

APPENDIX B | EMISSIONS INVENTORIES

Port of Seattle GHG Emissions Inventories

An emissions inventory estimates the amount of air pollutant or GHG emissions from a source or operation, using globally recognized protocols.²⁶ These protocols define three types (scopes) of emissions.

- **Scope 1 GHG emissions** are direct emissions from sources that are owned or controlled by the organization
- **Scope 2 GHG emissions** are indirect emissions from sources that are controlled by the organization
- **Scope 3 GHG emissions** are from sources not owned or directly controlled by the organization

Activity levels (such as hours of operation, power load, miles traveled) are multiplied by emission factors to calculate the amount of pollutant emitted.

Results are typically expressed in MT per year of the relevant air pollutant. GHG inventories usually report results for individual GHGs, or in carbon dioxide equivalents (CO₂e) per year. CO₂e is a composite measure of various GHG based on their global warming potential, which converts all GHG to the equivalent amount of CO₂.

Two Categories of Emissions and Two Types of Inventories

The Port’s maritime-related emissions fall into two distinct categories and each category is inventoried in a separate manner. Results from both inventories have been consolidated to form a complete picture of maritime-related emissions.

Table B-1. Port air and GHG emission categories, sectors, and inventory methods

| Category: Maritime Activity (Scope 3) | Category: Port Maritime Administration (Scope 1, 2, or 3 as noted) |
|---|---|
| Sectors: <ul style="list-style-type: none"> • Ocean-going vessels • Harbor craft (includes tugs, commercial fishing vessels and recreational vessels) • Locomotives • Cargo-handling equipment • Cruise buses on terminals | Sectors: <ul style="list-style-type: none"> • Port-owned building & campus energy (includes tenant-occupied space) • Port-owned fleet vehicles & equipment • Port employee commuting (Scope 3) • Solid waste (Scope 3) Employee business air travel (Scope 3) |

²⁶ Greenhouse Gas Protocol, [Corporate Accounting and Reporting Standard](#).

| <p>Category: Maritime Activity (Scope 3)</p> | <p>Category: Port Maritime Administration (Scope 1, 2, or 3 as noted)</p> |
|--|---|
| <p>Inventory Method:</p> <ul style="list-style-type: none"> • Port of Seattle emissions extracted from Puget Sound Maritime Air Emissions Inventory • Conducted every 5 years, including 2005 baseline, 2011, and 2016 • Includes air pollutants and GHG • Covers air pollutants and GHG | <p>Inventory Method:</p> <ul style="list-style-type: none"> • Maritime internal GHG inventory per Greenhouse Gas Protocol Corporate Reporting Standard • Conducted annually, including 2005/2007 baselines, 2011, 2015 and beyond • GHG only |

The **Maritime Activity** category includes externally controlled ships, harbor craft, recreational vessels, locomotives, vehicles, and cargo-handling equipment that are associated with the Port cruise terminals, grain terminal, and marinas. The Port is the hub for these sources but has limited influence over them.

The Port has collaborated with other ports, agencies, and organizations to conduct a regional inventory of these sectors — the Puget Sound Maritime Air Emissions Inventory (Inventory) — on a 5-year cycle.²⁷ The Inventory was conducted for calendar years 2005, 2011, and 2016. The next Inventory will be conducted for the year 2021. The Inventory quantifies emissions for criteria air pollutants as well as CO₂e and black carbon (soot).²⁸ Results are



Figure B-1. U.S. portion of the Georgia Basin-Puget Sound International Airshed used for emission inventory and emission reduction planning for Maritime Activity emissions (not applicable to Port Maritime Administration emissions).

²⁷ Puget Sound Maritime Air Forum, [2016 Puget Sound Maritime Air Emissions Inventory](#).

²⁸ The CO₂e emissions reported in the Inventory include CO₂, methane, and nitrous oxide; these are the GHG pollutants associated with maritime industry fuels. Because Port of Seattle uses CO₂ as the indicator pollutant to track progress, the CO₂e values reported in the Inventory are treated as surrogates for CO₂ value in Port reporting.

compiled by port and by sector. Maritime Activity GHG emissions for years 2005, 2011, and 2016 have been extracted from the Puget Sound Maritime Air Emissions Inventory inventories and combined with emission totals for Port Maritime Administration sources.

The **Port Maritime Administration category** includes facilities, equipment, and associated activities that the Port can control directly or guide in its role as property owner, landlord, and employer. The sectors that fall under this category are Port-owned buildings including office buildings, maintenance shops, marinas, terminals, commercial and industrial rental properties, and conference centers; Port-owned fleet vehicles, equipment, and vessels; solid waste from Port-owned facilities; Port employee commuting; and Port employee business air travel. Collectively these sectors contribute 6 percent of emissions. Port Maritime has conducted internal GHG inventories of annual Port Maritime Administration emissions for 2005 and 2007 (baseline years), 2011, and annually from 2015 on. The maritime inventories report GHG emissions in Metric tons CO₂.²⁹ These inventories follow the Greenhouse Gas Protocol Corporate Reporting Standard but have not been third-party verified.³⁰

Data Quality

Both the Inventory and internal Maritime GHG inventories use a mix of source-specific data and surrogate data (estimated activity and/or emissions). Because the Inventory is only conducted every 5 years, emissions from Maritime Activity in non-inventory years are assumed to be static until the next inventory cycle.

For the internal Maritime GHG inventories, surrogate data from the closest year was used to fill in missing years' information. There was less data available for the baseline years of 2005 and 2007, thus requiring use of surrogate data for some sectors. In subsequent years, data quality has improved, and the Port has identified additional tenant-managed properties to include as Scope 3 sources.

The Port has a wide variety of utility meters and submeters throughout its building and facilities and in some cases, multiple users share a single meter. When direct energy use by tenants is unknown, that usage is considered "Port-managed" energy use and is attributed to the Port as a Scope 1 or Scope 2 source. Energy metered directly to individual tenants is considered "tenant-managed" use, which is classified as a Scope 3 source. This data limitation results in an overestimation of GHG emissions from campus energy that is attributed to the Port vs. tenants.

²⁹ The Port Maritime internal GHG inventories use CO₂ as the indicator pollutant. For the solid waste and employee commute sectors, modeling methodologies report results in CO₂e, which the Port applies as a surrogate value for CO₂.

³⁰ Greenhouse Gas Protocol, [Corporate Accounting and Reporting Standard](#).

Table B-2. Port of Seattle Maritime GHG emissions 2005 – 2019 in metric tons CO₂. Inventories were completed for the Port's Century Agenda milestone years only, and then annually from 2015 (i.e., 2005, 2007, 2011, and annually from 2015).

| | GHG Scope | Baseline [^] (2005*/ 2007) | 2011* | 2015 | 2016* | 2017 | 2018 | 2019 | 2020 ^{^^} |
|-------------------------------------|--------------------------------------|---|---------------|----------------|----------------|---------------|---------------|---------------|--------------------|
| Maritime Activity** | | | | | | | | | |
| | Ocean-going vessel transit | 3 | 59,159 | 73,573 | 73,753 | 45,383 | 45,383 | 45,383 | 45,383 |
| | Ocean-going vessel hotel/maneuver | 3 | 11,732 | 13,517 | 13,517 | 13,156 | 13,156 | 13,156 | 13,156 |
| | Harbor craft | 3 | 2,967 | 3,726 | 3,726 | 4,083 | 4,083 | 4,083 | 4,083 |
| | Recreational vessels | 3 | 7,867 | 6,854 | 6,854 | 6,701 | 6,701 | 6,701 | 6,701 |
| | Locomotives | 3 | 7,545 | 6,239 | 6,239 | 4,540 | 4,540 | 4,540 | 4,540 |
| | Cargo-handling equipment | 3 | 3,926 | 407 | 407 | 354 | 354 | 354 | 354 |
| | Cruise buses on terminals | 3 | 13 | 13 | 13 | 15 | 15 | 15 | 15 |
| | subtotal | | 93,208 | 104,329 | 104,329 | 74,231 | 74,231 | 74,231 | 74,231 |
| Port Maritime Administration | | | | | | | | | |
| | Building electricity, Port-managed | 2 | 449 | 146 | 452 | 281 | 289 | 299 | 296 |
| | Building electricity, tenant-managed | 3 | 797 | 207 | 767 | 439 | 536 | 520 | 547 |
| | Building natural gas, Port-managed | 1 | 593 | 530 | 606 | 689 | 843 | 1,061 | 1,009 |
| | Building steam, Port-managed | 2 | 348 | 365 | 0 | 0 | 0 | 0 | 0 |
| | Remediation propane | 1 | 0 | 0 | 0 | 0 | 0 | 101 | 180 |
| | Vehicle fleet | 1 | 867 | 694 | 820 | 802 | 871 | 986 | 888 |
| | Solid waste** | 3 | 139 | 139 | 139 | 185 | 188 | 190 | 198 |
| | Employee commuting** | 3 | 1,021 | 1,282 | 1,345 | 1,392 | 1,305 | 1,335 | 1,254 |
| | Employee air travel** | 3 | 100 | 100 | 100 | 86 | 86 | 125 | 125 |
| | subtotal | | 4,312 | 3,463 | 4,229 | 3,875 | 4,118 | 4,517 | 3,075 |
| | Air travel offsets*** | | 0 | 0 | 0 | (86) | (125) | (125) | (15) |
| | net Port Admin. | | 4,312 | 3,463 | 4,229 | 3,789 | 4,392 | 4,544 | 3,060 |
| | NET EMISSIONS | | 97,520 | 107,792 | 108,558 | 78,020 | 78,623 | 78,775 | 77,291 |

- ^ Baseline value noted (2005 is baseline year for Scope 1 and 2 sources, 2007 is baseline year for Scope 3 sources)
- ^^ 2020 values do not represent typical emissions due to impacts of the COVID-19 pandemic on Port operations, and have not been included in GHG emission projections included in this Plan
- * Inventory years for the Puget Sound Maritime Air Emissions Inventory
- ** Emissions from this category were calculated in CO₂e; this is proxy for the CO₂ totals reported here
- *** The Port of Seattle began buying carbon offsets for business air travel emissions in 2016

Table B-3. Maritime Activity air pollutant emissions for 2005, 2011, and 2016 in tons/year.³¹ Maritime Activity air pollutant emissions for years 2005, 2011, and 2016.

| * | NO _x | VOC | CO | SO ₂ | PM ₁₀ | PM _{2.5} | DPM | BC |
|--------------------------|-----------------|--------------|----------------|-----------------|------------------|-------------------|--------------|-------------|
| 2016 | | | | | | | | |
| Ocean-going vessels | 1,174 | 41 | 102 | 41 | 23 | 21 | 22 | 1 |
| Harbor craft | 75.7 | 2.40 | 12.51 | 0.04 | 2.49 | 2.29 | 2.49 | 1.76 |
| Recreational vessels | 52.4 | 94.0 | 657.9 | 0.1 | 2.0 | 1.8 | 0.3 | 0.5 |
| Locomotives | 61.6 | 2.7 | 13.1 | 0.1 | 1.6 | 1.5 | 1.6 | 1.2 |
| Cargo-handling equipment | 6.0 | 1.1 | 18.0 | 0.0 | 0.3 | 0.3 | 0.3 | 0.2 |
| Heavy-duty vehicles | 0.3 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Fleet vehicles | 0.9 | 0.2 | 3.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2016 total | 1,370.6 | 141.6 | 807.6 | 41.4 | 29.0 | 27.2 | 26.9 | 4.9 |
| 2011 | | | | | | | | |
| Ocean-going vessels | 1,729.2 | 57.8 | 137.4 | 1,335.2 | 166.2 | 132.8 | 164.1 | 4.0 |
| Harbor craft | 68.4 | 2.34 | 10.47 | 0.04 | 2.72 | 2.50 | 2.73 | 1.93 |
| Recreational vessels | 57.5 | 135.4 | 826.6 | 0.1 | 2.8 | 2.6 | 0.4 | 0.6 |
| Locomotives | 107.8 | 6.1 | 18.0 | 1.0 | 4.0 | 3.6 | 4.0 | 2.8 |
| Cargo-handling equipment | 5.3 | 0.9 | 20.7 | 0.0 | 0.2 | 0.2 | 0.2 | 0.1 |
| Heavy-duty vehicles | 0.4 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Fleet vehicles | 1.3 | 0.3 | 5.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2011 total | 1,970.0 | 202.8 | 1,018.2 | 1,336.3 | 175.9 | 141.7 | 171.4 | 9.6 |
| 2005 | | | | | | | | |
| Ocean-going vessels | 1,506.6 | 51.6 | 120.8 | 981.4 | 141.6 | 113.0 | 139.7 | 3.4 |
| Harbor craft | 57.8 | 1.83 | 7.57 | 6.08 | 2.52 | 2.32 | 2.52 | 1.79 |
| Recreational vessels | 56.1 | 198.2 | 1,221.4 | 1.8 | 4.2 | 3.9 | 0.5 | 0.9 |
| Locomotives | 172.0 | 8.3 | 22.8 | 13.9 | 4.8 | 4.4 | 4.8 | 3.4 |
| Cargo-handling equipment | 33.3 | 34.8 | 1,133.9 | 0.8 | 1.9 | 1.8 | 1.6 | 1.2 |
| Heavy-duty vehicles | 0.5 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Fleet vehicles | 2.6 | 0.7 | 11.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2005 total | 1,829.0 | 295.4 | 2,518.0 | 1,004.1 | 155.0 | 125.4 | 149.2 | 10.7 |

***Key to abbreviations in column headers:**

NO_x: nitrogen oxides

VOC: volatile organic compounds

CO: carbon monoxide

SO₂: sulfur dioxide

PM₁₀: particulate matter 10 micrometers or less in diameter

PM_{2.5}: particulate matter 2.5 micrometers or less in diameter

DPM: diesel particulate matter

BC: black carbon

³¹ Puget Sound Maritime Air Forum, [2016 Puget Sound Maritime Air Emissions Inventory](#). Excerpt from Tables 9.59 and 9.60.