



JUNE 2023

MARYLAND'S CLIMATE PATHWAY

EXECUTIVE SUMMARY

Target

How Maryland can meet its climate goals of 60% reduction of GHG emissions by 2031 and attain a net-zero economy by 2045

Future

The benefits of this pathway extend beyond emissions reductions to improved air quality, job creation, cost-savings, and more

Global

By achieving Maryland's climate targets the State can set a national and global example for how a state can go all-in on climate action



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Maryland
Department of
the Environment

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EXECUTIVE SUMMARY

KEY FINDINGS:

- The *Maryland's Climate Pathway* report demonstrates how Maryland can meet its ambitious climate goals of 60% reduction of greenhouse gas emissions by 2031 relative to 2006 levels, and attain a net-zero economy by 2045, all while realizing health and economic benefits for Marylanders, including improved air quality, new jobs, and household cost savings.
- Maryland can do this through the coordinated implementation of current and new policies across each sector of the economy, combined with a strong federal partnership and a broader all-of-society approach that integrates actions from cities, counties, local jurisdictions, business and industry leaders, community organizations, and more.
- The first step is fully implementing the policies already in place in Maryland. As of 2020, Maryland had already achieved half of the reductions needed—36.7 MMTCO_{2e} of the 73.3 MMTCO_{2e} to meet the 2031 target. Full implementation of existing policies can achieve another 26.0 MMTCO_{2e} by 2031, leaving one fifth of the reductions left—a gap of 10.6 MMTCO_{2e} that must be filled by new policy action.
- This analysis offers a pathway to success to fill this gap and achieve the economy-wide 60% goal, illustrating potential actions across all sectors with additional reductions, including 3.6 MMTCO_{2e} from transportation, 2.3 MMTCO_{2e} from electricity generation, and 1.6 MMTCO_{2e} from buildings.
- Additional policies from the agriculture, waste, and industrial sectors, including critical reductions in methane, are needed to achieve the 2031 target and support broad economic, social, and environmental benefits for Marylanders. Taking these steps now to achieve the 2031 goals will also place Maryland on a pathway toward its 2045 goal of net-zero emissions.
- At its full potential, this pathway delivers substantial health, employment, and economic benefits to Maryland's people and further bolsters the leadership and ability of the State's economy to be globally competitive. New policy action will deliver even more health benefits through improved air quality and reduced respiratory ailments, especially for vulnerable populations—the equivalent of \$1.09-\$2.44 billion in health benefits by 2031. These benefits extend to the economy with the projected cumulative creation of more than 16,000 new jobs and increased personal income by nearly \$1.5 billion by 2031.
- Maryland can also draw from the substantial resources being generated through federal partnerships, including the Inflation Reduction Act of 2022, which catalyzes and funds critical actions at state and local levels. With these actions, the State of Maryland can achieve its goals—and build a better future for Maryland by extending resources, cost-savings, new jobs, cleaner air, safer homes and roads, food security, and more.

Maryland's Climate Pathway

Maryland has set a bold and ambitious vision for its future: thriving communities, a clean and vibrant economy powered by the jobs of the 21st Century, enhanced health, and other benefits shared by all. As part of this vision, the State of Maryland has committed in statute to reshaping its economy towards delivering highly ambitious and forward-looking climate goals. The Climate Solutions Now Act (CSNA) sets Maryland's sights high—in fact, the highest in the United States—with a goal of a 60% reduction in greenhouse gas (GHG) emissions by 2031 relative to 2006 levels and a net-zero emissions economy by 2045.

The rapid, clean, affordable, and just energy and economic transition needed to achieve these goals will be challenging, but it is possible. This report, Maryland's Climate Pathway, sets forth a pathway to meet the CSNA goal through an all-of-society approach combined with a suite of actions across all economic sectors and GHGs, while realizing additional economic, health, and environmental benefits for Marylanders. Such actions include those from the Maryland General Assembly and the executive branch; counties, cities, tribal governments, and communities; industries and businesses, universities, and other organizations; and, especially critical, partnership with the federal government. In achieving this pathway, Maryland can also serve as a global example of an all-of-society approach on climate that integrates these measures to enable bold action to mitigate GHG emissions, prepare for the heightened impacts of climate change, and transition to a sustainable and low-carbon economy.

Maryland has consistently maintained its strong commitment to investing in its people, vibrant economy, diverse communities, and natural environment. It is one of the nation's most densely populated states, with over 6 million residents. The State boasts a tapestry of landscapes, from the Appalachian Mountains to the Chesapeake Bay and the Atlantic Ocean coastline. The economic mix comprises cutting-edge biotechnology, advanced healthcare, bustling government institutions, renowned educational establishments, and robust manufacturing. However, amid this prosperity, the unfolding threat of climate change casts a shadow over Maryland's people and ecosystems. Rising sea levels and extreme weather events like heavy rainfall, heat waves, and floods are causing substantial property damage, disrupting transportation and utilities, and endangering public health.

These burdens are not endured equally. Vulnerable communities, including low-income populations, people of color, and those residing in flood-prone areas, face the brunt of these impacts. Their safety, health, and economic well-being are at heightened risk as they contend with the intersections of heat, air pollution, and limited access to vital infrastructure. Beyond these most vulnerable groups, all Marylanders can be impacted, through poor air quality, real health dangers for even healthy individuals, substantial amounts of lost workdays and school days, curtailed recreational opportunities, and more. Maryland will need to navigate these challenges and more, to deliver the necessary rapid, clean, affordable, and just energy and economic transition to ensure these vulnerable communities are protected.

MARYLAND'S CLIMATE PATHWAY

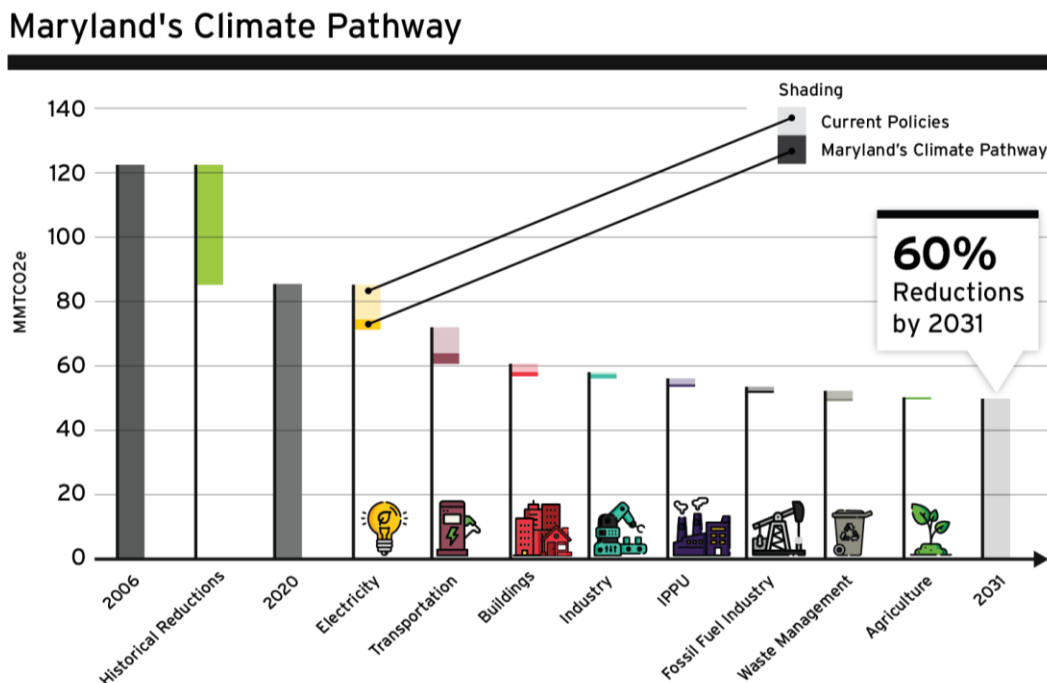


Figure ES.1. GHG emissions reductions by sector under Current Policies and the additional policies included in Maryland's Climate Pathway to reach the State's goal of 60% emissions reduction by 2031.

Maryland's Climate Pathway, as outlined in this report, represents a comprehensive approach to meeting the State's goals. The State is already recognized as a climate leader due to its existing policies, which are poised to make significant emissions reductions. By implementing additional measures, Maryland can achieve its 2031 goal and pave the way toward net-zero emissions by 2045. This modeled pathway results from a rigorous process involving collaboration between the State and local governments, research institutions in Maryland, and years of modeling cultivation to develop a first-of-its-kind analysis of an all-of-society approach. This report's analytical team worked closely with the Maryland Department of the Environment (MDE) and other state agencies and stakeholders to identify the most effective and feasible policies for Maryland. Through this approach, they analyzed the potential emissions reductions and identified the most efficient path to meet the State's GHG reduction targets. The strategy employed in this report combines a globally recognized integrated assessment model with a thorough evaluation of individual policies and climate actions across all sectors and society to ensure the accuracy and consistency of the pathway.

The analysis presents two scenarios. The "Current Policies" scenario quantifies the impact of existing federal and state-level actions on emissions reductions in Maryland. The "Maryland's Climate Pathway" scenario adopts a comprehensive approach involving actions and reductions across every sector. It incorporates all existing policies from the "Current Policies" scenario and introduces additional measures to bridge the gap to the State's climate targets. To meet the State's goals, Maryland's Climate Pathway involves both the

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extension and expansion of existing policies, as well as the introduction of new policies that will lead to deeper reductions.

Full implementation of Current Policies puts Maryland on track to reduce emissions by 51% in 2031 relative to the 2006 baseline, leaving a gap of 10.6 MMTCO₂e (million metric tons of carbon dioxide (CO₂) equivalents) to reach the 2031 target (Figure ES.1.). Historical efforts had already achieved 36.7 MMTCO₂e of reductions as of the most recent state emissions inventory in 2020 (Figure ES.1.). However, under current policies, emissions stop declining by 2040 and resume growth through mid-century. This occurs because: many current policies at both the State and federal levels expire before 2040; as policy support is withdrawn, emissions reductions slow or reverse in many sectors; the demand for energy services continues to increase. CO₂ removal approaches are not a part of the pathway to the 2031 goal, because the 60% reduction target applies to gross emissions, therefore, does not include any negative emissions. Removal approaches are included in the model in later years to demonstrate the pathway's trajectory toward achieving the 2045 net-zero target.

The largest contributions to reductions in Maryland's Climate Pathway come from the electricity sector (Section 2.1) and the transportation sector (Section 2.2), but the pathway will require action across all sectors of the Maryland economy to achieve the needed emission reductions to reach Maryland's climate goals (Table ES.1). Additionally, the Pathway includes an economy-wide cap-and-invest program as a supporting policy that achieves the last 4.8 MMTCO₂e of emissions reductions to close the gap in 2031 and help to fund future emissions reductions programs.

Maryland's Climate Pathway

Sectors	Mitigation Strategies	Current & Potential Policy Approaches
	Provide market incentive for cost-effective mitigation	<ul style="list-style-type: none"> Implement a cap and invest program
	Shift the electricity grid to clean generation	<ul style="list-style-type: none"> Expand Renewable Portfolio Standard (RPS) to reach 100% clean electricity Implement and raise awareness of IRA incentives, including tax credits and direct pay for clean energy production in low-income communities
	Shift PJM electricity grid to clean generation	<ul style="list-style-type: none"> Strengthen the Regional Greenhouse Gas Initiative (RGGI) target to zero emissions by 2040
	Reduce passenger vehicle use	<ul style="list-style-type: none"> Adopt new smart growth strategies Increase public transit opportunities and access to safe walking/biking paths Incentivize remote work, when possible
	Shift passenger vehicle fleet to ZEVs	<ul style="list-style-type: none"> Achieve Advanced Clean Cars II targets Implement and educate on IRA incentives Implement electric vehicle (EV) infrastructure investments from BIL
	Shift freight trucking fleet to ZEVs	<ul style="list-style-type: none"> Achieve Advanced Clean Trucks & Advanced Clean Fleets targets Implement and educate on IRA & BIL incentives
	Electrify nonroad fuel usage	<ul style="list-style-type: none"> Set new standards for equipment in construction, lawn care, warehouses, etc.
	Improve building efficiency	<ul style="list-style-type: none"> Implement Building Energy Performance Standards and EmPOWER program Implement and raise awareness of IRA incentives, including consumer tax credits for energy efficiency and clean energy upgrades Set enhanced standards for new buildings
	Electrify all appliances	<ul style="list-style-type: none"> Set zero-emission appliance standards Set clean heat standards Set all-electric construction standards
	Electrify industrial processes	<ul style="list-style-type: none"> Implement EmPOWER program Adopt Buy Clean policies (i.e. cement)
	Explore alternative fuels & energy sources	<ul style="list-style-type: none"> Implement and raise awareness of IRA's hydrogen and CCS tax credits Facilitate cement fuel switching
	Reduce HFC emissions	<ul style="list-style-type: none"> Achieve AIM Act targets for HFC reductions Achieve Maryland's HFC regulations
	Enhance efficiency in cement material	<ul style="list-style-type: none"> Set new construction standards to reduce excessive use of cement Adopt Buy Clean policies that prioritize cement products with high clinker replacement factor
	Reduce natural gas consumption	<ul style="list-style-type: none"> Achieve policies across all consuming sectors
	Prevent and repair emissions leaks	<ul style="list-style-type: none"> Implement Maryland natural gas methane regulation Implement IRA methane fee
	Reduce methane from landfills	<ul style="list-style-type: none"> Implement Maryland landfill methane regulation
	Divert and redirect waste	<ul style="list-style-type: none"> Realize Maryland Sustainable Materials Management Incentivize and facilitate composting Prioritize circular economy policies
	Reduce methane emissions from enteric fermentation and manure management	<ul style="list-style-type: none"> Incentivize best practices Facilitate knowledge sharing

Table ES.1. Mitigation strategies for 2031 in Maryland's Climate Pathway by sector and policy approaches that can contribute to these essential strategies. See relevant sections 2.1-2.9 for details on specific policies.

BENEFITS OF CLIMATE GOAL ACHIEVEMENT

The REMI PI+ model, a comprehensive economic modeling tool, was used to analyze the potential impacts of Maryland's Climate Pathway on the State's economy. It is projected to create new job opportunities across various sectors. Investments in renewable energy, energy efficiency, and other clean technologies would support local businesses and contribute to workforce development. Maryland can foster innovation, attract new industries, and drive economic growth by investing in sustainable infrastructure and transitioning to cleaner energy sources. The transition will foster further innovation and technological advancement that can lead to new industries and increased competitiveness, resulting in job opportunities and economic benefits in emerging sectors.

Implementing energy efficiency measures as part of the Pathway would also lead to significant energy savings for households, businesses, and the public sector, which could be reinvested in the economy, stimulating additional economic activity and benefiting Maryland residents. While the REMI PI+ model's estimates are based on assumptions and data inputs, its findings suggest that Maryland's Climate Pathway has the potential to bring about positive economic changes. It would foster sustainable growth, job creation, and technological innovation while addressing the urgent need to mitigate climate change.

EQUITY AND IMPLEMENTATION CONSIDERATIONS

Successfully achieving the policies outlined in the Maryland's Climate Pathway scenario hinges on the full implementation of federal, state, regional, and local policies and realization of substantial and sustained benefits for the broad public and communities that can ensure Maryland's clean future. To realize this vision, it will be essential to support equitable access to the incentives and benefits included in the Pathway and the widespread adoption of key mitigation strategies across economic sectors and people's daily lives. These actions can be taken across all sectors, including:

Electricity. Decarbonizing the electricity sector is a central component of success, not only for reducing emissions within the sector, but also for enabling the decarbonization of other sectors, such as transportation, buildings, and industry, where electrification is a key solution. This shift is essential, but to realize the emissions reductions needed in the electricity sector based on our model, several critical policies and regulatory actions will need to be implemented. Importantly, to achieve 100% clean energy sources by 2035, coal phaseout and grid stability need to be prioritized to secure the renewable energy transition. Maryland can also leverage its involvement with the Regional Greenhouse Gas Initiative to set a cap for net-zero by 2040. Finally, the deployment of renewables, particularly solar photovoltaics, will need to accelerate rapidly in the near term. These actions raise particular challenges within the sector to ensure this transition is equitable through programs such as community solar and to ensure that imported electricity from outside of Maryland is clean, so that emissions reductions outside of State borders can also be accounted for in the State GHG Inventory.

Transportation. Maryland has shown climate leadership in the transportation sector by moving to adopt standards like Advanced Clean Cars II and passing the Maryland Clean Trucks Act. Yet, barriers still need to be overcome to achieve the transition to electric vehicles (EVs) and the infrastructure required to support

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them. Access to charging stations, affordability of EVs, and addressing range anxiety are key concerns. Additionally, reducing vehicle miles traveled (VMT) and promoting alternative modes of transportation, such as e-bikes and public transit, are important strategies to reduce emissions. However, challenges exist in terms of infrastructure, financing, and public perception of these modes. Ensuring equitable implementation of these strategies is also a significant challenge, as it is crucial to address the needs and accessibility of underserved communities.

Buildings. One of Maryland's priorities in the building sector is building electrification and efficiency measures. This involves transitioning to higher-efficiency electrical appliances and utilizing a cleaner electricity grid to reduce emissions. However, challenges arise regarding access and affordability for all individuals, particularly low-income homeowners and renters. Integrating renewable energy sources into building electrification also poses scalability, grid stability, and storage capacity challenges. Retrofitting older buildings to accommodate zero-emission appliances, such as heat pumps, can be complex and may require significant modifications. Additional concerns include historic preservation requirements, upfront costs, and installation disruptions. Overcoming these challenges requires targeted policies, support for low-income households, and coordination between policymakers, manufacturers, consumers, and energy providers.

Industry. Decarbonizing the industrial sector has historically been one of the toughest goals to accomplish due to policy limitations and technical challenges. Removing the Greenhouse Gas Reduction Act's exemption for the manufacturing sector will be a key step in facilitating emissions reductions within the sector. Additional research, funding, and multi-stakeholder support are needed to deploy and improve solutions such as electrification through heat pumps and resistive heating, zero-carbon fuels like hydrogen, and utilizing alternative sources of high heat such as solar thermal. Special effort will also be needed to address emissions from non-combustion sources such as cement and HFC's. Even with these actions, residual emissions from this sector may require offsetting through natural sinks or CO₂ removal methods, and, to meet the State's goals, other sectors may need to decarbonize rapidly to ensure the scalability of negative emissions.

Waste. Waste management policies are an opportunity for Maryland to achieve both emissions reductions and co-benefits to Marylanders through improved environmental health. Waste diversion policies can help the State reduce methane emissions and reduce the amount of waste that accumulates in landfills. To create better waste management policies, Maryland can improve data on waste sources and composition; address barriers to waste diversion policies like composting; adjust the inventory accounting methodology for waste incineration; and look for opportunities to achieve wastewater emissions reductions.

Agriculture. Maryland's farmers have already taken significant action to reduce non-CO₂ GHG emissions from agricultural soils as part of the State's commitment to a healthy Chesapeake Bay. Taking additional action in Maryland's agricultural sector will help the State preserve the largest commercial industry for years to come. The biggest problem in the agricultural sector is the potent GHG, methane. It will also be essential to employ best practices to manage agricultural soils as a carbon sink, in concert with the State's forests, Maryland's largest carbon sink, to maintain and expand natural methods of carbon sequestration to support the State's net-zero goals.

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Maryland Local Leaders

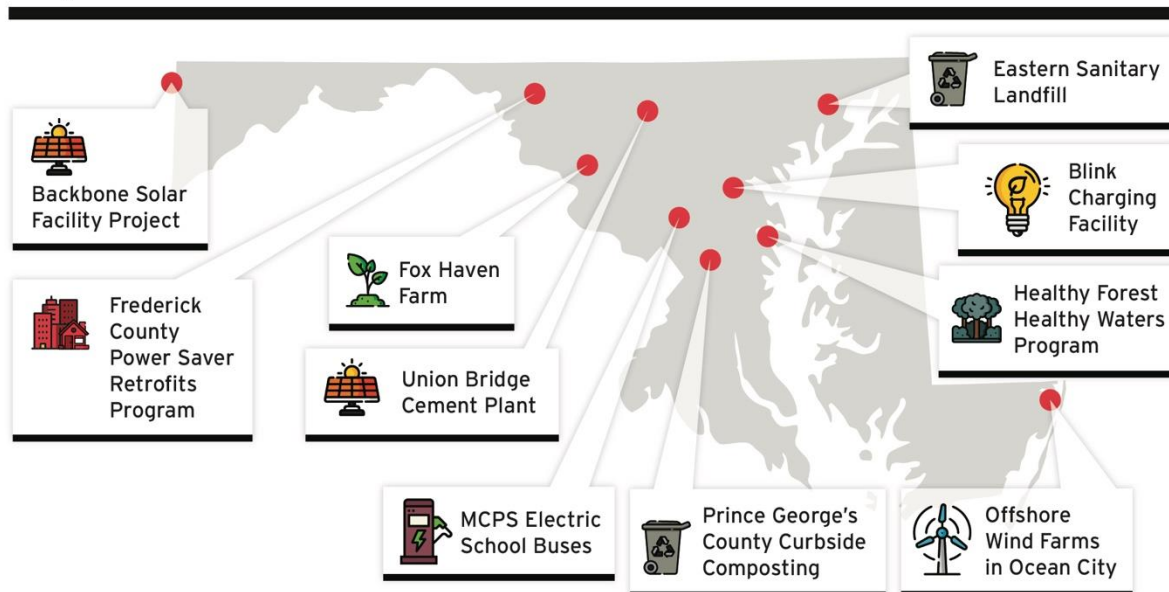


Figure ES.2. Maryland community leaders as highlighted in the implementation sections and case studies throughout the report to demonstrate how Maryland's Climate Pathway is already underway.

CONCLUSION

Achieving the 2031 goal will require immediate and sustained effort across Maryland's entire economy and at all governance levels. It will first require effective, collaborative implementation of current policies, in partnership with the federal government and the State's other governance levels including counties and cities. Through the pathway presented in this report, Maryland can achieve the 2031 target, set itself on a path to net-zero, and establish new policies that can create over 6,600 new jobs and provide up to \$667 million of annual health benefits from co-pollutant reduction.

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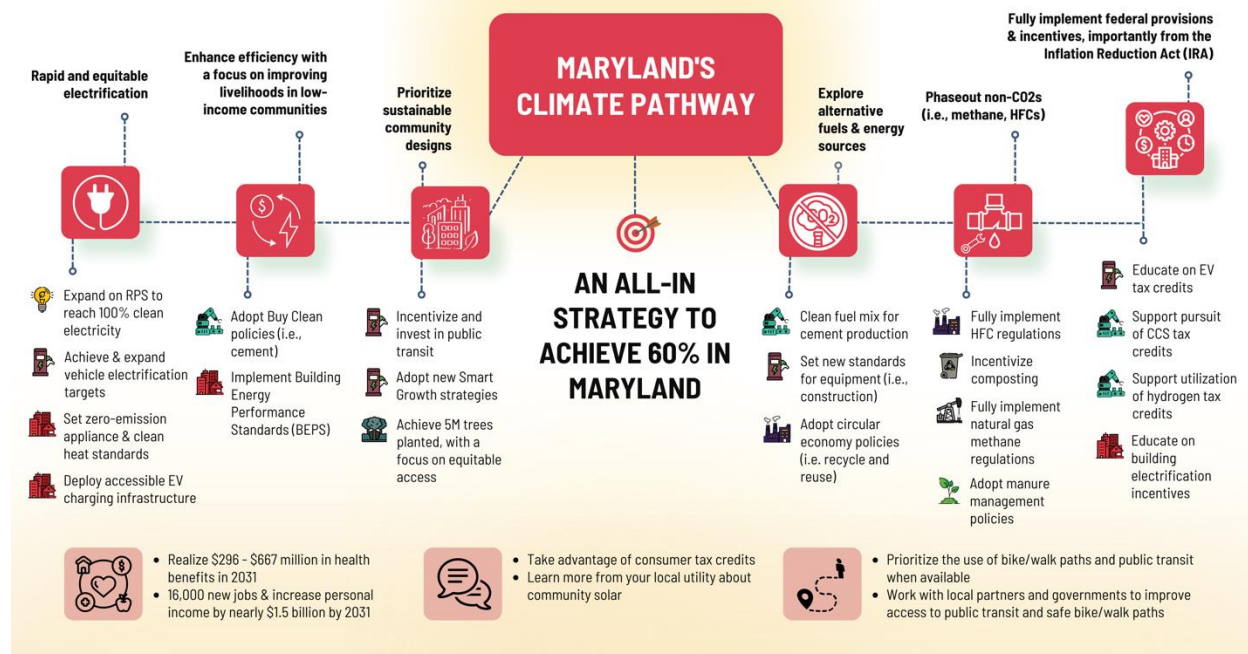


Figure ES.3. Key mitigation strategies and policy opportunities featured in the report that enable Maryland to achieve its 2031 goal.

As we embark on this path, additional collaboration and analysis will be required to sharpen our understanding of opportunities and implementation across several key areas, such as agriculture, forestry, and land use, and policy implementation challenges. In addition, enhanced discussion, analysis, and collaboration will be helpful to better structure and manage Maryland's transition to high renewables penetration and phasing down of natural gas distribution systems, particularly in planning for the post-2030 period. Stakeholder engagement and broad-based efforts involving government, community groups, businesses, and individuals will be crucial for achieving Maryland's climate action goals and can be supported by public outreach campaigns, engagement with businesses, and prioritizing equity and community involvement in policy development and implementation.

This Pathway shows that through working together, Maryland's ambitious 2031 climate goal is within reach. Achieving it will provide substantial benefits to Marylanders and will set the State squarely on a path to achieve its 2045 net-zero emissions goal. Maryland's Climate Pathway offers an initial comprehensive, all-of-society view of how the State can not only reach its goals but also set an example in the United States and world of how to develop a new, healthy, and vibrant economy that works for all residents.