State of Oregon
Department of Environmental Quality Memorandum

Date: July 9, 2020

To: Environmental Quality Commission

From: Richard Whitman, Director

Subject: Item F: Diesel engine emissions in Oregon (Informational)
July 16-17, 2020, EQC meeting

Purpose of item

This in the first in a series of informational briefings for the commission where agency staff will describe the environmental and public health impacts of diesel engine exhaust, characterize the diesel engines emissions in Oregon, inventory existing programs and policies that address diesel engine emissions and prepare the commission for relevant rulemakings and other actions on the horizon.

Background

Diesel engines offer fuel economy, power and durability. In the United States, approximately 80 percent of all freight is moved by diesel engines. Diesel engines also power most non-road equipment as used in the construction, agricultural, marine and locomotive sectors. While the operational advantages of diesel are clear, diesel engines emit large amounts of nitrogen oxides, particulate matter, and toxic air pollutants.

In 2007, the Oregon Legislature directed the Environmental Quality Commission in statute to "establish a goal to reduce excess lifetime risk of cancer due to exposure to diesel engine emissions to no more than one case per million individuals by 2017" (ORS 468A.793). The state did not meet that goal, renewing conversations in the legislature and the community about the health effects associated with diesel engine exhaust and options for reducing emissions.

This informational item includes key information on the environmental and public health impacts of diesel engine exhaust, summarizes the sources of diesel emissions in Oregon and describes the regulatory framework at the federal level used to reduce diesel engine emissions from mobile sources.

Environmental and public health impacts

Diesel engine exhaust is a complex mixture of gasses and particles that both on their own, and collectively, are associated with a variety of health effects. In 2015, DEQ published a comprehensive review of peer-reviewed science

examining the health effects of diesel engine exhaust, included as Attachment 1 in Supporting Materials to this staff report. In summary, that report found exposure to diesel engine exhaust is associated with a variety of effects, including:

- Increased risk of certain cancers, including lung and bladder cancers.
- Cardiovascular effects including an increased risk of heart attacks.
- Pulmonary effects, such as upper respiratory system irritation and decreased lung functions.
- Neurodevelopmental effects including decreased cognitive function and decreased birthweight.

Diesel engines are responsible for approximately 25 percent of all NOx emissions in the state, a precursor to the formation of ground level ozone. Communities across the Oregon, including the Portland-metropolitan area and the Rogue Valley have experienced increasing levels of ozone in recent years. Increasing levels of ozone – or smog – leads to a wide variety of health effects including aggravated asthma, decreased lung function and chronic obstruction pulmonary disease. The state also risks its attainment status of the National Ambient Air Quality Standard for ozone.

EPA estimates that cleaning up diesel engines as a result of federal regulations will ultimately reduce documented public health and environmental impacts to be worth more than $296 billion annually. In Oregon alone, the direct and indirect public health and environmental impact of exposure to diesel exhaust could be valued up to $3.5 billion per year. This is one indicator of how serious the effects of diesel exhaust exposure can be.

A 2005 analysis conducted by the Clean Air Task Force, a research and advocacy organization, used EPA emissions data to estimate that diesel emissions result in the following annual impacts in Oregon:

Adults	
176	Premature Deaths
145	Non-Fatal Heart Attacks
25,910	Work Loss Days
151,520	Minor Restricted Activity Days
Children	
119	Asthma Emergency Department Visits
250	Acute Bronchitis

3,203	Lower Respiratory Symptoms
2,449	Upper Respiratory Symptoms
5,376	Asthma Exacerbation

In addition to the health effects, combustion of diesel fuel is a significant source of greenhouse gas emissions. Transportation accounts for approximately 40 percent of all statewide greenhouse gas emissions in Oregon. This represents the largest source of emissions and a source that has seen increased emissions in recent years. While heavy-duty trucks and buses, which typically are fueled by diesel, only account for four percent of vehicles on the road nationally, they are responsible for nearly 25 percent of total transportation sector greenhouse gas emissions nationally, and 23 percent in Oregon. Emissions from trucks are one of the fastest growing sources of greenhouse gas emissions, and the number of truck miles traveled on the nation's roads is projected to continue to grow significantly in the coming decades.

While carbon dioxide is typically regarded as the key greenhouse gas of concern, black carbon, a constituent of diesel engine exhaust, is increasingly recognized as a significant climate-forcing agent. In the United States, diesel engines are the largest source of black carbon. Black carbon emissions contribute to climate change by:

- Warming the atmosphere directly by absorbing solar radiation and emitting it as heat;
- Darkening snow and ice, causing them to warm and melt much faster;
- Affecting the properties of clouds, including their reflectivity and lifetime, stability and precipitation.

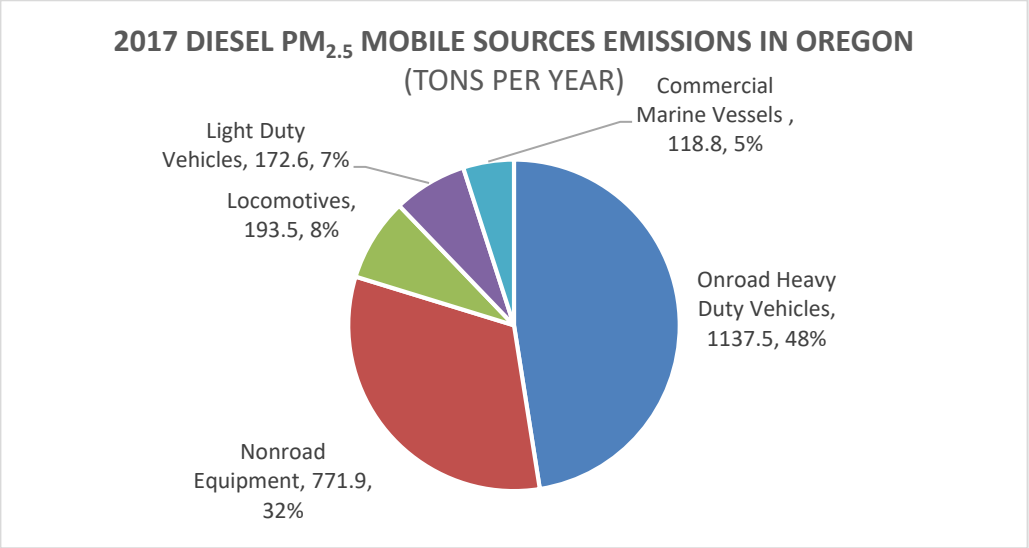
The climate-forcing effects of black carbon are short-lived, meaning any action to reduce emissions results in near-term benefits.

Sources of diesel emissions

DEQ characterizes the magnitude and relative contribution of the sources of diesel engine emissions using emissions inventories. An emissions inventory is a tool used in air quality management to quantify the amount of emissions of a particular pollutant in a set geography over a certain period of time. Data is typically displayed by source or sector categories, and it is important to note that an emissions inventory itself cannot quantify the concentration of a pollutant in the air at a particular point of exposure. The most widely used inventory is the National Emissions Inventory.

The NEI is a comprehensive and detailed estimate of air emissions of criteria pollutants, criteria precursors, and hazardous air pollutants, including diesel particulate matter, from all human-made and natural sources of air pollution. The NEI is released every three years based primarily upon data provided by state, local, and tribal air agencies for sources in their jurisdictions and supplemented by data developed by the EPA.

The pie chart below shows the mobile sources of diesel particulate matter, one element of diesel engine exhaust, in Oregon in the year 2017, the most recent NEI dataset available.



Mobile sources are responsible for the vast majority of emissions in Oregon. Within the mobile source categories, heavy-duty trucks and non-road equipment are the most significant source categories:

- Heavy-duty vehicles refers to trucks with a Gross Vehicle Weight Rating of 14,000 pounds or more. Trucks of this size and nature vary and include in-town delivery trucks, bucket-lift trucks, refuse hauling trucks, school busses and long-haul trucks
- Non-road equipment refers to the variety of equipment and machinery used in construction, agriculture, mining and logging.

The wide variety of equipment classified as “non-road,” the variable applications and use of that equipment, and lack of registration data all present challenges for characterizing emissions from the non-road sectors.

Recognizing this, in 2017 the legislature appropriated $500,000 to DEQ to allow the agency to hire a third-party entity to conduct a statewide and cross-sector survey of non-road diesel engines in Oregon. The purpose of the project is to better estimate non-road diesel equipment emissions.

DEQ awarded the project contract to Eastern Research Group in 2018 after consulting with stakeholders on the design and scope of the project. ERG is a nationally-recognized expert in this work and has conducted similar surveys in other states. ERG recently submitted its final report to DEQ. Their work relied on three primary data collection strategies:

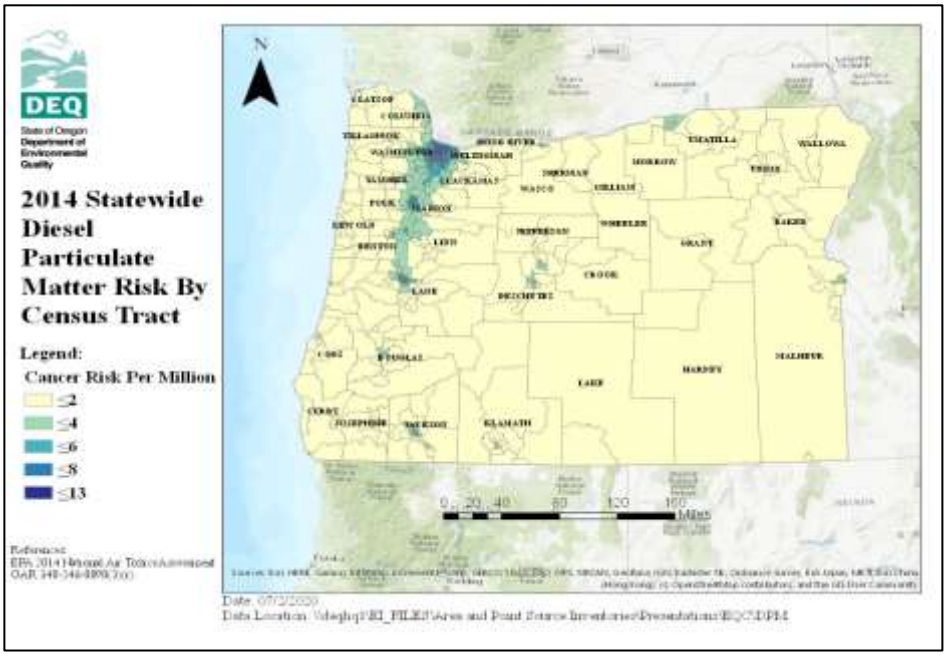
1. Publicly-owned fleet surveys
2. Random sample survey of privately-owned fleets
3. Industry specific profiles of equipment use

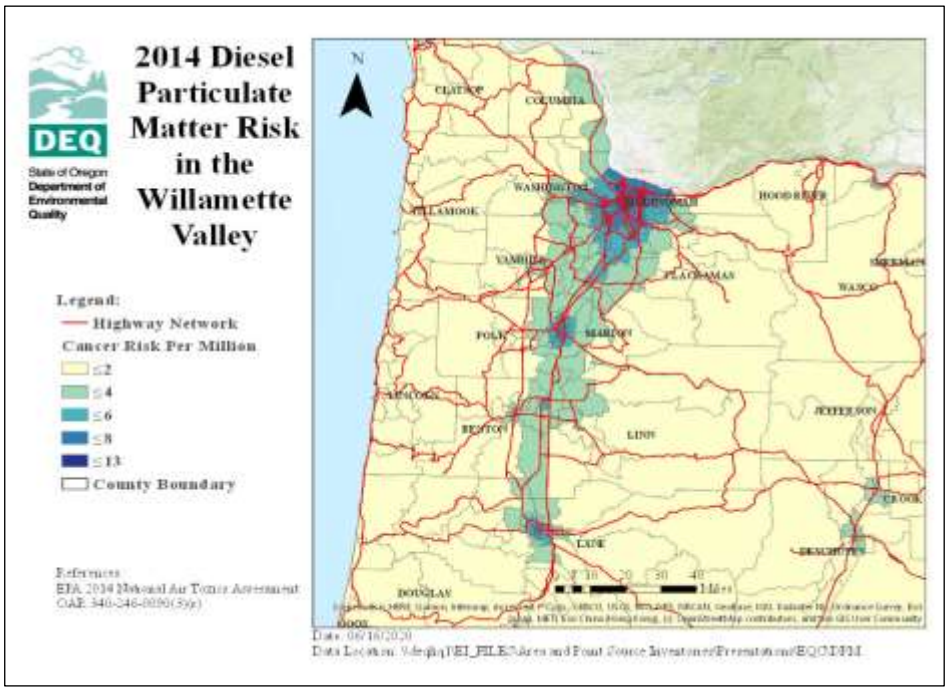
DEQ staff are synthesizing the report and its findings. At a high-level, key findings include:

- Total statewide emissions of criteria air pollutants from non-road diesel engines as estimated by the National Emissions Inventory are comparable to those estimated under the enhanced Non-road Emissions Inventory study. This analysis excluded locomotive, commercial marine, aircraft and stationary diesel engines.
- Agriculture sector emissions account for a larger share, at the statewide level, than previously estimated.
- Construction sector activity and emissions account for a smaller share at the statewide level than previously estimated, but still are a significant source of emissions in certain areas of the state.
- The relative contribution of sources varies substantially across Oregon's counties. For example, construction is the largest source in Multnomah County, logging in Lane County and agriculture in Klamath County.

DEQ uses dispersion modelling to estimate the ambient concentrations of particular pollutants found in the air at a certain place and time. Dispersion modeling uses air quality monitoring, emissions inventory, meteorological, and other data to model concentrations of air pollutants in the air across a defined geography. Dispersion modeling is widely used by regulators, researchers and regulated entities to evaluate air quality. It is the only way of characterizing concentrations of pollutants at a fine scale across a community or geography.

The most comprehensive dispersion model is the National Air Toxics Assessment. NATA is EPA's review of air toxics in the United States. EPA developed NATA as a screening tool for state, local and tribal air agencies. The results include ambient concentrations and associated human health risks at the national, state, county and sub-county levels. The maps below illustrates the degree to which emissions at the census-tract level exceed the state's Ambient Benchmark Concentration (0.1 ug/m3) for diesel.





These data represent census-tract level averages. Certain areas, such as those very near to high traffic corridors, experience ambient concentration of diesel particulate matter much higher than the corresponding census tract average.

Ambient Benchmark Concentrations serve as risk evaluation benchmarks and as targets for risk reduction planning. Oregon's benchmarks represent ambient concentrations that would result in a cancer risk of one-in-a-million additional cancers based on a lifetime of exposure. The State of California Office of Environmental Health Hazard Assessment has also identified a toxicity reference associated with an excess cancer risk of one in one million. Applying California's much more stringent value, of 0.003 ug/m3, would result in Oregon counties experiencing levels of diesel particulate matter pollution hundreds of times over the health benchmark.

DEQ has also conducted more refined dispersion modeling in a narrowly-defined geographical area for diesel particulate matter as part of the Portland Air Toxics Assessment. That comprehensive assessment included:

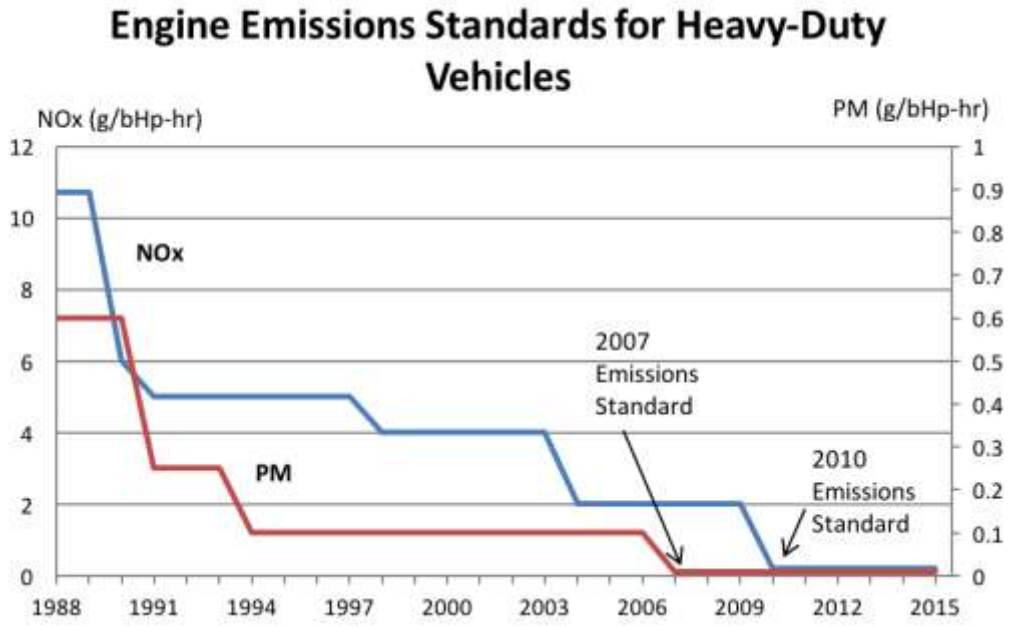
- A region-wide assessment of diesel particulate matter concentrations. This refined spatial analysis showed nearly all areas of the Portland-metro area experience unhealthy levels of diesel particulate matter and that certain areas experience levels over 10 times Oregon's Ambient Benchmark Concentration.
- An Environmental Justice analysis that demonstrated communities of color and lower-income communities are disproportionately impacted by on-road sources of pollution, including diesel-powered vehicles.
- An analysis demonstrating that emissions of diesel particulate matter would need to decrease approximately 90 percent in order to achieve the levels in the air consistent with the state's Ambient Benchmark Concentration.

Federal regulatory framework

Under the Federal Clean Air Act, EPA has the authority to establish emission standards for new trucks and for a wide variety of diesel engines used in non-road equipment. In certain circumstances, the California Air Resources Board may also establish standards for new engines. Currently, EPA and CARB standards for new heavy-duty diesel engines are identical. At the federal level, there are no regulations governing the performance or emissions of "in-use" equipment. That is to say, the federal standards are designed to reduce emissions upstream by improving the performance of new engines as they are manufactured. As time progresses it is expected that those newer trucks will

represent an increasing share of trucks and equipment in use as older, higher-emitting engines are retired. However, the durability of diesel engines means a well-maintained engine can continue to operate for decades and the introduction of newer, cleaner, diesel engines is slow.

The figure below shows the history of diesel engines emission standards for heavy-duty diesel trucks. In this figure, "heavy-duty" means those greater than 14,000 pounds Gross Vehicle Weight Rating.. The federal standards establish limits on the emissions limits that new trucks must meet. The standards apply to the two pollutants of particular concern: diesel particulate matter (PM) and nitrogen oxides (NOx).

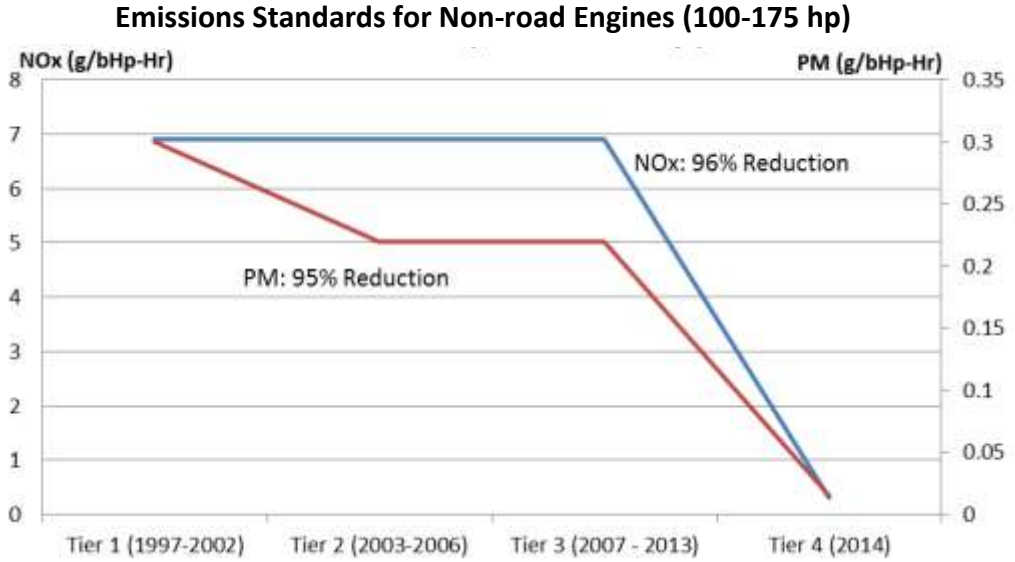


The emission limits have been revised to be more protective over the last thirty years. The current emissions standards are:

- Diesel particulate matter emissions not to exceed 0.01 g/bhp-hr for 2007 model year and newer engines; and
- Nitrogen oxide emissions not to exceed 0.2 g/bhp-hr for 2010 and newer model year engines.

In the non-road context, the standards are conceptually similar, limiting diesel particulate matter and NOx emissions for new engines but have been phased-in both over time and by engine horsepower. The figure below illustrates the emission standard history for engines with a horsepower rating between 100

and 175, which represents a typical backhoe. Because the standards have phased in over different periods of time depending on the engine size, their performance is typically noted by emission standard "tier" as opposed to engine model year like a heavy-duty truck. Tier 4 represents the newest and most protective emission standard.



Standards for locomotive engines, marine vessels and other non-road applications are found in separate regulations.

Next steps

DEQ staff will brief the commission in fall 2020 and winter 2020-2021 on:

- An inventory of existing policies and programs in Oregon designed to reduce diesel engine emissions.
- A review of the commission's relevant legal authorities pursuant to the Federal Clean Air Act and Oregon Revised Statutes.
- A review of new or modified rules DEQ intends to propose to the commission in the coming year, including rules governing the distribution of remaining Volkswagen Mitigation Settlement funds, rule updates needed to implement the Statewide Transportation Strategy, a program to certify and verify retrofit technologies used to comply with House Bill 2007 (2019), and rules governing a voluntary emissions labelling program for construction equipment.

Supporting materials

1. The Concerns about Diesel Engine Exhaust. Oregon DEQ, 2015. https://www.oregon.gov/deq/FilterDocs/DieselEffectsReport.pdf

2. Diesel and Health in America: The Lingering Threat
https://www.catf.us/wp-content/uploads/2019/02/CATF_Pub_Diesel_Health_America.pdf
3. Oregon Non-Road Diesel Equipment Survey and Emissions Inventory
https://www.oregon.gov/deq/aq/Documents/orNon-roadDieselRep.pdf
4. Portland Air Toxics Assessment and Solutions Process
https://www.oregon.gov/deq/FilterDocs/PortlandAirtoxics.zip

Report compiled from program information