2024

OREGON'S HIDDEN AIR POLLUTION PROBLEM: FOSSIL FUELS IN BUILDINGS

HOW STATE POLICYMAKERS CAN CLEAN THE AIR, BOOST CLIMATE RESILIENCE, AND SAVE MONEY BY ADOPTING HEALTHY AIR STANDARDS FOR HVAC AND WATER HEATING EQUIPMENT

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Astoria, Oregon

EXECUTIVE SUMMARY

Burning fossil fuels such as gas and propane to heat homes and businesses generates a range of dangerous air pollutants that endanger health, including nitrogen oxides (NO_x), fine particulate matter ($PM_{2.5}$), benzene, formaldehyde, and carbon monoxide (CO). These air pollutants — also found in car exhaust — dirty the air Oregonians breathe both indoors and outside and increase the risk of health harms like asthma, cardiovascular disease, cancer, and premature death.

More than half of homes in the state burn fossil fuels for at least one end use. The vast majority — more than 80% — of the building pollution fouling Oregon's air comes from fossil fuel HVAC (heating, ventilation, and air conditioning) systems and water heaters.[1] Fossil fuel building equipment in the state's homes and businesses generates as much outdoor NO_x pollution as the state's cement manufacturing and power generation combined.[2]

While Oregon limits lung-damaging pollution from other major sectors like heavy industry and transportation, air regulators have yet to address health impacts from fossil fueled heating equipment in buildings. This policy shortcoming leads to tangible harms that disproportionately fall on low-income communities and communities of color. Burning fossil fuels in homes adds to existing concentrated pollution "hotspots," which disproportionately occur in these communities. Racial and ethnic groups are also disproportionately exposed to ozone and other criteria pollutants such as NO_x, $PM_{2.5}$, and CO.[3]

Heating equipment in buildings has an underrecognized impact on outdoor air quality. Outdoor pollution from fossil fuel powered building equipment caused an estimated 20 premature deaths in Oregon in 2017, according to data from Harvard public health researchers.[4]

Outdoor fossil fuel pollution from Oregon's homes and businesses drives health impacts pegged at almost $88 million annually.[5] When climate change damages to health, property, agriculture, infrastructure, and social stability are added to the societal costs of this building pollution, that price tag reaches a staggering $1.1 billion.[6]

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[1] U.S. Energy Information Administration (EIA), 2020 Residential Energy Consumption Survey, 2023 & 2018 Commercial Buildings Energy Consumption Survey, 2023. Breakdown of NOx emissions by end use assumes each end use's emissions are proportional to its fuel consumption. The NOx emissions for each combination of building type & fuel type are divided between end uses by the percentage of fuel used in each end use within that building/fuel type. This division is made at the smallest census region for which complete and accurate data is available.

[2] U.S. Environmental Protection Agency (EPA), 2020 National Emissions Inventory, March 2023. 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.

[3] Timothy Q. Donaghy et al., "Fossil fuel racism in the United States: How phasing out coal, oil, and gas can protect communities," *Energy Research & Social Science* 100:103104, June 2023.

[4] 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," *Environmental Research Letters* 16(5):054030, May 2021, as well as additional analysis from the study's lead author.

[5] EPA, CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA), April 2021. Analysis used selected subsectors: commercial gas, commercial oil, and residential other.

[6] Based on estimates of premature death & emissions cited in this report, & using EPA's Value of Statistical Life (September 2023) & latest Social Cost of Carbon (November 2023, 2% discount rate).

Salem, Oregon

Gas-fueled building equipment contributes significantly to Multnomah County's air pollution as well, generating three-fourths as much NO_x pollution as comes from gas power plants across the entire state.[7] Gas heating equipment is the second-largest source of NO_x pollution in the county, behind cars and trucks.

Fortunately, Oregon regulators can reduce pollution from fossil fuel HVAC and water heating equipment by adopting healthy air standards for heating equipment that gradually transition homes and businesses to clean alternatives, including highly efficient and zero-emission electric heat pumps. Heat pump technologies can provide space heating and water heating in buildings without generating any air pollution from onsite fossil fuel combustion, and the same device can cool the building as well — something that is increasingly critical in a warming climate.

A growing number of regulators across the country are considering or pursuing zero-emission healthy air standards for space and water heating equipment, and the Bay Area Air Quality Management District has already adopted them. These standards ensure newly purchased and installed HVAC systems and water heaters are pollution-free, whether being used for new construction or to replace an old fossil fuel furnace or water heater.

Late last year, Oregon Governor Tina Kotek joined nine other states in committing to explore the adoption of zero-emission standards for space and water heating equipment as part of a series of climate pledges from the bipartisan coalition of 25 governors known as the U.S. Climate Alliance. In February 2024, Oregon joined eight other states in another agreement to ensure 65% of residential HVAC and water heater sales are heat pumps by 2030 and 90% by 2040.

Governor Kotek can uphold her commitments by directing the Oregon Department of Environmental Quality (DEQ) to pursue healthy air standards that will gradually transition homes and businesses in the state to zero-pollution alternatives like heat pumps.

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[7] EPA, 2020 National Emissions Inventory. See note 2.

Many Oregon households may be able to save on energy bills by upgrading to highly efficient heat pumps for space and water heating. A typical new home with heat pumps in the state will save $390 on utilities each year compared to homes that burn gas,[8] and a rapid transition to electric heat pumps in the state's homes and businesses could unlock more than $1 billion in system-wide savings by 2050.[9]

KEY FINDINGS

- Burning fossil fuels in Oregon's homes and businesses releases more than 4,000 tons of harmful NO_x emissions into the outdoor environment each year — as much as the state's power generation and cement manufacturing combined.[10]
- Gas-fueled equipment in Multnomah County's buildings alone generates three-fourths as much NO_x pollution as comes from gas power plants across the entire state.
- Fossil fuel equipment in Oregon homes and businesses releases as much climate pollution as 1.1 million passenger cars,[11, 12] more than are registered in Multnomah and Washington Counties combined.
- Outdoor pollution from fossil-fueled equipment in buildings caused an estimated 20 premature deaths in Oregon in 2017, according to data from Harvard public health researchers.[13] This pollution is also responsible for approximately 250 cases of respiratory illness and 450 work loss days per year, with total health impacts costing almost $88 million annually, according to analysis using the U.S. Environmental Protection Agency's (EPA) Co-Benefits Risk Assessment tool.[14]
- Taking into account the climate damages from burning fossil fuels in homes and businesses, in addition to the health harms, leads to an even larger societal cost: a staggering $1.1 billion annually.[15]
- DEQ can address building pollution and facilitate a smooth, equitable transition to pollution-free homes and businesses by gradually phasing in healthy air standards for HVAC and water heating equipment.

[8] RMI, "All-Electric Construction: A Good Deal for Oregon," 2023.

[9] Kenji Takahashi et al, *Toward Net Zero Emissions from Oregon Buildings: Emissions and Cost Analysis of Efficient Electrification Scenarios*, June 2022.

[10] EPA, 2020 National Emissions Inventory. See note 2.

[11] EIA, "Energy-Related CO_2 Emission Data Tables – Sectoral specific emission tables by state," July 2023.

[12] EPA, "Greenhouse Gas Equivalencies Calculator," 2024.

[13] 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," *Environmental Research Letters* 16(5):054030, May 2021, as well as additional analysis from the study's lead author.

[14] EPA, CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA). See note 5.

[15] Based on estimates of premature death & emissions cited in this report, & using EPA's Value of Statistical Life (September 2023) & latest Social Cost of Carbon (November 2023, 2% discount rate).

SECTION ONE: FOSSIL FUEL HEATING EQUIPMENT CONTRIBUTES TO OREGON'S AIR POLLUTION PROBLEM

Burning fossil fuels in space and water heating equipment is an underrecognized source of pollution in Oregon that has led to poor air quality and disproportionate health burdens falling on communities of color. Oregon must work to reduce pollution from buildings to protect the health and safety of its residents.

More than 41% of Oregon homes burn fossil fuels like gas, propane, and oil for space heating, while at least 33% burn fossil fuels for water heating. In total, 49% of the state's housing units burn gas for one or more uses, with an additional 7% using propane and around 1% combusting oil in the home.

Fossil fueled equipment in Oregon's homes and businesses generates as much outdoor air pollution from nitrogen oxides (NO_x) as the state's cement manufacturing and power generation combined.[16] Outdoor pollution from fossil fueled equipment in buildings caused an estimated 20 premature deaths in Oregon in 2017, according to data from Harvard public health researchers.[17] This pollution is also responsible for approximately 250 cases of respiratory symptoms — including acute bronchitis, episodes of upper and lower respiratory symptoms, and youth asthma exacerbations — and 450 work loss days per year.[18]

The total health impacts from fossil fuel building equipment are valued at almost $88 million annually, according to analysis using the United States Environmental Protection Agency's (EPA) Co-Benefits Risk Assessment tool.[19] Adding the climate damages to health, property, agriculture, infrastructure, and social stability from burning fossil fuels in homes and businesses to the direct health costs leads to an even larger societal price: a staggering $1.1 billion annually.[20]

Salem, Oregon

[16] EPA, 2020 National Emissions Inventory. See note 2.

[17] 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," *Environmental Research Letters* 16(5):054030, May 2021, as well as additional analysis from the study's lead author.

[18] EPA, CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA). See note 5.

[19] EPA, CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA). See note 5.

[20] Based on estimates of premature death & emissions cited in this report, & using EPA's Value of Statistical Life (September 2023) & latest Social Cost of Carbon (November 2023, 2% discount rate).

FOSSIL FUEL BUILDING EQUIPMENT RELEASES HEALTH-HARMING POLLUTION

The combustion of fossil fuels like gas and propane in building equipment generates the following air pollutants linked to poor health outcomes:

Nitrogen oxide pollution (NO_x):

- The EPA has determined that short term exposure to NO_x is causal of asthma attacks and long-term exposure is "likely causal" of the development of asthma.[21] Short-term exposure to nitrogen dioxide (NO_2, a component of NO_x), as well as long-term exposure to low levels of NO_2, is correlated with higher overall mortality rates among older adults.[22]
- A causal link between short- and long-term exposure to NO_2 and a variety of other health harms, such as heart rate variability, systemic inflammation of other organs, adverse birth outcomes, cancer, and premature death has also been cited by EPA and Health Canada in their risk assessments for NO_2.[23, 24]
- Reducing ambient NO_2 has been shown to decrease asthma rates. In a longitudinal study over 20 years of more than 4,000 children, improving pollution controls on cars was shown to decrease childhood asthma rates in tandem with lowered levels of ambient NO_2. "Each 4.3–parts-per-billion decrease in NO_2 was associated with a reduction of 0.83 cases per 100 person-years in asthma incidence."[25]
- U.S. residents living in counties with higher levels of long-term NO_2 pollution were found to be more likely to die of COVID-19 in a peer-reviewed study. The study found that a small reduction of 4.6 parts per billion of NO_2 would have prevented 14,762 COVID deaths in the U.S. as of July 2020.[26]

Ozone:

- NO_x is also a precursor to ozone pollution (a major component of smog), created by chemical reactions with volatile organic compounds (VOCs) in the presence of sunlight. Immediate problems — in addition to increased risk of premature death — include shortness of breath, wheezing and coughing, asthma attacks, increased risk of respiratory infections, and increased risk of emergency room visits and hospitalizations, especially among those with underlying chronic respiratory illnesses.
- Long-term ozone exposure is associated with increased respiratory illnesses, metabolic disorders, nervous system issues, reproductive issues (including reduced male and female fertility and poor birth outcomes), cancer, and also increased cardiovascular mortality, which is the main driver of total mortality.

Fine particulate matter ($PM_{2.5}$) contributes to premature death, decreased lung function, increased hospital admissions for cardiovascular disease, increased risk of stroke, higher likelihood of children developing asthma, and possibly increased risk of dementia.[27]

Formaldehyde contributes to eye, nose, and throat irritation at low levels and is a known carcinogen.

Carbon monoxide (CO): Breathing CO reduces the amount of oxygen that can be transported in the bloodstream to vital organs like the heart and brain. CO poisoning can be deadly, and even breathing low levels of CO can cause headache, nausea, dizziness, weakness, confusion, and disorientation. Prolonged exposure to low levels can cause permanent mental and physical problems, including increased symptoms of angina in those with underlying coronary artery disease.

Benzene is recognized by the EPA as a known human carcinogen and the World Health Organization states that "no safe level of exposure can be recommended." Benzene exposure increases the risk of cancers and other disorders of the blood system.

A 2022 report from the Multnomah County Department of Health found significant threats posed by the continued use of fossil fuels in buildings, recommending against combustion appliances "to protect public health, improve indoor and outdoor air, reduce emissions and mitigate climate change."

Many populations within the state routinely breathe unhealthy levels of air pollution. NO_x pollution from fossil fuel heating systems and water heaters can contribute to the formation of both ozone and $PM_{2.5}$ through a series of chemical reactions in the atmosphere, and pollution from this equipment compounds the air quality risks communities already suffer from other sources, such as cars and trucks, wood-burning stoves and fireplaces, and industrial activity.

[21] EPA, Integrated Science Assessment (ISA) for Oxides of Nitrogen – *Health Criteria*, January 2016.

[22] Yaoyao Qian et al., "Long-term exposure to low-level NO_2 and mortality among the elderly population in the southeastern United States," *Environmental Health Perspectives* 129(12):127009, December 2021.

[23] EPA, *Integrated Science Assessment (ISA) for Oxides of Nitrogen – Health Criteria*, January 2016.

[24] Health Canada, *Human Health Risk Assessment for Ambient Nitrogen Dioxide*, May 2016.

[25] Erika Garcia et al., "Association of Changes in Air Quality With Incident Asthma in Children in California, 1993-2014," *JAMA* 321(19):1906-1915, May 2019.

[26] Donghai Liang et al., "Urban Air Pollution May Enhance COVID-19 Case-Fatality and Mortality Rates in the United States," *The Innovation* 1(3):100047, September 2020.

[27] Elissa H. Wilker et al., "Ambient air pollution and clinical dementia: systematic review and meta-analysis," *BMJ* 381(8378):e071620, April 2023.

Five counties in the state — Harney, Jackson, Klamath, Lake, and Lane — received an "F" grade for particle pollution in the American Lung Association's (ALA) 2023 State of the Air report, and two counties, Crook and Josephine, received a "D" grade. Two more counties, Multnomah and Washington, received a "C" grade on particle pollution from the ALA.

On February 7, 2024, the EPA announced a final rule to strengthen the nation's National Ambient Air Quality Standards for $PM_{2.5}$, which will require Oregon to adopt new pollution reduction measures. EPA is setting the level of the primary health-based annual $PM_{2.5}$ standard at 9.0 micrograms per cubic meter to reflect new science on harms caused by fine particle pollution. Crook, Harney, Jackson, Klamath, and Lane Counties do not currently meet the new annual standard, and the Oregon Department of Environmental Quality (DEQ) will be required by the Clean Air Act to develop and implement new control measures to reduce $PM_{2.5}$ pollution.

Oregon counties also breathe unhealthy levels of ozone pollution. According to ALA, Jackson and Clackamas counties received a "C" grade for ozone pollution.

Health impacts from unhealthy levels of $PM_{2.5}$ and ozone are disproportionately borne by low-income communities and Black, Indigenous, and other people of color (BIPOC). In the United States, people of color are 64% more likely than white people to live in a county with a failing grade for air pollution from the American Lung Association.

People of color in the U.S. are also exposed to more pollution from fossil fuel heating equipment specifically. In a recent multi-institutional study, residential gas combustion was linked to the most disproportionate $PM_{2.5}$ exposure to people of color of any source examined.[28]

These disparities in exposure to multiple air pollutants are evident in Oregon as well. Black Oregonians are exposed to nearly twice the $PM_{2.5}$ pollution from residential gas combustion as white residents.[29]

In addition to significant discrepancies between counties in exposure to dangerous air pollution, neighborhood-level differences in pollution levels within cities are also prevalent and disproportionately impact communities of color.[30] In Multnomah County, for example, county data suggest that impacts from outdoor air pollution are unequally distributed across communities.[31]

Air regulators must continue their vital work cutting pollution until all communities — and not just higher-income and predominantly white communities — have access to healthy air.

[28] Christopher W. Tessum et al., "$PM_{2.5}$ polluters disproportionately and systemically affect people of color in the United States," *Science Advances* 7(18), April 2021, Figure 1G.

[29] Christopher W. Tessum et al., "$PM_{2.5}$ polluters disproportionately and systemically affect people of color in the United States," *Science Advances* 7(18), April 2021, Supplementary Data File S2. Oregonians of color are exposed to 1.2 times as much $PM_{2.5}$ from residential gas appliances as white residents, & Black Oregonians' exposure is 1.9 times as high as white residents'.

[30] See, e.g., the EPA EJScreen analysis of Multnomah County described in Section Four of this report.

[31] Multnomah County Health Department, *2014 Report Card on Racial and Ethnic Disparities*, December 2014.

CARBON MONOXIDE POISONING FROM GAS HEATING EQUIPMENT

Malfunctioning gas heating equipment and improper venting of devices exposes far too many Americans to dangerous levels of carbon monoxide — a colorless, odorless, and tasteless gas that is toxic for humans.

CO poisoning can occur when gas heating equipment does not burn its fuel completely, often due to a malfunctioning burner or insufficient oxygen supply. Symptoms may include headache, dizziness, nausea, confusion, shortness of breath, weakness, and in severe cases, loss of consciousness and death.

Accidental CO poisoning deaths are on the rise.[32] At least 543 people in the U.S. died unintentionally from non-fire-related carbon monoxide exposure in 2021, up from 393 in 2015, according to an analysis of the most recently available data from the Centers for Disease Control and Prevention (CDC) and the National Center for Health Statistics. That's the sharpest increase in more than 40 years.

CO poisoning is serious even when it's not fatal, and it's often misdiagnosed and mistaken for other illnesses such as the flu. The CDC **found** that an average of 20,636 emergency department visits for nonfatal, unintentional, non-fire-related carbon monoxide exposures occurred each year from 2004 to 2006. More than 70% of these exposures occurred in homes, and 41% occurred between December and February, suggesting a disproportionate link between dangerous exposure and residential heating.

[32] Neil B. Hampson, "Carbon monoxide poisoning mortality in the United States from 2015–2021," *Clinical Toxicology* 61(7):483-491, August 2023.

SECTION TWO: TRANSITIONING TO ELECTRIC EQUIPMENT CAN REDUCE CLIMATE POLLUTION, SAVE RESIDENTS MONEY, & IMPROVE RESILIENCE TO EXTREME HEAT

In addition to dirtying Oregon's air, burning fossil fuels in homes and businesses is also a key driver of climate-warming carbon pollution. The state's fossil fuel HVAC (heating, ventilation, and air conditioning) and water heating equipment is responsible for more than five million metric tons of greenhouse gas emissions annually — more than the state's entire industrial sector emits.[33, 34]

Oregon cannot meet its climate targets without addressing the carbon pollution from combustion in buildings.[35] While the state has made progress in reducing emissions from other sectors, emissions from the building sector have remained fairly flat over the past two decades.[36, 37] And in the last five years, utilities in Oregon have extended gas service to more than 56,000 additional customers.[38]

Fortunately, a rapid transition to highly efficient electric heat pumps provides a clear pathway for policymakers to tackle planet-warming pollution from homes and businesses. Replacing a gas furnace with a heat pump eliminates direct emissions from building combustion. Even after accounting for the upstream emissions associated with electricity generation, which will only decrease each year as the grid gets cleaner, a switch to heat pumps could cut climate pollution from the average Oregon home by 41% in the first year and a stunning 84% over the lifetime of the equipment, according to analysis from RMI.

Implementing a zero-emission standard for space and water heating equipment could rapidly reduce planet-warming emissions, according to a report from Synapse Energy Economics. Ensuring only pollution-free HVACs and water heaters are installed in Oregon homes starting in 2030 could cut climate pollution from homes by 47% by 2035 and just shy of 100% by 2050, while reducing the state's overall energy costs.

ECONOMIC BENEFITS FROM UPGRADING TO HEAT PUMPS

Many Oregon households may be able to save on energy bills by upgrading to highly efficient heat pumps for space and water heating.

For new homes, building with electric equipment both saves money on long-term utility bills and reduces upfront construction costs. A single family home with electric equipment costs $1,600 less to construct in

[33] EIA, "Energy-Related CO_2 Emission Data Tables – Sectoral specific emission tables by state," July 2023.

[34] Oregon Department of Environmental Quality (DEQ), "Oregon Greenhouse Gas Sector-Based Inventory Data," 2023.

[35] Oregon Global Warming Commission, "Oregon Climate Action Roadmap to 2030," 2023.

[36] RMI, "All-Electric Buildings: Key to Achieving Oregon's Climate Goals," 2023.

[37] RMI, "The Impact of Fossil Fuels in Buildings: A Fact Base," 2019.

[38] EIA, "Number of Natural Gas Residential Consumers," January 2024.

Oregon than a home that burns gas, according to an analysis by RMI.[39] And a typical new home with heat pumps in the state will save $390 on utilities each year compared to homes that burn gas.[40]

An analysis from Synapse Energy Economics found that a rapid transition to electric heat pumps in the state's homes and businesses could unlock more than $1 billion in system-wide savings by 2050.[41] The report also modeled the household bill impacts in two Oregon cities — Portland and Bend — and found that households upgrading to heat pumps without an electrical panel upgrade gain $161 and $192 in annual savings, respectively.

The installation of heat pumps has also been demonstrated to increase home values by up to 7%.[42]

Economic benefits from highly efficient electric heating equipment will likely grow in the coming years as more homes transition away from gas, leaving a smaller pool of customers to shoulder the cost of maintaining the increasingly expensive gas system. According to a report from the American Council for an Energy-Efficient Economy, gas costs for individual households could increase by as much as 130% by 2030 under a high electrification scenario. Protecting low-income households, both homeowners and renters, from the risk of rapidly increasing gas bills will be essential for an equitable clean energy transition.

THE UPFRONT COST OF HEAT PUMPS IS BECOMING MORE AFFORDABLE WITH FEDERAL & STATE INCENTIVES

Oregonians will soon be able to access thousands of dollars in federal incentives for electric heat pumps, which can be stacked with state and local incentives that are already available, substantially lowering the upfront cost of upgrading to pollution-free HVAC and water heating equipment.

The federal government's new High-Efficiency Electric Home Rebate program (HEEHRA), which was created by the Inflation Reduction Act of 2022, will subsidize low-income households up to $8,000 for a new heat pump for home heating and cooling, $1,750 for a heat pump water heater, and $4,000 for a new electric panel. The program will cover 50% of the costs for moderate-income households as well. These incentives are likely to become available later this year.

Households that upgrade to air-source heat pumps can already access a capped 30% tax credit, and those that upgrade to geothermal heat pumps can access an uncapped 30% tax credit. Commercial buildings can take advantage of Inflation Reduction Act funds as well, with a $5 per square foot tax deduction based on significant efficiency improvements resulting from heat pump installation.

Federal incentives can be stacked with state programs available through the Energy Trust of Oregon and additional subsidies provided by municipalities and utilities, offering a historic opportunity for Oregonians to more affordably transition to highly efficient, zero-pollution heating equipment.

[39] RMI, "All-Electric Construction: A Good Deal for Oregon," 2023.

[40] RMI, "All-Electric Construction: A Good Deal for Oregon," 2023.

[41] Kenji Takahashi et al, *Toward Net Zero Emissions from Oregon Buildings: Emissions and Cost Analysis of Efficient Electrification Scenarios*, June 2022.

[42] Xingchi Shen et al., "Estimation of change in house sales prices in the United States after heat pump adoption," *Nature Energy* 6:30-37, October 2020.

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**

Income-eligible rebates from The High-Efficiency Electric Home Rebate Act (HEEHRA)
Source: Rewiring America

Oregon's 2023 Climate Resilience Package will support the transition to heat pumps in homes by positioning the state to leverage federal funding under the Inflation Reduction Act. The state legislature also passed SB 1536 in 2022 in order to expand access to high-efficiency cooling systems, establishing a $10 million heat pump deployment program within the Oregon Department of Energy (ODOE) and creating a $15 million rebate program for landlords who install heat pumps.

Homes and businesses can make affordable upgrades to highly efficient and pollution-free heat pumps with this range of complementary incentives. Adopting healthy air standards for HVACs and water heaters with a clear future implementation date will further support the clean heating transition by sending a strong market signal that will drive increased supply from manufacturers, bringing down unit costs, as well as increased awareness and demand from homeowners and business owners to leverage available funding sources.

WHAT IS AN ELECTRIC HEAT PUMP?

Electric heat pump equipment exists for both HVAC systems and water heating (commonly referred to as "heat pump" for space heating and "heat pump water heater" for water heating).

Heat pump technology works by transferring heat from one place to another. In heating mode, the equipment 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, cooling the indoor environment and replacing the function of traditional air conditioning. This is similar to how refrigerators operate.

Across the country, heat pumps and heat pump water heaters are rapidly becoming the preferred heating appliances due to their incredible efficiency – **two to four times** greater than fossil fuel water heaters and furnaces.

There are **several types** of heat pumps.

Heat pumps to replace furnaces and boilers:

Air-Source Heat Pump (ASHP): Extracts heat from the outdoor air and transfers it indoors for heating. ASHPs can also 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.

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. They require more extensive installation involving buried pipes (ground loops), which can make them more expensive initially than ASHPs, though they are cheaper to operate over the long run and provide the most efficient form of heating available today.

Ducted Heat Pumps: Heat pumps can also be categorized based on their distribution systems. Ducted heat pumps use common home heating ducts often found in homes with fossil fuel furnaces 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 heating 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 50-100 gallon storage tank with an integrated heat pump. Heat pump water heaters also dehumidify their surrounding area, making them a valuable addition to damp basements.

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

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

Air-Source Heat Pumps

CLIMATE RESILIENCE BENEFITS FROM UPGRADING TO HEAT PUMPS

Transitioning homes to clean energy equipment will make Oregon households more resilient in the face of the climate impacts the state is already experiencing, from blankets of wildfire smoke to severe heat waves.

Heat pumps provide some of the most efficient cooling on the market. Installing them in Oregon homes can help keep households safe during extreme heat events, such as the climate change-fueled 2021 heat dome during which temperatures across the state reached a blistering 116 degrees. According to a review of the more than 100 heat-related deaths in Portland during the event, 85% occurred in homes without air conditioning.

WHAT ABOUT WHEN THE POWER GOES OUT?

Oregon's increasingly frequent bouts of extreme weather include ice and wind storms that can impact the energy grid. While there is much to be done to strengthen electrical infrastructure to withstand these weather events, continued reliance on gas-powered heating equipment in buildings will not deliver the carbon-free resilience Oregon needs.

Most gas-powered building equipment does not function when there is an electrical outage. According to the **Oregon Citizens' Utility Board (OCUB)**, the only gas devices that can reliably function in a power outage are fireplaces and ranges. (Even these can be tricky as they often rely on an electric mechanism to create a spark.) Only a select few gas-powered water heaters can function when the power is out.

Appliance Type	Functions During Power Outage?
Gas furnace	No
Gas hot water heater	Not in most cases
Tankless gas hot water heaters	No
Gas stovetops	Yes
Gas ovens	No
Gas fireplaces	Yes

Gas system failures can also occur during cold snaps. For example, the Jackson Prairie Underground Storage Facility, a major regional gas hub in Washington, went down during a severe winter storm in January 2024. The emergency threatened access to heating for millions of Americans. This same facility also encountered problems in February 2019.[43]

[43] Puget Sound Energy, *2023 Gas Utility Integrated Resource Plan – Chapter Six: Gas Analysis*, March 2023.

As Oregon works to achieve its climate goals and transition off of fossil fuels, it is critical that the state invests significant resources into maintaining, modernizing, and hardening the electrical grid, which will become the primary energy system in the coming decades. The same cannot be said for methane gas, and it does not make sense to continue to use ratepayer dollars to make costly investments in a fossil fuel system when the state has committed to climate pollution 45% by 2035 and 80% by 2050, with the Oregon Global Warming Commission calling in 2023 for even greenhouse gas emission reduction targets.

Electrifying homes with heat pumps and other modern, energy efficient building systems can be a valuable tool in building an electricity grid that can withstand extreme weather impacts. Equipping homes that currently rely on energy-intensive resistance heating with heat pumps will reduce energy consumption and strain on the grid. And pairing electrification with other passive and energy efficient building design measures like insulation and air sealing will help keep buildings safe and habitable in the event of power outages.

Lack of adequate cooling in Oregon homes is widespread due to the state's historically mild temperatures. According to ODOE's recent Oregon Cooling Needs Study, 58% of survey respondents lacked sufficient cooling devices at home, while 84% said that they wanted to improve their cooling systems.

In addition to providing cooling currently absent in many buildings, heat pumps can also boost climate resilience by filtering the air in homes. Access to air filtration systems is especially important as Oregon's wildfire season becomes longer and more severe due to climate change, which can inundate communities with unhealthy smoke for weeks at a time. Modern heat pump systems can be outfitted with plasma filters, ionic filters, and high-efficiency particulate air (HEPA) filters to remove air pollutants from smoke and support cleaner air for Oregonians.

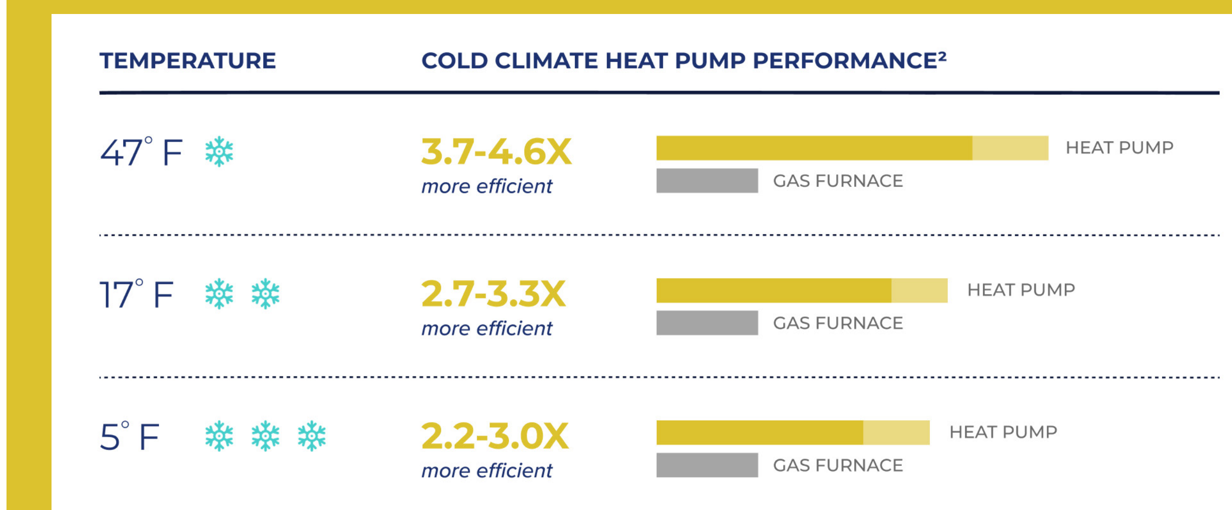
Ashland, Oregon

DO HEAT PUMPS WORK IN COLD CLIMATES?

Heat pumps can provide heating reliably across Oregon, even in sub-zero temperatures. Heat pump technology has advanced markedly in recent years, and there are now more than 100 heat pump manufacturers offering thousands of cold climate heat pump models that can serve a wide range of building types at Oregon's temperature extremes.[44]

Heat pumps perform two to four times more efficiently than gas, oil, or propane systems in Oregon's climate thanks to improved performance in both mild temperatures and extreme cold. New research shows cold climate heat pumps can remain 50% more efficient than fossil fuel systems even at -22 degrees Fahrenheit.[45]

Over 1.5 million American homes already use heat pumps to stay warm in sub-freezing conditions.[46] The Electric Power Research Institute **found** that cold climate heat pumps were able to meet 100% of home heating needs in 0 degree Fahrenheit conditions, and **Efficiency Maine** highlights a heat pump performing well without backup during a -49 degree Fahrenheit wind chill. Indeed, the world's highest concentration of heat pumps per capita is in frosty **Sweden, Finland, and Norway**.



Values represent the 5th and 95th percentiles of performance on the Northeast Energy Efficiency Partnerships' **Cold Climate Air Source Heat Pump Product List**

Source: RMI, **Cold Climate Heat Pumps: A Reliable Solution for Oregon**

[44] RMI, "Cold Climate Heat Pumps: A Reliable Solution for Oregon," 2023.

[45] Duncan Gibb et al., "Coming in from the cold: Heat pump efficiency at low temperatures," *Joule* 7:1939-1942, September 2023.

[46] EIA, 2020 Residential Energy Consumption Survey. See note 1.

PORTLAND CLEAN ENERGY FUND

The Portland Clean Energy Fund (PCEF), a program created by a voter-approved ballot measure in 2018, distributes funds generated by a tax on large corporations to projects that reduce climate pollution and protect frontline communities. In the few years since its implementation, the measure has provided $265 million to support clean energy and climate justice projects and is projected to raise an additional $750 million through 2028, totaling nearly $1 billion in its first ten years.

After the 2021 Pacific Northwest heat dome impacted the region, the PCEF program began its Cooling Portland project, which has installed over 7,000 heat pumps since its inception in 2022, with a focus on low-income and vulnerable communities. The program is currently offering qualifying households in Portland free heat pumps.

Supporters of the Portland Clean Energy Fund Ballot Measure — Photo Credit: Madison Rowley

SECTION THREE: IT'S TIME FOR OREGON TO RAMP UP HEAT PUMP ADOPTION

The transition from fossil fuel-burning HVAC systems and water heaters to pollution-free electric heat pumps is already underway in the U.S. In 2022, heat pump sales exceeded gas furnace sales nationally for the first time, and growth has only continued to accelerate since. Last year, the U.S. had one of the fastest growing markets for heat pumps in the world.

In Oregon, the state recognizes the need to accelerate the shift toward heat pump adoption. In a press release for Climate Week in September 2023, Governor Kotek joined with the U.S. Climate Alliance (USCA) — a bipartisan group of 25 governors across the nation — in committing to a series of efforts to address emissions associated with buildings, including the collective goal of 20 million heat pump installations across the nation by 2030, effectively aiming to quadruple the adoption of heat pumps nationwide. Building on this commitment, Oregon joined eight other states in February 2024 in signing an agreement to ensure 65% of residential HVAC and water heater sales are heat pumps by 2030 and 90% by 2040.

Oregon's 2023 Climate Resilience Package also set a goal of installing 500,000 heat pumps in homes and laid the groundwork to create a one-stop shop within ODOE for clean energy rebates. Governor Kotek is continuing to push heat pump adoption in her 2024 legislative proposal with a $20 million allocation for climate-friendly incentives in new low-income housing.

These actions have played an important role in accelerating Oregon's heat pump market and preparing the state for further bold action that aligns with its decarbonization targets. But more is needed to ensure that Oregon's electrification transition sustains the momentum needed to reach its targets. Healthy air standards for new HVAC and water heating equipment can play a critical role. This work will be key to driving a smooth, equitable, and timely transition to pollution-free space and water heating.

Oregon has set targets to reduce economy-wide greenhouse gas emissions 45% (below 1990 levels) by 2035 and 80% by 2050, with the Oregon Global Warming Commission calling to further strengthen these targets in a recent report to the legislature.[47] Synapse Energy Economics found that implementing a zero-emission building equipment standard by 2030 is consistent with greenhouse gas reductions beyond the state's 80% reduction target.[48]

Similarly, the Oregon Global Warming Commission's roadmap to meeting near-term decarbonization goals recommended several actions that healthy air standards would help achieve, including full electrification of new Oregon homes by 2025, reaching 100% electric new equipment sales by 2035, and converting all existing homes and businesses to heat pumps and heat pump water heaters by 2043.[49]

Oregon will likely need to begin implementing a zero-emission healthy air standard for space and water heating equipment no later than 2030 to achieve its climate targets, given that a science-based decarbonization trajectory requires even more rapid reductions than those contemplated in current state goals and that newly installed fossil fuel HVAC systems and water heaters may continue emitting pollution for 15 years or more. DEQ should enact standards as soon as possible that ramp up to 100% clean new equipment sales by 2030 in order to give the market enough time to make the transition smoothly, affordably, and equitably.

[47] Oregon Global Warming Commission, *Biennial Report to the Oregon Legislature*, 2023, p.2.

[48] Kenji Takahashi et al, *Toward Net Zero Emissions from Oregon Buildings: Emissions and Cost Analysis of Efficient Electrification Scenarios*, June 2022, p.19.

[49] Oregon Global Warming Commission, "Oregon Climate Action Roadmap to 2030," 2023, pp.14-15.

SECTION FOUR: STATE & LOCAL GOVERNMENTS CAN ACCELERATE THE TRANSITION TO HEAT PUMPS WITH HEALTHY AIR STANDARDS FOR HVACS & WATER HEATERS

DEVELOPING EQUITABLE & HEALTH-PROTECTIVE STANDARDS FOR HVACS & WATER HEATERS ACROSS OREGON

Zero-emission healthy air standards for heating equipment take effect when a furnace or water heater breaks and needs to be replaced or when a new building is built, ensuring only pollution-free options are available for purchase.

DEQ can build upon Oregon's interstate commitments and other work to accelerate the transition to clean buildings by kicking off the development of a zero-emission healthy air standard for HVAC and water heating equipment. This regulation should be incorporated into DEQ's State Implementation Plan (SIP), which is a package of regulations to achieve and maintain pollution limits under the federal Clean Air Act.

Sending an early market signal by setting a future effective date for healthy air standards is key for smooth and targeted implementation. By enacting the policy this year with future compliance dates, DEQ can maximize lead time for policymakers and market actors to focus on the complementary policies and business choices that will maximize the equitable and affordable application of those standards.

DEQ's policy could be modeled after the examples being set in other states. For example, the Bay Area Air Quality Management District's standards ensure all new HVACs and water heaters sold and installed in the San Francisco Bay Area will be pollution-free starting in 2027 for many water heaters and 2029 for many HVAC systems, with larger multifamily and commercial water heating coming along in 2031.

HEALTHY AIR STANDARDS AROUND THE NATION

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. In fact, some states like Texas have had a **low-NO_x** emissions standard – a regulation that limits but does not fully exclude NO_x pollution from heating equipment – on the books for over 20 years.

Washington:

- Regional regulators at the Southwest Clean Air Agency adopted a low-NO_x standard for gas-fired water heaters and boilers in 2010.

Texas:

- The state first adopted rules requiring new water heaters, small boilers, and process heaters statewide to meet specific NO_x emission limits in 2000, 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.

California:

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

Colorado:

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

As states continue to identify new strategies to meet federally binding air quality standards and support their climate targets, a growing number of regulators have adopted or are considering **zero-pollution** standards on HVAC and water heating.

San Francisco Bay Area:

- Regional regulators adopted the nation's first zero-pollution standard for space and water heating equipment in 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 avoid 15,000 asthma attacks and up to 85 premature deaths each 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:

- The state committed to zero-pollution HVAC and water heater standards by 2030 in its 2022 ozone SIP — recognizing these standards as an important control measure to achieve emission reductions — and kicked off development of statewide healthy air standards in 2023.

Maryland:

- The state has committed to initiate a rulemaking process for zero-pollution HVAC and water heating standards in 2024 to help achieve its climate goals.

Colorado:

- In 2023, the state passed a bill committing to evaluate its existing low-NO_x furnace and water heater requirements by 2030 and further strengthen them as needed to meet state climate and air quality goals.

U.S. Climate Alliance:

- Oregon, Washington, and six additional states — Connecticut, Hawaii, Massachusetts, New York, Pennsylvania, and Rhode Island — joined California and Maryland in committing in 2023 to explore the adoption of zero-emission standards for space and water heating equipment.
- Building on this commitment, Oregon joined eight other states — California, Colorado, Maine, Maryland, Massachusetts, New Jersey, New York, and Rhode Island — in signing a 2024 agreement to ensure 65% of residential HVAC and water heater sales are heat pumps by 2030 and 90% by 2040.

Heat Pump HVAC External Compressor Unit

PREPARING FOR EQUITABLE IMPLEMENTATION WITH COMPLEMENTARY POLICIES

DEQ should prioritize equity in both process and design when developing healthy air standards for HVACs and water heaters. This should involve early and frequent collaboration with environmental justice leaders, affordable housing providers, and frontline community members, especially those most impacted by furnace and water heater pollution. The goal of this engagement is to ensure that residents suffering from air pollution and struggling to pay their energy bills will benefit from the transition without additional financial burden.

Equity design elements are similarly important. For example, the Bay Area Air Quality Management District's zero-NO_x furnace and water heater policy includes an equity "checkpoint" two years before rules go into effect. Progress at that milestone is informed by feedback from an implementation working group of diverse participants from across the region — including community-based organizations, equipment manufacturers, utilities, local governments, housing developers, labor representatives, state agencies, technology entrepreneurs, and other experts. This working group collaborates to help ensure targeted investments and salient equity protections are in place before the rules take effect.

DEQ should pursue convening a similar working group, which should include representatives from impacted constituencies that can provide key perspectives and can help ensure that any policy avoids additional gentrification and displacement, supports deep retrofits of low-income and rental housing, establishes job training programs, and generates family-wage jobs for working Oregonians.

For a healthy air standard to be truly equitable, parallel work must continue at the Oregon Public Utility Commission (OPUC) and ODOE in order to plan for the orderly phase-out of the gas system and protect ratepayers from continued uneconomic investments in gas infrastructure that will lead to bill increases, while simultaneously expanding subsidies and administering state and federal funds to mitigate the cost of retrofits.

The OPUC must investigate a redesign of utility rates for an electric future, with a focus on supporting affordability for low- and moderate-income residents, and should require greater investments in electric grid resilience as the gas system is decommissioned in order to provide greater service reliability in the face of increasingly frequent climate change-driven weather events.

Healthy air standards for HVAC and water heating equipment send a clear signal about the scale and pace at which the gas system will be phased down, allowing the OPUC and utilities to plan for a managed, equitable transition. Similarly, such standards will help organize and accelerate the effective development and use of incentive and financing programs, such as those created by the Inflation Reduction Act, Oregon's Climate Resilience Package, and Portland's Clean Energy Fund. These and other funding sources that can be leveraged to successfully implement healthy air standards are discussed in Section Two above.

The sooner Oregon commits to zero-pollution building equipment standards, the better positioned it will be to achieve equitable and affordable implementation of the policy by 2030, which will be a critical part of meeting the state's 2050 climate targets.

LEADING THE WAY IN MULTNOMAH COUNTY

Multnomah County experiences **significant air pollution**. Gas-fueled building equipment in Multnomah County contributes significantly to this pollution, generating nearly 1,000 tons of NO_x pollution annually.[50] Due to its larger population and greater volume of heating equipment, the county has the largest NO_x pollution of any county in the state, 35% higher than the next highest county.[51] Gas heating equipment is the second-largest source of NO_x pollution in the county, behind cars and trucks.

Air pollution from a variety of sources disproportionately impacts communities of color in Multnomah County. An **analysis** focused on Portland found that unhealthy air quality is more likely to occur in neighborhoods with high populations of Hispanic and African-American residents. People of color in Portland are also more likely to live near one of the city's top ten industrial polluters. According to data from EPA's EJScreen tool, areas in the county with high concentrations of low-income and BIPOC communities are likely to experience levels of particulate matter, ozone, and other dangerous air pollutants that are two to three times higher.[52]

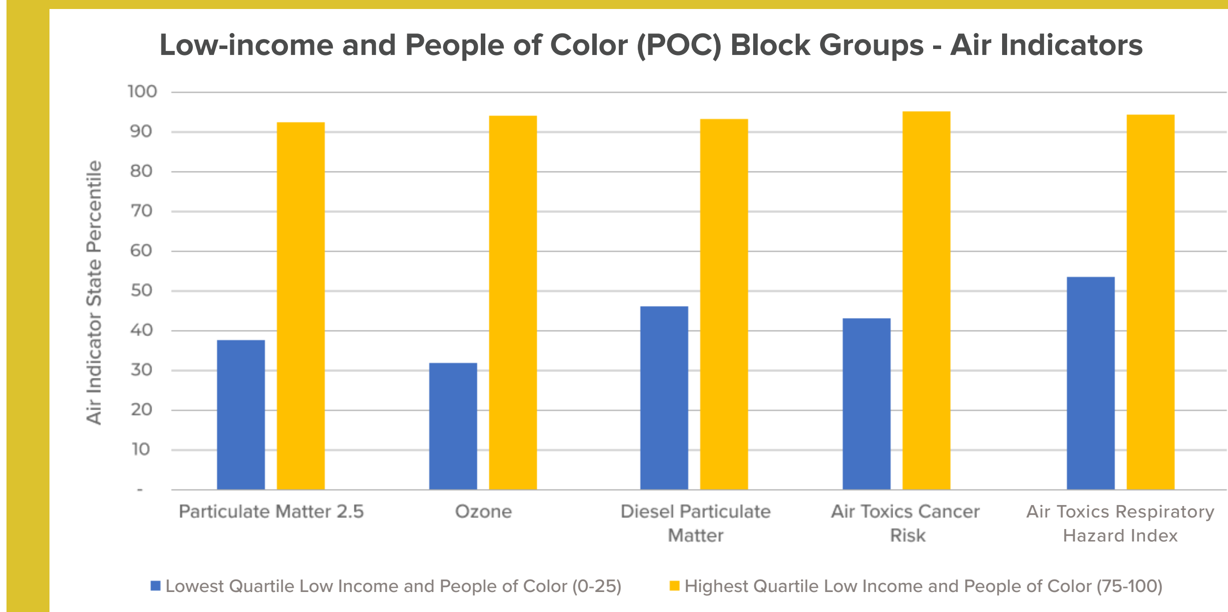
Local community in Astoria, Oregon

[50] EPA, 2020 National Emissions Inventory. See note 2.

[51] EPA, 2020 National Emissions Inventory. See note 2.

[52] EPA, EJScreen: Environmental Justice Screening and Mapping Tool, September 2023. Analysis used the latest data for Multnomah County with state percentiles (i.e., data showing the percentile of each indicator compared to all block groups in the state). Block groups in the county in the highest quartile (75th-100th percentile) of both low-income residents & people of color were compared to those in the lowest quartile (0-25th percentile) of those characteristics.

One in ten adults in Multnomah County report an asthma diagnosis, making the disease among the most prevalent chronic illnesses in the county. Because exposure to NO_x, ozone, and $PM_{2.5}$ can trigger and exacerbate asthma attacks, reducing NO_x emissions from buildings and other sources should be a priority for the County. Asthma rates are higher in low-income communities and communities of color, who are more likely to live in places where outdoor air is more polluted.[53]



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Multnomah County can move quickly to address this pollution burden on a parallel track to DEQ's broader statewide policy by developing a healthy air standard for HVACs and water heating equipment similar to those described above. Leadership by the County in this area would be consistent with concerns already laid out in a 2022 **report** by the County Department of Health that found significant threats posed by the continued use of fossil fuels in homes, recommending against combustion appliances "to protect public health, improve indoor and outdoor air, reduce emissions and mitigate climate change." County action on pollution from space and water heating equipment will protect residents while setting an example for the rest of the state.

[53] National Academy of Medicine (formerly Institute of Medicine) Committee on Environmental Justice, *Toward Environmental Justice: Research, Education, and Health Policy Needs*, 1999.

CONCLUSION

Burning fossil fuels in homes and businesses is an underrecognized driver of unhealthy air quality in Oregon, which disproportionately impacts low-income communities and communities of color. DEQ should develop and implement a healthy air standard that will ensure by 2030 that when a fossil fuel HVAC system or water heater burns out, it will be replaced with a pollution-free alternative like a highly efficient electric heat pump. In addition to delivering cleaner air and better health outcomes to communities burdened by air pollution, healthy air standards will advance key climate, resilience, and economic co-benefits.

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ACKNOWLEDGEMENTS

We would like to thank the following individuals for their input and expertise:

- Denise Grab, RMI
- Leah Louis-Prescott, RMI
- Jim Dennison, Sierra Club
- Cara Fogler, Sierra Club
- Samantha Hernandez, Oregon Physicians for Social Responsibility
- Theodora Tsongas, Oregon Physicians for Social Responsibility

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