SEPTEMBER 2023

CUTTING THROUGH THE SMOG:

HOW AIR QUALITY STANDARDS HELP SOLVE THE HIDDEN HEALTH TOLL OF AIR POLLUTION FROM MARYLAND'S HOMES AND BUSINESSES

CASA

Green & Healthy Homes Initiative®

Chesapeake Climate Action Network

RMI

Executive Summary

For decades, millions of Maryland residents, particularly those residing in and around Baltimore, have lived with poor air quality, leading to countless missed days of work and school, high rates of childhood asthma and emergency room visits, as well as premature death. Baltimore's air pollution levels have consistently violated federal air quality standards under the Clean Air Act. While the Maryland Department of the Environment (MDE) has made strides toward reducing emissions from major industrial sources and diesel vehicles, **pollution from burning fossil fuels in homes and commercial buildings has increased in recent years.**

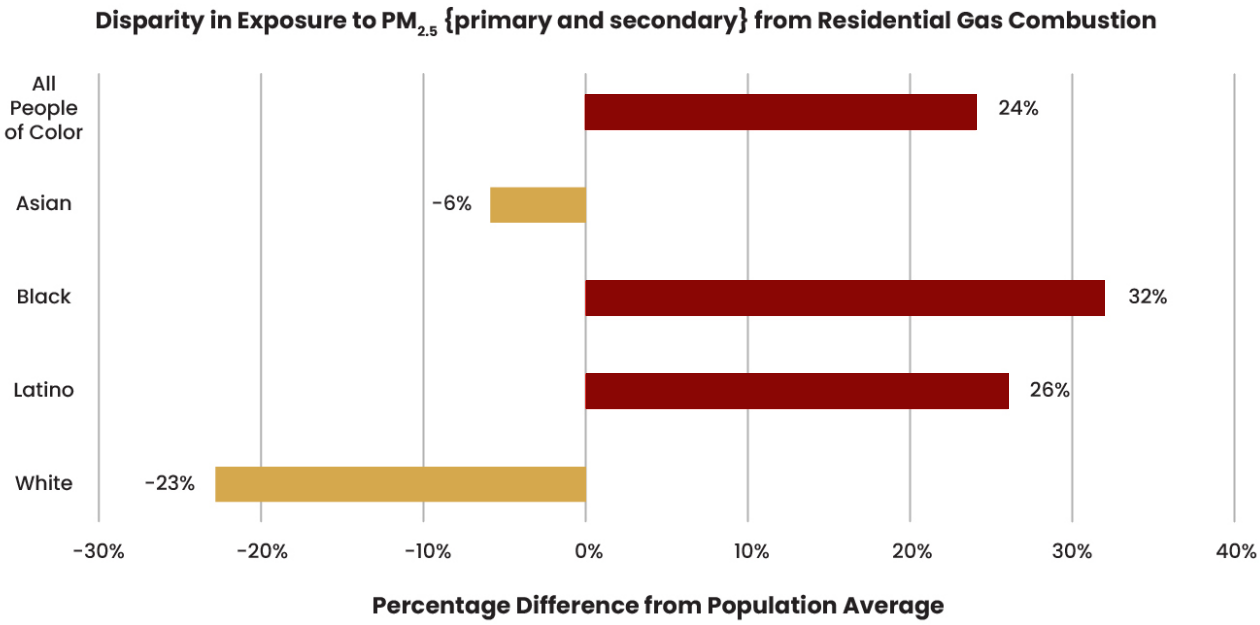
Fossil fuel equipment such as heating systems (also referred to as heating, ventilation, and air conditioning (HVAC) systems) and water heaters in homes and buildings emit nitrogen oxides (NO_x), a common family of air pollution that not only harms health directly, but contributes to the formation of deadly fine particulate matter ($PM_{2.5}$), and can combine with volatile organic compounds (VOCs) to form ozone in the presence of sunlight. These pollutants are linked to respiratory, cardiovascular, cognitive, reproductive and developmental harms, as well as cancer and premature death.

In Maryland, **fossil fuel equipment in residential and commercial buildings emits more than three times as much health-harming NO_x as all the state's power plants put together.**[1] Statewide, eliminating fossil fuel equipment would remove nearly as much NO_x as taking half the state's diesel vehicles off the road.[2]

Millions of Maryland residents have shouldered the economic and health costs of exposure to air pollution from fossil fuel equipment such as HVACs and water heaters that are vented outdoors. According to data from Harvard public health researchers, **outdoor building pollution caused an estimated 163 premature deaths in Maryland in 2017 alone.**[3] Pollution from fossil fuel equipment in Maryland is responsible for additional health and economic impacts, including about 3,500 cases of respiratory symptoms and 6,500 work loss days per year, costing more than $1.3 billion in health impacts annually.[4]

In the Baltimore metro area, where fossil fuel equipment emits more than five times as much NO_x as the region's power plants, **pollution from the region's buildings drives 60% of these health impacts**, while another 25% more of total health impacts from fossil fuel equipment pollution come from Maryland's part of the Washington metro area.[5]

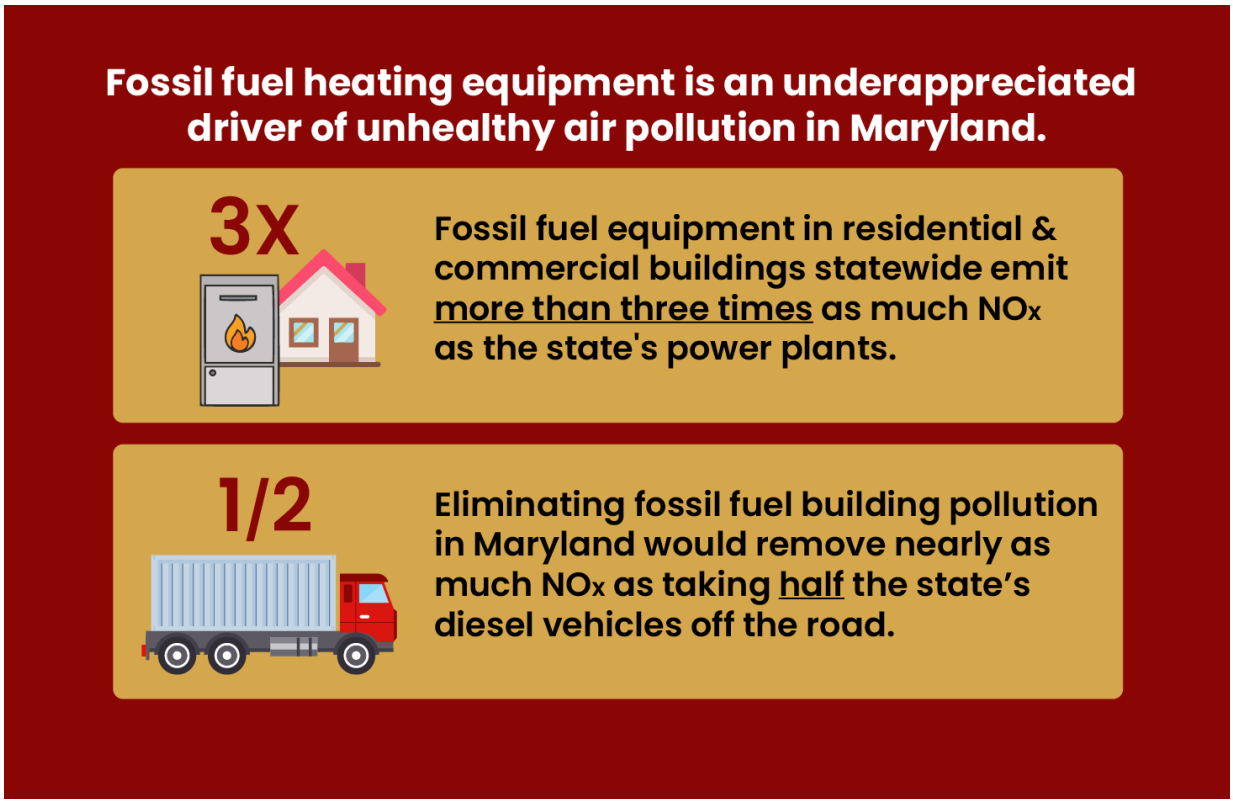
People of Color are exposed to 60% more pollution from residential gas appliances in Maryland



Source: Christopher W. Tessum et al., $PM_{2.5}$ *Polluters Disproportionately and Systematically Affect People of Color in the United States*, 7 Sci. Adv. eabf4491 (2021).

The Baltimore metro area, has been out of attainment with federal air quality standards for more than 30 years**.** Though the state is moving toward attainment, it will need to continue to demonstrate compliance with the federal standard. Reducing building equipment pollution is one way to ensure Maryland maintains safe ozone levels.

Low-income neighborhoods and communities of color in Maryland face disproportionately higher rates of exposure to pollution from homes and buildings, which undermines their health and well-being. Compared to white Marylanders, Black residents are exposed to about 70% more pollution from residential gas equipment, such as gas furnaces and gas water heaters.[6]



Solutions

While the Baltimore metro area today is on a path to regaining attainment for federal ozone standards, no significant progress has been made to reduce NO_x emissions from the region's buildings. In fact, such pollution from homes and businesses has increased in recent years. State and local leaders urgently need to implement policies that will ensure Maryland not only obtains, but maintains cleaner air on a long-term basis, starting with the building sector.

Maryland policymakers and state leaders can drastically reduce fossil fuel equipment pollution and begin to close health disparities across the state by pursuing **air quality standards for HVACs and water heaters**. Zero-emission technologies, such as **highly efficient electric heat pumps,** improve health and create more resilient homes to withstand the challenges posed by climate change. In addition, heat pumps can provide affordable, reliable clean heating, as well as much-needed cooling year round.

The Maryland Commission on Climate Change has recommended an air quality equipment standard for HVACs and water heaters in a 2022 report. More recently, MDE has proposed it in its 2023 Maryland Climate Pathway. Elected officials should follow in the footsteps of zero-NO_x appliance standards adopted by California's Bay Area Air Quality Management District and precede California's statewide zero-emission appliance standards currently under development.

To pursue cleaner air while cutting pollution from the building sector, **Maryland should follow these recommendations to develop a zero-pollution standard for space heating and water heating** with a goal of achieving a structured phaseout of non-essential pollution-producing equipment by 2030. By adopting this standard, the Moore administration can establish Maryland as a nationwide leader on eliminating pollution from buildings, meeting the state's ambitious climate goals and fulfilling its mission to deliver an equitable transition for millions of Marylanders toward healthier, more affordable homes powered by 100% renewable energy.

Topline Findings

1. Statewide, **fossil fuel equipment emits more than three times as much health-harming nitrogen oxides (NO_x)** as the state's power plants.[7]
2. **Eliminating fossil fuel equipment would remove nearly as much NO_x as taking half the state's diesel vehicles** off the road.[8]
3. NO_x pollution from burning **fossil fuels in buildings has increased 3.7%** from 2017–2023 while NO_x pollution from other sectors has gone down.
4. In 2017 alone, outdoor pollution from fossil fuel equipment caused an estimated **163 premature deaths,**[9] about **3,500 cases of respiratory symptoms**, and **6,500 work loss days per year,** costing more than **$1.3 billion** in health impacts annually.[10]
5. **People of color in Maryland are exposed to 60% more residential gas equipment pollution** than white people, with Black Marylanders exposed to 70% more pollution from residential gas equipment than white Marylanders.[11]
6. An air quality standard is key to meeting Maryland's climate commitments as **fossil fuel use in buildings represents 13% of Maryland's greenhouse gas emissions.**

7. In some parts of the United States, **space cooling can represent more than 70% of electrical demand** on extremely hot days. Heat pumps, which use 29% less electricity compared to central ACs, can improve resilience amid warming temperatures.

8. **If Maryland homes fully upgrade to heat pumps and other electric appliances, the state's overall electricity consumption for home heating and cooling will decrease** despite the increase in electric equipment. This is because high-efficiency heat pumps are displacing widely used lower efficiency electric resistance heating systems and air conditioning systems.

9. Adopting an **air quality equipment standard can save 98% of Maryland households money on their monthly energy bills**, and the median low-income household in Maryland would see $373 in savings per year with a heat pump compared to a gas furnace.

10. Maryland is on pace to electrify more than 50% of all homes by 2030, but will **need further action to meet its climate goals.**

11. Maryland has the **obligation and legal authority to pursue air quality equipment standards** for HVACs and water heaters.

12. Transitioning Maryland homes from fossil fuel equipment to **highly efficient electric alternatives would deliver cleaner air**, keeping major metro areas in attainment with federal ozone standards while delivering climate resilience, public health improvements and benefits to the state's electric grid.

13. **A phased zero-emission air quality standard**, coupled with policies focused on increasing affordability and access to whole-home retrofits for low-income and middle-income households, **can dramatically accelerate the transition to electric alternatives.**

Footnotes

[1] Emissions data from EPA, 2020 National Emissions Inventory. Appliance emission estimates include residential & commercial emissions for the gas, oil, & other fuel categories, with commercial emissions adjusted to exclude certain non-appliance sources like pipeline compressor stations.

[2] Emissions data from EPA 2020 National Emissions Inventory; see note 1.

[3] Based on RMI analysis using median estimates from the results of 3 reduced complexity models used in: Jonathan J. Buonocore et al., A Decade of The U.S. Energy Mix Transitioning Away from Coal: Historical Reconstruction of the Reductions in the Public Health Burden of Energy, 2021 Environ. Res. Lett. 16 054030, https://doi.org/10.1088/1748-9326/abe74c, as well as additional analysis from the study's lead author.

[4] Analysis using EPA, CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) with selected subsectors: commercial gas, commercial oil, and residential other.

[5] Emissions data from EPA 2020 National Emissions Inventory; see note 1.

[6] Christopher W. Tessum et al., PM2.5 Polluters Disproportionately and Systemically Affect People of Color in the United States, Sci. Adv. 7:18, supplementary data file S2 (2021), https://advances.sciencemag.org/content/suppl/2021/04/26/7.18.eabf4491.DC1.

[7] Emissions data from EPA 2020 National Emissions Inventory; see note 1.

[8] Emissions data from EPA 2020 National Emissions Inventory; see note 1.

[9] Based on RMI analysis using median estimates from the results of 3 reduced complexity models used in: Jonathan J. Buonocore et al., A Decade of The U.S. Energy Mix Transitioning Away from Coal: Historical Reconstruction of the Reductions in the Public Health Burden of Energy, 2021 Environ. Res. Lett. 16 054030, https://doi.org/10.1088/1748-9326/abe74c, as well as additional analysis from the study's lead author.

[10] Analysis using EPA, CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA); see note 4.

[11] See note 6.

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About the report authors

Chesapeake Climate Action Network ("CCAN") is a grassroots, nonprofit organization dedicated to fighting climate change in Maryland, Virginia, Washington, D.C and beyond. CCAN envisions an economy where dirty fossil fuels are phased out while energy efficiency and truly clean sources of power increasingly sustain every aspect of our lives. Working with a large and growing network of allies, CCAN has been central to climate victories in Maryland, helping pass a 50% renewable electricity requirement, ushering in one of the nation's most ambitious offshore wind programs, forcing the clean up of three coal ash dump sites, helping enact a landmark bill to ban fracking, and successfully advocating for the strongest statewide carbon cap in the country.

With over 150,000 lifetime Latino, immigrant and working-class members across 46 states, **CASA** is the foremost immigrant organization in the Mid-Atlantic region and a national leader in ensuring that all individuals have the core support systems necessary for full participation in society. CASA creates change with its powerbuilding model blending human services, community organizing and advocacy in order to serve the full spectrum of the needs, dreams and aspirations of members.

The Green & Healthy Homes Initiative is dedicated to addressing the social determinants of health, opportunity, and equity through the creation of healthy, safe, and energy efficient homes. By delivering a standard of excellence in its work, GHHI aims to eradicate the negative health impacts of unhealthy housing and unjust policies for children, seniors, and families to ensure better health, economic, climate, and social outcomes in historically disinvested communities – with an emphasis on communities of color.

RMI (founded as Rocky Mountain Institute) is an independent nonprofit founded in 1982 that transforms global energy systems through market- driven solutions to align with a 1.5°C future and secure a clean, prosperous, zero-carbon future for all. We work in the world's most critical geographies and engage businesses, policymakers, communities, and NGOs to identify and scale energy system interventions that will cut greenhouse gas emissions at least 50 percent by 2030. RMI has offices in Basalt and Boulder, Colorado; New York City; Oakland, California; Washington, D.C.; and Beijing.

Section 1: Pollution from fossil fuel equipment impacts public health.

Maryland needs to maintain federal air quality standards.

For decades, Maryland's two major metro areas, the Baltimore metropolitan region and the Maryland portion of the Washington metro area, have been out of attainment with federal health-protective air quality standards for ozone pollution under the Clean Air Act. Four counties in Maryland — Anne Arundel, Baltimore, Harford and Prince George's — received a failing grade for their number of high ozone days in the American Lung Association's 2023 State of the Air report. Though the state is moving toward attainment, it will need to demonstrate ongoing compliance with federal ozone limits and ensure ozone pollution continues to trend downward.

Fossil fuel equipment pollution from buildings has been a major and unappreciated culprit of air pollution in both the Baltimore and Washington metro areas. Gas, oil and propane-based equipment emits NO_x, an air pollutant that reacts with volatile organic compounds (VOCs) in the presence of sunlight to form ozone or smog. Such fossil fuel equipment in buildings across the state emits more than three times as much health-harming NO_x as the state's power plants. The situation is even more dire in the Baltimore metro area.[12]

Upgrading to electric water heating and HVAC systems in buildings would remove nearly as much NO_x as taking half the state's diesel vehicles off the road.[13] This way Maryland could eliminate a key ingredient in the formation of ozone, alleviating local air pollution and improving public health.

While Maryland has submitted plans to demonstrate how to bring the Baltimore metro area into federal attainment, this plan does not measurably address NO_x emissions from buildings. While NO_x pollution from other sectors has ticked down in recent years, NO_x pollution from burning fossil fuels in residential, commercial and institutional buildings is on the rise — increasing 3.7% from 2017 to 2023.

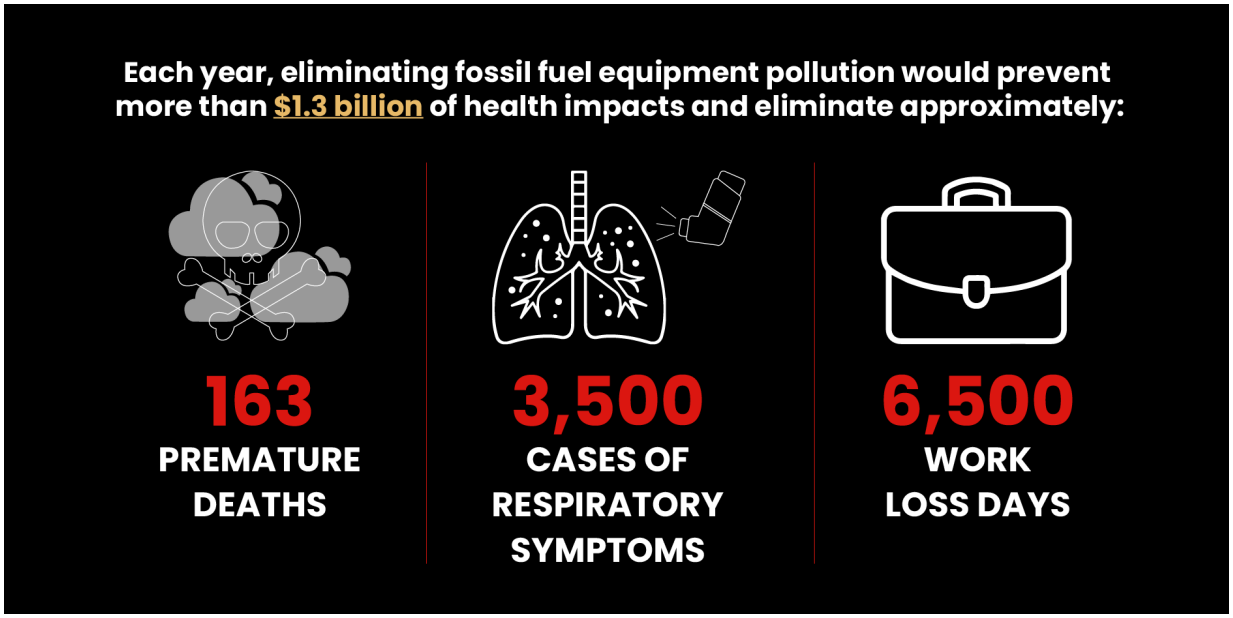
The state should consider in its future ozone plans how it will address this pollution from buildings to ensure Maryland remains on track to meet federal targets. As long as NO_x emissions from fossil fuel equipment goes unaddressed by state environmental and air quality regulators, it will remain a key roadblock to meeting federal air quality standards.

[12] Emissions data from EPA 2020 National Emissions Inventory; see note 1.
[13] Emissions data from EPA 2020 National Emissions Inventory; see note 1.

Ozone pollution harms public health.

Ozone pollution poses multiple serious threats to health and can even be deadly. The short-term health impacts from breathing ozone include shortness of breath, wheezing, coughing, asthma attacks, increased risk of respiratory infections and increased susceptibility to pulmonary inflammation. Long-term exposure increases the risk of premature death, respiratory and cardiovascular harm, asthma development, worsened allergies, lower birth weight and decreased lung function in newborns, as well as increased rates of hospitalizations and ER visits for those living with a lung disease like asthma or chronic obstructive pulmonary disease.

Anyone who spends time outdoors when ozone levels are high is at risk. Older adults and people with existing lung diseases are especially vulnerable to ozone pollution, as well as those who work or exercise outdoors. The developing lungs of children and teens are more vulnerable, with a growing body of research linking NO_x to childhood asthma. Prenatal exposure may also result in lower IQs and irreversible learning deficits.



Low-income communities and communities of color bear a disproportionate burden of health impacts from fossil fuel equipment.

While everyone is at risk of hazardous health impacts from breathing in ozone and NO_x, air pollution in Maryland disproportionately impacts people of color. People of color also bear a disproportionate burden of exposure to fine particulate matter ($PM_{2.5}$) from gas equipment, and nationally, people of color are 64% more likely than white people to live in a county with a failing grade for air pollution.

The health impacts felt by communities of color in the Baltimore region from disproportionate exposure to pollution from fossil fuel equipment can be compounded by higher exposure to other major sources of NO_x emissions.

Air pollution exposure contributes to higher rates of asthma for Black residents in Maryland, and Black children are 1.5 times more likely to have ever been diagnosed with asthma in their lifetime than white children in the state. Black children are admitted to the emergency room for asthma at a rate five times higher than white children, and in the city of Baltimore, Black residents visit the emergency room at a rate 6.5 times higher and are hospitalized at a rate 2.9 times higher for asthma. Baltimore City's rate of ER visits due to asthma is the highest in Maryland.

CASE STUDY

How compounding exposure to major sources of NO_x pollution impacts low-income communities and communities of color in Maryland.

Credit: Zumper.com

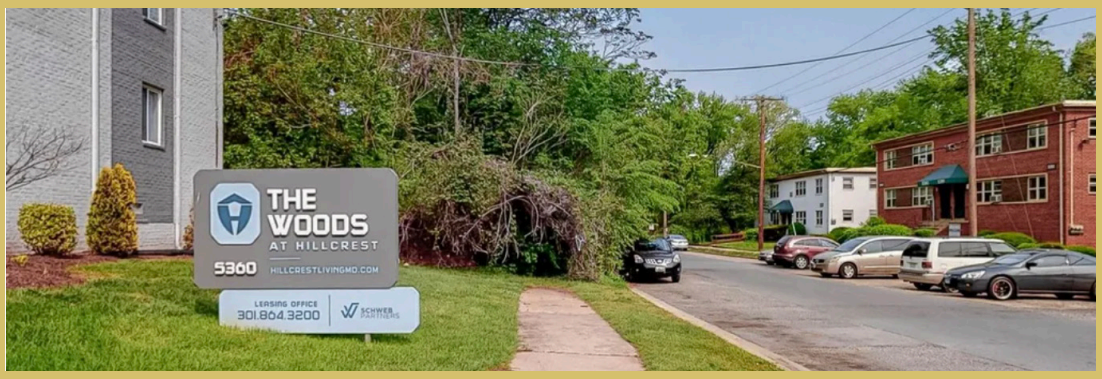
The Village at Hillcrest, located at 4101 53rd Avenue, was built in 1942 and is made up of 154 units that rely on methane gas for heating and cooking.

On the Maryland-D.C. border, in the adjacent Maryland communities of Bladensburg and Hyattsville, lie the Village at Hillcrest and the Woods at Hillcrest apartment complexes. The cumulative pollution burden impact on low-income communities and people of color is especially felt in these communities.

These affordable housing complexes are home to many low-income families, primarily Black and Hispanic individuals, as well as those unable to access healthcare due to documentation status. These historically disenfranchised groups continue to breathe some of the worst air quality in

Maryland today as a result of exposure to residential fossil fuel equipment, the apartments' position near a major commuter zone, as well as its close proximity to polluting businesses and industrial facilities.

Both apartment complexes lie in Census Tract 8040.02, where approximately 58% of buildings rely on gas for heating and cooking. These apartments also lie in close proximity to the Bladensburg Industrial Park and a number of highly polluting industrial facilities, including Aggregate Industries' Bladensburg Asphalt Division, Aggregate Industries' Bladensburg Ready-Mix Concrete & Hot Mix Asphalt Plant, DC Materials and the Recycle One Processing Facility & Transfer Station. Annapolis Road, which splits into Route 450 and Landover Road as well as Edmonston Road and Kenilworth Avenue, also passes by these apartments, overburdening communities during peak traffic and commuter hours.



Credit: Zumper.com

The Woods at Hillcrest, located at 5360 Quincy Place, was built in 1948 and is made up of 120 units that rely on methane gas for heating and cooking.

Demographic profile: Hyattsville/Bladensburg's population demographics are approximately 63% Black or African-American ,and 31% Latinx/Hispanic, with a poverty rate of 8.7%.[14]

Environmental justice burden: Using MDE's EJScreen scoring, the communities in which the apartment complexes lie have been given the following scores, highlighting the outsized pollution burdens residents in these apartments face compared to overall socioeconomic factors of the community.

The below EJScreen scoring is assigned for the apartments' location (Tract 8040.02) and the adjacent tract 0.1 miles away (Tract 8043):

Total environmental justice concerns: Averages the pollution burden and population characteristics score	Tract 8040.02 scores higher than 78% of MD tracts; Tract 8043 scores higher than 81% of MD tracts

Pollution exposure: Proximity and levels of particulate matter, ozone, traffic volume, respiratory hazard index	Tract 8040.02 scores higher than 87% of MD tracts; Tract 8043 scores higher than 98% of MD tracts
Pollution environmental effect: Lead paint indicator, proximity to risk management sites, treatment storage and disposal facilities, Superfund sites, water discharge facilities	Tract 8040.02 scores higher than 81% of MD tracts; Tract 8043 scores higher than 88% of MD tracts
Socioeconomic factors: Percent of non-white, low-income residents, individuals with less than a high school education	Tract 8040.02 scores higher than 93% of MD tracts; Tract 8043 scores higher than 79% of MD tracts

[14] 2020 census, https://www.census.gov/quickfacts/fact/table/bladensburgtownmaryland,hyattsvillecitymaryland/PST045222

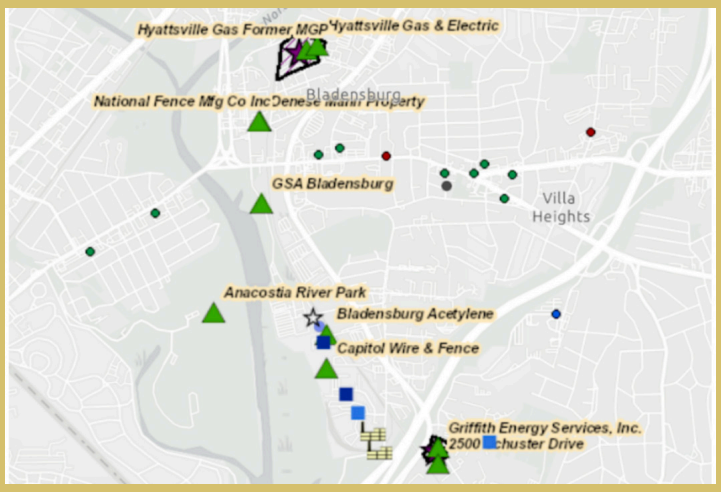


Figure 1.
Dark and light blue squares represent active emission centers
Green and red dots represent commercial and institutional food scrap generators
Green-labeled triangles represent Land Restoration Programs
Blue dots represent Solid Waste Facilities
Beige buildings represent Wastewater Discharge Facilities

Solutions

Low-income communities and communities of color deserve climate and environmental justice. Given the large impact of NO_x pollution from fossil fuel equipment in Maryland compared to other sources of pollution such as power plants, any comprehensive strategy to reduce pollution in overburdened communities must incorporate air quality standards for

HVACs and water heaters. Maryland leaders can follow several pathways to help clean up the air faster for those experiencing the greatest pollution burden:

- **Adopt air quality equipment standards for HVACs and water heaters** to increase market availability of pollution-free equipment and ensure owners of large multifamily buildings replace aging fossil fuel equipment with highly efficient, pollution-free alternatives when existing equipment burns out.
- **Reform the EmPower Program to prioritize communities with high EJ screening scores and incentivize adoption of pollution-free equipment.** Changes should include a pathway for tenants to advocate for healthier buildings and a mandate — supported by subsidies and incentives — for owners of large multifamily buildings to retrofit and upgrade buildings with clean, electric alternatives.
- **Address the air pollution burden from other sources** through measures such as requiring EJ screening before pollution permits are granted.
- **Prevent the expansion of heavily trafficked roads** in vulnerable and over-polluted communities.

Section 2: Transitioning homes and businesses to electric heat pumps can deliver cleaner air and climate-ready buildings.

Fossil fuel equipment is a major source of greenhouse gas emissions.

Burning fossil fuels in homes and buildings is not only a threat to public health, but a major driver of climate change. In Maryland, buildings directly emit almost 11 million metric tons of greenhouse gases per year, over 13% of statewide emissions. That's more than the state's entire industrial sector produces annually. The total statewide health and climate impacts of fossil fuel-equipment pollution in 2017 were estimated to be at least $2.1 billion and would be even higher using EPA's latest proposed value for the social cost of carbon.[15]

For homes ready to make the switch, a highly efficient, all-electric alternative with zero onsite pollution exists: the heat pump. By transitioning from fossil fuel equipment to heat pumps for space and water heating, the average Maryland home would eliminate as much climate pollution as taking two gasoline vehicles off the road.[16]

Electric heat pumps can provide clean cooling and protect Maryland's grid.

Baltimore is set to see the average number of days over 90 degrees F more than double over the next 40 years. In some parts of the United States, space cooling can represent more than 70% of peak residential electrical demand on extremely hot days. The average heat pump uses 29% less electricity to maintain the same level of cooling during periods of peak demand compared to central air conditioning.

In fact, Maryland could see a net reduction in electricity consumption for home heating and cooling if homes upgrade to heat pumps and other electric appliances. According to an analysis of the energy impacts of electrifying homes in Maryland, Northeast States for Coordinated Air Use Management (NESCAUM) found that when all homes fully electrify and upgrade to heat pumps for HVACs and water heating, the overall electricity consumption for home heating and cooling actually decreases, despite the net increase in electric equipment. This reduction is because high-efficiency heat pumps are displacing lower efficiency electric resistance heating systems and air conditioning systems that are currently in wide use in the state, in addition to replacing less efficient fossil fuel-fired equipment. Thus, the transition to heat pumps can reduce strain on the grid and help the state avoid blackouts during increasingly prevalent extreme heat events.

Amid rising temperatures and longer bouts of extreme heat, ensuring that residents have efficient, affordable cooling is not only essential to the health and wellbeing of the region, it is vital to maintaining grid resiliency during summer months.

Climate Resiliency

Eliminating fossil fuel equipment can make the Baltimore region more resilient against the impacts of climate change and reduce air pollution as unhealthy conditions become more frequent.

In June 2023, the Baltimore region recorded a Code Maroon air quality alert due to smoke from Canadian wildfires, the highest health warning given by the EPA and a level considered hazardous to the health of everyone in the area. The Baltimore region continued to experience periods of unhealthy air quality as smoke from wildfires settled across the U.S. throughout the summer.

Inside the home, adopting highly efficient electric heat pumps can protect residents from poor air quality driven by climate change by filtering outdoor air more effectively than an older existing system.

[15] Based on estimates of premature death and emissions cited in this fact sheet, & using EPA Value of Statistical Life & Interagency Working Group Social Cost of Carbon (3% discount rate).

[16] Greenhouse gas emissions data from MDE and household fuel use data from 2020 American Community Survey.

Maryland's aging buildings, often drafty and outdated, weren't built for today's climate, nor for the climate to come. Upgrading Maryland's buildings to highly efficient heat pumps, paired with energy efficiency measures such as increased insulation, can ensure existing homes are more resilient against warming temperatures. This transition to more climate-ready homes can also protect Maryland's electric grid by reducing strain during periods of peak demand.

Section 3: Heat pumps are a superior choice that can provide affordable, reliable clean heating and cooling.

Source: Getty images
An HVAC worker installs a heat pump

Heat pumps are the superior heating and cooling option for Maryland homes.

Heat pumps are two-way heating and cooling systems that pump hot air out in the summer, cooling indoor spaces, and pump hot air indoors in the winter, keeping homes warm. The latest heat pumps are a highly efficient, advanced technology, outperforming even top-of-the-line central air conditioners (ACs) and gas furnaces. In fact, heat pumps are two to four times more efficient than fossil fuel equipment or traditional electric resistance heating.

Thanks to their superior technology and high efficiency, heat pumps have received certification and Most Efficient recognition by ENERGY STAR™, the widely popular program that ensures Americans save money by adopting the most efficient technology available. In 2023, the

Department of Energy proposed sunsetting the certification pathway to the ENERGY STAR label for central ACs in favor of heat pumps because of their greatly improved performance.

Heat pumps can also withstand even the coldest Maryland winters. Thanks to increased demand and technology innovations resulting from the U.S. Department of Energy's Cold Climate Heat Pump Technology Challenge, residents can access cold climate heat pumps that can perform as low as minus 22 degrees Fahrenheit without the need for back-up heating.

What is an electric heat pump?

Electric heat pump equipment exists for both space heating and water heating (commonly referred to as "heat pump" for space heating and "heat pump water heater" for water heating). In 2022, heat pump sales surpassed gas furnace sales for the first time, and this trend is likely to continue in the future.

Heat pump technology works by transferring heat from one place to another. In heating mode, the heat pump extracts heat from the outside air (even in cold temperatures) and transfers it indoors to warm the space. In cooling mode, the process is reversed, and heat is taken from the indoor air and expelled outside, effectively cooling the indoor environment. This is similar to how our refrigerators cool our food.

Across the country, heat pumps and heat pump water heaters are rapidly becoming the preferred heating equipment due to their incredible efficiency — two to four times more efficient than gas water heaters and gas furnaces.

There are several types of heat pumps.

Heat pumps to replace traditional heating equipment:

Air-Source Heat Pump (ASHP): Extracts heat from the outdoor air and transfers it indoors for heating purposes. ASHPs can also reverse their operation to provide cooling by extracting heat from indoor air and releasing it outside. They are relatively easy to install and cost-effective, making them a popular choice for residential and commercial applications, especially in more temperate climate zones.

Ground-Source Heat Pump (GSHP) or Geothermal Heat Pump: GSHPs use the relatively stable temperature of the ground or groundwater as a heat source in the winter and a heat sink in the summer. However, they require

more extensive installation involving buried pipes (ground loops) in the ground, which can make them more expensive initially.

Ducted Heat Pumps: Heat pumps can be categorized based on their distribution systems. Ducted heat pumps use a network of ducts to distribute heated or cooled air throughout a building. Ground source heat pumps are ducted and air source heat pumps may be ducted.

Ductless Mini-Split Heat Pump: This type of air source heat pump is ductless and consists of an outdoor unit (compressor/condenser) and one or more indoor units (evaporators). They are ideal for heating or cooling individual rooms or zones in homes where ductwork is not feasible or desired.

Packaged Rooftop Unit (RTU): This type of air source heat pump can be used for commercial buildings. This HVAC system sits on a building's rooftop and connects to ductwork to provide heating and cooling.

Packaged Terminal Heat Pump (PTHP): This is a ductless air source heat pump that is usually used in multifamily and commercial buildings. PTHPs are a decentralized system of single units often found below windows.

Heat pump water heaters to replace traditional water heaters:

Unitary heat pump water heater (240-volt): This is a common option for single family homes, as it offers a 50 to 100 gallon storage tank with an integrated heat pump.

"Plug-in" unitary heat pump water heater (120-volt): This emerging technology offers an easy replacement option for homes by plugging in to a standard outlet. This can benefit residents who have limited panel capacity for a 240-voltage unitary system by avoiding the need for an electrical panel upgrade. Four manufacturers are offering or developing 120-volt heat pump water heaters.

Central heat pump water heater: This refers to a centrally located water heating system often used for multifamily and commercial buildings.

Heat pumps can increase affordability by reducing monthly energy bills.

Highly efficient electric heat pumps can replace both central ACs and fossil fuel heating, putting money back in people's pockets in the form of reduced monthly energy bills. In Maryland, 98% of households would have lower operational costs with an air source heat pump compared to a high-efficiency gas furnace. As the cost of methane gas is expected to triple in the next 20 years, the median low-income household is expected to save $373 a year more when using a heat pump instead of a gas furnace.

HEEHRA Rebate Levels
For Qualified Electrification Projects

Income Eligibility and % Costs Covered	
Low-income: <80% Area Median Income (AMI) % costs covered (including installation)	**100%**
Moderate-income: 80-150% AMI % costs covered (including installation)	**50%**
Overall Incentives	
Max consumer rebate	**$14,000**
Max contractor rebate	**$500**
Rebates for Qualified Electrification Projects	
Heat pump HVAC	**$8,000**
Heat pump water heater	**$1,750**
Electric stove/cooktop	**$840**
Heat pump clothes dryer	**$840**
Breaker box	**$4,000**
Electric wiring	**$2,500**
Weatherization insulation, air sealing, ventilation	**$1,600**

Source: Rewiring America

Income-eligible rebates from The High-Efficiency Electric Home Rebate Act (HEEHRA)

Starting in 2024, Maryland households will be able to access incentives through the federal Inflation Reduction Act (IRA) that will cover up to 100% of electrification project costs for low-income households and 50% of costs for moderate-income households. The IRA also offers tax credits for residents and commercial building owners that make heat pumps more affordable for all homes and businesses.

Weatherization is key to delivering the grid and cost savings benefits of heat pumps for low-income households.

Low-income households make up 20% of all households in Maryland, or approximately 450,000 homes. These households are more likely to live in draftier homes and may need support to upgrade to zero-emission equipment.

In order to maximize the benefits of heat pumps, Maryland state leaders must take advantage of more than $2 billion in funding from the Inflation Reduction Act and other programs available for whole-home upgrades and ensure no one is left behind in the transition to zero-emission equipment. This includes funding for health and safety repairs, insulation and weatherization upgrades, remediation of health hazards such as mold and lead and adoption of zero-emission equipment.

Maryland is already a regional leader in heat pump adoption.

More than a quarter of the state's 2.28 million homes already rely on highly efficient electric heat pumps, and 54% of Maryland homes are already on pace to adopt heat pumps by 2030. If every homeowner in search of a central AC instead adopts a highly efficient heat pump, the rate of adoption could accelerate to 73% by 2030.

While this is a great start, there will still be a gap between heat pump adoption and heat pump sales targets without policy intervention. The state must also ensure that all households, no matter income levels, can adopt these efficient technologies. Maryland will need to accelerate the adoption of heat pumps if it hopes to meet its ambitious state targets, transitioning 95% of HVAC and water heater sales to be heat pumps by 2030.

Section 4: Maryland environmental regulators have the legal authority and obligation to reduce pollution from buildings.

Maryland has an obligation to reduce pollution from buildings.

Maryland must substantially reduce emissions from residential and commercial buildings in order to meet the state's commitment to reduce greenhouse gas emissions 60% from 2006 levels by 2031. Maryland can jumpstart the transition to heat pumps and accelerate the Moore administration's ambitious climate goals by adopting zero-pollution standards for furnaces and water heaters.

Air quality equipment standards for HVACs and water heaters are "**critical, not only to achieving environmental goals but to create healthier homes**," according to MDE's 2023 Maryland Climate Pathway report.

The Maryland Commission on Climate Change recommended that MDE develop air quality equipment standards for residential and commercial HVACs and water heaters as a necessary step to achieve state climate goals. These standards require any furnace or water heater sold, purchased or installed after a certain date to be free of pollution. Importantly, the standards target a critical decision point when existing equipment needs replacement or a new construction project is being built, which is the most cost-effective time to electrify. It also helps avoid installing equipment that would lock in decades of pollution over its 10 to 20 year life span. Given the long lifetime of equipment, these standards would catalyze a gradual transition toward clean alternatives like heat pumps as existing equipment reaches the end of its useful life.

In addition to climate benefits, zero-emission HVACs and water heater rules would help the state stay on track to meet federal ozone standards. In March, Maryland filed a State Implementation Plan stating it is on track to meet federal ozone standards for the Baltimore metro area. However, the state does not yet have a substantial plan to reduce NO_x emissions from buildings, and it will need to continue to demonstrate its attainment with federal ozone limits.

By pursuing a structured phaseout of non-essential emissions-producing equipment by 2030, Maryland can eliminate a major source of NO_x emissions, alleviating ozone formation and helping the Baltimore region maintain attainment with federal ozone standards. Eliminating NO_x pollution from buildings will also improve public health, saving residents billions of dollars in lost work days and preventing chronic health conditions and premature deaths.

MDE can model air quality equipment standards on examples set in other states, including zero-NO_x appliance standards adopted by the San Francisco Bay Area's air regulator in March 2023 and the zero-emission standards under development at the California Air Resources Board.

MDE has the legal authority to pursue air quality standards.

As the state's air quality and climate regulator, MDE has authority to require reduced emissions from space and water heating equipment. The federal Clean Air Act expressly preserves states' authority to enact standards governing the emissions of outdoor air pollutants, which includes the authority to enact zero-emission standards on HVACs and water heaters. MDE should use this regulatory authority to protect Marylanders from these significant sources of dangerous air pollution.

Maryland law also explicitly authorizes MDE to regulate air pollution, including the carbon dioxide and NO_x emitted by fossil fuel equipment in buildings.[17] Pursuing emissions standards for new space and water heaters that take effect as early as 2027 is a key measure that can both help Maryland comply with its climate laws, including the Climate Solution Now Act's mandated 60% greenhouse gas emission reductions by 2031, and with federal air quality standards for ozone.

The federal Clean Air Act grants states broad authority to identify and enact regulations that limit pollution from stationary sources, and some states have already exercised this authority to limit pollution from space and water heaters. Indeed, states like Texas have had a low-NO_x standard on the books for more than 20 years.

- **Texas:**

  First adopted rules in 2000 requiring new water heaters, small boilers, and process heaters statewide to meet specific NO_x emission limits as part of the state's plan for meeting federal air quality standards for ozone.

- **Utah:**

  Air regulators voted in 2015 to adopt a ultra-low NO_x standard for water heaters, which went into effect in 2017.

[17] Md. Code Ann., Envir. §§ 2-1201; 2-301(a)(1); 2-302(c)(1).

- **California:**

  Multiple regional regulators have adopted low-NO_x and ultra-low-NO_x space heater and water heater standards, dating back to as early as 1978.

- **Colorado:**

  In 2023, Colorado passed a bill enacting low-NO_x limits for space and water heaters that will take effect in 2026.

As states continue to identify new strategies to meet federal air quality standards and support their climate targets, a growing number of regulators have adopted or are considering zero-pollution standards.

- **San Francisco Bay Area:**

  Adopted the nation's first zero-pollution standard for space and water heating in March 2023. The new rules tackle pollution from gas water heaters and furnaces, which are responsible for more nitrogen oxide pollution than all passenger vehicles in the Bay Area combined.

  Regulators estimate that implementation of the rule will prevent 15,000 asthma attacks and avoid up to 85 premature deaths every year due to improvements in air quality. The standard will take effect in 2027 for residential water heaters, 2029 for residential furnaces, and 2031 for multifamily and commercial water heaters.

- **California:**

  Committed to zero-pollution space and water heater standards by 2030 in its 2022 ozone SIP, recognizing these standards as an important control measure to achieve ozone reductions. In May of 2023, the agency kicked off development of statewide zero-emission standards.

- **Colorado:**

  Committed to further strengthening its low-NO_x requirements by 2030 to meet state climate and air quality goals.

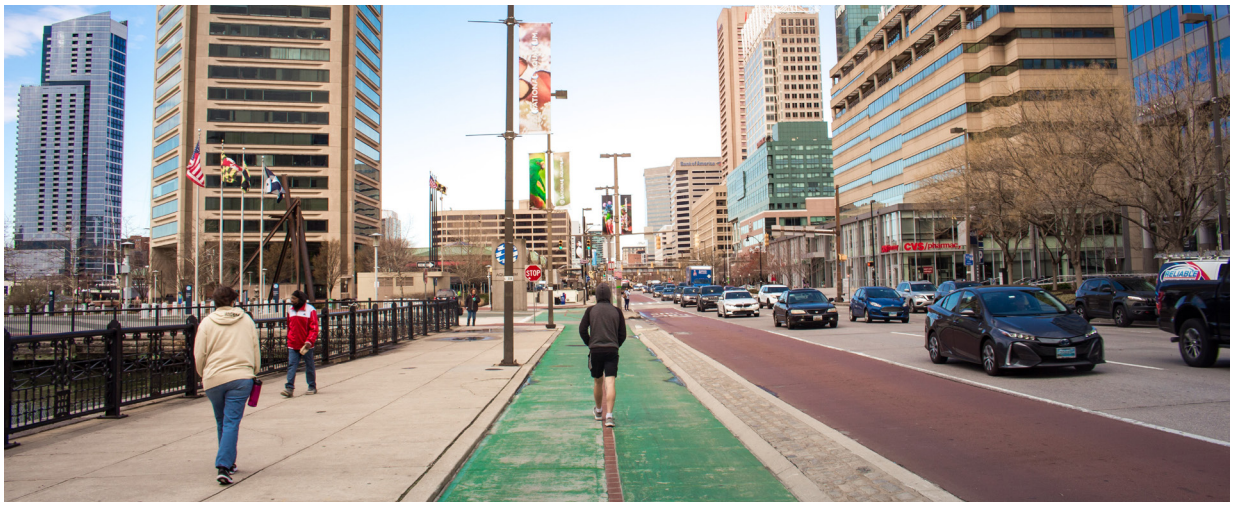
Air quality equipment standards for HVACs and water heaters should be part of a suite of equity-focused policies.

Air quality equipment standards should be part of a suite of policies that set Maryland on a path to equitably transition the state's homes toward clean, healthy, affordable housing. Standards are a key piece of the solution because they set a clear date for the transition, but they should be bolstered by other equity-focused policies that take effect before 2027 such as whole-home retrofit programs to ensure households in need of repair before adopting zero-emission equipment are not deferred from energy services. By approaching standards as part of a broader equitable building decarbonization effort, Maryland can help create a glide path to equitable and affordable implementation starting in 2027.

Maryland is already supporting equity and affordability of heat pumps and energy efficiency for low-income households through a variety of programs such as the Maryland PACE program, EmPOWER Maryland, and various energy efficiency and weatherization programs housed within the Department of Housing and Community Development (DHCD). In addition, Gov. Wes Moore recently launched a comprehensive energy efficiency retrofits pilot program, providing the repairs necessary to proceed with home upgrades deferred for health and safety reasons. This program addresses historic inequities by requiring that more EmPOWER energy efficiency program funds are spent in low-income homes while establishing a more holistic approach to meeting the needs of the state's under-resourced communities, increasing housing intervention program effectiveness in the process.

Yet, there is substantially more the state can and must do before 2027 to ensure the success of the transition for low-income residents.

- To start, Maryland should establish a clear building decarbonization goal for 2030 with interim targets, including specific goals for low- to moderate-income homes.



Downtown Baltimore, MD

- Second, the state should fully enact and scale a whole-home initiative that delivers integrated housing interventions and aligns, braids, and coordinates resources that prioritize electrification and the health of residents through housing improvements. Whole-home upgrades include health and safety repairs, insulation and weatherization upgrades, remediation of health hazards such as mold and lead, and adoption of zero-emission equipment. A successful whole-home upgrade initiative will require adequate funding, and the state must fully leverage federal resources while also committing resources of its own.
- Third, lawmakers must go beyond Gov. Moore's efforts to improve EmPOWER Maryland by overhauling the program to equitably serve low-income ratepayers and align with the state's climate goals. These updates should include requiring at least 40% of EmPOWER funds to be directed to whole-home retrofits in low-income communities, allowing and encouraging fuel-switching from fossil fuels to electric appliances, and phasing out existing subsidies for gas appliances.
- Fourth, the Public Service Commission (PSC) must begin long-term utility planning to manage the transition of Maryland's buildings sector away from fossil fuels and reduce energy burdens for residents and business owners.
- Finally, all of this work should be coupled with educational initiatives to ensure consumers are making informed decisions and that contractors receive training in this fast-growing sector.

Policies that deliver cleaner air can result in dramatic Medicaid savings

By pursuing air quality standards alongside targeted policies to address common asthma triggers or health hazards in homes in need of repairs, Maryland can achieve significant cost savings by lowering the rate of asthma-related ER visits and hospitalizations.

In demonstration projects conducted by Green & Healthy Homes Initiative, hospitalization rates decreased by as much as 66% and Medicaid costs per patient dropped on average of $2,959 per patient after receiving asthma-related healthy homes services that were integrated with weatherization, energy efficiency interventions, and in some cases swapping out fossil fuel equipment with electric alternatives.

Maryland can catalyze a vibrant, competitive, pollution-free equipment market by making a commitment to air quality standards for HVACs and water heaters.

While MDE may not have authority to enact every complementary policy, it can play a crucial role in advancing them by developing zero-emission air quality standards as soon as possible. This would send a strong and immediate signal to market actors to prepare for the transition to pollution-free building equipment.

Committing to zero-emission air quality standards can move the market forward by ensuring manufacturers know that there will be steady, increased demand for pollution-free electric HVACs and water heaters. This market signal, paired with the availability of federal incentives for low- to moderate-income households through the Inflation Reduction Act, will ramp up both sales and manufacturing, moving the supply chain forward and ultimately lowering the cost of new equipment for consumers.

The standards also increase the urgency for equity and affordability protections by setting a date by which those protections must be in effect. Knowing that there is a 2027 deadline can help bring stakeholders to the table to engage on the transition plans and help accelerate the adoption of complementary solutions. The sooner the state commits to the zero-emission space and water heater standards, the better positioned it will be to equitably and affordably implement the policy.

MDE should center equity in the process and design of air quality equipment standards.

When developing the air quality standards, MDE can and should consider equity in both the process and outcomes of the policy. MDE should ensure the rulemaking for zero-emission standards provides time for a planning process centered around impacted communities and focused on facilitating an affordable transition for low-income residents. The state should collaborate early and often with environmental justice leaders, low-income residents, and other key community members that are most impacted by space and water heater pollution. MDE should also coordinate with other state agencies — including but not limited to the Maryland Energy Administration, Maryland Department of Human Services, Maryland Department of Health, Maryland Office of People's Counsel, Maryland Department of Labor's Building Codes Administration, DHCD, and the PSC – to ensure complementary policies are enacted to deliver an affordable, equitable transition toward zero-emission HVACs and water heaters.

The rulemaking should also consider key equity design elements for the standards to help the state move toward equitable outcomes. For example, the state could consider a rule that requires a certain percentage of space and water heater sales to be zero-emission, ramping up over time to meet 100% in 2030 (e.g., 25% of sales are zero-emission in 2027, 50% in 2028, 75% in 2029, 100% in 2030). Such a standard could align sales targets with a ramp-up of investments

and programs for equitable electrification. Maryland could also look to the Bay Area's zero-NO_x rules for equity design elements. The Bay Area includes a "checkpoint" for equity review two years before its zero-NO_x regulations go into effect to ensure communities aren't left behind. The Bay Area rules also commit regulators to hosting an ongoing implementation working group with diverse stakeholders to help address equity and affordability for the rules.

Additionally, the state should consider a whole-home retrofit and electrification approach in which a variety of housing needs and upgrades are addressed through a streamlined program. This would ensure that existing conditions in the home do not exclude impacted low-income households from receiving energy services.

Conclusion

The buildings in which we live, work, and play are intrinsically linked to our health and wellbeing. Millions of Maryland residents have lived in communities with dangerous levels of air pollution that far exceed federal air quality standards, with 60% of health impacts from this pollution arising from the Baltimore metro area.[18] Low-income communities and communities of color have historically suffered from disproportionately higher unhealthy air quality, contributing to higher rates of asthma and other chronic health impacts. While Maryland environmental regulators have made strides to alleviate smog by reducing nitrogen oxides (NO_x) emissions from industrial and transportation sources, NO_x pollution from burning fossil fuels in homes and businesses has remained stubbornly high.

The Moore administration has made it a priority to pursue ambitious climate targets as well as policies that ensure low- and moderate-income Marylanders are not left behind in the transition toward clean energy. By pursuing an air quality equipment standard for HVACs and water heaters, Gov. Moore can establish Maryland as a national leader, drastically reducing emissions from buildings while investing in complementary policies that help low- and moderate-income households access programs for whole-home upgrades and weatherization to reap the full benefits of all-electric equipment.

Establishing an implementation timeline starting in 2027 and ramping up to full implementation by 2030 can also help residents take advantage of federal incentives to lower the cost of highly efficient, zero-emission alternatives such as heat pumps — and prepare both the equipment

[18] Emissions data from EPA 2020 National Emissions Inventory; see note 1.

marketplace and HVAC, plumbing, and home repair professionals for the fast-growing demand for all-electric alternatives. This approach would provide a cost-effective strategy for current residents to upgrade to heat pumps regardless of when existing fossil fuel equipment burns out.

Maryland is already a regional leader in zero-emission equipment adoption, with more than 50% of households in the state expected to adopt heat pumps by 2030. The policy intervention discussed here would accelerate market mechanisms already at work, while ensuring that low-income residents are the first to benefit from the health and climate resilience advantages of efficient, all-electric homes that can run on 100% renewable energy.

Credits

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