

SECTION 4 | STRATEGIES TO REDUCE IMPACTS: MARITIME ACTIVITY

Maritime Activity Sectors Can Chart a Course to Zero by Implementing 19 Strategies

The Port has influence, but not control, over Maritime Activity sectors that produce GHG Scope 3 emissions: the ships, harbor vessels, trains, and equipment that account for 94 percent of the Port's total maritime emissions. The Port can influence decisions through partnerships, programs, and lease terms, for example. The Port can also play a leadership role by advocating for new technologies and fuels.

The Plan identifies 19 strategies across five sectors to reduce Maritime Activity emissions by 2030 and make progress toward the 2020 Strategy 2050 vision. These strategies align with the shared objectives of participating ports in the 2020 Strategy:²¹

- **Continually improve efficiency and reduce emissions.** Until zero-emission options are viable, efficiency improvements can reduce emissions of both GHG and DPM. In some sectors, old high-emitting diesel engines can be replaced with new diesel engines equipped with advanced emission controls that will significantly reduce DPM emissions. Improved equipment efficiencies can also reduce GHG emissions by reducing fuel use.
- **Provide infrastructure needed to support zero-emission equipment.** As industry identifies preferred technologies to phase out emissions, investment in infrastructure will be required to ensure that those technologies and fuels are available at the Port. The Port can play a role in ensuring that barriers to the installation of zero-emission infrastructure at the point of charge or fueling are minimized by working with government, industry, and utilities to plan for power capacity and fuel supply needs.
- **Demonstrate and adopt zero-emission equipment.** In most cases, suitable zero-emission technologies and fuels needed for maritime applications are not readily available or affordable. The Port can advance new technologies by supporting pilot projects and can adopt small-scale zero-emission technologies in Port-owned workboats and cargo-handling equipment.

In addition to sector-specific strategies that address these three themes, the Plan includes cross-sector strategies that will enable future action across the board. These strategies are foundational to achieving deep decarbonization in Port activities, focusing on cross-industry energy planning; green leasing; regulatory policy advocacy; and engagement with community, industry, and government.

²¹ For more detail, see the [2020 Northwest Ports Clean Air Strategy](#).

CROSS-SECTOR MARITIME ACTIVITY

Strategies

XS1

Facilitate cross-industry clean energy planning

XS2

Leverage green lease terms

XS3

Advocate for local, state, and federal policy and funding that supports climate action

XS4

Engage with community, industry, and government

Cross-sector strategies enable future action toward a zero-emission future across multiple sectors.

CROSS-SECTOR MARITIME ACTIVITY

Context

Phasing out emissions from Maritime Activity involves not only sector-specific strategies, but also a cross-sector (XS) focus on across-the-board issues that are tackled most effectively with a holistic approach. The Plan identifies four XS strategies that will enable future action. These XS strategies are foundational to meeting 2020 Strategy objectives to support continual improvements in efficiency and emission reductions, while concurrently promoting transition to zero-emissions infrastructure and equipment. The action timeframe goals include 1-3 years, 5 years, and 10 years consistent with the 2020 Strategy objectives.

Strategies to 2030

XS1

Facilitate cross-industry clean energy planning. The Seattle Waterfront Clean Energy Strategy (SWCES) will develop and deliver a harbor-wide maritime energy distribution system and infrastructure to provide zero-emission energy for port, maritime, industrial, and other waterfront uses. The Port will work with Seattle City Light, NWSA, maritime industry, and others to evaluate future energy and electrical grid needs, costs, technology choices, enabling policy, resilience, and other elements essential to decarbonize Seattle’s waterfront maritime industry. The SWCES impacts all sectors addressed in the Plan and represents a critical early planning action toward phasing out emissions by 2050.

Actions	By 2025
	<ul style="list-style-type: none"> ◆ Complete the Seattle Waterfront Clean Energy Strategy, in collaboration with NWSA, Seattle City Light, NGOs, clean tech and maritime industry partners ◆ Engage Port tenants and maritime industry on barriers to zero-emission infrastructure and equipment adoption ◆ Evaluate lifecycle emissions of alternative fuels used in seaport applications ◆ Form one or more maritime clean energy partnerships to collaborate on research development, and demonstration of projects to support zero-emission technology for maritime applications ◆ In collaboration with SWCES partners, develop and implement a coordinated strategy to attract funding and support joint projects to implement SWCES-recommended projects
	By 2030
	<ul style="list-style-type: none"> ◆ Work with partners to design and construct energy infrastructure capital improvements to address power supply constraints, improve resiliency and reliability, and facilitate industry transition to zero-emission energy
Actions	Ongoing
	<ul style="list-style-type: none"> ◆ Conduct periodic zero-emissions technology assessments to evaluate the status of technology and supporting infrastructure needed for zero-emission operations

XS2

Leverage green lease terms. “Green” lease terms are environmental requirements within a lease agreement that encourage or require port tenants to adopt practices that, among other environmental actions, reduce emissions or energy use. The Port is a “landlord port,” meaning that much of port-owned land and properties are leased to private companies; therefore, the emissions from those companies are not under direct Port control. Adding green lease terms to the Port’s Maritime and Economic Development Divisions’ eligible leases is a critical step to help reduce emissions from Port tenants’ operations across all sectors identified in this Plan. Green leasing can bolster Port Maritime Administration strategies for solid waste and building and campus energy. Green leasing is also applicable to Maritime Activity sectors, depending on the nature of the Port’s business relationship with vessel, vehicle, and equipment owners. The first step to leverage green leasing for emissions reduction is to develop a standard set of lease terms and then to pilot those terms with tenants as lease negotiation opportunities arise.

Actions	By 2025
	<ul style="list-style-type: none"> ◆ Research green leasing approaches and develop a library of lease terminology to advance sustainability and emission reduction goals ◆ Inventory maritime property leases and identify near-term opportunities to incorporate green lease terms ◆ Engage tenants and pilot green lease terms where opportunities arise with new leases
	By 2030
	<ul style="list-style-type: none"> ◆ Incorporate green lease terms into all new and renewed landside leases

Washington Clean Fuel Standard: Maritime Industry Benefits

In 2021, the Washington State Legislature passed a Clean Fuel Standard that will curb carbon emissions from transportation. The law requires fuel suppliers to gradually reduce the carbon intensity of transportation fuels to 20 percent below 2017 levels by 2038 through improved efficiency, incorporating lower carbon fuels, or purchasing credits generated by low-carbon fuel providers. The Port advocated for the Clean Fuel Standard as a critical policy to help the maritime industry reduce GHG emissions and improve air quality in near-port communities. The policy can offer several benefits to the maritime industry beyond GHG reduction. These include lowering the cost of low carbon fuels compared to conventional fossil fuels, reducing DPM emissions from biodiesel and renewable diesel (34-70 percent), spurring innovation and new technology development, and creating new revenue opportunities.

Sources: Washington State Department of Ecology, Clean Fuel Standard and Western Washington Clean Cities, Renewable Diesel in Washington Fact Sheet.

XS3

Advocate for local, state, and federal policy and funding that supports climate action. The Port operates within the bounds of the legal authority delegated to it by the State of Washington. This authority provides defined opportunities for how the Port can influence and support climate action and air pollution reductions. In many cases, the actions required to achieve this plan's vision call for policy and funding action beyond the authority of the Port. Therefore, coordinated, and strategic policy and funding support will be needed from other local and regional jurisdictions and through state, and federal action. Policy change will be instrumental in achieving the 2020 Strategy vision and could create new revenue streams to support decarbonization across the maritime sector. Additionally, with the large amount of investment required to install infrastructure and purchase equipment to achieve the zero-emission objectives, external funding is needed to offset the costs of these investments. The Port will work with local, state, and federal agencies to advocate for existing sources of grant funding to continue and for new funding sources to support demonstration projects and the transition to zero-emission technology. The Port will also work with industry and community partners to identify priority projects in need of grant funding.

- Ongoing**
- ◆ Continue advocating for state and federal legislation and funding that supports advancement of MCAAP goals and strategies
 - ◆ Advocate for local utilities to achieve the 100 percent clean electricity supply requirement under the Washington state Clean Energy Transformation Act soon as possible ahead of the 2045 commitment
 - ◆ Identify new business models and financial strategies to support implementation
 - ◆ Collaborate on state and federal environmental port initiatives such as EPA's Ports Initiative and with industry organizations such as American Association of Port Authorities, and Washington Public Ports Association
 - ◆ Continue participating in Green Marine (a third-party voluntary environmental certification program for the marine industry, including ports) and maintain or exceed 2020 performance score

Actions



XC4

Engage with community, industry, and government. The 2020 Strategy and the Port’s implementation actions were informed by a multi-year engagement process that sought input from community, industry, government, and non-government representatives. Ongoing collaboration across the Port network is essential to achieve the Strategy vision and the Port’s GHG reduction goals. The Port will continue engaging partners in the implementation of the actions identified for each sector. The Port will collaborate to conduct pilot projects, pursue funding, share progress and to use community and industry input to prioritize actions that reduce air pollution in regions that need it most.

Actions	Ongoing
	<ul style="list-style-type: none"> ◆ Continue to engage the Duwamish Valley Community to define climate and air quality priorities, measures, and strategies for reducing emissions from Port operations and develop materials to increase understanding of Port emission sources, strategies, programs, and engagement opportunities ◆ Publicly communicate sustainability measures (e.g., shore power use, equipment replacements, efficiency measures), and implementation progress annually via Port channels ◆ Support workforce development and training for vessel and equipment operators and mechanics in Washington to operate and maintain zero-emission maritime equipment ◆ Encourage start-up businesses in Port-related industries to partner with the Port’s Maritime Innovation Center to focus on reducing emissions from the maritime sector ◆ Continuously improve regional air quality information, including evaluating options to inventory maritime emissions at the Port annually, quantify lifecycle emissions, and improve equity indicators to measure and inform implementation ◆ Prioritize WMBE and community-based businesses in contracting ◆ Support youth engagement, training, professional development, and connection to maritime careers through the Maritime High School, Port internship opportunities, and other youth engagement programs

WATERSIDE MARITIME ACTIVITY



Strategies

- OGV1** Install shore power at all major cruise berths by 2030
- OGV2** Support domestic and international efforts to phase out emissions from ocean-going vessels
- OGV3** Support continual advancements in equipment efficiency and emission reduction from ocean-going vessels
- HV1** Provide infrastructure to enable adoption of zero-emission harbor vessels by 2030
- HV2** Support accelerated turnover of harbor vessels to zero emissions models by 2050
- HV3** Support continual advancement in vessel efficiency and emission reduction for harbor vessels

Emissions: Scope 3

% of Port Maritime GHG 2019 emissions:

Ocean-going vessels 74%

Harbor vessels 14%

% of Port Maritime DPM 2019 emissions:

Ocean-going vessels 83%

Harbor vessels 11%

211

Cruise sailings from the Port in 2019

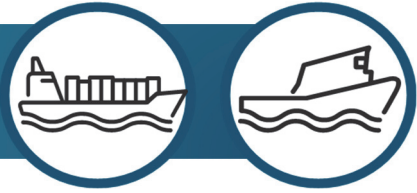
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Grain vessel shipments from the Port in 2019

Ocean-going vessels include grain and cruise ships that call at Port terminals. Harbor vessels include tugboats that assist ocean carriers, as well as commercial fishing vessels and recreational vessels that moor at Port marinas.

WATERSIDE MARITIME ACTIVITY SECTORS

OCEAN-GOING & HARBOR VESSELS



Context

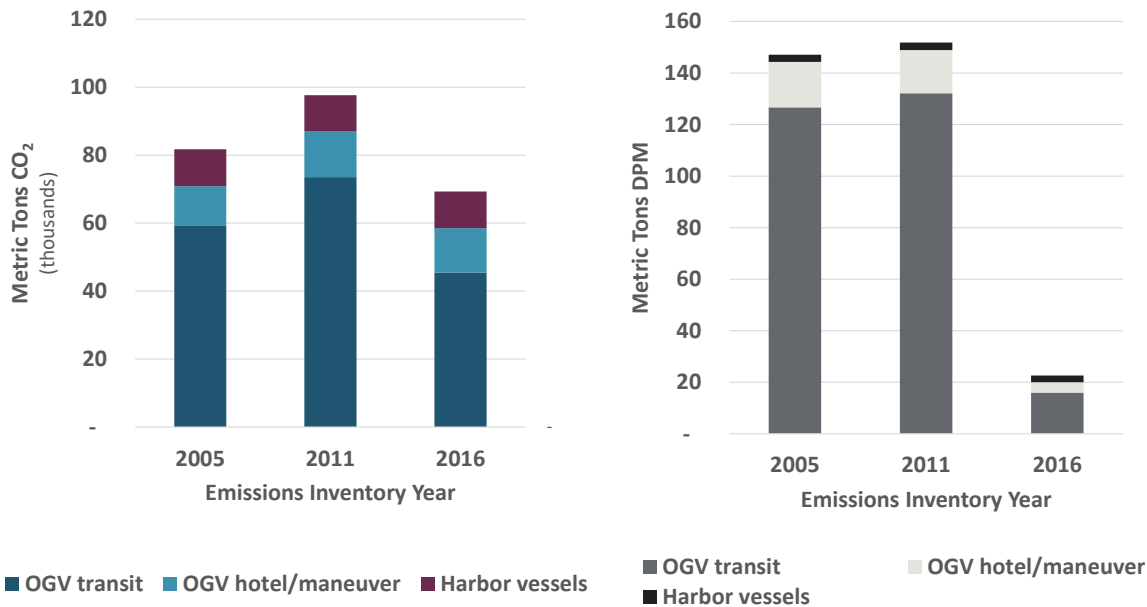
Ocean-going vessels calling at the Port include grain ships (bulk carriers) and cruise ships powered by diesel engines. Port emission inventories include the emissions generated while ships transit Puget Sound from the mouth of the Straits of Juan de Fuca to the Port, while maneuvering, at anchor, and while generating power at berth (hoteling). While hoteling, ships run diesel engines to meet energy needs unless they can connect to shore power and the berth is shore power equipped. To use shore power, both landside and on-ship infrastructure is needed. Many cruise ships are shore power-capable, but virtually no bulk carriers are so equipped.

Harbor vessels addressed in the Plan include tugboats that assist grain ships, as well as commercial fishing vessels and recreational vessels moored at Port marinas. Tugs, fishing vessels, and some recreational vessels are powered by diesel engines. Shore power is available at all the Port's commercial and recreational marinas and is widely used.

GHG emissions from waterside sectors were higher in 2011 than in 2005 due to a higher number of vessel calls. In 2016, GHG emissions from ocean-going vessels decreased due to more efficient, larger-capacity cruise ships and fewer grain calls. DPM emissions from waterside sectors declined steeply in 2016 due to use of shore power by some cruise ships at berth, regulatory changes requiring ocean-going vessels and large harbor vessels to burn low sulfur fuel, and far more advanced pollution controls on new vessel engines. These fuel and engine standards target air pollutants and have a minimal impact on GHG emissions.



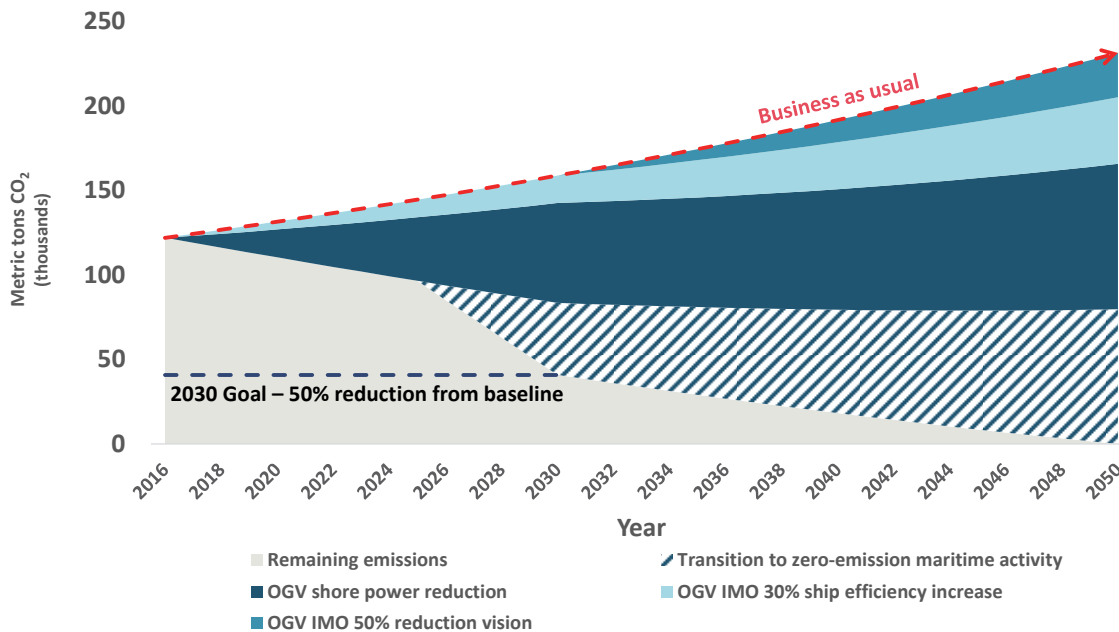
Figure 20. Annual GHG and DPM emissions from Maritime Activity waterside sources 2005 – 2016



Emissions were inventoried in the Puget Sound Maritime Air Emissions Inventories for years 2005, 2011, and 2016.

Strategies to 2030

Figure 21. Annual GHG emissions from Maritime Activity waterside sectors projected to 2050



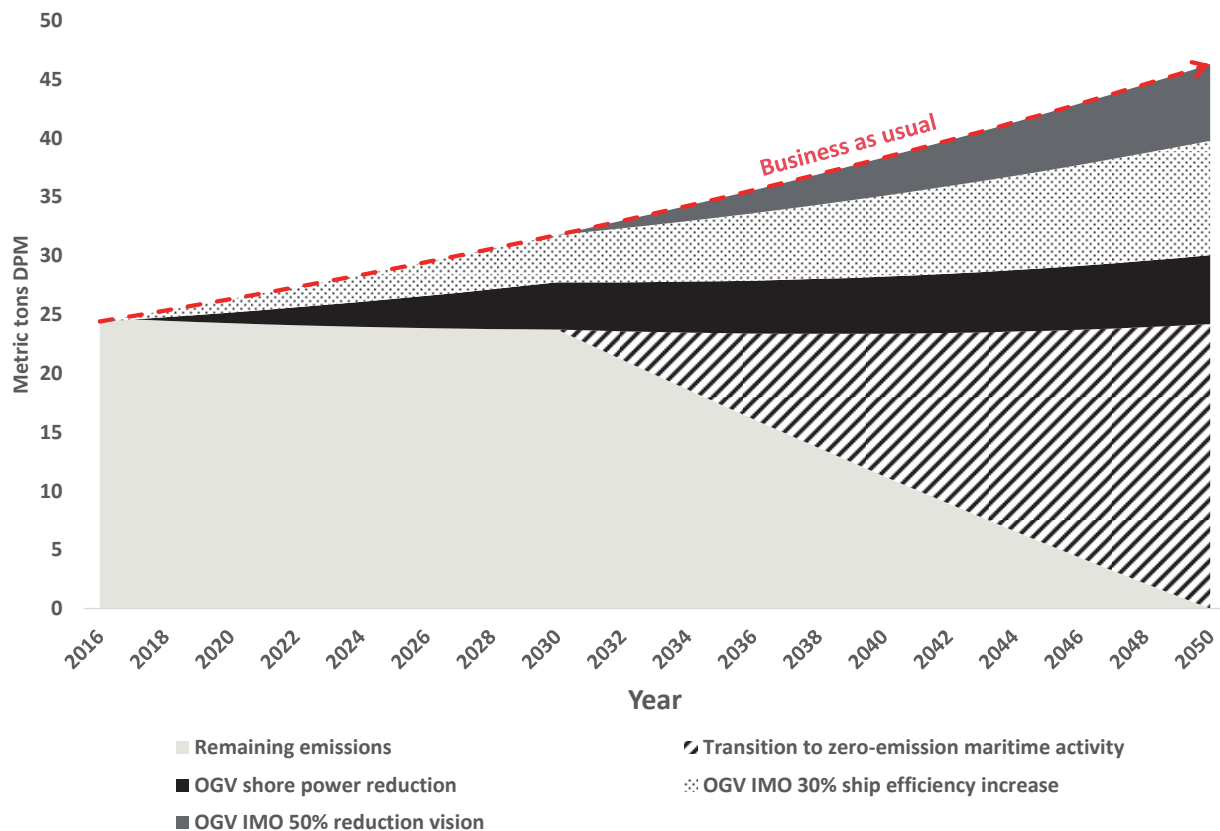
Annual emissions will continue increasing through 2030 under a business-as-usual scenario that includes projected growth and assumes that no further emission reduction actions are taken. Mandated vessel efficiency improvements and additional shore power will reduce emissions. Transition to zero-emission maritime activity represents reductions from strategies in this plan that are not quantified, and new/innovative technologies that will be required to meet the 2050 Northwest Ports Clean Air Strategy vision.

Success Story: Shore Power

Since 2005, the Port has provided cruise ships with shore power and in 2009, became the first cruise port in the world to provide shore power at two cruise berths. In 2019, 89 percent of shore power-capable ships (85 total calls) plugged into shore power at the Smith Cove Cruise Terminal at Terminal 91, which eliminated over 600 hours of onboard diesel engine use and an estimated 2,900 MT of CO₂ in just one season.



Figure 22. Annual DPM emissions from Maritime Activity waterside sectors projected to 2050



Annual emissions will continue increasing through 2030 under a business-as-usual scenario that includes projected growth and assumes that no further emission reduction actions are taken. Mandated vessel efficiency improvements and additional shore power will reduce emissions. Transition to zero-emission maritime activity represents reductions from strategies in this plan that are not quantified, and new/innovative technologies that will be required to meet the 2050 Northwest Ports Clean Air Strategy vision.

OCEAN-GOING VESSELS

OGV1

Install shore power at all major cruise berths by 2030. Shore power minimizes both GHG and DPM emissions and is currently the only zero-emission technology available for ships at berth. An increasing portion of cruise ships are equipped with shore power capability. As of 2020, the single berth facility at Pier 66’s Bell Street Pier Cruise Terminal does not have shore power for cruise vessels, but the Port plans to install a shore power connection by the 2023 cruise season.

Emissions Reduced Annually by 2030

**Approximately
13,000 MT CO₂ and 8 MT DPM
per year**
by installing additional shore power and maximizing connections

Actions	By 2025
	<ul style="list-style-type: none"> ◆ Install shore power at Pier 66 Cruise Terminal by 2023 and pursue funding to offset infrastructure costs ◆ Require shore power use by shore power-equipped homeport cruise ships at Terminal 91²² ◆ Require shore power use by shore power-equipped homeport cruise ships at Pier 66 and any future cruise berths upon installation and commissioning of new shore power system(s) ◆ Evaluate shore power delivery options and rate structure at Port facilities, working with cruise lines and utility providers
	By 2030
	<ul style="list-style-type: none"> ◆ Collaborate with cruise lines to increase the number of annual shore power equipped calls at the Port with a goal to reach 100 percent shore power-equipped homeport calls and a 100 percent connection rate by 2030 ◆ Evaluate feasibility, cost, and benefit of adding a second shore power connection to the west berth of Terminal 91 to increase opportunity of ships to plug in regardless of orientation
	Ongoing
	<ul style="list-style-type: none"> ◆ Collaborate with cruise lines annually to report on shore power utilization, best practices, and avoided emissions

²² The shore power requirement applies to shore power-equipped ships unless they are unable to connect (e.g., adverse weather conditions that would make the connection unsafe).

OGV2

Support domestic and international efforts to phase out emissions from ocean-going vessels. The Port will advocate to strengthen standards and policies at national and international levels to support the development sustainable maritime fuels and the transition to zero-emission vessel technologies. International policy engagement activities would be complemented by partnerships to support planning and research, market assessments focused on the Pacific Northwest, and pilot projects with industry partners.

Actions	By 2025
	<ul style="list-style-type: none"> ◆ Develop a national and international engagement strategy to advocate for strengthened standards, sustainable fuels, and the transition to zero-emission ocean-going vessels ◆ Evaluate and align with international decarbonization initiatives ◆ Identify partnerships for policy alignment and amplification, including with industry and other ports ◆ Conduct a maritime zero carbon energy source assessment to evaluate the status of supply and delivery options, off-takers, policy and economic drivers, Port roles and other considerations to advance deployment of energy sources to replace fossil fuels for cruise ships in the Pacific Northwest ◆ Implement the International Association of Ports and Harbors’ Cruise Emissions Reporting Project at the Port and collaborate with cruise lines to maximize participation
	By 2030
	<ul style="list-style-type: none"> ◆ Support development of a zero-emission ocean-going vessel demonstration by 2030, working with governments, industry, and non-government organizations

OGV3

Support continual advancements in equipment efficiency and emission reduction from ocean-going vessels. Until zero-emission vessels are developed, continuous improvement in vessel efficiency is the best strategy to reduce GHG and DPM emissions. Ship efficiency gains may occur through improved ship design and operational practices such as slow steaming. The Port will also coordinate with cruise lines to evaluate a carbon offset program for cruise passengers.

Actions	By 2025
	<ul style="list-style-type: none"> ◆ Complete Port-specific cruise ship emission research and develop recommendations ◆ Continue to evaluate opportunities to decrease emissions from cruise ships underway ◆ Evaluate the cost and benefits of environmental incentive programs for cruise ships ◆ Develop a cross-media (e.g., air, noise, water quality, and human health) cruise environmental strategy for the Port, in partnership with the cruise lines, and implement early actions ◆ Evaluate an optional carbon offset or “Good Traveler” type program for Seattle’s homeport cruise passengers, in coordination with cruise lines ◆ Evaluate emissions impact of slow steaming with the Quiet Sound program (once implemented)

- By 2030**
- ◆ Continue implementing the cruise environmental strategy

HARBOR VESSELS

HV1

Provide infrastructure to enable adoption of zero-emission harbor vessels by 2030. Although the Port's commercial marinas offer shore power at most berths, shore power can be added in a few locations to accommodate tugboats. Upgraded utility infrastructure is needed to enable hybrid or zero-emission harbor vessels.

- By 2025**
- ◆ Install new shore power capacity for tugs at Harbor Island Marina E Dock
- ◆ Evaluate new shore power capability, charging, and fueling needs for harbor vessels at Pier 17, Pier 28, and Pier 46 North, and berths 6 and 8 at Terminal 91
- ◆ Improve tracking and reporting of usage rates with a goal of reporting usage annually
- By 2030**
- ◆ Upgrade utility infrastructure to enable hybrid or zero-emission technology or alternative fuels for harbor vessels at Port-owned berths

HV2

Support accelerated turnover of harbor vessels to zero-emission models by 2050. Zero-emission technologies such as battery electric, hydrogen fuel cells and alternative liquid fuels are being developed for some types of harbor vessels. The Port will demonstrate zero-emission outboard engines in Port-owned vessels.

- By 2025**
- ◆ Demonstrate zero-emission outboard engines in Port-owned vessel fleets and communicate results
- ◆ Engage commercial fishing fleets and industry to identify barriers and opportunities to transition to zero-emission fishing vessels
- By 2030**
- ◆ Support development of a zero-emission harbor vessel, working with governments, industry, and non-government organizations

HV3

Support continual advancements in vessel efficiency and emission reduction from harbor vessels. Until zero-emission harbor vessels are widely adopted, the Port will promote use of low carbon fuels and efficiency improvements for assist tugs, commercial fishing vessels, and recreational vessels.

Actions	By 2025
	<ul style="list-style-type: none"> ◆ Engage harbor vessel fuel providers to discuss opportunities and barriers to supplying low-carbon fuels ◆ Evaluate incentive programs to accelerate use of low carbon fuels and the transition to zero-emission harbor vessels
	By 2030
	<ul style="list-style-type: none"> ◆ Support demonstration and educational events to encourage zero-emission technologies for recreational, fishing, and workboats in partnership with Puget Sound Clean Air Agency, NWSA, and others

Success Story: Maritime Innovation

Washington Maritime Blue, the Port, and WeWork Labs have partnered to launch Washington's first maritime accelerator to help maritime companies innovate and grow, establish Washington as a global leader in maritime innovation, and increase the sustainability of maritime businesses.



Performance Metrics

Sector	Metrics	Targets/Objectives
OGV	Percent of vessel calls with Tier 3 marine engines, cleaner fuel, or other emission-reduction technologies while underway	Continuous improvement
	Percent of major cruise and container berths with shore power installed	100 percent by 2030
	Percent of shore-power-capable ships that plug in and percent of total ships that plug in to shore power	Continuous improvement
HV	Percent of tugs by tier level	Information only
	Percent of commercial vessels with hybrid engines or using renewable fuels	Information only
	Percent of zero-emissions commercial vessels	100 percent by 2050
	Total cost of ownership of zero-emissions tug relative to diesel tug	Information only

LANDSIDE MARITIME ACTIVITY



Strategies

- CHE1** Provide infrastructure to enable zero-emission CHE by 2030
- CHE2** Support adoption of zero emissions CHE by 2050
- CHE3** Support continual advancements in equipment efficiency and emission reduction from CHE equipment
- TR1** Provide infrastructure to enable adoption of zero-emission trucks by 2030
- TR2** Support adoption of zero-emission truck equipment by 2050
- TR3** Support continual advancements in vehicle efficiency and emission reductions from trucks
- RR1** Provide infrastructure to enable adoption of zero-emission on-terminal rail by 2030
- RR2** Support adoption of zero-emission rail by 2050
- RR3** Support continual advancements in equipment efficiency and emission reductions from rail

Emissions: Scope 3

% of Port Maritime GHG 2019 emissions:
Cargo-handling equipment <1%
Trucks <1%
Rail 6%

% of Port Maritime DPM 2019 emissions:
Cargo-handling equipment <1%
Trucks <1%
Rail 6%

2

On-terminal switcher locomotives

90

Cargo-handling equipment (CHE) units

Cargo-handling equipment is used on port terminals. Grain cargo is shipped over land by rail, using line-haul and on-terminal locomotives. The truck category has only measured shuttle vans on cruise terminals in the past but will be expanded to include medium- and heavy-duty trucks and buses supporting cruise operations.

LANDSIDE MARITIME ACTIVITY SECTORS CARGO-HANDLING EQUIPMENT, TRUCKS, & RAIL



Context

Landside Maritime Activity sectors support operations at the Port's cruise terminals, grain terminal, and commercial marinas. **Cargo-handling equipment (CHE)** is used to lift and move goods to and from storage areas, ships, trucks, and railcars. The Port's cruise terminals use many electric and propane-powered pieces of CHE. Larger CHE, such as mobile cranes, are diesel-powered.

The **truck** sector includes heavy-duty vehicles. To date, the Port has only included shuttle vans used on cruise terminals in this category. This Plan includes strategies to expand the truck sector to buses that transport passengers to and from cruise terminals and trucks that serve cruise ships and fishing fleets. Container trucks moving cargo to and from marine terminal are excluded because they are managed by the NWSA.

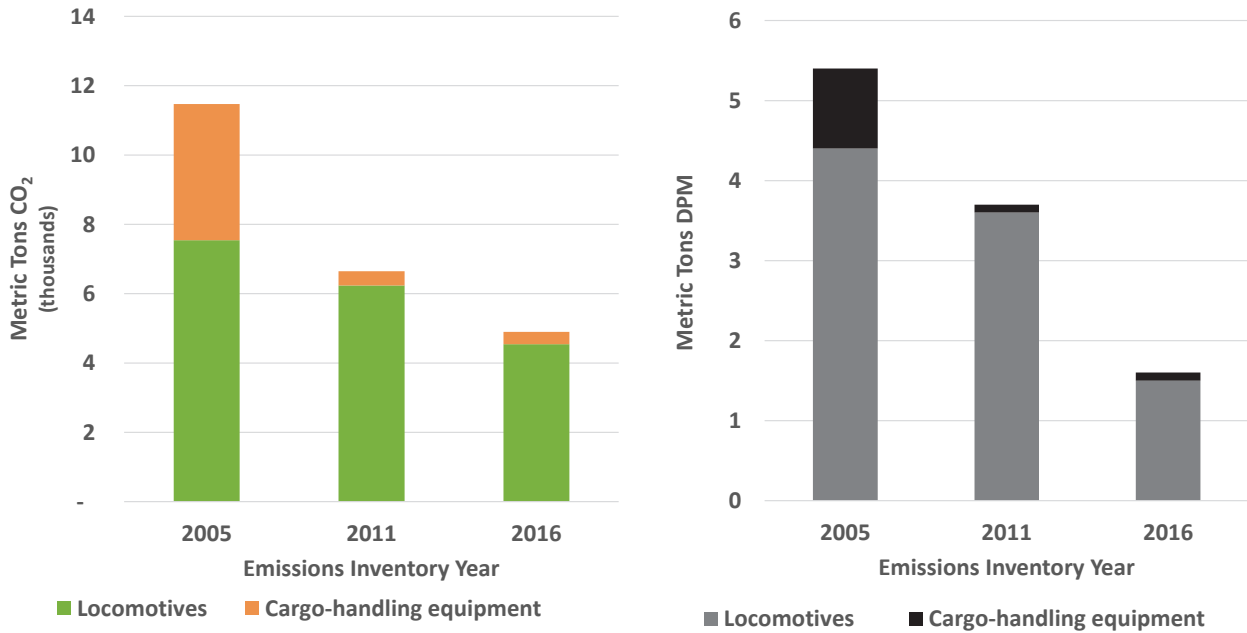
The **rail** sector includes locomotives serving the grain operations. "Line-haul" locomotives are those that pull train cars on travel off-terminal to deliver grain shipments and "switcher" locomotives are used to move railcars within the grain terminal. Line haul locomotives travel throughout the airshed and account for 98 percent of the grain-related rail emissions.

GHG emissions from landside sectors declined from 2005 to 2016. Cargo-handling equipment turned over to more electric units. Rail emissions were lower in 2016 due to lower grain throughput.

DPM emissions from landside sectors declined in 2016 due to the use of more electric cargo-handling equipment, lower grain throughput which reduced rail emissions, and regulatory changes requiring use of low sulfur fuel.



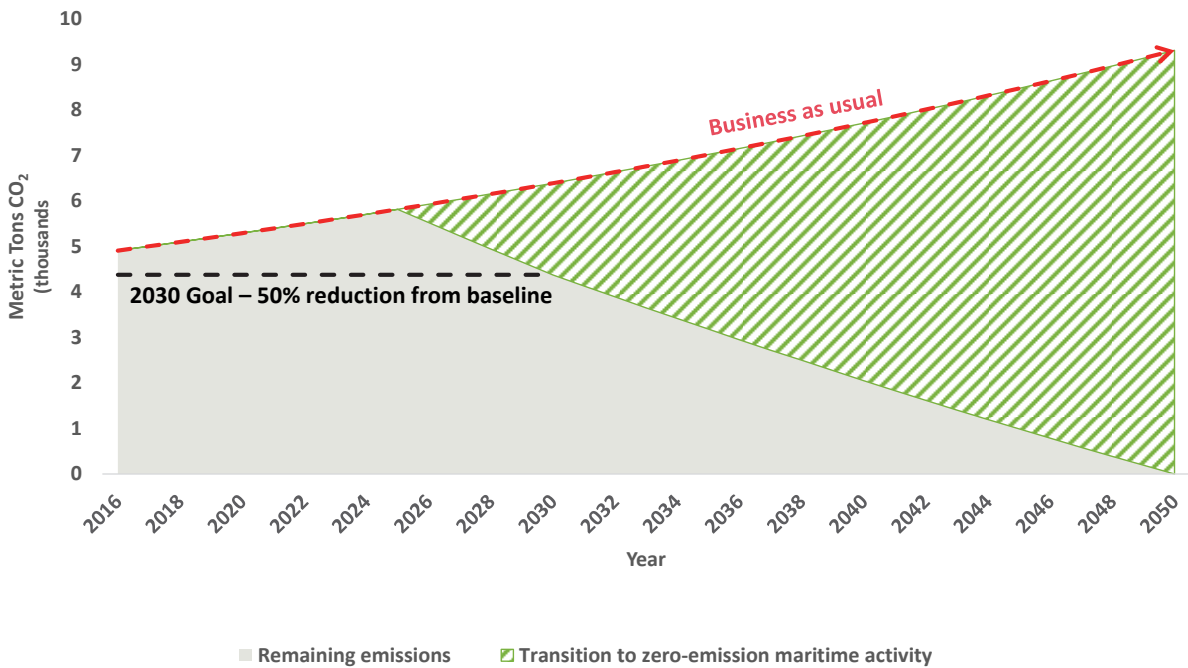
Figure 23. Annual GHG and DPM emissions from Maritime Activity landside sources 2005 – 2016



Emissions were inventoried in the Puget Sound Maritime Air Emissions Inventories for years 2005, 2011, and 2016.

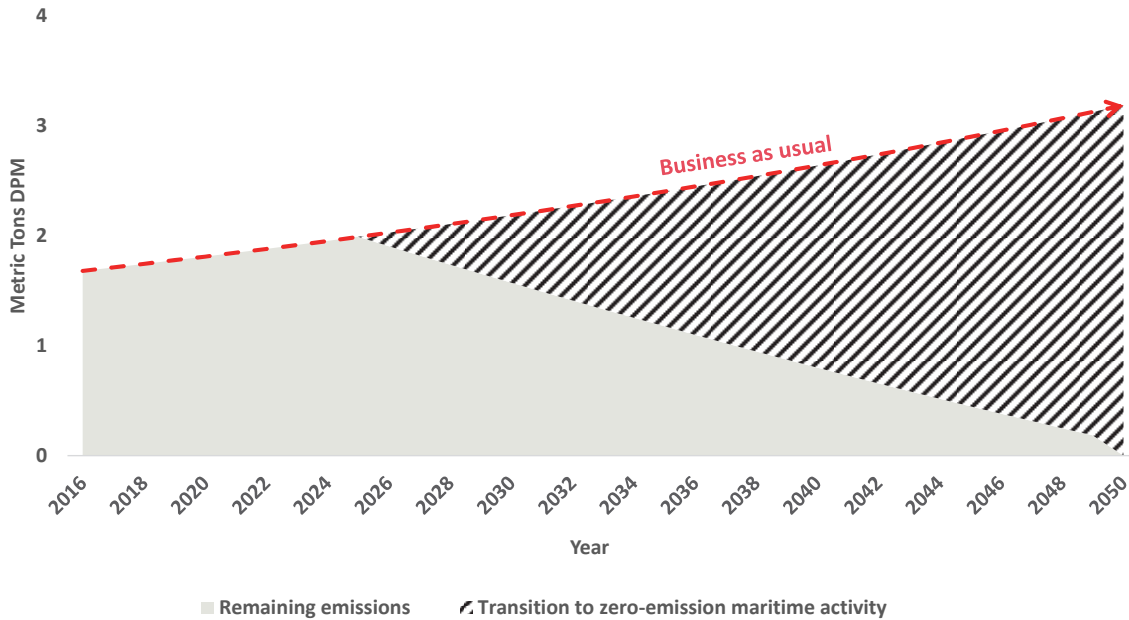
Strategies to 2030

Figure 24. Annual GHG emissions from Maritime Activity landside sectors projected to 2050



Annual emissions will continue increasing through 2030 under a business-as-usual scenario that includes projected growth and assumes that no further emission reduction actions are taken. Mandated vessel efficiency improvements and additional shore power will reduce emissions.

Figure 25. Annual DPM emissions from Maritime Activity landside sectors projected to 2050



Annual emissions will continue increasing through 2030 under a business-as-usual scenario that includes projected growth and assumes that no further emission reduction actions are taken. Mandated vessel efficiency improvements and additional shore power will reduce emissions.

CARGO-HANDLING EQUIPMENT

CHE1

Provide infrastructure to enable zero-emission CHE by 2030. Infrastructure needed will be identified in the Seattle Waterfront Clean Energy Strategy (Maritime Activity strategy XS1.)

Actions	By 2025
	<ul style="list-style-type: none"> ◆ As part of SWCES process, engage Port tenants to begin planning and designing infrastructure to support zero-emission CHE at Terminal 91, Pier 66, and Fishermen’s Terminal, and pursue funding for installing such infrastructure
	By 2030
	<ul style="list-style-type: none"> ◆ Complete planning design and install necessary infrastructure for zero-emission CHE
	Ongoing
	<ul style="list-style-type: none"> ◆ Advocate for standardization and interoperability of CHE fueling infrastructure in partnership with ports, partners, and industry

CHE2

Support adoption of zero-emission CHE by 2050. This strategy will focus on replacement of diesel- powered units. This strategy overlaps with Fleet Vehicles and Equipment strategies FV1 and FV2 for Port-owned units and Maritime Activity strategy XS1.

Actions	By 2025
	<ul style="list-style-type: none"> ◆ Collaborate with terminal operators (e.g., cruise, cargo) and fishing operations to assess and demonstrate the feasibility of zero-emission equipment, including conducting and sharing lessons from pilot projects on port-owned equipment

CHE3

Support continual advancements in equipment efficiency and emission reduction from CHE equipment. The Port will promote fuel efficiency, low carbon fuels and early replacement of diesel and propane-powered cargo-handling equipment

Actions	By 2025
	<ul style="list-style-type: none"> ◆ Collaborate with terminal operators (e.g., cruise, cargo, fishing operations) to update and formalize data sharing on equipment inventories, replacement plans, and fuel efficiency plans
	Within 5 years
	<ul style="list-style-type: none"> ◆ Evaluate environmental incentive programs to accelerate Port tenant and customer CHE upgrades or low carbon fuel use

**Success Story:
Alternative Fuels**

Switcher locomotives at the Port's grain terminal use biodiesel and are equipped with anti-idling equipment which reduces fuel consumption by up to 50 percent.

In 2019, 85 percent of the cargo-handling equipment of CHE at Port of Seattle marine terminals used electricity or propane as fuel.



TRUCKS

TR1

Provide infrastructure to enable adoption of zero-emission supply trucks and buses by 2030. Zero-emission technology is becoming increasingly available for some classes of trucks, but the cost and complexity of charging or fueling infrastructure can impede adoption. The Port will demonstrate new infrastructure.

- | | |
|---------|--|
| Actions | By 2025 |
| | <ul style="list-style-type: none"> ◆ Evaluate opportunities to demonstrate zero-emission infrastructure for supply trucks that could serve the port's cruise ships or fishing fleets ◆ Evaluate opportunities to demonstrate zero-emission infrastructure for buses that transport passengers to cruise terminals in collaboration with cruise lines and bus companies |

TR2

Support adoption of zero-emission supply truck and bus equipment by 2050. As zero-emission trucks and buses are developed, the Port will collaborate to demonstrate new technology. Technologies under development include battery electric and hydrogen fuel cells.

- | | |
|---------|--|
| Actions | By 2025 |
| | <ul style="list-style-type: none"> ◆ Evaluate opportunities to demonstrate zero-emission truck technology that could serve the port's cruise ships and fishing fleets ◆ Evaluate opportunities to demonstrate low- or zero-emission bus technology for buses that transport passengers to cruise terminals in collaboration with cruise lines and local bus companies ◆ With other ports and partners, advocate for policies and business models that make zero-emission trucks more cost competitive |

TR3

Support continual advancements in vehicle efficiency and emission reduction from trucks and buses. Until zero-emission technology is adopted, vehicle efficiency measures such as idle-reduction and use of low carbon fuels can help reduce DPM and GHG emissions.

- | | |
|---------|---|
| Actions | By 2025 |
| | <ul style="list-style-type: none"> ◆ Evaluate how to capture emissions associated with cruise truck deliveries and ground transportation in future Puget Sound Maritime Air Emissions Inventories ◆ Engage commercial fishing and cruise trucking contacts to discuss truck and bus fleet needs and opportunities for alternative fuels or zero-emission technology ◆ Engage cruise lines and bus companies to explore opportunities for alternative fuels or low- or zero-emission technology buses that transport passengers to cruise terminals |
| | By 2030 |
| | <ul style="list-style-type: none"> ◆ Research and develop strategies to reduce emissions from passenger ground transportation serving cruise terminals ◆ Evaluate installation of electricity connections to replace fossil fuel-powered refrigerated containers at Terminal 91 |

RAIL

RR1

Provide infrastructure to enable adoption of zero-emission on-terminal rail by 2030. Zero-emission technologies for locomotives are still under development. Options will be evaluated as part of Maritime Activity strategy XS1 – Seattle Waterfront Clean Energy Strategy.

- Actions** **By 2025**
- ◆ As part of SWCES process, engage Port tenants to begin planning and installing necessary infrastructure to support near- or zero-emission locomotives for switching and delivering cargo to Port terminals

RR2

Support adoption of zero-emission rail by 2050. The Port has limited influence over railroad companies but will advocate for state and federal regulatory changes to reduce emissions. This will be one element of XS3.

- Actions** **By 2030**
- ◆ Explore opportunities to advocate for regulatory changes that reduce emissions from Class I Railroads

RR3

Support continual advancements in equipment efficiency and emission reductions from rail. Locomotives have long life spans and older engines lack modern emission controls. Until zero-emission technology is developed and adopted, the Port will promote replacement of older, unregulated locomotives with cleaner alternatives to reduce DPM emissions.

- Actions** **By 2025**
- ◆ Engage Class I Railroads, in collaboration with ports and partners, to identify emission reduction opportunities in Washington
- By 2030**
- ◆ Work with Port tenants to accelerate replacement of unregulated switcher locomotives for near or zero-emission alternatives

Performance Metrics

Sector	Metrics	Targets/Objectives
CHE	Percent of zero-emission CHE adopted	100 percent by 2050
	Total cost of ownership of zero-emission CHE relative to diesel CHE	Information only
Trucks	Percent of zero-emission trucks adopted	100 percent by 2050
	Total cost of ownership of zero-emission trucks relative to diesel trucks	Information only
Rail	Percent of unregulated engines known to be upgraded	20 percent are upgraded by 2020, relative to 2013
	Percent of switcher engines that use renewable fuels	Information only
	Percent of zero-emissions switcher engines adopted	100 percent by 2050