



Puget Sound Maritime Air Emissions Inventory



Overview

What is the emissions inventory?

The Puget Sound Maritime Air Emissions Inventory identifies and quantifies pollutants emitted from maritime-related diesel equipment operating within the greater Puget Sound region. It was conducted voluntarily and proactively, in advance of any regulatory directive, to provide a strong technical foundation to support future policy decisions. The inventory is not a policy document and does not include policy recommendations.

Why was the inventory developed?

The greater Puget Sound region currently meets federal, state and local air quality standards, and project partners want to keep it that way. The purpose of this emissions inventory is to provide scientifically valid data to improve understanding of the nature, location, and magnitude of emissions from maritime-related operations, which will aid in the planning and prioritization of pollution prevention investments in the region.

Who developed the emissions inventory?

The inventory was developed by Starcrest Consulting Group, LLC, in cooperation with members of the Puget Sound Maritime Air Forum (Forum), a voluntary association of private and public maritime organizations, ports, air agencies, environmental, public health advocacy groups, and other parties with operational or regulatory responsibilities related to the maritime industry. The Forum is committed to accurately quantifying and voluntarily reducing air emissions associated with the maritime transportation of freight and passengers. The emissions inventory is the first major product of this collaboration.

What does it measure?

This emissions inventory is unprecedented in scope. It estimates tons per year of emissions from maritime-related activities within the U.S. portion of the Puget Sound / Georgia Basin International Airshed for the base year 2005 (see Figure 1). This area spans approximately 140 miles south to north and

160 miles west to east, at its extremities. The project was closely coordinated with Environment Canada, the BC Chamber of Shipping and others who were concurrently preparing a similar emissions inventory for Georgia Basin.

Pollutants in the inventory include relevant U.S. Environmental Protection Agency (EPA) criteria pollutants and precursors (carbon monoxide, nitrogen oxides, sulfur dioxides, volatile organic compounds and particulate matter); greenhouse gases (carbon dioxide, methane and nitrous oxide); and diesel particulate matter. This is the first emissions inventory in the United States to include a detailed, activity-based inventory of greenhouse gases for maritime related sources.



Figure 1: Puget Sound / Georgia Basin International Airshed

Data was gathered for the following six major source categories associated with marine activities: ocean-going vessels (such as cargo and cruise ships, tankers); harbor vessels (tugs, ferries, recreational vessels, etc); cargo handling equipment (cranes, straddle carriers, forklifts, etc.); on-road heavy-duty vehicles (trucks, buses, etc.); on-terminal fleet vehicles (passenger cars and trucks); and rail operations. Military operations and equipment were not included due to security considerations.

Why does the inventory focus on diesel engines?

Marine diesel engines, like all diesel engines, are significant generators of fine particles and toxic emissions. Exposure to these pollutants can contribute to increased rates of lung cancer, chronic respiratory and cardiovascular disease, and other health effects. Diesel emissions also contribute to acid deposition, climate change and impaired visibility. Given these implications for public health and the environment, the reduction and minimization of these emissions are a top priority of the Forum. This inventory will help identify where pollution prevention efforts could provide the best public benefit.



While the EPA has not yet listed diesel exhaust emissions as a hazardous air pollutant, it is important to note that federal regulations are in place to require dramatically cleaner fuels and new diesel engines in the future. In the meantime, however, Forum members are proactively working together to achieve early emissions reductions from maritime-related operations to protect public health and the environment.

What are the findings?

Total emissions from maritime-related sources in the greater Puget Sound region are summarized in Table 1.

Table 1: Puget Sound 2005 Maritime Air Emissions Inventory Summary, tons per year

Source Category	NOx	VOC	CO	SO ₂	PM ₁₀	PM _{2.5}	DPM	Greenhouse Gases, CO ₂ eq
Ocean-going vessels:								
Hotelling	2,259	74	191	4,229	262	209	131	274,421
Maneuvering	313	24	33	191	22	17	21	12,481
Transiting	11,390	399	932	7,953	709	566	663	496,844
Harbor vessels	9,555	3,363	16,854	529	495	456	445	689,649
Rail, off-terminal	1,285	57	166	96	35	32	32	59,854
Rail, on-terminal	1,180	67	154	93	35	32	35	48,135
Cargo handling equipment	1,155	103	918	80	74	72	74	111,592
Heavy-duty vehicles, off-terminal	1,120	58	307	35	45	39	39	156,242
Heavy-duty vehicles, on-terminal	203	18	148	4	4	4	4	17,845
Fleet vehicles	10	5	50	0	0	0	0	3,365
Total	28,469	4,167	19,752	13,211	1,682	1,427	1,444	1,870,429

Legend

Transiting:	Vessel is traveling within the study area
Hotelling :	Vessel is at berth or anchor
Maneuvering:	Slow speed vessel operations while in-ports
Rail off-terminal:	Maritime-related rail activity occurring away from the marine terminals but within the study area.
Rail on-terminal:	Rail activity occurring on or nearby a marine terminal
HDV off-terminal:	Port-related truck activities (i.e., drayage) occurring near marine terminals and within the boundary of the study area.
HDV on-terminal:	Truck activities occurring at or on marine or rail terminals, including idling at terminal gates, and idling and traveling within terminals.

Findings, continued...

The Puget Sound Maritime Air Emissions Inventory shows that in 2005 maritime-related sources were responsible for the following percentages of emissions, which are broken down by regional Clean Air Agency jurisdiction:

Northwest Clean Air Agency

(Island, Skagit and Whatcom Counties)

- 16% of oxides of nitrogen
- 6% of volatile organic compounds
- 5% of carbon monoxide
- 19% of sulfur dioxide
- 6% of fine particulate matter, and
- 40% of diesel particulate matter.

Olympic Region Clean Air Agency

(Clallam, Grays Harbor, Jefferson, Mason, Pacific, and Thurston Counties)

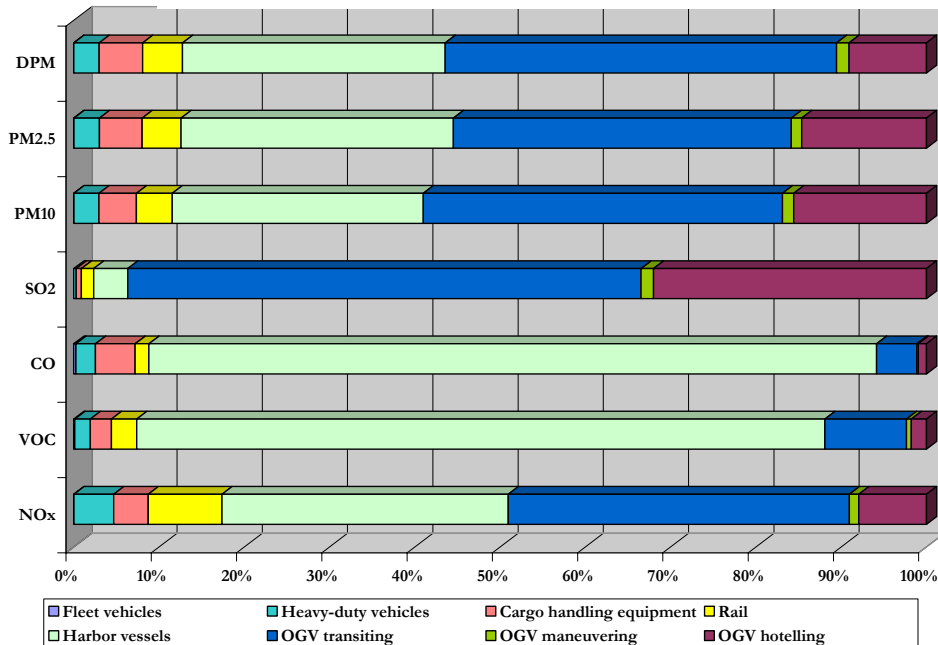
- 40% of oxides of nitrogen
- 4% of volatile organic compounds
- 2% of carbon monoxide
- 83% of sulfur dioxide
- 13% of fine particulate matter, and
- 66% of diesel particulate matter.

Puget Sound Clean Air Agency

(King, Kitsap, Pierce and Snohomish Counties)

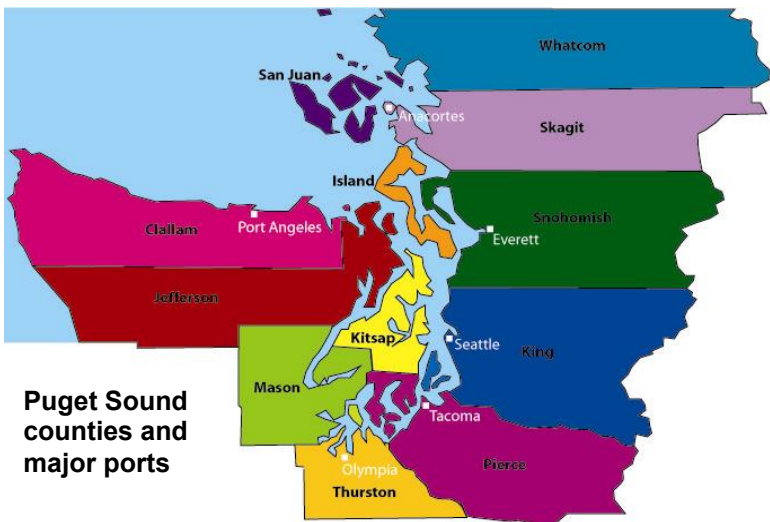
- 11% of oxides of nitrogen
- 2% of volatile organic compounds
- 1% of carbon monoxide
- 33% of sulfur dioxide
- 4% of fine particulate matter, and
- 28% of diesel particulate matter.

Puget Sound 2005 Maritime Emissions Inventory Summary, percent (%)



Please see the full report for details regarding emissions from each source category.

The report can be downloaded at maritimeairforum.org.



Puget Sound counties and major ports

Technical Approach

Data and technical guidance for this study was collected from ports, and individuals and companies (or their representatives) that own, operate, maintain and/or charter the equipment and vessels. Contributors included ports, terminal owners, vessel captains and engineers, equipment operators and others having first-hand knowledge of either equipment details or operational parameters. Data also was provided by regional Clean Air Agencies, other government agencies and industry associations. Forum members and the consultant worked with regulatory agencies to project activity or emissions levels for those facilities not actually surveyed in accordance with the Technical Approach, which is described in detail in the report.

Cautionary notes

This emissions inventory has been prepared in sufficient detail to provide the maritime community, regional air agencies and others with a scientific baseline to develop and measure regional air policy in the future. Total emissions, however, do not tell the whole story. The characteristics, duration and distribution of emissions are also important to consider. A ton of pollutants emitted near a dense urban environment, for example, is of greater significance to public health than the same emissions distributed over a sparsely-populated 100 mile area. This inventory will help identify where emission reductions could provide the best public health benefit.

It is also important to view this inventory in context with other sources of air emissions in the region. Marine-related sources are one component of total air emissions sources present in the Puget Sound air basin. Other categories that affect air quality include point sources (refineries, manufacturing facilities, etc.), on-road mobile sources (cars, trucks, buses and motorcycles), non-road equipment (construction equipment, farming equipment, etc.), and stationary area sources (home wood heating, open burning, auto body shops, etc.).

Who funded the emissions inventory and how much did it cost?

The cost of the inventory is estimated at roughly \$520,000, not including substantial in-kind contributions from project participants. Financial support was provided by the U.S. Environmental Protection Agency and members of the Forum's Steering Committee, which includes: American Lung Association of Washington and Idaho, BNSF Railway, Northwest Clean Air Agency, Northwest CruiseShip Association, Olympic Region Clean Air Agency, Pacific Merchant Shipping Association, Port of Everett, Port of Seattle, Port of Tacoma, Puget Sound Clean Air Agency, Washington State Department of Ecology, Washington State Ferries and Western States Petroleum Association.

What's being done now to reduce maritime air pollution?

In addition to participating in the emissions inventory project, Forum partners are also working within their own organizations, in local initiatives, nationally and internationally on efforts to reduce emissions. The Port of Seattle, Port of Tacoma and Vancouver Fraser Port Authority in British Columbia, for example, are collaborating on a joint action plan for reducing air emissions from their operations.



Other actions being implemented by Forum partners include switching to cleaner fuels, using shore power instead of ship engines when cruise ships are in port, replacing old engines with cleaner engines, retrofitting older engines with advanced pollution control devices, rebuilding engines, and implementing systems to use equipment more efficiently. Additionally, a number of important pilot projects are underway to test new technologies and fuels, such as a seawater scrubber demonstration project, and alternative fuels testing on different types of equipment.

The voluntary reductions achieved to date by the maritime industry in the Puget Sound region and other West Coast ports are unprecedented among industrial sectors.

What's next?

With maritime operations expected to grow significantly in the future, the ongoing commitments by Forum participants to minimize pollution are critical. This inventory provides the most complete picture to date of maritime-related emissions in the greater Puget Sound region. Review and assessment of this data will enable the maritime community to better design and implement cost-effective, fact-based air pollution control strategies to help maintain air quality standards, minimize health risks and protect the environment. Continued industry leadership by the Forum will play a key role in stimulating early action. To that end, the Forum will continue to facilitate the sharing of technical expertise and funding support for diesel emission reduction projects, and invites further collaborative work by interested parties on these efforts.

For more information about the Puget Sound Maritime Air Forum or to download the Puget Sound Maritime Air Emissions Inventory, visit www.maritimeairforum.org.