

Outdoor (Ambient) Air Quality

Summary

Air pollution affects the health of large segments of Washington's population. Local sources of air pollution such as car and diesel vehicle exhaust, nonroad vehicles and equipment, wood stoves, fireplaces, outdoor burning, wildfires and industrial facilities cause most air quality problems in Washington. People living closer to these sources are likely to have higher exposure to pollutants than those who live farther away. Cars and trucks are the largest source of air pollution, accounting for 55% of the air pollution from criteria pollutants in Washington. Poor air quality tends to occur most often during the winter and summer months. Some regions of Washington have higher levels of air pollution than others. Climate change is projected to worsen air pollution. Infants, children, the elderly, and people with lung disease, cardiovascular disease or diabetes are especially vulnerable to polluted air. Polluted air can also affect fetal development. Given the large proportion of Washington's air pollution caused by transportation, reducing transportation-related emissions through policy and individual actions will lead to improved air quality. Limiting wood and agricultural burning can also improve air quality.

Introduction

People do not have a choice in the air they breathe. Breathing polluted air shortens life expectancy and increases visits to healthcare providers and hospitals. Infants and children; older adults; pregnant women; and those with lung or heart disease, a history of stroke, or diabetes are more likely than others to develop health symptoms or have diseases worsen with

Definition: Outdoor (ambient) air quality is the condition of the air in the environment outside of buildings and accessible to people. Only six air pollutants (particulate matter, ground level ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, and lead) known as Criteria Pollutants are routinely measured. The number of days people are exposed to one of the six levels of fine particulate matter on the Washington State Department of Ecology's Washington Air Quality Index (WAQA) or the one of five levels of ozone on the EPA's Air Quality Index (AQI) is an indicator of the health hazard of air pollution. In addition to the criteria air pollutants, there are 187 Hazardous Air Pollutants that are monitored more selectively and are known or suspected of causing serious health problems.

exposure to air pollution.^{1,2} For example, breathing polluted air can cause people with lung or heart disease to have additional health problems such as asthma or heart attacks.^{3,4,5} As levels of air pollution rise, more people experience health complications or die from breathing polluted air.^{6,7,8}

Respiratory deaths in infants in the first year of life, lower infant birth weights and preeclampsia (a pregnancy complication) are also linked to air pollution.^{9,10,11} Air pollution can also decrease immunity through a variety of mechanisms.¹² In 2013, the World Health Organization's International Agency for Research on Cancer (IARC) classified outdoor air pollution as a human carcinogen based on its findings for lung and bladder cancer.¹³

Atmospheric conditions can increase air pollution. Air pollutants accumulate when there is little wind and further increase during air inversions when warm air traps cold air and pollutants near the ground, a pattern that occurs frequently in Washington between October and March. Air quality can also deteriorate during periods of hot and sunny summer weather. Wildfires that most often occur in Eastern Washington also increase air pollution in the summer. Wildfires often produce high levels of pollutants that can travel over long distances. Air pollution in Washington generally comes from sources within the state. This chapter covers three categories of air pollutants: criteria pollutants, hazardous air pollutants and diesel exhaust.

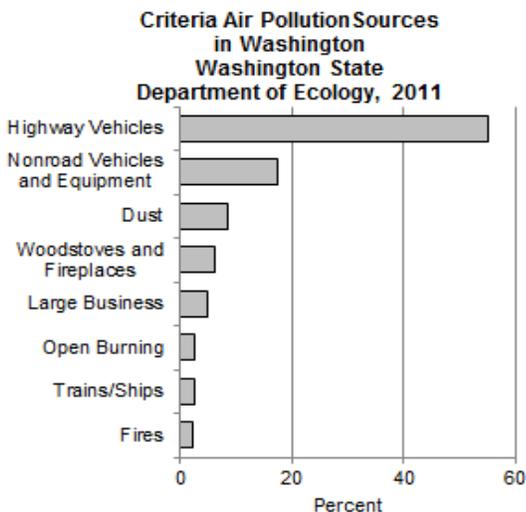
Criteria Air Pollutants

Under the Federal Clean Air Act, the U.S. Environmental Protection Agency (EPA) sets health-based National Ambient Air Quality Standards (NAAQS) for six pollutants called criteria pollutants: carbon monoxide, lead, nitrogen dioxide (NO₂), ground level ozone (ozone), particulate matter (PM) and sulfur dioxide (SO₂). The EPA sets standards for these pollutants because, historically, they were

found in many communities, can disperse over large areas, and are harmful to health. The Washington State Department of Ecology and regional and local clean air agencies also regulate these pollutants under Washington's Clean Air Act.

Washington monitors levels of all criteria pollutants, but monitoring for SO₂, NO₂ and lead is limited because Washington meets the NAAQS for these pollutants. Washington will increase monitoring for NO₂ over the next few years in response to the EPA's requirement to monitor NO₂ near major roadways where concentrations of NO₂ can be high. In 2010, the EPA revised the SO₂ standard to a one-hour standard of 75 parts per billion. There might be additional monitoring for SO₂ in the future to ensure that Washington meets the revised standard. The most extensive monitoring in Washington is for levels of particulate matter less than 2.5 microns in diameter (PM_{2.5}) and ozone because these pollutants are most likely to be present in Washington above levels known to impact health. These pollutants and carbon monoxide are discussed below.

In 2011, 55% of criteria pollutant emissions came from cars and trucks. Other major sources of these pollutants include nonroad vehicles (17%); dust (9%); wood stoves and fireplaces (6%); large business (5%); open burning (3%); trains and ships (3%); and fires (2%).¹⁴ Although highway vehicles account for a large percent of air pollution from criteria pollutants, they only account for a small percentage of PM_{2.5} emissions. Most PM_{2.5} emissions come from dust, woodstoves and fireplaces, outdoor burning, and nonroad vehicles and equipment.¹⁴



Sections on each criteria pollutant covered below provide information on health effects, sources of pollution in Washington, and whether we are meeting national standards. **Nonattainment areas** are those that do not meet national standards. **Maintenance areas** currently meet the NAAQS, but may need continued monitoring because historically they were nonattainment areas.

The sections on PM and ozone also discuss Ecology's Washington Air Quality Advisory (**WAQA**) and the EPA's Air Quality Index (**AQI**). For PM the indexes place PM_{2.5} air pollution levels in one of six color-coded categories: good, moderate, unhealthy for sensitive groups, unhealthy, very unhealthy and hazardous. For ozone there are five categories ranging from good to very unhealthy.

Particulate Matter

Health effects and sources. Studies indicate that air pollution from PM, especially PM_{2.5}, is associated with decreased lung development in children and with lung and cardiovascular disease in adults.¹⁵ Death rates from these diseases increase as PM levels rise. PM_{2.5} has been identified as a cause of lung cancer.¹⁶ Even very low levels of PM_{2.5} below the current federal standard have been linked to health effects in children, older adults, those with chronic diseases and other vulnerable populations.¹ In 2013, IARC classified PM as carcinogenic to humans.¹³

PM air pollution includes several types of particles. Fine particles come mainly from combustion, while coarse particles from 2.5 to 10 microns in diameter (PM₁₀) come from wind-blown dust as well as pollen and mold spores, and some types of bacteria. Particles emitted during combustion generally consist of a central carbon core upon which other toxic pollutants attach. Major sources of PM_{2.5} in Washington include wood stoves and fireplaces, dust, agricultural burning, wildfires, nonroad vehicles, ships, trains, industry and motor vehicles. In the winter, when PM_{2.5} pollution is highest, wood stoves and fireplaces account for 44% of this pollution in Washington.¹⁷

Monitoring and compliance. Monitoring for PM₁₀ is limited to six cities: Cheney, Colville, Harrah (on the Yakama Reservation), Kennewick, Spokane and Yakima.

In 2006, the EPA lowered the daily standard for PM_{2.5} from 65 to 35 µg/m³. Three years of subsequent monitoring data showed that a large region in the Tacoma-Pierce County area (including parts of Edgewood, Fife, Fircrest, Lakewood, Milton, Puyallup, Ruston, Sumner, Tacoma and University

Place) was not meeting the new 24-hour standard. The EPA declared the region a nonattainment area in 2009. Since 2006, local authorities and Ecology have been working to reduce PM_{2.5} in this area. Monitoring since 2009 has shown that the region's air quality has met the PM_{2.5} standard. Ecology is now developing a maintenance implementation plan for this area. The plan will define what actions will be taken to control air pollution so that the region's air continues to meet federal standards. The EPA must evaluate and approve the plan.¹⁸

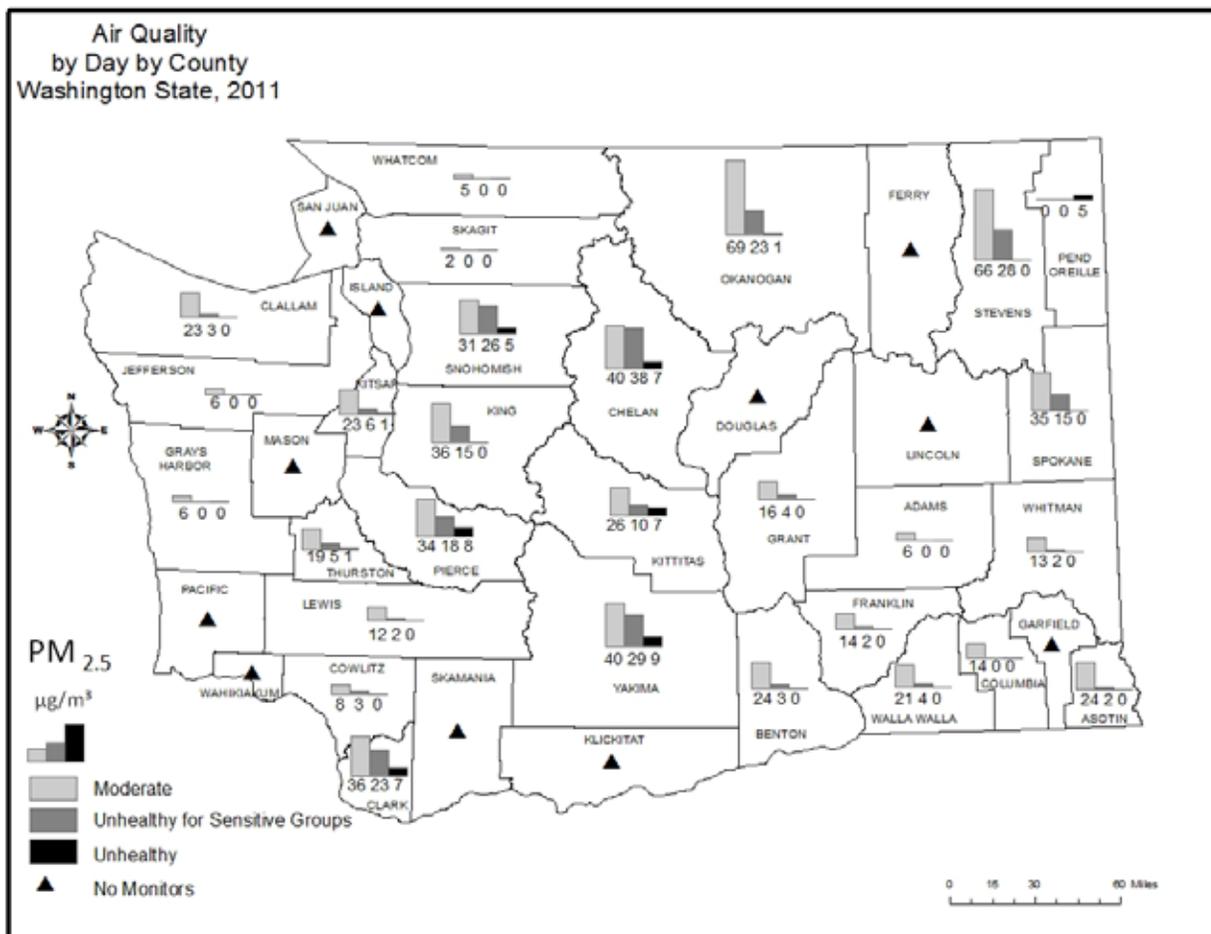
Ecology considers levels of daily fine particulate matter to be occasionally high enough in areas in or around Darrington, Ellensburg, Marysville, Olympia, Yakima, Vancouver and Wenatchee that these communities are vulnerable to becoming nonattainment areas.¹⁹

Ecology and regional clean air agencies regularly monitor PM_{2.5} in 29 Washington counties. They do not regularly monitor levels of

PM_{2.5} in the 10 counties that do not have a history of air quality problems, though these counties are monitored periodically. Monitoring equipment is placed where there are known pollution sources and in maintenance areas. Since 1997, when EPA issued the PM_{2.5} standard, Washington expanded the number of PM_{2.5} monitors to more than 70 sites. Information on PM_{2.5} monitoring locations is available online through the [Washington Tracking Network](#) (WTN).

Other measures of burden. For PM_{2.5}, Ecology sets levels in the WAQA to a lower threshold to be more protective of health than those set in the AQI. Thus, the WAQA will provide a warning sooner with less PM_{2.5} pollution in the air than the AQI.

The following map shows the number of days each county spent in three of the WAQA categories during 2011. In 2011, only 28 counties had monitoring throughout the year. (See [Technical Note](#) for information on data development.)



During 2011, all 28 counties had some days with air quality not in the good category. Twenty-one counties had one to 38 days in the unhealthy for sensitive groups category; all of these 21 counties also had days in the moderate category. Ten counties had between one to nine days in the unhealthy category. No counties experienced days in the very unhealthy or hazardous categories. Fine particulate air pollution can vary from year to year due to weather patterns, pollution sources, and natural events such as wildfires. The [Washington Tracking Network](#) provides similar data for 2001–2011.

Eastern Washington experiences wildfires almost every summer. Wildfires were particularly severe in 2012. The Wenatchee Complex fire began in early September and lasted more than a month. Ecology estimated that in Wenatchee, PM_{2.5} reached hazardous levels for 15 days on the WAQA.

During a six-week period (the four weeks of the wildfires plus two additional weeks), there were 3,400 more school absences among children attending kindergarten through 12th grade in Chelan, Douglas, Kittitas and Okanogan counties compared to the same time period the previous year.²⁰ Absences from three schools in the Cashmere School District that were closed for six days are not included in this estimate. During the same six weeks, there were 350 more visits for respiratory irritation in selected hospitals in Eastern Washington in 2012 compared to 2011.²¹ Data from the hospitals in Chelan, Douglas and Kittitas counties that were closest to the wildfires were not available.

The University of Washington Climate Impacts Group predicts that wildfires in the Columbia Basin will increase from an average of 425,000 acres burned annually during the 1916–2000 time period, to 1.1 million acres in 2040 and 2.0 million acres in 2080.²² Larger wildfires will produce more PM_{2.5} smoke pollution that can adversely impact health.

Ozone

Health effects and sources. Ozone in the upper atmosphere is beneficial in blocking the sun's ultraviolet rays, but near the ground it is harmful to breathe. Ground level ozone is a respiratory tract irritant and can cause premature aging of the lungs and aggravation and development of asthma.^{23,24} People who spend more time outdoors playing, exercising or

working will breathe more ozone and are at greater risk for adverse health effects from ozone than those who stay indoors or are more sedentary.

Ground level ozone forms from reactions involving volatile organic compounds (such as gasoline, paint thinners and dry cleaning fluids) and nitrogen oxides in the presence of ultraviolet sunlight. Major sources of chemicals that lead to ozone air pollution in Washington are cars, light and heavy trucks, buses, ships, trains, nonroad equipment and industry. Ozone pollution can affect large areas because winds transport it over long distances. Ozone levels are often elevated on hot, sunny and hazy days.

Climate change is expected to increase ozone levels. The University of Washington Climate Impacts Group estimates that ozone levels will increase by 16% in Spokane County and 28% in King County by midcentury (2045–2054) over levels from 1997–2006. They also estimate a corresponding increase in ozone-related deaths of 17% in Spokane County and 27% in King County by midcentury.²⁵

Monitoring and compliance. Pierce and King counties, urbanized areas of Snohomish County, the cities of Vancouver and Camas, and southwestern Clark County have been maintenance areas for ozone for about 15 years. The EPA revised the eight-hour standard (the average concentration levels in an eight-hour period) for ozone in March 2008 from 84 to 75 parts per billion. All eight counties—Clallam, Clark, King, Pierce, Skagit, Spokane, Thurston and Whatcom—that have ozone monitoring are currently meeting federal air quality standards. Recent studies support further strengthening this standard as it may not be protective enough of public health.²⁶ As a result, EPA is currently reviewing this standard and may propose to further strengthen it in 2014.

Other measures of burden. The levels for ozone are the same on the WAQA and AQI. Counties can meet the standard and still have days that suggest poor air quality based on these indexes. In 2011, the eight counties with monitors had a total of six days with elevated levels of ozone based on the AQI. All six of these days were in the moderate category. The [Washington Tracking Network](#) provides similar data for 2001–2011.

Carbon Monoxide

Health effects and sources. Carbon monoxide interferes with the ability of blood to carry oxygen. Individuals with heart disease are more likely to develop symptoms or worsening of their disease with exposure to carbon monoxide exposure.²⁷

Carbon monoxide is formed during combustion. Major sources of carbon monoxide include motor vehicles, nonroad vehicles and equipment, wood stoves, fireplaces, outdoor burning, trains and ships.

Monitoring and compliance. Since 1996, all regions of the state have met federal standards for carbon monoxide. Carbon monoxide monitoring is limited to five sites in Washington: Anacortes in Skagit County, two sites in Spokane, Seattle's Beacon Hill, and Cheeka Peak in Clallam County.

Toxic Air Pollutants and Diesel Exhaust

In addition to criteria air pollutants, the EPA regulates emissions of 187 hazardous air pollutants (HAPs). The EPA has developed rules to regulate various categories of industrial sources of HAPs. States also have authority to regulate toxic air pollutants for new industrial plants or facilities, or when existing facilities are modified. Ecology and regional and local clean air agencies regulate approximately 400 toxic air pollutants—including most of the HAPs—by specifying the minimum air emission control technology for sources, such as factories.

The EPA does not include diesel exhaust as a HAP. However, Ecology considers diesel exhaust, measured as diesel particulate matter (DPM), as a particularly important air pollutant in Washington and calls it a toxic air pollutant (TAP). Diesel exhaust contains a mixture of both criteria pollutants, including carbon monoxide, nitrogen oxides, sulfur oxides, particulate matter and HAPS such as benzene, 1,3-butadiene, formaldehyde and polycyclic aromatic hydrocarbons. Ecology ranked DPM as their highest priority TAP due to its potential to cause cancer and other adverse health effects.

The EPA developed the National Air Toxics Assessment (NATA) to help people understand the potential health risks from breathing air toxics. NATA uses a combination of emissions reporting and monitoring data plus modeling to estimate health risks and prioritize pollutants and emission sources. NATA helps identify areas that would benefit from interventions to lower emissions. NATA's cancer risk assessment is an indicator of the potential health risk of breathing HAPs. The NATA should not be used as an indication of an individual risk.²⁸

The EPA released the most current NATA in 2011, based on 2005 data. These data included 177 HAPs. The 2011 NATA identified 3,100 regions (census tracts) nationally with cancer risks greater than 100-in-a-million. This means that across the lifespans of one million people, 100 would develop cancer from breathing air toxics. Thirteen of those regions are in King County.²⁹ This assessment did not include cancer risk attributable to diesel exhaust. Puget Sound Clean Air Agency and Ecology revised NATA and included DPM in their cancer risk estimates. Including DPM raised the lifetime cancer risk in 13 King County regions—including 12 of the regions with risk of 100 per million—from 100 to 1,000 additional cancers per million people.³⁰ Additional regions in King County, as well as in Clark and Pierce counties, were also identified with a lifetime cancer risk **nearing** 1,000 per million population.³¹

Health effects and sources. HAPs and other regulated toxic air pollutants include chemicals known or suspected to cause birth defects, cancer or serious health effects on the reproductive or neurologic systems.

DPM causes lung damage, exacerbates allergies and asthma, and can cause lung and bladder cancers.³² In 2012, IARC reclassified diesel exhaust from probably carcinogenic to humans to carcinogenic based on findings for lung cancer.³³ The California Environmental Protection Agency (Ca/EPA) concludes that exposure to DPM also increases risk of developing and dying from heart and lung disease.³⁴ Using Ca/EPA methods, in 2007 Ecology estimated that at least 70% of the cancer risk in Washington associated with toxic air pollutants came from DPM.³⁵ In 2011, that risk estimate increased to 80%.³⁶

Most of the health risks from toxic air pollutants in Washington come from diesel exhaust sources, wood stoves and industry.³⁷ Major sources of diesel emissions include motor vehicles such as trucks and buses, port boats and equipment, trains, construction and agricultural equipment, and stationary sources such as diesel-powered generators. In 2011, DPM made up 9% of the PM_{2.5} emissions in Washington State.

People who live or work near high-traffic roadways can be exposed to higher levels of diesel exhaust than those who live elsewhere. The Centers for Disease Control and Prevention estimates that about 3% of Washington's population—almost 207,000 people in 2013—lived within about 500 feet of a major roadway serving at least 10,000 vehicles a day.³⁸ Ecology estimates many facilities serving

people sensitive to DPM air pollution are located near major roadways. These include 4,000 day care centers, 1,500 schools, 100 hospitals and 200 nursing homes.³⁹

The Puget Sound Clean Air Agency conducted an air toxics monitoring study using data from two monitors in Seattle and four in Tacoma during 2008–2009. This study found that DPM contributed the most to cancer risk from air toxics—followed in descending order by wood smoke particulate matter, carbon tetrachloride, benzene, 1,3 butadiene, formaldehyde, acetaldehyde, naphthalene, chloroform and tetrachloroethene.⁴⁰

Monitoring and compliance. State and federal rules and standards limit emissions of toxic air pollutants from industrial sources ranging from small operations such as dry cleaners, auto body shops, and surface coating operations to large industries such as pulp and paper mills, refineries and cement kilns. Ecology and local clean air agencies issue air permits and inspect large and small industrial operations for compliance with state and federal regulations. Compliance focuses on inspecting facilities to make sure that air pollution control equipment is in place and functioning and that facilities are keeping required maintenance and air pollution release records.

HAPs are not routinely monitored except at the Beacon Hill site. Levels of some HAPs, such as benzene, have been decreasing. Benzene levels have most likely decreased due to increased use of new cars with improved vehicle emissions standards and cleaner fuel.^{41,42}

Disparities

Air monitoring provides information on a small number of pollutants, and findings are highly accurate only at short distances from the monitors. Air pollution tends to be higher in urban areas, and disproportionately affects Washington's black, Asian, and Native Hawaiian and other Pacific Islander residents: 95% of blacks, 95% of Asians, and 97% of Hawaiian and other Pacific Islanders live in urban areas, while only 78% of whites live in these areas.^{43,44} Fifty thousand people live in the 13 regions in King County with the estimated highest cancer risk due to air toxics emissions. In 2010, 39% of residents in these regions were in nonwhite racial groupings compared with 31% in King County and the state average of 23%.⁴⁵

2020 Goals

The national *Healthy People 2020* report includes three objectives related to air pollution, only one of which we can meaningfully measure in Washington. Objective EH-1 is to reduce the number of days the AQI-weighted people days⁴⁶ exceeds 100 on the AQI by 10% nationally from 2.2 billion to 1.98 billion. This is a new goal that gives a relative measure of the number of days people are exposed to air pollution that would be in the AQI categories: unhealthy for sensitive groups, unhealthy, very unhealthy and hazardous. In Washington, there were 16,740,000 people days in 2011 that exceeded 100 on the AQI scale for PM_{2.5} or ozone. We would need to reduce this to 15,066,000 people days to achieve a 10% reduction by 2020.

Intervention Strategies

Outdoor air quality regulations, mainly the federal and state Clean Air Acts, have been effective in decreasing the level of many air pollutants.⁴⁷ These regulations rely on air pollution monitoring to identify sources of pollution and control of emissions at air pollution sources. Because many toxic air pollutants are emitted from the same sources that generate criteria pollutants, a portion of toxic air pollutant emissions are controlled by measures that control criteria pollutants.

Wood, agricultural and wildfire smoke. Beginning in 2008, the Washington Legislature passed several new laws to reduce wood smoke exposure and to stay in NAAQS compliance. In 2008, the legislature lowered the forecasted levels of PM_{2.5} needed to call burn bans so that local and regional clean air agencies could call bans sooner with less pollution in the air.⁴⁸ In 2009, the legislature added wood-burning devices to the real estate disclosure form. Owners must indicate if there is a wood stove or fireplace insert in the home and if it is EPA-certified as clean burning.⁴⁹ In 2012, they further lowered the forecasted levels of PM_{2.5} needed to call burn bans in nonattainment areas and in areas vulnerable to becoming nonattainment areas. Additionally, beginning in 2015 local clean air agencies or Ecology will have authority in nonattainment areas to prohibit the use of wood stoves and either have homeowners remove or make the stoves inoperable.⁵⁰

The state has contributed \$6.1 million since 2007 to replace nearly 3,000 older, more polluting uncertified wood stoves with cleaner burning devices. To implement the program, Ecology works with local jurisdictions and targets areas that are vulnerable to

becoming nonattainment areas to keep these areas in compliance with the PM_{2.5} standard.

Ecology has worked with a wide group of federal, state and local stakeholders to develop a maintenance implementation plan for PM_{2.5} in the Tacoma-Pierce County nonattainment area. The Puget Sound Clean Air Agency also established a task force to involve the public in the development of community-based solutions. The task force recommended: 1) enhancing enforcement of burn bans; and 2) requiring removal of uncertified wood stoves and inserts. During 2010–2013, approximately 1,000 older wood stoves were replaced or recycled with a cleaner burning device in this region.

State regulations have resulted in management of agricultural burning to avoid creating smoky areas where people live. Since 2007, outdoor burning has not been allowed in any urban growth area.

During the 2012 Washington wildfires, the department activated its incident command structure and coordinated response with local, state and federal agencies. It distributed more than 53,000 N95 respirator masks to local health departments. Answers to frequently asked questions were posted to the department's website in both English and Spanish.⁵¹

Transportation-related emissions. Some regions in Washington have established non-idling areas at schools and ferry terminals; provided electrical power to run truck engines at overnight truck stops and ship engines in ports; and have established programs to help retrofit private and government fleets of trucks and buses, replacing older engines and equipment with cleaner engine technology; and retrofiting locomotives with idle-reduction devices.

The State Clean Bus Program has retrofitted 6,430 school buses with diesel reduction technology and replaced 122 buses with newer buses, almost the entire state fleet that was built before 2007. Recently, idle-reduction technologies have been installed on an additional 620 school buses. These devices allow drivers to warm school bus cabins, defrost windows, and circulate and heat engine fluids without idling the engines.

In 2005, the legislature passed the Clean Car Law. Starting with 2009 models, new vehicles must meet strict clean air standards to be registered, leased, rented or sold in Washington.⁵²

In 2006, the EPA began requiring use of cleaner burning diesel fuel for highway vehicles. In combination with new emission control technology, the cleaner fuel will reduce PM and nitrogen oxide emissions from heavy-duty diesel vehicles. The standards, however, do not apply to pre-2007 vehicles that can stay on the road for many years and continue to emit larger amounts of diesel pollution.⁵³ Ecology and regional and local clean air agencies also regulate many components of diesel exhaust as HAPs.

Washington State's Commute Trip Reduction law requires employers with more than 100 employees in the nine most densely populated counties to establish a program to encourage workers to reduce commute trips and not drive alone.⁵⁴

In 2010, the International Maritime Organization designated portions of U.S. waters as Emission Control Areas (ECA), through the amendment to Annex VI of the International Convention for the Prevention of Pollution from Ships. In our region, the ECA includes the Columbia River and marine waters within 230 miles (200 nautical miles) of the coast. The agreement will reduce the sulfur content in fuels from an average of about 2.7% sulfur to 0.1% sulfur by January 2015. This cleaner fuel will result in decreases in both sulfur oxides and PM pollution in Washington. It should reduce emissions from ocean-going ships of sulfur oxides by about 95% and PM pollution by 60–80%.⁵⁵

With contributions from local jurisdictions and Ecology, the ports of Tacoma, Seattle and Vancouver have been updating their Northwest Ports Clean Air Strategy to further reduce diesel particulate matter per ton of cargo by 80% by 2020. The plan includes additional regulations on ocean-going vessels, engine standards for trucks that go in and out of the ports, and upgrades for train engines and other equipment that services ports, such as loading and cargo handling equipment.⁵⁶

Individual actions. Individuals can take steps to reduce air pollution by reducing or changing the fuel they use. Strategies include: combining car trips; carpooling; taking public transportation; not idling; not burning wood or switching to an electric or gas heating system; using certified wood or pellet stoves and correct burning practices; substituting electrical for gas-powered yard equipment; and composting instead of burning yard waste.

Individuals can reduce their exposure to outdoor air pollution when levels are elevated by limiting the time they spend outdoors, especially exercising, on days when air quality is poor. People can get

information on current air quality conditions from the Washington State Department of Ecology's WAQA or from local clean air agencies.^{57,58}

See Related Chapters: [Asthma](#), [Indoor Air Quality](#)

Data Sources

Daily PM_{2.5} monitoring data: Washington State Department of Ecology data from 2011. Data on WAQA and AQI values are from the Washington Tracking Network prepared by Environmental Epidemiology, Washington State Department of Health

For More Information

Washington State Department of Health, Environmental Epidemiology: (360) 236-3000 and Outdoor Air Quality: <http://www.doh.wa.gov/CommunityandEnvironment/AirQuality/OutdoorAir.aspx>

Washington State Department of Ecology, Air Quality Program: (360) 407-6800, and <http://ecy.wa.gov/programs/air/airhome.html>
<http://www.ecy.wa.gov/programs/air/pdfs/WAQA.pdf>

Technical Notes

Washington State Department of Ecology Draft 2011 Emissions Inventory was used for the chart Washington State Criteria Pollutants Sources. This chart excludes emissions from natural sources, ammonia, and volatile organic compounds.

Washington Tracking Network indicators were used for data on the WAQA and AQI. Technical notes on these indicators is available at:
<https://fortress.wa.gov/doh/wtn/WTNPortal/>

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Endnotes

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