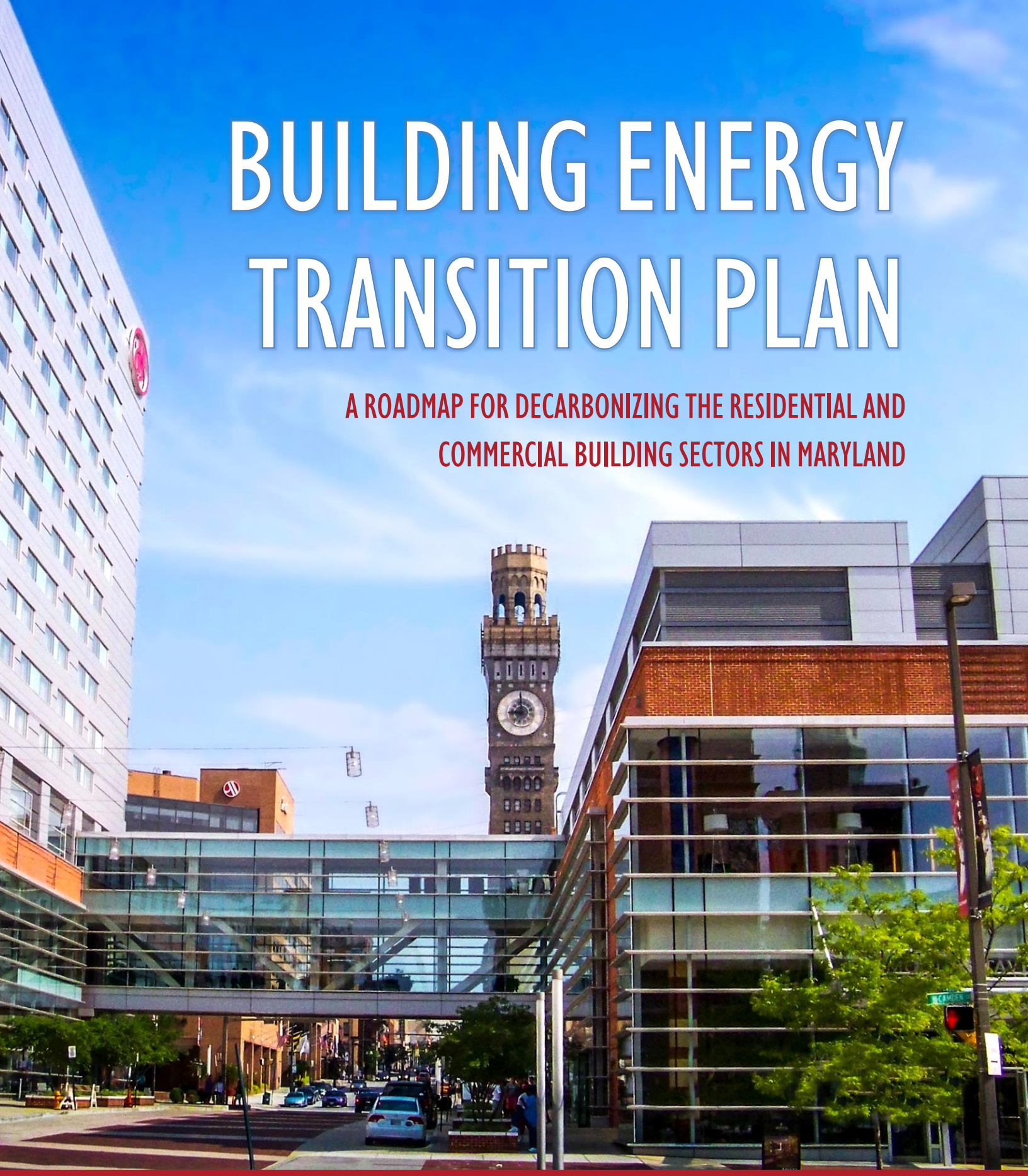

BUILDING ENERGY TRANSITION PLAN

A ROADMAP FOR DECARBONIZING THE RESIDENTIAL AND COMMERCIAL BUILDING SECTORS IN MARYLAND

MARYLAND COMMISSION on CLIMATE CHANGE

Ben Grumbles, Chair

This is a report by the Maryland Commission on Climate Change, which is charged with advising the Governor and General Assembly on ways to mitigate the causes of, prepare for, and adapt to the consequences of climate change. The Commission is chaired by the Maryland Department of the Environment Secretary Ben Grumbles and consists of members representing state agencies, the Maryland General Assembly, local government, business, environmental non-profit organizations, organized labor, philanthropic interests, and universities in Maryland.

Policy proposals included in this report are supported by the Commission but do not necessarily reflect current state policy. This report is meant to guide Maryland policymakers on decisions related to reducing greenhouse gas emissions from buildings in pursuit of achieving targets in Maryland's 2030 Greenhouse Gas Reduction Act Plan and the Commission's recommendation that Maryland achieve net-zero emissions economywide by 2045.

November 2021

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Executive Summary

Direct use of natural gas, heating oil, and propane in buildings – primarily for space heating and water heating – accounted for 13 percent of Maryland's greenhouse gas emissions in 2017. Maryland's 2030 Greenhouse Gas Reduction Act (GGRA) Plan calls for reducing emissions from buildings through energy efficiency and by converting fossil fuel heating systems to electric heat pumps. Heat pumps are essentially air conditioners that can reverse cycle to provide efficient heating and cooling in one system, powered by increasingly clean electricity. They are already the second most common heating system in Maryland.

While the 2030 GGRA Plan sets a goal of electrifying fossil fuel end-uses in buildings, it also calls on the Maryland Commission on Climate Change (MCCC) to develop a Building Energy Transition Plan to identify specific measures and goals to decarbonize the buildings sector.

Energy + Environmental Economics (E3) examined four scenarios that would nearly achieve net-zero emissions for Maryland's residential and commercial buildings sectors by 2045, aligning with the MCCC-recommended target for economywide emissions reductions. E3 found that a "MWG Policy" scenario is the lowest-cost scenario among all that were modeled. E3's findings include estimated future costs and benefits based on a certain set of assumptions; actual results could differ from the findings included in this report.

What is the MWG Policy scenario?

The MCCC's Mitigation Work Group (MWG) formed a Buildings Sub-Group to guide E3's study and craft this Building Energy Transition Plan. A broad and diverse group of stakeholders provided valuable input over seven months and developed the policy recommendations presented herein. E3 modeled an "MWG Policy" scenario to evaluate the impacts of this Plan and recommendations, which are based on four core concepts:

- Ensure an equitable and just transition, especially for low-income households
- Construct new buildings to meet space and water heating demand without fossil fuels
- Replace almost all fossil fuel heaters with heat pumps in existing homes by 2045
- Implement a flexible Building Emissions Standard for commercial buildings

E3 found that implementing this Plan would:

- Reduce emissions from residential and commercial buildings by 95 percent by 2045
- Reduce construction and energy costs for most building types
- Ramp up electricity system investments to around $1B annually by 2045
- Ramp down gas system investments, saving around $1B annually by 2045
- Increase electricity rates by 2 cents per kilowatt-hour by 2045
- Provide the lowest gas rates among all scenarios modeled

Core Recommendations

This Plan includes four Core Recommendations (and 12 additional recommendations) that are designed to achieve a just transition to a decarbonized buildings sector in Maryland.

1. **Adopt an All-Electric Construction Code** – The General Assembly should require the Maryland Building Code Administration to adopt a code that ensures that new buildings meet all water and space heating demand without the use of fossil fuels. A cost-effectiveness test would allow building projects to seek variances to code requirements while maintaining electric-ready standards.

2. **Develop a Clean Heat Retrofit Program** – The General Assembly should require and provide funding to state agencies to implement programs (with the utilities, if applicable) that would:
    a. Retrofit 100 percent of low-income households by 2030
    b. Encourage fuel-switching through EmPOWER beginning in 2024
    c. Encourage beneficial electrification through EmPOWER beginning in 2024
    d. Target 50 percent of residential heating system, cooling system, and water heater sales to be heat pumps by 2025, 95 percent by 2030
    e. Align energy plans, approvals, and funding with the objectives of this Plan

3. **Create a Building Emissions Standard** – The General Assembly should require the Maryland Department of the Environment to develop a Building Emissions Standard that would guide commercial and multifamily residential buildings to net-zero emissions by 2040. State-owned buildings would meet this standard by 2035. The General Assembly should also provide tax incentives and resources to help owners of covered buildings develop and implement emissions reduction measures. An alternative compliance pathway would be available to allow covered buildings to continue using fossil fuels when emissions reduction measures are unnecessarily expensive.

4. **Develop Utility Transition Plans** – The General Assembly should require the Public Service Commission to oversee a process whereby the electric and gas utility companies develop plans for achieving a structured and just transition to a near-zero emissions buildings sector in Maryland.

Background

The combustion of fossil fuels in buildings is a substantial source of greenhouse gas (GHG) emissions in Maryland. Most of this energy use is for space and water heating. Maryland's 2030 Greenhouse Gas Reduction Act (GGRA) Plan calls for reducing GHG emissions from residential and commercial buildings through energy efficiency and by converting fossil fuel heating systems to efficient electric heat pumps that are powered by increasingly clean and renewable electricity. The 2030 GGRA Plan shows a steady transition to heat pump adoption, leading to at least 80 percent of residential space heating systems being heat pumps by 2050.

While the 2030 GGRA Plan sets a goal of electrifying fossil fuel end-uses in buildings, it also calls on the Maryland Commission on Climate Change (MCCC) to develop a Building Energy Transition Plan to identify specific measures and goals to decarbonize the buildings sector. Programs are not yet in place to achieve the building energy transition envisioned by the 2030 GGRA Plan and additional building emissions reductions will be needed for Maryland to achieve post-2030 GGRA targets. More clarity is needed on the levels of efficiency, electrification, and other measures that will be necessary for Maryland to achieve its long-range emissions reduction goals while keeping energy costs affordable for Marylanders.

The MCCC's Mitigation Work Group (MWG) launched a Buildings Sub-Group in 2020 to explore pathways to attain deeper emissions reductions from buildings. The Sub-Group's work led to a report, Decarbonizing Buildings in Maryland, including recommendations for next-step actions. The Sub-Group continued its work in 2021, as called for in the 2030 GGRA Plan, to develop this Building Energy Transition Plan to serve as a roadmap for reaching net-zero emissions from residential and commercial buildings by 2045, aligning with the MCCC's recommendation that Maryland should achieve net-zero emissions economywide by that year.

The Maryland Department of the Environment (MDE) – with funding from the U.S. Climate Alliance and The Nature Conservancy – worked with Energy + Environmental Economics (E3) to conduct a Maryland Building Decarbonization Study, which serves as the foundation for this Building Energy Transition Plan. The Buildings Sub-Group provided guidance and review of E3's work from March through October 2021.

The contents of this Building Energy Transition Plan reflect findings from E3's study, the Sub-Group's proceedings over the past two years, input from various stakeholders, and building decarbonization policies developed by other states.

E3's Building Decarbonization Study

Key Findings

E3 initially modeled three scenarios that were selected by the Buildings Sub-Group in May 2021. Each scenario nearly[1] achieves net-zero emissions by 2045 for the residential and commercial buildings sectors. The initial three scenarios were:

> *High Electrification* – Almost all buildings adopt heat pumps and improve shell performance by 2045. All-electric new construction starting in 2025.
>
> *Electrification with Fuel Backup* – Existing buildings adopt and use heat pumps for most of the annual heating load by 2045, but existing furnaces and boilers provide backup heating in the coldest hours of the year. Fossil fuels are replaced with low-carbon renewable fuels by 2045. All-electric new construction starting in 2025.
>
> *High Decarbonized Methane* – Most buildings use fuel for heating and improve shell performance by 2045. Fossil fuels are replaced with low-carbon renewable fuels by 2045.

The initial study uncovered several key findings that informed the Buildings Sub-Group's crafting of policy recommendations. Key findings included:

All-electric new buildings typically have the lowest construction and operating costs

- All-electric buildings produce zero direct emissions[2] and zero indirect emissions when electricity is produced from zero-emissions sources (the 2030 GGRA Plan calls for 100 percent clean electricity generation in Maryland by 2040).
- For single-family homes, all-electric homes cost less to construct than new mixed-fuel homes.
- For multifamily buildings, all-electric buildings cost about the same to construct as mixed-fuel buildings.
- For commercial buildings, all-electric buildings can have higher or lower construction costs than mixed-fuel buildings depending on building type and use.
- All-electric new buildings of all types – residential and commercial – have the lowest total annual costs (including equipment, maintenance, and energy costs) in every net-zero emissions scenario modeled.

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[1] Each scenario depends on renewable low-carbon fuels to achieve net-zero direct emissions but methane leaks from in-state gas infrastructure would still produce indirect emissions, estimated to be at the following levels in 2045: 0.02 million metric tons (MMT) of carbon dioxide equivalent (CO2e) in the High Electrification scenario; 0.09 MMT CO2e in the Electrification with Fuel Backup scenario; and 0.19 MMT CO2e in the High Decarbonized Methane scenario. Indirect emissions from electricity consumption in buildings is assumed to be between 5 MMT CO2e and 0 CO2e depending on the pace of electricity sector decarbonization in states that supply power to Maryland.

[2] Excluding refrigerants such as hydrofluorocarbons that can leak from heat pump and air conditioning systems.

Retrofitting existing buildings with heat pumps can reduce equipment, maintenance, and energy costs

- Heat pumps work well in Maryland's climate and are already the second most common heating system used in buildings statewide.
- For single-family homes, the cost to install a heat pump (which provides heating and cooling) is close to the cost of replacing both an air conditioner and a gas furnace. At current utility rates, annual energy costs are comparable between homes with heat pumps and homes with gas furnaces. Annual energy costs are lower for homes with heat pumps than homes heated by electric resistance, oil, or propane.
- For multifamily buildings, the cost of installing heat pumps can be significantly less than the cost of replacing existing air conditioning and gas systems. At current utility rates, annual energy costs are comparable between housing units with heat pumps and units with gas heating.
- For commercial buildings, the cost-effectiveness of replacing heating and cooling systems with heat pumps depends on building type and use.

Electricity system capacity would need to increase to accommodate building and vehicle electrification

- Peak electricity demand could roughly double by 2045 driven by heating demand during the coldest hours of the year.
- New electricity system investments could increase electricity rates gradually, increasing residential electricity rates from 14 cents/kilowatt-hour (kWh) in 2021 to 18 cents/kWh in 2045 in a High Electrification scenario.
- Electricity system costs and rate impacts can be reduced through a variety of demand management measures.
- Annual electricity consumption in Maryland is projected to remain constant as increasing demand from buildings and vehicles is offset by energy efficiency.

Using low-carbon fuels for supplemental heating during the coldest hours of the year could reduce electricity system investments but a dual-fuel approach is complicated

- Replacing natural gas (historic cost around $3/MMBtu) with low-carbon fuels such as biomethane (estimated cost $10-25/MMBtu), hydrogen (estimated cost $15-25/MMBtu), or synthetic natural gas (estimated cost $30-70/MMBtu) could be a cost-effective alternative to building-out the electricity system to handle peak heating demand from a highly electrified building stock.
- An Electrification with Fuel Backup scenario would require sophisticated policy design and utility rate structures to encourage consumers to use fuel backup heating only during the coldest hours of the year.
- Using low-carbon fuels outside of the coldest hours of the year could lead to very high energy costs for consumers using fuel for heating.

Gas consumption is projected to decrease between 62 and 96 percent by 2045

- Gas consumption in buildings would decrease between 62 percent in the Electrification with Fuel Backup scenario and 96 percent in the High Electrification scenario.
- Gas delivery rates could increase more than 20-times the current rate for consumers left on the gas system, leading to significant equity concerns.

Stakeholder Feedback

The Buildings Sub-Group and MWG reviewed and discussed E3's initial findings between July and October 2021 and provided valuable feedback that led to the development of policy recommendations and refinement of E3's modeling. The following summarizes key points of discussion and explains how stakeholder input influenced the development of this Plan.

- **Equity and affordability are top priorities** – There was general agreement that reducing energy burden, making holistic improvements to homes, and ensuring that people are not left behind in the transition are priorities for decarbonization policy. This feedback informed recommendations on implementing holistic retrofits of 100 percent of low-income households by 2030, strengthening incentives for retrofit projects, mandating lowest-cost construction practices to improve housing affordability, and initiating utility transition planning processes to protect consumers from paying higher energy costs.
- **New buildings should be all-electric** – There was general agreement that new buildings should be constructed to all-electric standards but that a cost-effectiveness test should be used to allow buildings, especially commercial buildings, to be constructed with mixed-fuel equipment if all-electric construction is too expensive. This feedback was incorporated into a recommendation to adopt an all-electric construction code.
- **Commercial buildings need flexibility to reduce emissions** – There was general agreement that all-electric solutions are not always the most cost-effective measures for reducing emissions from commercial buildings. Commercial building owners should receive technical and financial support to identify and implement low-cost emissions mitigation measures, which could include offsetting emissions that are too expensive to eliminate. This feedback led to a recommendation to develop a flexible Building Emissions Standard.
- **A fuel-backup approach is problematic** – Several stakeholders raised concerns that implementing an Electrification with Fuel Backup scenario is impractical given utility ratemaking law and consumer behavior. Maryland's Office of People's Counsel wrote in its comments, "*The [Electrification with Fuel Backup scenario] would require coordinating rate setting for not one, but two, utilities. This expectation of precision rate setting is both legally and practically unrealistic... the effort under the [Electrification with Fuel Backup] scenario would require coordinating the price signals of two utilities with competing interests. These utilities will not agree on the proper price signals. Based on our experience, this assumption of efficient rate setting across utilities is not realistic.*"

The Office of People's Counsel added, "*The transition toward a clean energy system will require significant efforts to address equity impacts, but maintaining two systems [electric and gas] will significantly exacerbate inequities. It is undisputed that maintaining the gas system for backup use requires substantial increases in the rates for gas delivery. The high electrification case requires no backup fuels, thus obviating the need for the massive capital investments that have yet to be made to maintain the gas infrastructure.*" Other stakeholders expressed similar concerns. This feedback led to having E3 model a fourth scenario that shows a more practical approach to decarbonizing buildings.

- **Impacts of climate change, methane leaks from gas distribution, competition for low-carbon fuels, and other factors should be included in E3's modeling** – Stakeholders suggested several ways of improving E3's study methodology throughout the process. The U.S. Climate Alliance graciously provided additional funding to allow E3 to run several sensitivity analyses to address most of the improvements requested by stakeholders. The additional analyses refined E3's study results but did not change the key findings mentioned above.

Final Scenario Results

Several rounds of discussion on E3's initial study and draft versions of this Plan helped the Buildings Sub-Group and MWG hone-in on a roadmap and recommendations for decarbonizing buildings in Maryland. The core concepts are to:

- **Ensure an equitable and just transition, especially for low-income households**
- **Construct new buildings to meet space and water heating demand without fossil fuels**
- **Replace almost all fossil fuel heaters with heat pumps in existing homes by 2045**
- **Implement a flexible Building Emissions Standard for commercial buildings**

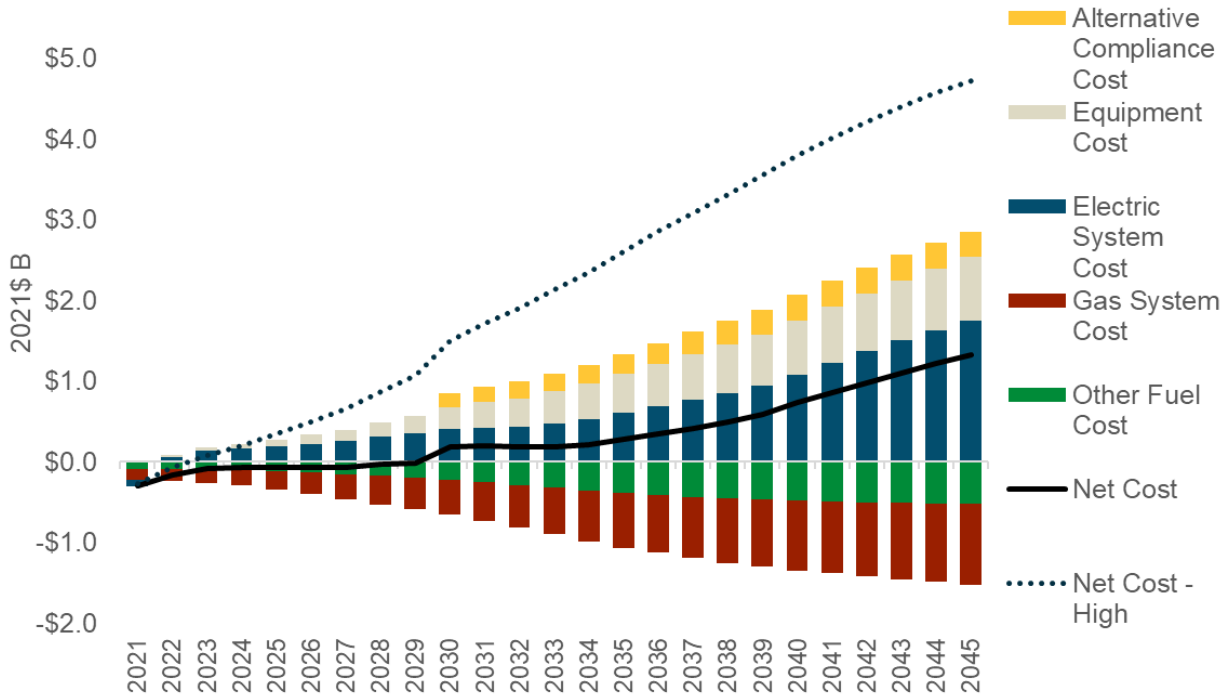
With additional funding from the U.S. Climate Alliance, E3 modeled a fourth scenario, called the "MWG Policy" scenario, to estimate the costs associated with this Plan. **The results show that the MWG Policy scenario has the lowest total cost of all four scenarios while also avoiding the need to maintain backup systems in homes or transitioning to expensive low-carbon fuels**.

Detailed results are included on the following pages.

Total Costs

The MWG Policy scenario requires investments in electricity grid infrastructure (to increase system capacity) and in building equipment (to replace fuel heaters with electric heat pumps). These investments help consumers reduce costs for natural gas, oil, and propane. Annual costs and savings are shown in Figure 1. This represents the lowest-cost scenario of all the decarbonization scenarios modeled.

Figure 1: Annual Incremental Total Resource Costs relative to Reference. Results account for climate change impacts on heating and cooling demand. Building shell improvements are excluded.[3]



In the low-cost scenario, net costs (without accounting for economic benefits such as job creation, health impacts, etc.) would remain around business-as-usual levels through the 2020s. Net costs increase in the 2030s and 2040s as capacity is added to the electricity system and most buildings complete the transition to becoming all-electric. Costs would level off after this period of infrastructure investments.

Alternative compliance costs, which are associated with the Building Emissions Standard proposed in this Plan, could begin in the 2030s for commercial, multifamily, and state-owned buildings that do not meet emissions reduction targets. The alternative compliance costs shown in Figure 1 are based on a modeling exercise assuming that owners of many buildings covered by the Building Emissions Standard would choose to pay a rate of $100 per metric ton of carbon dioxide equivalent (tCO2e) in leu of reducing emissions below target levels. Assumptions here are rough, so these above all other costs should not be taken as certain.

[3] E3 included deep shell retrofits (wall insulation, roof insulation, glazing, air-tightness, and heat recovery) in its original study but determined that shell improvements are not necessary as cost-control measures in any scenario. E3 removed shell improvements from Figure 1 to illustrate a more likely cost projection for the MWG scenario.

Electricity System Impacts

Electricity system investments – for generation capacity, transmission, and distribution – are significantly lower in the MWG Policy scenario than in the High Electrification scenario. That is because achieving high electrification in Maryland's residential buildings has a small impact on peak electricity demand. E3's work on the MWG Policy scenario uncovered that commercial buildings in Maryland have a much greater impact on peak electricity demand than residential buildings have. As a result, the MWG Policy scenario, which modeled high electrification in the residential sector and modest electrification in the commercial sector, is projected to increase peak electricity demand only 3 gigawatts by 2045.

Figure 2: Incremental Electric System Costs relative to Reference in 2045. Details of the electric sector cost assumptions are documented in E3's Maryland Building Decarbonization Study.

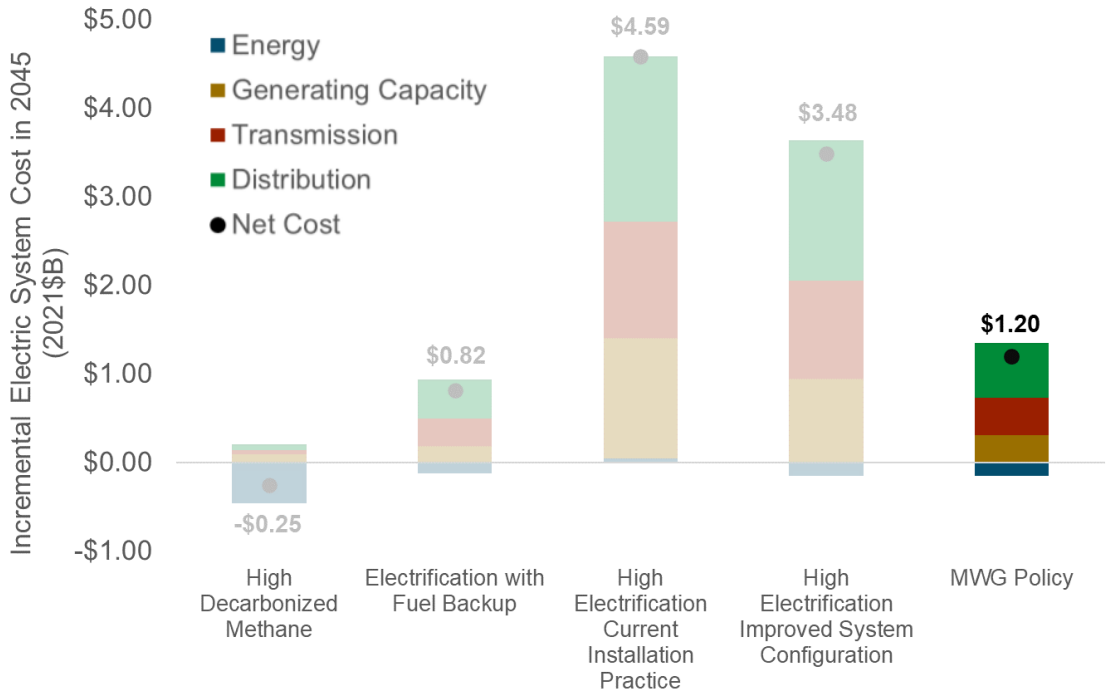
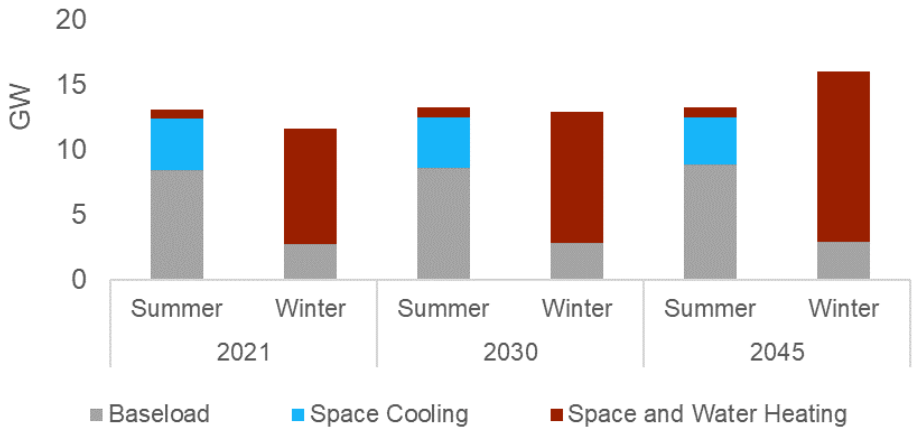


Figure 3: Peak Electricity Load Projections for the MWG Policy scenario. Based on typical summer and winter peak electricity demand.



Gas System Impacts

Gas system throughput decreases 75 percent in the MWG Policy scenario, which results in $1.3B in avoided gas system infrastructure costs and $20.7B in avoided fuel costs from 2021 through 2045. Fuel costs are much lower in the MWG scenario than the Electrification with Fuel Backup or High Decarbonized Methane scenarios because the MWG scenario avoids transitioning to expensive low-carbon fuels.

Figure 4: Incremental Gas System Costs relative to Reference in 2045. Details of the gas sector cost assumptions are documented in E3's Maryland Building Decarbonization Study.

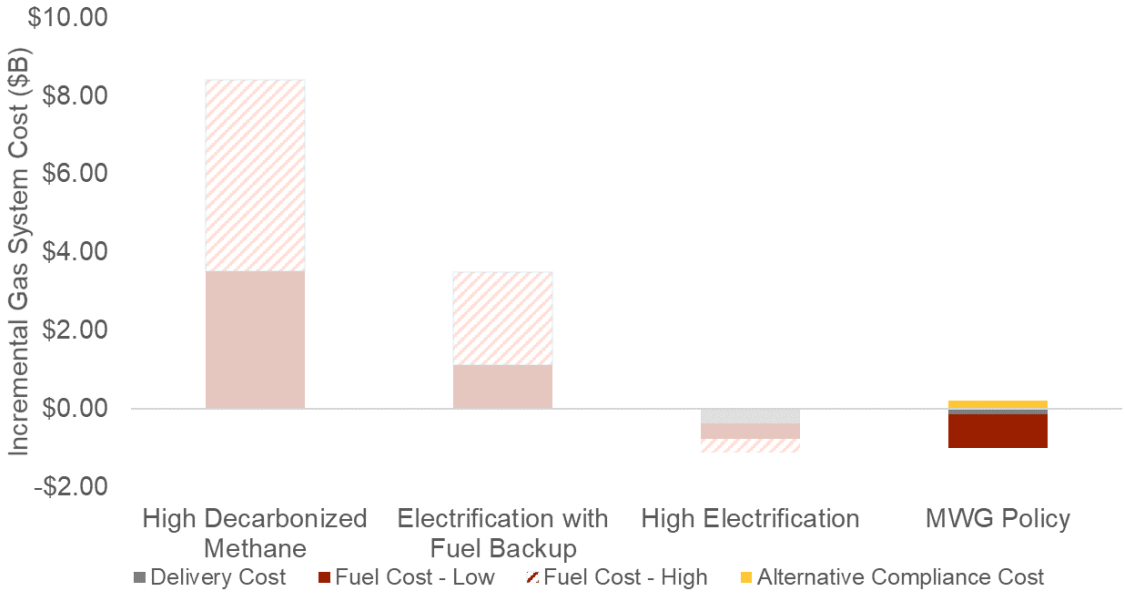
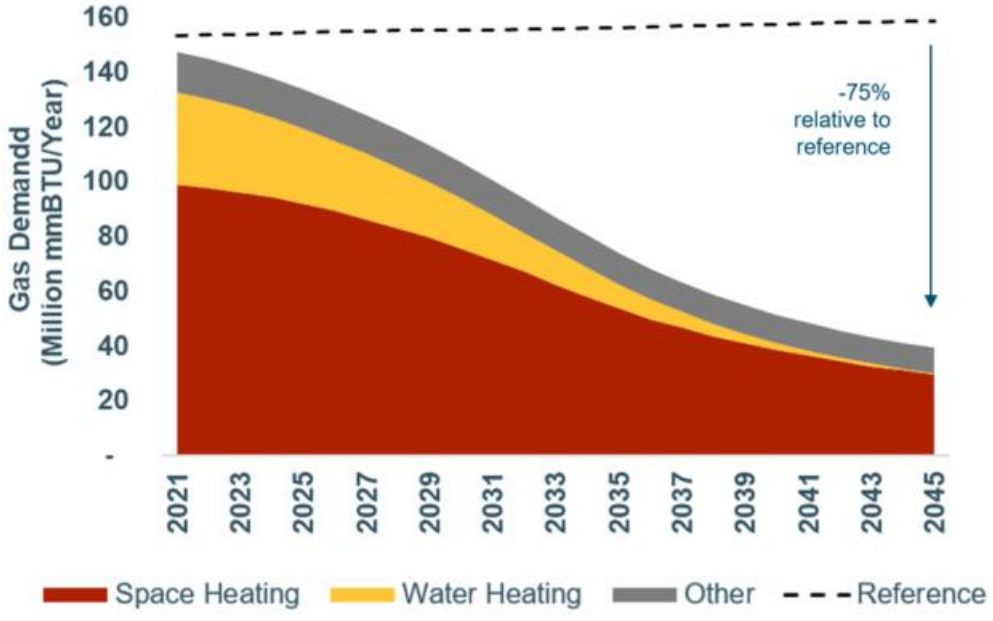


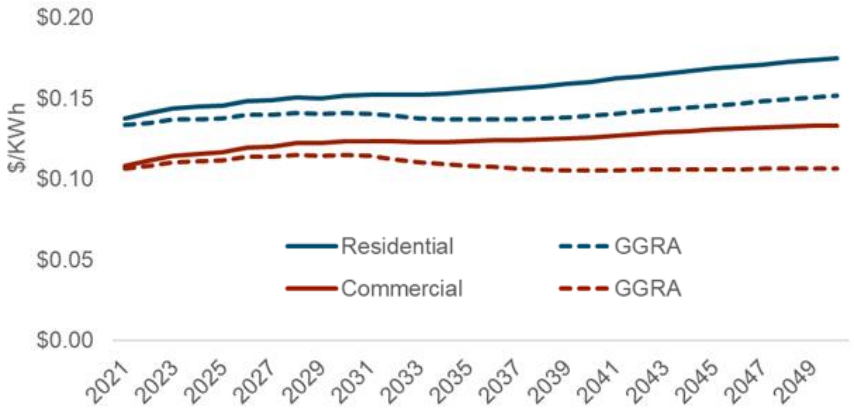
Figure 5: Gas Demand in 2021-2045 in the MWG Policy scenario. Most remaining gas consumption in 2045 would be in commercial buildings. Emissions from gas consumption in commercial buildings would be offset through the proposed Building Emissions Standard alternative compliance path.



Electricity and Gas Rate Impacts

Electricity rates increase gradually in the MWG Policy scenario to pay for the incremental electricity system costs. Rates are projected to increase from around 14 cents/kWh in 2021 to 17 cents/kWh in 2045 for residential customers and from around 11 cents/kWh in 2021 to 13 cents/kWh in 2045 for commercial customers. For both customer classes, rates are projected to increase by 2 cents/kWh by 2045 compared to the reference case.

Figure 6: Electricity Rates in the MWG Policy scenario



Although gas rate impacts are smaller in the MWG Policy scenario than any other scenario modeled, gas rates increase as consumers leave the gas system, leaving fewer consumers to pay for gas system costs. Gas rates remain flat through the 2020s but then climb to the $40-50/MMBtu range by 2045. This Plan recommends transitioning 100 percent of low-income households to heat pumps by 2030 to reduce energy burden for the most vulnerable Marylanders. Heat pump adoption in the commercial sector and the rest of the residential sector would ramp up in the 2030s as the costs of operating gas heating systems increase.

Figure 7: Residential Gas Rates

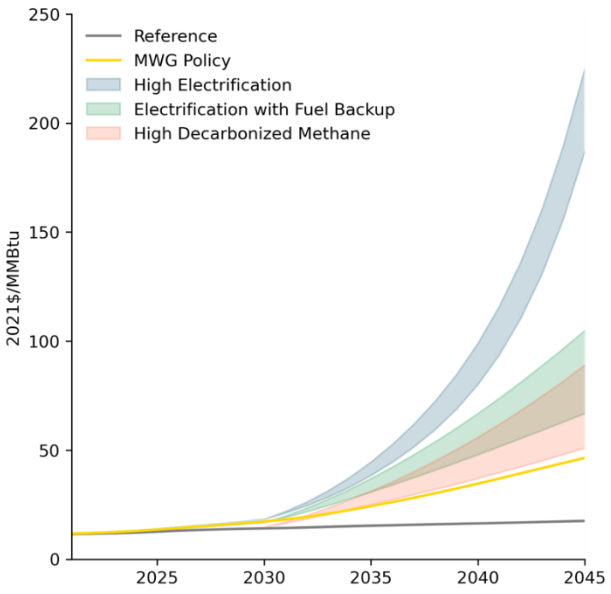
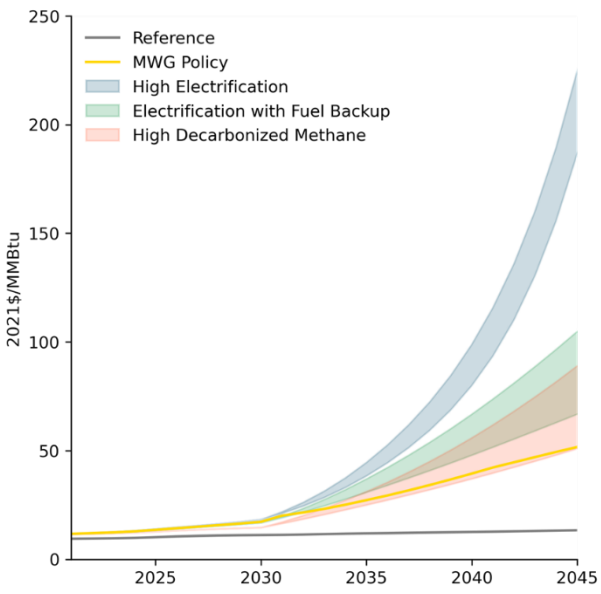


Figure 8: Commercial Gas Rates



Consumer Costs

Much of the heating equipment installed in the 2020s will be operational through the 2030s and into the 2040s, so it is important to consider not only what energy costs are today but what they will be over the lifecycle of equipment. E3 estimated annualized lifecycle consumer costs – including costs for equipment, operations and maintenance, and utility bills – for several types of buildings. Results are summarized in the following table.

Table 1: Annualized Consumer Costs in the MWG Policy scenario. Gas, electricity, and equipment costs are based on 2035 rates. Costs for shell improvements are included but E3 found that many shell improvements are not cost-effective, so actual consumer costs could be lower the costs reflected in this table. "Difference" is the annualized savings (or cost) of all-electric compared with mixed-fuel buildings.

		Mixed-Fuel	All-Electric	Difference
Single-family Residential	New Construction	$5,500	$3,800	$1,700
	Retrofit	$6,100	$5,500	$600
Multifamily Residential	New Construction	$4,100	$3,400	$700
	Retrofit	$3,900	$3,500	$400
Small Commercial	New Construction	$18,400	$15,500	$900
	Retrofit	$17,800	$15,500	$2,300
Large Commercial	New Construction	$150,000	$147,000	$3,000
	Retrofit	$139,000	$147,000	($8,000)

E3 found that, given continued improvement in the cost and performance of electric space and water heating equipment and projected increases in natural gas rates by 2035, most all-electric buildings will have lower lifecycle costs than mixed-fuel alternatives. The exception is an existing, large, mixed-fuel commercial building where the cost to retrofit it into an all-electric building could result in higher annualized costs. This is an example of the type of building that might pursue the Building Emissions Standard alternative compliance path instead of implementing measures to achieve net-zero direct emissions.

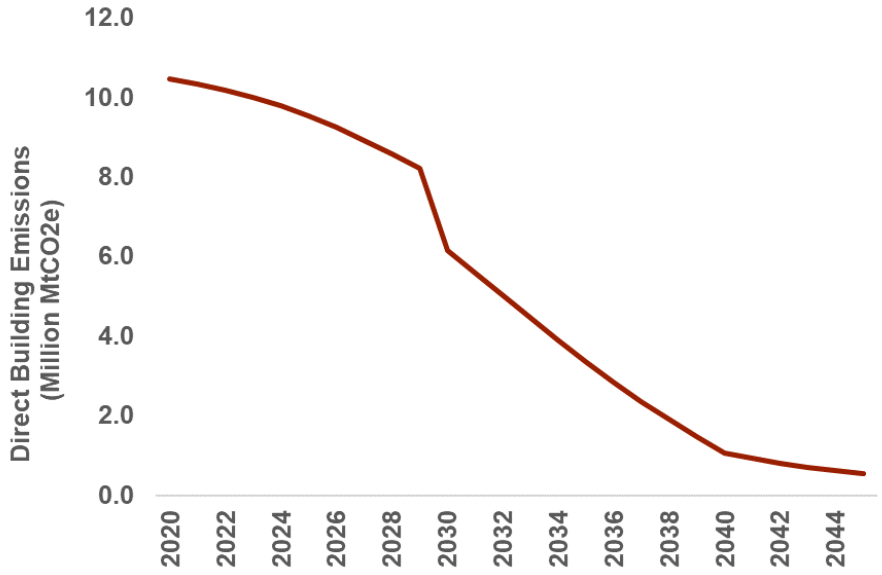
Emissions Reductions

Residential sector emissions reductions are heavily dependent on heat pump adoption rates. If greater than 90 percent of homes adopt heat pumps by 2045, then residential emissions would decrease at least 90 percent. E3's modeling assumes strong heat pump adoption rates, resulting in residential emissions falling around 90 percent, from 5.4 million metric tons of carbon dioxide equivalent (MMT CO2e) in 2017 to around 0.6 MMT CO2e by 2045.

Commercial sector emissions fall less sharply due to continued reliance on fossil fuels in many buildings. E3 estimates that commercial sector emissions could fall from 5.3 MMT CO2e in 2017 to around 3.1 MMT CO2e by 2045. These emissions, however, would be offset through the Building Emissions Standard alternative compliance program. Revenue from the alternative compliance program would be invested in carbon sequestration, negative emissions technologies, or other measures that would net-out remaining emissions from commercial, multifamily, and institutional buildings and allow the state to meet its emerging 2045 net-zero emissions goal.

Overall, E3 estimates that residential and commercial building emissions could decrease around 95 percent by 2045 including offsets from the alternative compliance program.

Figure 9: Greenhouse Gas Emissions in the MWG Policy scenario. Graph shows *net* emissions from residential and commercial buildings (direct emissions less commercial building emissions that are offset through the Building Emissions Standard alternative compliance program).



Roadmap and Recommendations

Building Decarbonization Roadmap for Maryland

Red shading indicates transition time to near-zero emissions

Legend: P = Proposed herein E = Existing but should be strengthened G = GGRA Plan target L = Legislation introduced S = In statute

Core Recommendations

Each of the Core Recommendations correspond with a critical component of the Building Decarbonization Roadmap for Maryland (above), which presents a suite of policies that would collectively guide Maryland's residential and commercial building sectors to nearly achieve net-zero emissions by 2045.

1. Adopt an All-Electric Construction Code

The General Assembly should require the Maryland Building Code Administration to adopt a code that ensures that new buildings meet all water and space heating demand without the use of fossil fuels (allowing for the use of electric heat pumps, solar thermal, and other existing and potential clean energy solutions) and are ready for solar, electric vehicle charging, and building-grid interaction. This code shall apply to all new residential, commercial, and state-funded buildings beginning as early as possible but no later than 2024. Legislation should ensure that the Building Code Administration or appropriate local jurisdictions have authority, resources, and direction to effectively enforce compliance with the code. The Building Code Administration shall also develop and implement training courses on the benefits and challenges of all-electric and electric-ready buildings for building developers, realtors, real estate appraisers, and lenders.

The Building Code Administration shall allow exemptions for building types for which compliance with these requirements is not feasible. The Building Code Administration shall also develop a cost-effectiveness test to allow building projects to seek variances to code requirements while maintaining electric-ready standards. The cost-effectiveness test shall include the federal Social Cost of Carbon. If a new commercial building receives a variance and produces greenhouse gas emissions on-site, then it would participate in the Building Emissions Standard (proposed herein) and follow its own tailored plan for reaching net-zero emissions.

Discussion: A recommendation to adopt an all-electric construction code was supported by the MWG in 2020 but the MCCC wanted to receive this Building Energy Transition Plan before voting on the measure. Studies including E3's Maryland Buildings Decarbonization Study and RMI's The New Economics of Electrifying Buildings add to a body of work demonstrating that all-electric new homes have lower construction and energy costs than mixed-fuel homes. This means that all-electric new homes help improve housing affordability and local air quality while reducing greenhouse gas emissions in Maryland.

For commercial construction, all-electric design can increase construction and/or energy costs, which is why a test is proposed to help commercial building developers identify cost-effective clean energy solutions or receive a variance from the all-electric code. Residential building projects would also be able to seek variances using the cost-effectiveness test.

The New Building Institute's Building Decarbonization Code, which is an overlay to the 2021 International Energy Conservation Code (IECC) and compatible with ASHRAE 90.1, includes an all-electric pathway that is one possible solution for code adoption. California and Washington recently adopted building energy efficiency codes and EV infrastructure codes.

2. Develop a Clean Heat Retrofit Program

The General Assembly should require state agencies to develop and implement (with the utilities, if applicable) a Clean Heat Retrofit Program that meets the following targets:

A. **Retrofit 100 percent of low-income households by 2030** – Provide funding to enable the Maryland Energy Administration (MEA), the Department of Housing & Community Development (DHCD), and local governments and organizations to offer little-to-no upfront cost comprehensive retrofits to 100 percent of low-income households by 2030. Holistic retrofits would include weatherization, heat pump installation, and otherwise improve the health and safety of homes statewide. Dedicate funds to address safety-and-health upgrades and electric-panel and wiring improvements, which are commonly needed in low-income households before electrification projects can be completed. Building electrification programs should prioritize low-income customers and be funded and designed to ensure that they do not increase the energy burden of low and moderate-income customers.

   Discussion: It is critical that the state assist households with high energy burden to transition off the gas system before gas rates increase above current levels. Note that gas rates could increase for reasons described in this Plan or for other reasons such as impacts from new regulations, increasing gas supply costs, etc.

B. **Encourage fuel-switching through EmPOWER beginning in 2024** (modified MCCC recommendation from 2020) – Require incentives for the electrification of existing fossil fuel systems through the EmPOWER program and direct the Public Service Commission (PSC) to require the electric utilities to proactively encourage customers with gas, oil, or propane heating systems to replace or supplement those systems with electric heat pumps, especially for low-income households and consumers. State agencies also should modify programs they manage to facilitate fuel-switching if not already allowed.

   Discussion: Gas heating systems are added to this recommendation, which was otherwise approved by the MCCC in 2020. Not yet enacted in state policy. Currently being discussed by the PSC's EmPOWER Future Programming Work Group.

C. **Encourage beneficial electrification through EmPOWER beginning in 2024** (MCCC recommendation from 2020) – Require that the core objective of EmPOWER change from electricity reduction to a portfolio of mutually reinforcing goals,

including GHG emissions reduction, energy savings, net customer benefits, and reaching underserved customers. Encourage beneficial electrification, which are strategies that provide three forms of societal benefits: reduced energy consumption (total source BTUs), lower consumer costs, and reduced GHG emissions. Beneficial electrification programs should be prioritized first for low-income households and consumers and should be aligned with other health and safety upgrades to consider a whole-home or whole-building retrofit approach to ensure cost-effectiveness and a focus on benefitting underserved homes and businesses first.

Discussion: Approved by the MCCC in 2020. Not yet enacted in state policy. Currently being discussed by the PSC's EmPOWER Future Programming Work Group.

D. **Target 50 percent of residential HVAC and water heater sales to be heat pumps by 2025, 95 percent by 2030** (modified MCCC recommendation from 2020) – Require that incentives (for consumers, contractors, and manufactures) through EmPOWER and other programs are sufficient to meet a target of 50 percent of HVAC and water heater sales to be heat pumps by 2025 and 95 percent by 2030. Heat pumps (air source or ground source) should be sized to meet all space heating and cooling demand. Heat pump water heaters should be grid-interactive to serve as energy storage devices. Grid-interactive electric resistance water heaters are allowed when heat pump water heaters cannot be installed. Require that electric utilities provide payment options such as on-bill, low-interest financing to spread out upfront costs including electrical upgrades. These targets apply to residential systems but consideration should be given to developing proper incentives and financing options for commercial system electrification.

Discussion: In 2020, the MCCC approved a recommendation that 50 percent of space heater sales should be heat pumps by 2025. The target makes more sense as an HVAC sales target because heat pumps replace heating and cooling systems. Water heaters are added to the recommendation this year. If HVAC and water heater sales reach around 95 percent heat pumps by 2030, then most existing homes would be retrofit with heat pumps by 2045 based on typical equipment replacement schedules.

E. **Align energy plans, approvals, and funding with the objectives of this Plan** – Ensure that the state government's plans, approvals, and funding decisions related to energy align with the objectives of this Building Energy Transition Plan.

Discussion: This recommendation, which previously focused on discontinuing the use of the Strategic Energy Investment Fund to expand fossil fuel use and infrastructure, was broadened to be inclusive of all energy-related decisions.

3. Create a Building Emissions Standard

The General Assembly should require MDE to develop a Building Emissions Standard that shall achieve net-zero emissions from commercial and multifamily residential buildings by 2040. State-owned buildings shall meet this standard by 2035. Historic buildings shall be exempt. The Standard shall give commercial, multifamily, and institutional building owners flexibility in bringing their buildings in line with the state's emissions reduction targets. The Standard shall include measurement and reporting of direct (on-site) emissions and support from the state to implement emissions reduction measures. Emissions reduction measures include but are not limited to:

- Maintaining and retro-commissioning building energy systems
- Implementing HVAC scheduling and other smart control systems
- Making building shell and other energy efficiency improvements
- Replacing fuel burning equipment with efficient electric equipment including air source heat pumps, ground source heat pumps, and induction cooktops
- Installing variable refrigerant flow (VRF) and other systems that capture and utilize waste heat
- Switching fossil fuels with low-carbon renewable fuels
- Installing carbon capture systems (possibly for facilities like larger combined heat and power or district energy plants) if the captured emissions can be stored or utilized in a way that leads to permanent and verifiable emissions reductions

Buildings covered by the Building Emissions Standard shall:

- Measure and report direct emissions to MDE annually starting in 2025
- Achieve net-zero direct emissions by 2040 (2035 for state-owned buildings)

The MCCC's MWG will study and recommend interim targets for covered buildings as part of the MWG's 2022 work plan.

The General Assembly shall provide resources to MEA to offer technical and financial support to help owners of covered buildings develop and implement emissions reduction measures. An alternative compliance pathway should be available to allow commercial building owners to pay a reasonable fee for emissions above target levels. The alternative compliance payment should be reasonable, perhaps corresponding with the cost of implementing additional carbon sequestration or negative emissions technologies in Maryland, but not less than the federal Social Cost of Carbon. The state should create commercial tax credits and direct subsidy payments for upgrades related to building decarbonization projects large enough to reduce the simple payback period to between 3 and 7 years.

Discussion: New York City and Boston are among the U.S. jurisdictions that have implemented building performance standards aimed at guiding commercial buildings to net-zero emissions by mid-century. Building performance standards commonly include interim targets for energy intensity or emissions – thresholds that decrease every five years or so. This proposal previously included just one interim target (50 percent reduction by 2030) in recognition that buildings will not undergo many equipment replacement cycles between now and 2040 (2035 for state-owned buildings). However, the MWG replaced the proposed 2030 target with a plan to study and recommend interim targets in 2022.

The target date is set at 2040 to allow the state time to invest revenue from non-compliance payments into carbon sequestration, negative emissions technologies, or other measures that will help net-out remaining emissions from commercial, multifamily, and institutional buildings and allow the state to meet its emerging 2045 net-zero emissions goal.

4. Develop Utility Transition Plans

The General Assembly should require the PSC to oversee a process whereby the electric and gas utility companies develop plans for achieving a structured and just transition to a near-zero emissions buildings sector in Maryland. Key objectives of those plans include:

<u>Gas Transition Plans</u>

- Appropriate gas system investments/divestments for a shrinking customer base and reductions in gas throughput in the range of 50 to 100 percent by 2045
- Comprehensive equity strategy to enable LMI households to improve energy efficiency and electrify affordably
- Regulatory, legislative, and other policy changes needed for a managed and just transition of the gas system and infrastructure
- Operational practices to meet current customer needs and maintain safe and reliable service while minimizing infrastructure investments
- Assessment of existing gas infrastructure and options for contraction
- Alternative models for the gas utility's long-term role, business model, ownership structure, and regulatory compact, as part of a managed transition

<u>Electric Transition Plans</u>

- Electric system investments for a highly electrified buildings sector
- Ratepayer protections, especially for LMI Marylanders
- Incentives to facilitate the transition to a highly electrified buildings sector
- Demand management solutions to reduce winter peak electricity demand

The PSC shall amend or reject plans that do not meet these objectives. The PSC shall set up a stakeholder process to review the Electric and Gas Transition Plans.

Discussion: E3 estimates that between 2021 and 2045, gas consumption would decrease by 96 percent in a High Electrification scenario, 75 percent in the MWG Policy scenario, and 62 percent by electrifying building heating loads to the point when summer and winter peak electricity demand is roughly equal, which is considered a no-regret action by ICF for decarbonizing buildings. In any scenario, Maryland should expect a significant reduction in gas consumption and should plan for that transition.

California, Colorado, Massachusetts, Minnesota, New York, and Washington are among the states that have opened PSC proceedings on the role of gas distribution companies in a clean energy future.

Additional Recommendations

The recommendations in this section further support building decarbonization in Maryland and are complementary to the Core Recommendations above. Some of the following are MCCC recommendations from 2020 that are not yet enacted by the state, and some are recommendations offered by participants of the Buildings Sub-Group.

5. **Prioritize an equitable level of benefits for all Marylanders** (MCCC recommendation from 2020)

   The Governor, State Agencies, Commissions, and General Assembly should ensure that all policy decisions to reduce GHG emissions from the building sector in Maryland, including those within these recommendations, prioritize an equitable level of benefits to limited income households, the state's affordable and multifamily housing stock, and low-income ratepayers, and concurrently with the benefits provided to others.

   Discussion: Approved by the MCCC in 2020. Not fully enacted in state policy.

6. **Improve interagency coordination for holistic building retrofits** (MCCC recommendation from 2020)

   The Governor, via Executive Order, or General Assembly, via legislation, should revive an Interagency Task Force with the goal of increased and consistent coordination across programs, policies, and funding streams to retrofit Maryland's existing residential and commercial buildings to achieve healthier, safer, more efficient, and climate-friendly homes and businesses. This Green and Healthy Task Force would identify opportunities to align lead, mold, asbestos, and indoor air quality remediation intervention schedules with energy efficiency upgrades and electrification retrofit programs to ensure a more cost-effective, whole-building retrofit program that meets Maryland's various health, safety, affordability, and climate action goals. Progress should be tracked and measured through a public state dashboard. Funding should be provided to make holistic improvements to every limited income and affordable housing unit in the state by 2030.

   Discussion: The last sentence of this recommendation was added based on Buildings Sub-Group participant comments in 2021. The rest was approved by the MCCC in 2020.

7. **Use federal funds for comprehensive retrofits of low-income housing**

   Maryland should prioritize the use of any relevant federal resources coming from the budget reconciliation process, American Rescue Plan Act, and other funding sources to perform comprehensive health, safety, efficiency, and electrification retrofits for affordable housing and should ensure that any new federal funds are not used to support the expansion or installation of new fossil fuel infrastructure or appliances.

Discussion: Proposed by Buildings Sub-group participants.

8. **Sunset financial subsidies for fossil fuel appliances within EmPOWER**

   EmPOWER Maryland and other energy programs in the state should be focused on providing financial assistance only to non-fossil fuel equipment, appliances, and infrastructure associated with the building sector and any and all incentives and subsidies for fossil fuel systems should be eliminated. This should be paired with an increased incentive size for non-fossil appliances and systems installed for limited income consumers.

   Discussion: Proposed by Buildings Sub-group participants.

9. **Offer incentives for net-zero energy all-electric new buildings** (MCCC recommendation from 2020)

   The Maryland Building Codes Administration should develop optional codes and standards for efficient all-electric net-zero energy buildings, including allowance of near-site renewable energy systems such as community solar projects, and determine how to incentivize builders to design to those standards. This work should be coordinated with the DHCD in shaping incentive offerings since DHCD already has a Net Zero Loan Program in place and could provide useful insights on program design and existing market gaps to increase the reach of other incentive efforts.

   Discussion: Approved by the MCCC in 2020. Not fully enacted in state policy.

10. **Lead by example through the electrification and decarbonization of state buildings** (modified MCCC recommendation from 2020)

    The General Assembly should require that all new state-owned buildings and major renovations to existing state-owned buildings use efficient electric systems for primary space and water heating unless granted an exception based on cost or building characteristics that would make an electric system impractical, including existing use of district heat or combined heat and power. This requirement should apply to projects covered by the Maryland High Performance Building Act.

    The General Assembly should require that when existing fossil fueled space and water heating equipment is replaced in State-owned buildings, at least two alternate systems should be proposed, with an Energy Simulation and Life Cycle Cost Analysis of the proposed systems. The Energy Simulation and Life Cycle Cost Analysis should include a cost of carbon equal to the federal Social Cost of Carbon. The State should provide all necessary funds to address any additional costs incurred, net of utility incentives, from switching to zero/low-carbon equipment.

Climate change mitigation, adaptation, and resiliency, including contributing to Maryland's greenhouse gas reduction goals, should be demonstrably central design goals in any building construction or renovation procured with any funds, loans, grants, tax or other benefit from the State of Maryland.

Discussion: The first paragraph was approved by the MCCC in 2020. The second and third paragraphs were offered by Buildings Sub-Group participants.

11. Allow local jurisdictions to set higher fines for non-compliance on building performance

The General Assembly should create enabling legislation to allow local jurisdictions to set higher fines for non-compliance with local building energy/emissions performance standards. The current limit is $500.

Discussion: Montgomery County has proposed to create Building Energy Performance Standards to guide commercial and multi-family buildings to greater energy efficiency and lower emissions. Counties including Montgomery are unable to levy a fine for non-compliance that is sufficient to motivate compliance with the standards.

12. Offer tax credits or other incentives for enhanced energy efficiency in new construction

Several Maryland counties provide property tax credits or other incentives for energy efficient and green buildings. State funding for these incentives in addition to the county support would encourage other counties to act similarly. Montgomery County, which is committed to an 80 percent reduction in greenhouse gas emissions by 2027 and zero emissions by 2035, has property tax credits for new and existing multifamily and commercial buildings based on energy reductions and certifications, and is looking at expanding incentives. Anne Arundel, Baltimore, and Howard Counties offer a tax credit for high performance homes and Anne Arundel and Baltimore Counties award a higher tax credit for a higher performance score.

Discussion: Proposed by Buildings Sub-group participants.

13. Allow above-code green programs to comply with the state-adopted International Energy Conservation Code (IECC)

The State can ease the path to building more energy efficient homes by declaring that residential buildings constructed to above-code green programs comply with the State-adopted IECC. The ANSI-approved ICC 700 National Green Building Standard, Energy Star certifications, and Leadership in Energy and Environmental Design (LEED) rating system are nationally recognized above-code programs. These programs work with experts to ensure

that energy and other targets are met and are performing properly. They can help accelerate growth to homes reaching Zero Energy because certifications under above code programs are supported by appraisers and lenders recognizing the greater value of highly efficient buildings. The GSE Fannie Mae has developed Single-Family Green Mortgage-Backed Securities (MBS) that link to Energy Star certifications and is expected to include other green certifications. Fannie Mae already has Multifamily Green MBS that recognize multiple green building certifications.

Discussion: Proposed by Buildings Sub-group participants.

14. Allow a portfolio approach to renewable energy generation

On-site energy generation and sharing of energy among a portfolio of buildings should be incentivized by lifting the limitations on net metering, virtual net metering, and meter aggregation that apply to commercial property. The state should work to address or mitigate the unfavorable Federal tax treatment that limits on-site energy generation by real estate investment trusts.

Discussion: Proposed by Buildings Sub-group participants.

15. Evaluate property tax assessment processes to support decarbonization efforts

Local governments should begin to evaluate and make contingencies for changes to building valuations and tax base resulting from obsolescence or reduced operating income as well as the possible need to increase the use of real estate tax credits to offset the costs and reduce the payback periods of building decarbonization projects.

Discussion: Proposed by Buildings Sub-group participants.

16. Identify locations that need grid upgrades to accommodate new all-electric buildings

Electricity utilities should provide information about locations where the grid is not sufficient to serve new construction of multi-story, all-electric buildings with electric vehicle charging and a method to determine the cost and timetable for necessary upgrades.

Discussion: Proposed by Buildings Sub-group participants.

Appendix: Building Decarbonization Policies in Other States

California

- **New Construction – Heat Pumps and EV-Ready Building Codes**: In August 2021, California adopted its 2022 building energy efficiency standards for new and existing buildings, becoming the first state to establish electric heat pumps as a baseline technology in its building codes.[4] The codes also establish "electric-ready" requirements so homes are able to support EV charging and electric heating and cooking, in addition to expanding standards for onsite solar and battery storage and strengthening ventilation standards.[5] After the code becomes effective in 2023, experts estimate that this combination of standards will lead most new homes and buildings to be built gas-free, which is an already established trend that this code will reinforce. The 2022 code is estimated to provide $1.5 billion in consumer benefits and reduce 10 million metric tons of greenhouse gases over the course of 30 years.[6] California also has the statewide TECH and BUILD initiatives to drive market adoption of heat pumps in existing and new buildings, respectively.

Colorado

- **Building Standards – Statewide Performance Standards**: In June 2021, Colorado became the second state to advance a statewide building performance standard with its passage of legislation that calls for the development of standards that achieve a 7 percent reduction in GHG emissions by 2025 and a 20 percent reduction by 2030, below 2021 levels. This bill also requires annual energy use reporting from owners of buildings larger than 50,000 square feet, beginning in 2022.[7]
- **Energy Efficiency for Gas Utilities**: In June 2021, Colorado adapted their energy efficiency policies to better support greenhouse gas reductions.[8]
    - Senate Bill 21-264 requires gas utilities to file and implement first-in-the-nation "Clean Heat Plans" that may utilize electrification, efficiency, leak reduction, and

[4] Natural Resources Defense Council. "California Passes Nation's First Building Code that Establishes Pollution-free Electric Heat Pumps as Baseline Technology; Leads Transition Off of Fossil Fuels in New Homes." August 11, 2021. https://www.nrdc.org/media/2021/210811-0.
[5] California Energy Commission. "Energy Commission Adopts Updated Building Standards to Improve Efficiency, Reduce Emissions From Homes and Businesses." August 11, 2021. https://www.energy.ca.gov/news/2021-08/energy-commission-adopts-updated-building-standards-improve-efficiency-reduce-0.
[6] California Energy Commission, 2022 Building Energy Efficiency Standards Summary, https://www.energy.ca.gov/sites/default/files/2021-08/CEC_2022_EnergyCodeUpdateSummary_ADA.pdf
[7] Colorado General Assembly. "HB21-1286: Energy Performance For Buildings." Accessed August 31, 2021. https://leg.colorado.gov/bills/hb21-1286.
[8] Colorado Energy Office. "Colorado adopts nation-leading policies to reduce GHG pollution from buildings." June 8, 2021. https://energyoffice.colorado.gov/press-releases/colorado-adopts-nation-leading-policies-to-reduce-ghg-pollution-from-buildings.

recovered methane or biomethane to reduce GHG emissions 4 percent by 2025 and 22 percent by 2030;

- Senate Bill 21-246 requires electric utilities to file plans that support cost-effective beneficial electrification and directs the Public Utilities Commission (PUC) to include the social cost of carbon and methane emissions in its cost-effectiveness tests; and
- House Bill 21-1238 directs the PUC to set energy savings targets for gas utility demand-side management (DSM) programs, requiring the use of the social cost of carbon and of methane in its cost-effectiveness evaluations. These bills also implemented labor standards for certain commercial electrification and DSM projects. Colorado also passed several bills to finance and fund building transformation, including a bill to fund low-income weatherization assistance grants and another to support low-income energy efficiency, electrification, and renewable energy programs.

Maine

- **Heat Pump Programs**: Maine has set goals to aggressively pursue the installation and use of heat pumps. Between 2013 and 2019, the Efficiency Maine Trust incentivized over 46,000 installations, putting a heat pump in almost 10% of Maine homes. In 2019, the Maine Legislature established the goal to install 100,000 new high-performance heat pumps over five years in Maine through the legislatively enacted LD 1766: An Act to Transform Maine's Heat Pump Market to Advance Economic Security and Climate Objectives. This legislation provides supplementary funding for the Efficiency Maine Trust's incentive programs.[9]

Massachusetts

- **New Construction – Stretch Codes:** In its comprehensive climate bill enacted in March 2021, Massachusetts authorized its energy department to establish, by 2023, a "highly efficient stretch energy code" for new buildings that municipalities may adopt.[10]
    - "Under the Mass Save program, the state's utilities promote new construction meeting Passive House standards. The program was launched in July 2019. As of May 2020, about 50 projects had enrolled in the program, and it hopes to complete more than 4,000 units by 2023. The program began with training for builders in Passive House design and construction techniques. The program will help pay for a project feasibility study (up to $5,000) and for energy modeling

[9] The Efficiency Maine Trust (2019). Beneficial Electrification: Barriers and Opportunities in Maine. https://www.efficiencymaine.com/docs/EMT_BeneficialElectrification-Study_2020_1_31.pdf

[10] Office of Governor Charlie Baker. "Governor Baker Signs Climate Legislation to Reduce Greenhouse Gas Emissions, Protect Environmental Justice Communities." March 26, 2021. https://www.mass.gov/news/governor-baker-signs-climate-legislation-to-reduce-greenhouse-gas-emissions-protect-environmental-justice-communities.

(75% up to $20,000). Financial incentives of $3,000 per unit are offered for meeting Passive House standards. Upon completion of a design that meets program standards, an incentive of $500 per unit is paid. The remaining $2,500 per unit is paid upon completion of construction and a final inspection, including a blower door test. In addition, performance incentives of $0.75 per kilowatt-hour (kWh) and $7.50 per therm are paid for actual first-year energy savings (Mass Save 2020). The feasibility studies have been helpful. Builders appreciate knowing up front the per-unit incentives. And 15 program leaders have found that it is possible to exceed the Passive House standards."[11]

- **Energy Efficiency for Electric and Gas Utilities**: In July 2021, the Baker-Polito Administration established GHG reduction goals for its statewide, three-year energy efficiency plan. The plan, which will cover the years 2022 through 2024 and guide the deployment of ratepayer-funded building efficiency programs, must be designed such that electric and gas utilities reduce 504,000 and 341,000 metric tons of CO_2e, respectively. Investments will include building retrofits and weatherization, building electrification, and equitable workforce development.[12]

New York

- **Heat Pump Programs**: In 2019, New York passed the New York Climate Leadership and Community Protection Act. The Act aims to achieve 40% emissions reductions by 2030. The Act established economy-wide and electric sector targets that includes goals for energy efficiency, renewable energy, and energy storage technology. Notably, New York's Public Service Commission has created incentives and targets for heat pumps under their energy efficiency programs (Wilt 2020[13]; New York PSC 2020[14]).
    - Committed financial incentives: "This Commission order will direct nearly $2 billion in additional utility energy efficiency and electrification actions: $893 million for electric energy efficiency; $553 million for gas energy efficiency; and $454 million for heat pumps through 2025." [15]
    - Energy Savings Targets for Heat Pumps: "New York's electric utilities and NYSERDA are directed to jointly develop a consistent statewide heat pump program framework to be administered by the utilities in their service territories

[11] Nadel, S. 2020. Programs to Promote Zero-Energy New Homes and Buildings. Washington, DC: American Council for an Energy-Efficient Economy. September 2020. https://www.aceee.org/sites/default/files/pdfs/zeb_topic_brief_final_9-29-20.pdf
[12] Massachusetts Executive Office of Energy and Environmental Affairs. "Baker-Polito Administration Sets Ambitious Emissions Reduction Goal for Energy Efficiency Plan." July 15, 2021. https://www.mass.gov/news/baker-polito-administration-sets-ambitious-emissions-reduction-goal-for-energy-efficiency-plan.
[13] The Natural Resources Defense Council, More Efficiency for New York Means More Savings, Carbon & $, January 16, 2020. https://www.nrdc.org/experts/samantha-wilt/win-nyers-new-energy-efficiency-order-saves-ghg.
[14] New York State Clean Heat Program, https://saveenergy.ny.gov/NYScleanheat/
[15] Press Release - Governor Cuomo Announces Additional $2 Billion in Utility Energy Efficiency and Building Electrification Initiatives to Combat Climate Change, January 16, 2020. https://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=18-M-0084&submit=Search.

and combined with LIPA sets a minimum target of 4.6 TBtu for savings from heat pump installations across the state." NYSERDA is seeking to invest $200 million in market development programs to increase consumer awareness of heat pumps, increase skilled workers in the clean heating and cooling industry, provide technical assistance, and increase the benefits for low to moderate income customers

  - Proven Industry Growth: "The contractor industry has grown substantially in New York State since 2017, with 112 ground-source heat pump installers and more than 350 air-source heat pump contractors participating in NYSERDA's heat pump programs as of March 2020. Through 2019, nearly 11,000 program participants received incentives and services under NYSERDA's programs, supporting approximately 21,500 heat pump installations."[16]

- **Carbon Neutral Buildings Roadmap**: To meet the ambitious goals of the Climate Act, the Carbon Neutral Buildings Roadmap was created to identify pathways to decarbonize New York's building stock by 2050.[17]
  - Development of the Roadmap includes analyzing the state's entire building stock, researching critical building decarbonization barriers, modeling various solutions sets, and developing technology and policy recommendations to achieve the Climate Act goals, with a primary focus on four building typologies: Single Family Homes, Multifamily Residential (Low and mid-rise), Commercial Office (Low and mid-rise), and Higher Education.
  - The Roadmap will be updated approximately every 2 – 3 years to account for policy, market, and technological developments, and to analyze additional building typologies. The Roadmap is intended to:
    - Provide cutting-edge research related to building decarbonization
    - Send market signals to the real estate, finance, manufacturing, and construction sectors
    - Spur economic development and the creation of quality clean energy jobs; and raise awareness of the benefits to deep decarbonization, such as: Energy savings; Health & safety, comfort, and productivity; Resilience; and Provide guidance for other state agencies and local governments.
- **New Construction - Buildings of Excellence Competition:** The Buildings of Excellence competition began in 2019 and provides up to $40 million in monetary awards to visionary architects and developers that design and construct low or zero carbon

[16] Nadel, S. 2020. Programs to Electrify Space Heating in Homes and Buildings. Washington, DC: American Council for an Energy-Efficient Economy. June 2020. https://www.aceee.org/sites/default/files/pdfs/programs_to_electrify_space_heating_brief_final_6-23-20.pdf.
[17] New York State Energy Research and Development Authority, Program: Carbon Neutral Buildings, https://www.nyserda.ny.gov/All-Programs/Programs/Carbon-Neutral-Buildings

emitting multifamily buildings. The competition is meant to recognize and encourage best practices for sustainable buildings. [18]

Vermont

- **Heat Pump Programs**: Vermont has extensive heat pump programs supported by both Efficiency Vermont and electric utilities. Tier III of Vermont's renewable energy standard requires electric utilities to acquire fossil fuel savings from energy transformation projects such as building and transportation electrification.

Washington

- **Building Standards – First Statewide Commercial Buildings Performance Standard**: In December 2020, Washington finalized the rules to implement its first-in-the-nation Commercial Clean Buildings Performance Standard, which the state enacted in 2019 legislation. The rules set a state target 15% below the 2009 to 2018 energy use average of commercial buildings larger than 50,000 square feet.[19]

[18] New York State Energy Research and Development Authority, Program: Buildings of Excellence, https://www.nyserda.ny.gov/all-programs/programs/multifamily-buildings-of-excellence
[19] Washington State Department of Commerce. "Clean Buildings Standards." N.d. Accessed August 31, 2021. https://www.commerce.wa.gov/growing-the-economy/energy/buildings/clean-buildings-standards/.