Port of Seattle®

CHARTING THE COURSE TO ZERO

Port of Seattle's Maritime Climate and Air Action Plan

March 2021 | Draft

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EXECUTIVE SUMMARY

Charting the Course to Zero: Port of Seattle's Maritime Climate and Air Action Plan (the Plan) is a comprehensive plan to address climate change and air pollution from maritime sources. It charts the course to achieve the Port of Seattle's (the Port) Century Agenda targets for maritime-related greenhouse gas (GHG) emission reduction and implement the 2020 Northwest Ports Clean Air Strategy (2020 Strategy) vision to phase out emissions from seaport-related sources by 2050. The Plan was created to address the urgency of the climate crisis and the needs of near-port communities in Seattle that are disproportionately impacted by air pollution. The Plan identifies strategies and actions the Port will take to reduce maritime-related air and GHG emissions in the next ten years towards a vision of zero emissions by midcentury. It covers GHG emission sources related to administrative operations of the Port's Maritime and Economic Development Divisions, such as energy used in port buildings, fuel used in fleet vehicles and equipment, and emissions associated with employee commuting and solid waste transportation and disposal. It also covers air pollutant and GHG emission sources from Port Maritime tenants and the maritime supply chain, such as cruise sailings, grain terminal operations, commercial fishing, and recreational marinas. In addition to emission reduction opportunities, the plan encompasses the future carbon sequestration potential of the Port's shoreline and habitat restoration programs.

The Plan does not include GHG or air pollutant emissions associated with Seattle-Tacoma International Airport (SEA Airport) administration, airlines, tenants, or ground transportation, as SEA Airport creates its own separate plans and inventories to track and address these sources. The Plan also excludes emissions from the Northwest Seaport Alliance's (NWSA) lines of business, such as container trucks.

While this Plan provides detail on how the Port of Seattle will address the 2020 Strategy objectives, implementation and the specific actions the Port will take will continue to be defined by ongoing engagement with near-port communities, government agencies, and maritime industries.

The Port's greenhouse gas reduction targets

SCOPES 1 AND 2: Port-controlled and Port indirect emissions

- 15 percent below 2005 levels by 2020
- 50 percent below 2005 levels by 2030
- Carbon neutral OR carbon negative by 2050

SCOPE 3: Emissions the Port has influence over, but not direct control

- 50 percent below 2007 levels by 2030
- 80 percent below 2007 levels by 2050

In 2017, the Port Commission adopted greenhouse gas reduction targets that aligned with the Paris Climate Agreement. The Port's targets include a critical interim goal to cut emissions in half by 2030. The targets also entail a long-range commitment to deeply "decarbonize" maritime activity and make Port operations carbon neutral or carbon negative by 2050 and reduce Port-influenced emissions by 80% by 2050.[1] Subsequently, the International Panel on Climate Change (IPCC) released a Special Report stating that climate change impacts could be significantly reduced by limiting global warming to 1.5 degrees Celsius (°C), and demonstrating that reaching net-zero carbon by 2050 is imperative.[2] This Plan is based on the 2020 Strategy vision for 2050 which incorporates the latest IPCC recommendations.

Community health and equity considerations

The adverse effects of climate change are more likely to be borne by historically marginalized communities, including Black, Indigenous, and people of color (BIPOC). In addition, BIPOC communities are also disproportionately exposed to air pollution and other environmental hazards. Although King County meets national air quality standards, the Port recognizes that pollution exposure, access to economic opportunity, and human health vary based on where people live. In Seattle, communities in the Duwamish Valley bear a disproportionate burden of health impacts and environmental injustices compared to other areas of the city. In 2019 The Port demonstrated its commitment to equity, diversity, and inclusion through adoption of Port Commission Resolution 3767, the Duwamish Valley Community Benefits Commitment, and creation of an Office of Equity, Diversity, and Inclusion. This Plan furthers these initiatives by identifying actions and investments needed to combat global climate change and address air pollution faced by near-port communities.

[1] This Plan uses the terms "carbon" and "greenhouse gas" interchangeably, unless otherwise noted.

[2] International Panel on Climate Change, https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf

The Northwest Ports Clean Air Strategy 2020 vision

For more than a decade, the Port has worked collaboratively with regional ports, government, community, and industry partners to reduce seaport-related air pollution and GHG emissions. With the release of the 2020 Strategy, the Port continues its commitment to work jointly with the NWSA, the Port of Tacoma, and the Port of Vancouver (Canada) to phase out emissions in the ports' shared airshed. The ports recognize that broad, transformative changes are needed to reduce the impacts of seaport-related emissions on public health and limit global climate change as soon as possible, and that ports must play a key role in enabling those changes. The updated 2020 Strategy reflects a new vision that acknowledges the urgency of the climate crisis and that there is no safe level of air pollution:

Phase out emissions from seaport-related activities by 2050, supporting cleaner air for our local communities and fulfilling our responsibility to help limit global temperature rise to 1.5°C.

Port emission sources

Port emissions include Port-owned or controlled sources (GHG Scope 1), indirect emissions from purchased electricity (GHG Scope 2), and Port-influenced sources (GHG Scope 3). This Plan addresses all three scopes, but sorts emissions into two main categories which overlay the scope designations: Port Maritime Administration and Maritime Activity.

Port Maritime Administration sectors covered by this Plan include Port-owned buildings and campuses, fleet vehicles and equipment, solid waste generated by the Port and its tenants, and Port employee commuting. Although these sources account for only 6% of the Port's total emissions, the Port has control or influence in these areas.

Maritime Activity sectors covered by this Plan include cruise and grain ships, harbor vessels (tugboats, commercial fishing vessels, and recreational vessels), locomotives, trucks (including cruise buses), and cargo-handling equipment. The Port has limited influence over these sources, which account for 94% of the Port's emissions.

Table ES-1. Emission sectors by level of control (GHG Scopes)

Category/Sector	% of Scopes 1 and 2 emissions	% of Scope 3 emissions	% of Total emissions (2019)
Port Maritime Administration			
Building and Campus Energy – assigned to Port	51%		2%
Building and Campus Energy – assigned to tenants	16%	1%	1%
Fleet Vehicles and Equipment	32%		1%
Employee Commuting		1%	1%
Solid Waste			<1%
Maritime Activity			
Ocean-going Vessels (OGVs)		77%	74%
Harbor Vessels		14%	14%
Cargo-handling Equipment		<1%	<1%
Trucks		<1%	<1%
Rail		6%	6%

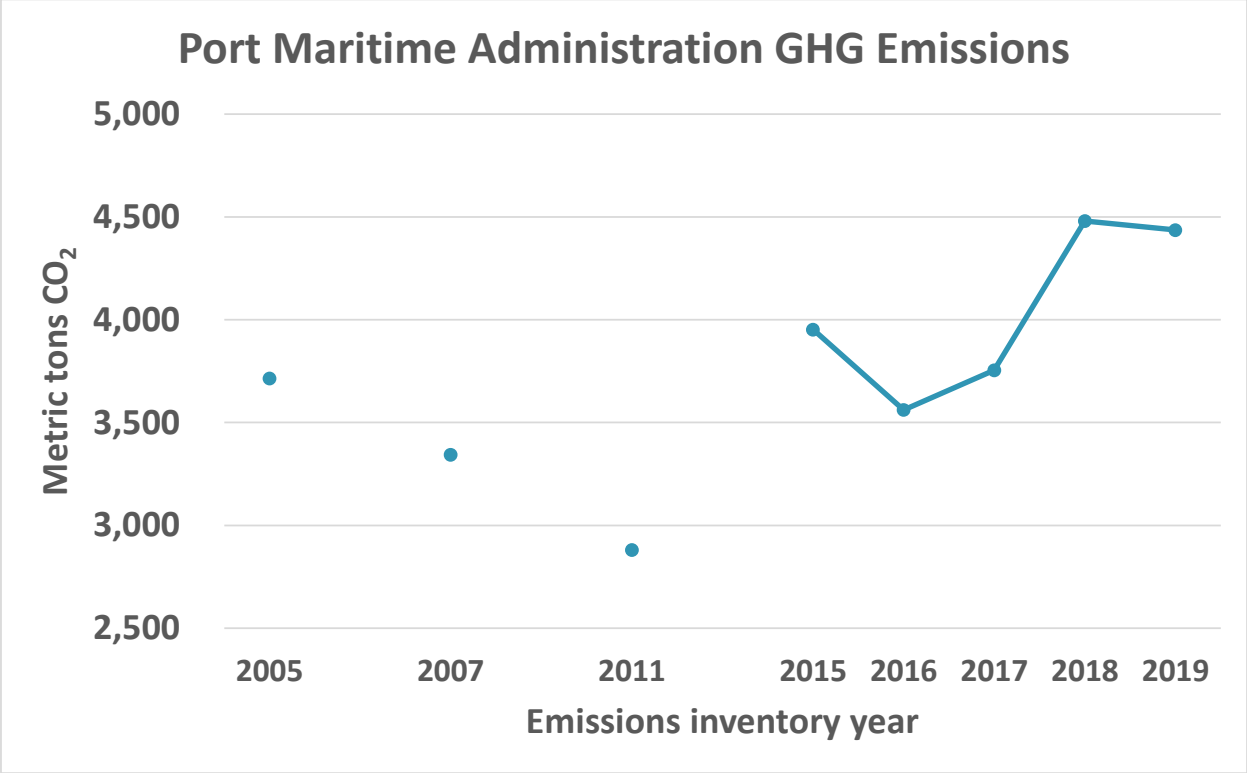
Emission trends

In 2019, Port Maritime emissions of GHG totaled 78,688 metric tons (MT) of carbon dioxide (CO_2). Without adopting aggressive strategies, emissions could grow by over 20% by 2030, under a business-as-usual scenario that includes projected business growth and no new actions to address climate change or air pollution.[3]

Port Maritime Administration sectors have not made consistent progress toward the Port's emission reduction targets since the 2005 baseline year, despite improvements in some areas. Most of the increase is from building and campus energy use.

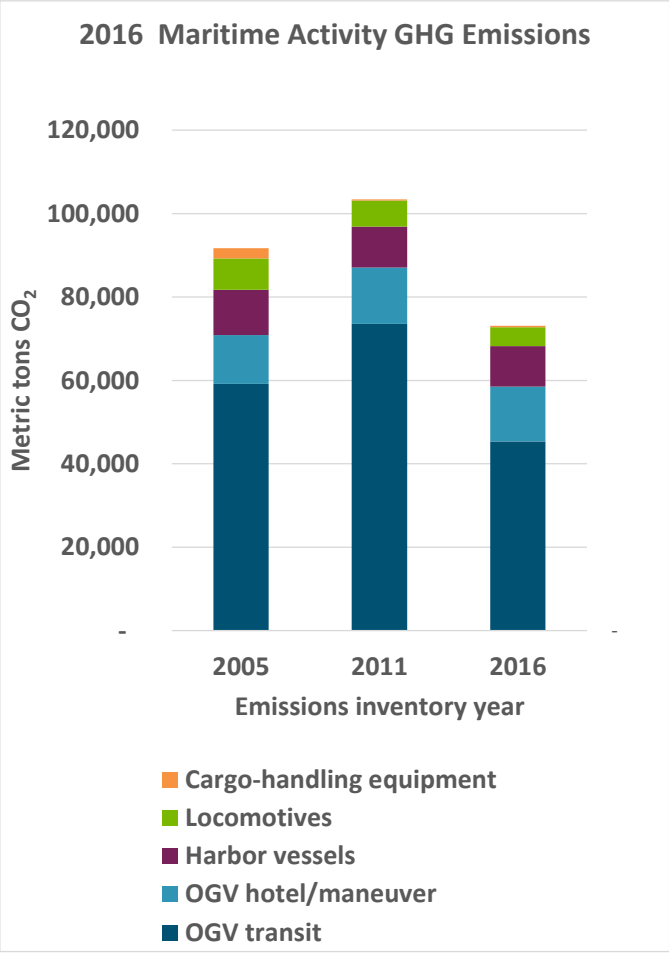
[3] This analysis did not consider COVID-19 impacts, which are discussed later in the Plan.

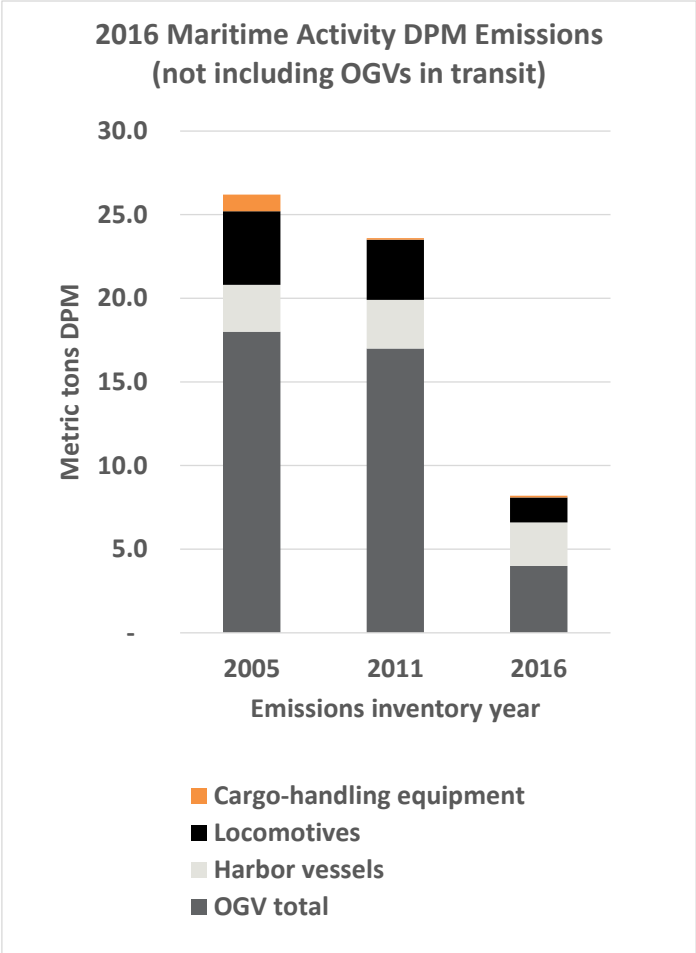
Figure ES-1. Annual GHG emissions from Port Maritime Administration sources 2005 – 2019. *Emissions were inventoried for the Port's Century Agenda milestone years: 2005, 2007, and 2011, and annually since 2015. Note: the scale along the vertical axis has been narrowed to highlight the small changes in recent years.*



Air pollutant and GHG emissions from **Maritime Activity** sectors have declined significantly since 2005. Emissions from these sources are measured every five years in the Puget Sound Maritime Air Emissions Inventory. The most recent inventory of Maritime Activity sectors was completed for the year 2016. Maritime Activity emissions were lower for all air pollutants and GHG in 2016 compared to 2005. Regulatory changes requiring the use of low sulfur fuel and more advanced pollution controls over this period resulted in a steep reduction in diesel particulate matter (DPM) and other air pollutants. GHG emissions declined due to lower cargo throughput, vessel efficiency improvements, and turnover to cleaner and electric cargo-handling equipment.

Figure ES-2. Annual GHG and DPM emissions from Maritime Activity sources 2005 – 2016. *Emissions were inventoried in the Puget Sound Maritime Air Emissions Inventories for years 2005, 2011, and 2016.*





Strategies to reduce impacts

The Plan identies a set of ambitious, timely strategies and actions to be taken by 2030 for both Port Maritime Administration and Maritime Activity sectors to decrease GHG and air pollutant emssions. These strategies represent one path to achieve the 2030 goal of 50% GHG reduction and will be refined in updates to the Plan as more information becomes available, and to keep on track to reach zero emissions by 2050.

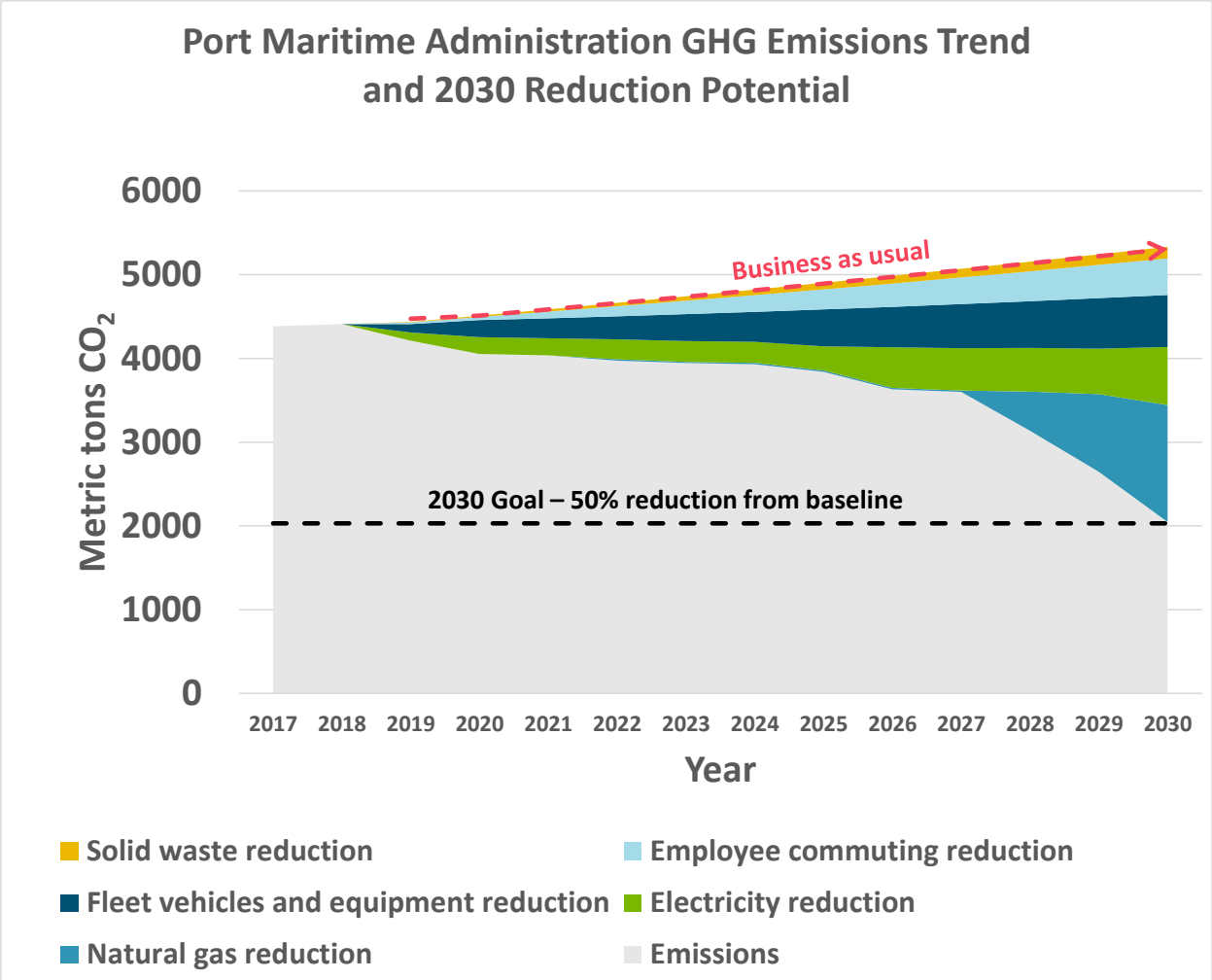
Port Maritime Administration sectors

Section 3 of the Plan highlights 23 strategies across five sectors to reduce GHG emissions from Port Maritime Administration sources. These strategies focus on three themes:

- Reduce energy and fuel use
- Shift from fossil-based energy to renewable energy
- Leverage habitat restoration projects to sequester carbon.

Implementing these strategies will reduce annual 2030 emissions by almost 1,400 MT (MT CO_2), which will collectively reduce Port Maritime Administrations emissions by 50% from the baseline level.

Figure ES-3. Annual GHG emissions from Port Maritime Administration projected to 2030 in MT CO_2. *Annual emissions from Port Maritime Administration 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. The strategies identified in this Plan can reduce Port Maritime Administration emissions by 50% to meet the Port's 2030 GHG reduction target.*



Maritime Activity sectors

Reducing emissions from Maritime Activity sources is especially challenging because the Port has limited influence over them, and the zero-emission pathways for some sectors are yet to be determined. Section 4 of the Plan identifies 19 strategies across 5 sectors. These strategies focus on the following themes highlighted in the 2020 Strategy:

- **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 yet readily available or affordable. The Port can advance new technologies by supporting pilot projects and can adopt small-scale zero-emission technologies for some sectors, such as 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 Maritime Activity sectors, focusing on cross-industry energy planning; green leasing; regulatory policy advocacy; and engagement with community, industry, and government.

To keep on course to achieve the 2050 vision, implementation of Maritime Activity strategies will need to reduce annual emissions by at least 37,000 MT CO_2/year by 2030, which will collectively reduce Maritime Activity emissions by 50% from the baseline level.

Figure ES-4. Annual GHG emissions from Maritime Activity projected to 2050 in MT CO_2. *Annual emissions from Maritime Activity will continue increasing through 2050 under a business-as-usual scenario that includes projected growth and assumes that no further emission reduction actions are taken. The strategies identified in this Plan can reduce Maritime Activity GHG emissions by approximately half. 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.*

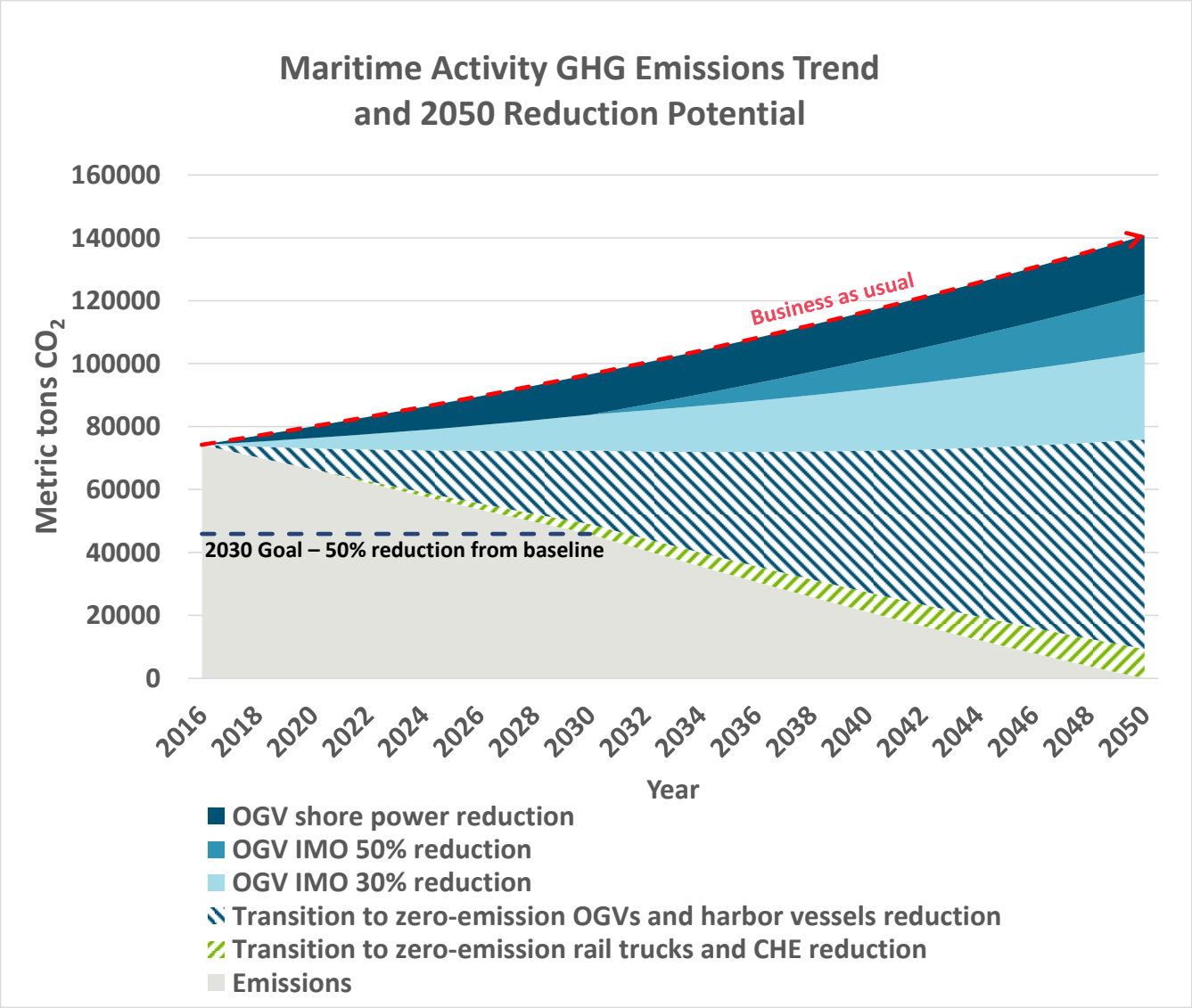


***Figure ES-5. Annual DPM emissions from Maritime Activity projected to 2050 in MT**. Annual DPM emissions from Maritime Activity will continue increasing through 2050 under a business-as-usual scenario that includes projected growth and assumes that no further emission reduction actions are taken. The strategies identified in this Plan can reduce Maritime Activity DPM emissions by approximately half. 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.*

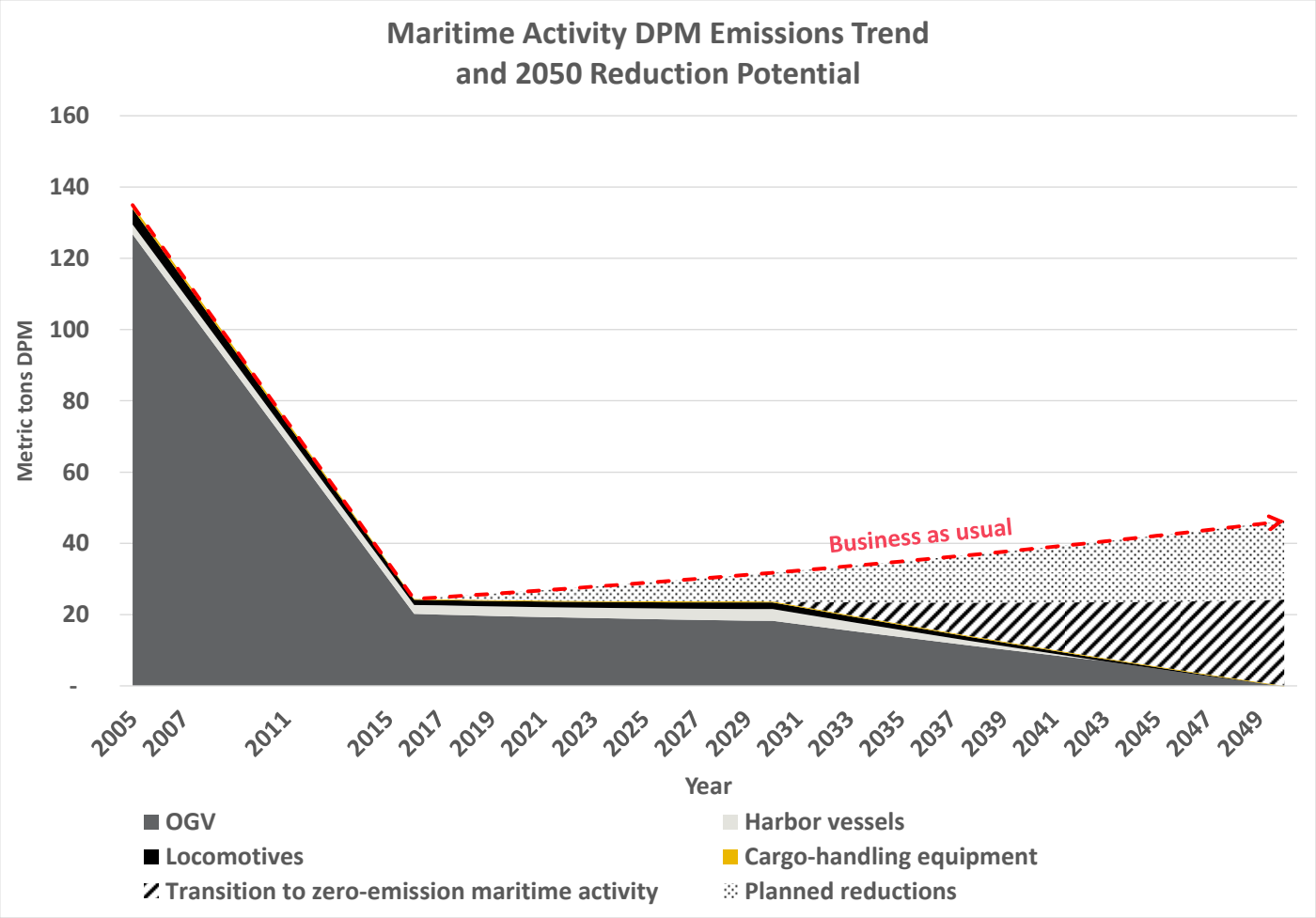


Table ES-2. Emission reduction strategies and emission reduction potential related to the Port's 2030 GHG reduction goals. *At the sector level, the table shows 2019 GHG emissions, and GHG Scope designation. For each strategy, the table lists the approximate potential GHG emission reduction in 2030 (based on projected 2030 emissions levels which incorporate business growth assumptions).*

Port Maritime Administration Strategies		
Building and Campus Energy	**2019 Emissions: 2,480 MT CO_2**	**GHG Scopes: 1, 2, 3**
GHG Reduction Strategies		**Approximate Annual MT CO_2 Reduction Potential by 2030**
BC1: Eliminate fossil natural gas		1,400
BC2: Implement energy audit conservation measures		380
BC3: Install energy efficient lighting and controls		200
BC4: Reduce plug loads and upgrade controls		70
BC5: Maximize use of renewable energy		40
BC6: Advance energy data management and planning		critical to other efforts
BC7: Apply high performance lease terms		critical to other efforts
BC8: Strengthen energy conservation communication and education		critical to other efforts

Fleet Vehicles and Equipment	**2019 Emissions: 896 MT CO_2**	**GHG Scope: 1**
GHG Reduction Strategies		**Approximate Annual MT CO_2 Reduction Potential by 2030**
FV1: Use drop-in renewable fuels		300
FV2: Transition to electric vehicles		250
FV3: Right-size vehicles and fleet		75
FV4: Use technology to gather data and improve efficiency		critical to other efforts
FV5: Educate Port drivers on eco-driving and fleet use practices		critical to other efforts

Employee Commuting	**2019 Emissions: 800 MT CO_2**	**GHG Scope: 3**
GHG Reduction Strategies		**Approximate Annual MT CO_2 Reduction Potential by 2030**
EC1: Encourage use of flexible work arrangements		220
EC2: Update employee commute benefits for low-emission commutes		130
EC3: Expand employee communication and education		40
EC4: Continue to advocate for better transportation access		40

Solid Waste	2019 Emissions: 198 MT CO_2	GHG Scope: 3
GHG Reduction Strategies		**Approximate Annual MT CO_2 Reduction Potential by 2030**
SW1: Maximize diversion of common recyclables and organics		60
SW2: Minimize solid waste generation		60
SW3: Expand specialized items recycling		15
SW4: Enhance communications with employees and tenants		critical to other efforts

Habitat Restoration and Carbon Sequestration	
GHG Reduction Strategies	**Approximate Annual MT CO_2 Reduction Potential by 2030**
HR1: Complete Smith Cove Blue Carbon Benefits Study	To be determined
HR2: Continue shoreline restoration projects	To be determined

Maritime Activity and Cross-Sector Strategies	
GHG and DPM Reduction Strategies	**Approximate Annual MT CO_2 Reduction Potential by 2030**
XS1: Facilitate cross-industry planning	critical to other efforts
XS2: Leverage green lease terms	critical to other efforts
XS3: Advocate for local, state, and federal policy and funding	critical to other efforts
XS4: Engage with community, industry, and government	critical to other efforts

Waterside: Ocean-going Vessels and Harbor Vessels	2019 Emissions: 69,323 MT CO_2	GHG Scope: 3
GHG and DPM Reduction Strategies		**Approximate Annual MT CO_2 Reduction Potential by 2030**
OGV1: Install shore power at all major cruise berths by 2030		13,000
OGV2: Support international efforts to phase out emissions from OGV		critical to other efforts
OGV3: Support OGV efficiency improvements and emission reductions		critical to other efforts
HV1: Provide infrastructure for zero-emission HV by 2030		critical to other efforts
HV2: Support accelerated turnover of HV to zero-emission models		critical to other efforts
HV3: Support HV efficiency improvements and emission reductions		critical to other efforts

Landside: Cargo-handling equipment, Trucks, and Rail	2019 Emissions: 4,909 MT CO_2	GHG Scope: 3
GHG and DPM Reduction Strategies		**Approximate Annual MT CO_2 Reduction Potential by 2030**
CHE1: Provide infrastructure for zero-emission CHE by 2030		critical to other efforts
CHE2: Support adoption of zero-emission CHE by 2050		critical to other efforts
CHE3: Support CHE efficiency improvement and emission reductions		critical to other efforts
TR1: Provide infrastructure for zero-emission trucks by 2030		critical to other efforts
TR2: Support adoption of zero-emission trucks by 2050		critical to other efforts
TR3: Support truck efficiency improvements and emission reductions		critical to other efforts
RR1: Provide infrastructure for zero-emission on-terminal rail by 2030		critical to other efforts
RR2: Support adoption of zero-emission rail by 2050		critical to other efforts
RR3: Support rail efficiency improvements and emission reductions		critical to other efforts

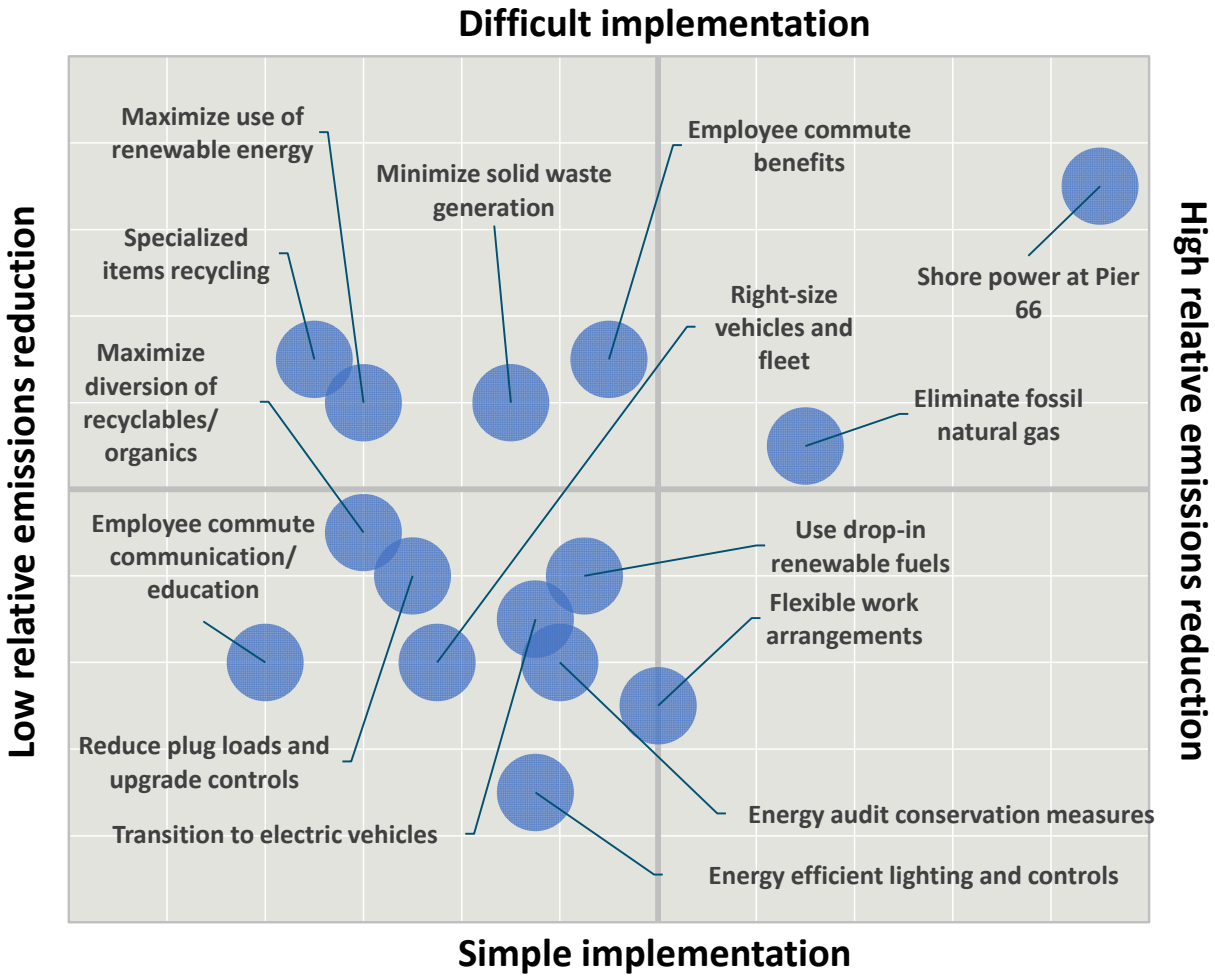
Implementation

The Port cannot fully implement the Plan alone. Collaboration throughout the region and with a coalition of partners is essential. The Port will continue to collaborate with the NWSA, Port of Tacoma and Port of Vancouver (Canada) to implement the 2020 Strategy. The Port will also continue to engage partners and support partner-led efforts across the port network, including with port tenants, industry, governments, non-governmental organizations, and near-port communities. When implementing the Plan, the Port will advance its commitment to collaboration with Duwamish Valley community members to identify projects and priorities of greatest impact and value in regions that need clean air and climate action most.

Implementation will also require a significant amount of leadership, innovation, and investment by the Port and by others. Actions proposed in the Plan will be evaluated and prioritized for implementation based on sustainability, cost, equity impacts, and emission reduction potential, per the Port's Sustainable Evaluation Framework policy.

Tracking and reporting on progress is another key to successful implementation. The Plan relies on emissions inventory data to assess emission trends and to quantify impacts of strategy implementation. As more information is gathered—for example, impacts of the COVID-19 pandemic—the Port will revise emission inventory results and emission projections. The Plan also includes performance metrics that will be used to gauge annual progress in meeting targets and objectives. Progress reports will be published annually, and the Plan will be updated as needed. The Port will take an adaptive management approach to monitoring, reporting, and reviewing the Plan, which is consistent with the 2020 Strategy framework.

***Figure ES-6. Estimated GHG reductions and implementation difficulty for strategies**. The strategies in the Plan are distributed according to relative emission reduction and implementation difficulty. Implementation difficulty incorporates cost, technology maturity, and the Port's control over the emissions and implementation of the strategy. The implementation and reduction rubrics are discussed in Appendix C.*



SECTION 1 | INTRODUCTION

Implementing the Northwest Ports Clean Air Strategy at the Port of Seattle

For more than a decade, the Port of Seattle (the Port) has worked collaboratively with regional ports, government, community, and industry partners to reduce seaport-related air pollution and greenhouse gas (GHG) emissions. With the release of the 2020 Northwest Ports Clean Air Strategy (2020 Strategy) the Port continues its commitment to work jointly with the Port of Tacoma, the Northwest Seaport Alliance (NWSA), and the Port of Vancouver (Canada) to phase out emissions in the ports' shared airshed. The ports recognize that broad, transformative changes are needed in the coming decades to protect air quality and limit global climate change, and that they play a key role in enabling those changes.

The 2020 Strategy provides the overarching policy framework to guide the Port's decision-making and actions related to air quality and climate protection in its maritime operations. *Charting the Course to Zero: Port of Seattle's Maritime Climate and Air Action Plan* (the Plan) is the Port of Seattle's implementation plan to carry out the 2020 Strategy, along with the Port's Century Agenda goals and GHG reduction targets. The Plan adds critical detail on strategies and actions that the Port can take to cut 2005 baseline emissions in half by 2030 and continue reducing air pollutant emissions. In some places, the Plan goes beyond the commitments of the 2020 Strategy to set accelerated timelines and address sectors not covered in the 2020 Strategy. Future updates to the Plan will address a longer planning horizon to phase out emissions from maritime operations by 2050.

What this Plan covers: scope and organization

The Plan's scope covers climate impacts and air pollution from Port Maritime functions

Port Maritime Scope | The Plan's scope is limited to Port of Seattle seaport operations, which include cruise, grain cargo, commercial and recreational marinas, and maritime-related commercial and industrial real estate. The

term "Maritime" in this Plan refers collectively to these functions. The Plan excludes the Port's aviation-related operations associated with Seattle-Tacoma International Airport (SEA Airport).

While seaport-related, emissions associated with the NWSA's lines of business are not addressed in this plan. Excluded emissions include those from NWSA-managed buildings, container trucks, container and cargo ships, harbor vessels, and cargo handling equipment operating at NWSA terminals. The Port works collaboratively with the NWSA and will provide input on NWSA's air and climate action initiatives, particularly where they overlap with Seattle's near-port communities.

Focus | The Plan focuses on actions to reduce GHG emissions and improve air quality. The Plan does not address actions to adapt to or prepare for the impacts of a changing climate, which are addressed in separate planning efforts by the Port.

Pollutants covered | The Plan identifies strategies to reduce emissions of GHGs and air pollutants produced by maritime-related sources. The primary air pollutant of concern for near-port communities is diesel particulate matter (DPM), found in diesel exhaust, which is the leading source of toxic air pollution in the Puget Sound.[4] Strategies to reduce DPM will also reduce other pollutants including sulfur dioxide, oxides of nitrogen, black carbon, and volatile organic compounds.

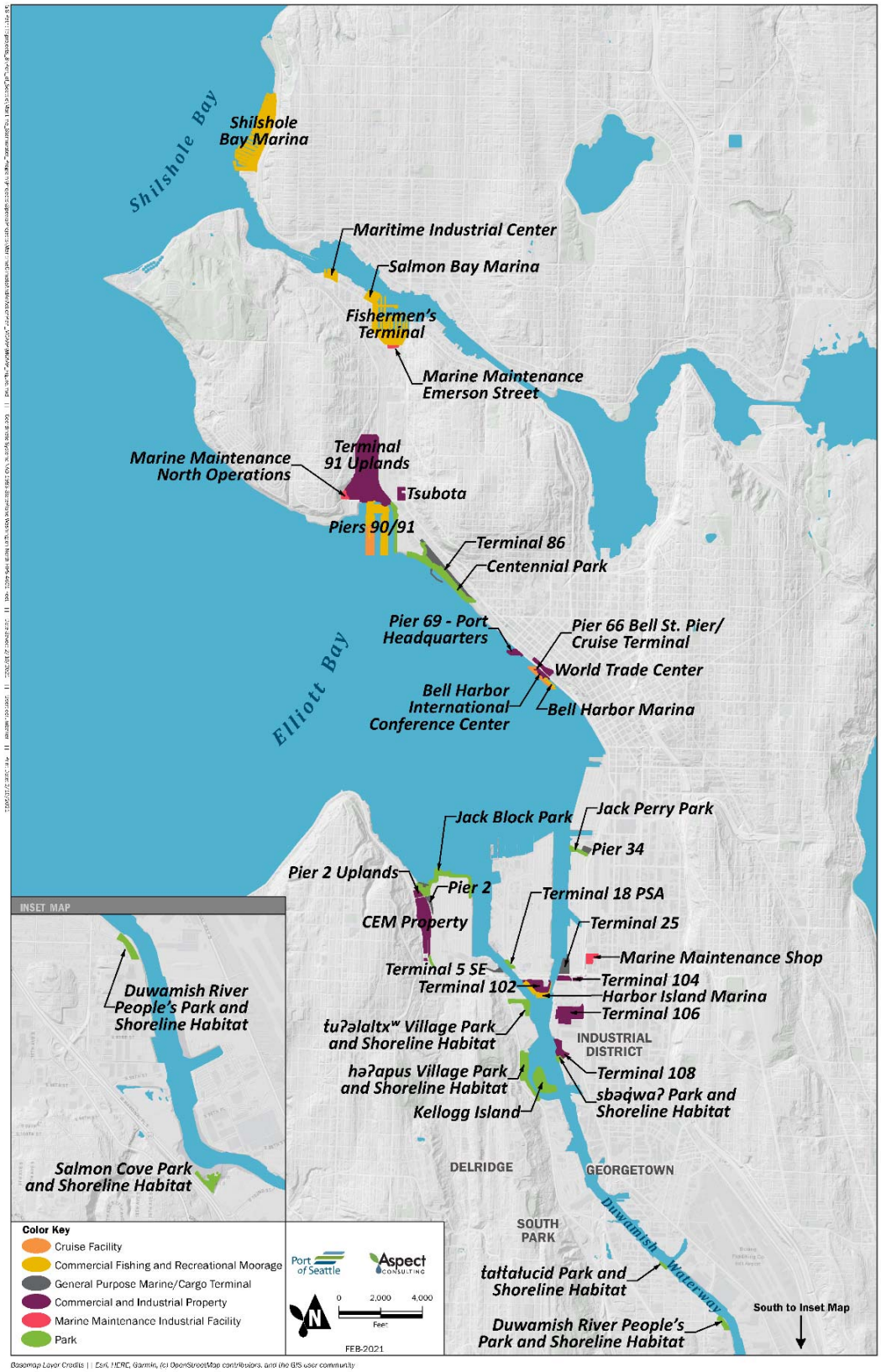
The Plan provides context, emission trends, emission reduction strategies, and implementation steps

The Plan provides Port context for the 2020 Strategy vision, guiding principles, and targets to reduce emissions from air pollutants and GHGs. It discusses emission trends, strategies to reduce Port emissions by 50% from baseline levels by 2030, emission reduction targets, and action to be taken over the next decade to implement the strategies. Future updates to the Plan will address a longer planning horizon to phase out emissions from our maritime operations by 2050.

The emission reduction strategies in Sections 3 and 4 are organized by sector (a sector is a category of emission source, such as fleet vehicles). Each sector sub-section can be used as a stand-alone document. The sub-sections include a brief description of the sector, sector-specific progress to date, emission reduction strategies and implementing actions, and the estimated GHG emission reduction potential for each strategy.

[4] https://pscleanair.gov/DocumentCenter/View/143/Fact-Sheet-on-Air-Toxics-PDF?bidId=

***Figure 1. Port of Seattle Maritime facilities**. Facilities shown fall within the scope of the Plan.*



The Plan depends on ongoing engagement to inform implementation

The Plan provides interim actions and details on how the Port will achieve to the vision and objectives set by the 2020 Strategy. However, while the Plan charts the course toward zero emissions at the Port, many decision points remain intentionally open-ended regarding the Port's actions and priorities. Engagement with near-port communities impacted by maritime emissions, maritime industries, government agencies, Tribal nations, and others will be critical to identify, scope, and prioritize projects that can improve air quality, protect community health, and achieve GHG emission reductions targets. The Port is committed to working with near-port communities on an ongoing basis to identify community-based projects and investment priorities and to help inform an equitable transition to zero emission maritime activities and port maritime administration.

Why we need this plan: climate change, air quality, and the Port of Seattle

The Port developed this Plan at the intersection of two global crises: climate change and the emergence of coronavirus disease 2019 (COVID-19). Although global attention has turned to the COVID-19 pandemic, climate change remains the challenge of our lifetime and one for which action cannot be ignored or delayed. Scientists predict the impacts observed today will only get worse unless there is significant and immediate global action.

Bold action is needed to combat global climate change

The International Panel on Climate Change (IPCC) determined that global temperature increase must be limited to 1.5 degrees Celsius (°C) above pre-industrial levels to avoid the most extreme impacts of climate change.[5] Even still, widescale impacts will mean more intense or more frequent droughts, wildfires, heat waves, rainstorms, sea level rise, floods, and landslides in the coming years, as well as geopolitical disruptions and global changes in resource availability.

For Port operations specifically, rising temperatures, changing weather patterns and reduced snowpack threaten access to relatively clean, affordable electricity from hydropower. Climate change may also affect production of agricultural exports that move through Port terminals. Sea-level rise and storm events threaten marine terminal infrastructure, stormwater systems, port properties, and cargo movements at the Port of Seattle and ports throughout the world.[6]

The International Panel on Climate Change determined that global temperature increase must be limited to 1.5° C above pre-industrial levels to avoid the most extreme impacts of climate change.

The effects of climate change—some of which are already happening now—will further strain natural resources, public

[5] IPCC, 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press. https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf

[6] Gellings, Joseph, "Climate change adaptation planning for Port of Seattle waterfront properties" (2018). Salish Sea Ecosystem Conference. 152. https://cedar.wwu.edu/ssec/2018ssec/allsessions/152

health, social systems, human well-being, and the economy. These devastating impacts will now be felt amidst the backdrop of a global effort to recover from a pandemic. While compounding the unknowns about the future, the response to COVID-19 has demonstrated how governments, organizations, and individuals can and must take bold, comprehensive, coordinated, and immediate actions in response to an unprecedented global crisis. The same level of coordinated action is needed to tackle climate change. This is particularly true for the maritime sector where a complex interconnected network of industry, government, non-governmental organizations, and community groups play a role. Working with tenants, partners, and communities, the Port is committed to leading a collaborative effort to achieve zero emissions by 2050.

Near-port communities are disproportionately exposed to air pollution

Both climate change and COVID-19 have local impacts. Adverse effects of these crises are more likely to be borne by historically marginalized communities, including Black, Indigenous, and people of color (BIPOC). In addition, BIPOC communities, neighborhoods with lower levels of educational achievement and higher rates of poverty and unemployment are also disproportionately exposed to air pollution and

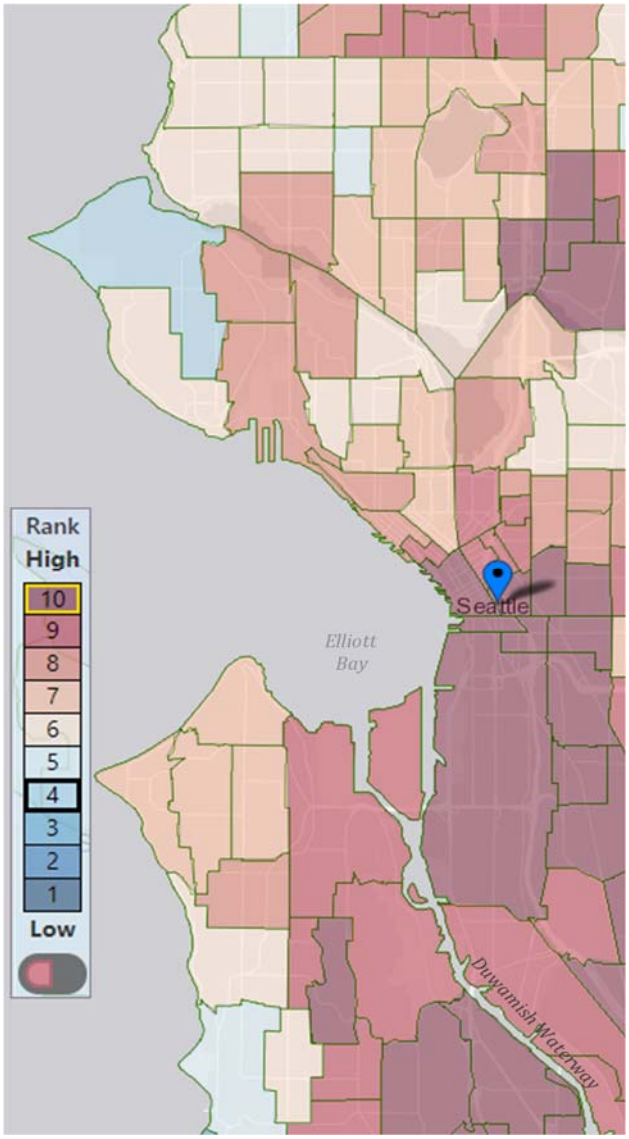
*According to the June 2018, **Duwamish Valley Action Plan***

other environmental hazards.[7] Although King County meets national air quality standards, the Port recognizes that pollution exposure, access to economic opportunity, and human health vary based on where people live. In Seattle, communities in the Duwamish Valley bear a disproportionate burden of health impacts and environmental injustices compared to other areas of the city. The Duwamish Valley comprises the neighborhoods of Georgetown and South Park, which border the Duwamish River and are home to about 5,600 people.

[7] Katz, Cheryl. (2012). *People in Poor Neighborhoods Breathe More Hazardous Particles*. Scientific American. Retrieved from https://www.scientificamerican.com/article/people-poor-neighborhoods-breate-more-hazardous-particles/.

The Duwamish River is an area of cultural significance to Native American tribes who historically used the river for transportation, fishing, and shellfish harvesting.[8] The river was dramatically altered to create the marine industrial assets there today. The Duwamish Manufacturing/Industrial Center represents nearly 80% of Seattle's industrial land.[9] The Duwamish Valley has the greatest number of contaminated waste sites, poorly built environment characteristics, and severe air pollution compared to the rest of Seattle. Life expectancy in the neighborhoods of Georgetown and South Park is up to 13 years shorter than wealthier parts of Seattle.[10]

The Washington Environmental Public Health Tracking Network's Environmental Health Disparities Map (an example is shown to the right) also illustrates the disparity among neighborhoods in Seattle and heavy burden of pollution – particularly diesel pollution – borne by communities that border port properties in Elliott Bay. Census tracts where Terminals 5, 18, 30, and 46 are located, as well as census tracts that border the Duwamish River, are ranked as 9 or 10 on the Washington Health Disparities Map for the "Diesel Pollution and Disproportionate Impact" indicator.[11] This is a combined indicator of diesel pollution burden and priority populations, with 10 being the highest ranking.



The Washington Tracking Network's Environmental Health Disparities Map compares communities across the state for environmental health disparities at the census tract level. The indicator visible in this snapshot of Elliott Bay and a portion of the Duwamish Waterway in Seattle is a combined score for Diesel Pollution and Disproportionate Impact.

In the Summer of 2020, a study in the Duwamish Valley engaged students to measure localized air pollution impacts by collecting and analyzing moss samples. Mosses are known to collect certain types of harmful air pollutants linked to fossil fuels and industrial pollution. The study's results showed areas within Duwamish neighborhoods with significantly higher levels of heavy metals and other air pollutant indicators. The findings demonstrate the need for immediate action but also provide valuable insight into where air quality

[8] https://www.duwamishcleanup.org/river-history-and-photographs

[9] City of Seattle Department of Planning and Development. Seattle's Industrial Lands – Background Report. May 2007.

[10] Gould L, Cummings BJ. Duwamish Valley Cumulative Health Impacts Analysis. Seattle, WA: Just Health Action and Duwamish River Cleanup Coalition/Technical Advisory Group. March 2013.

[11] Map retrieved 30 June 2020 from https://fortress.wa.gov/doh/wtn/WTNIBL/.

improvements are needed most. Adding to the urgency, air pollution exposure has been found to increase a person's risk of death from COVID-19.[12]

The Port recognizes the environmental health disparities experienced in the Duwamish Valley, and that maritime activity—including ships, trains, trucks, and other equipment—contributes to air pollution. Even as marine and vehicle engines are becoming cleaner and more efficient, diesel exhaust remains a leading source of air pollution in the Puget Sound. More effective actions and investments are needed to address health and economic inequities and to dismantle environmental injustices. When implementing the Plan, the Port will advance its commitment to collaboration with Duwamish Valley community members to identify projects and priorities of greatest impact and value in regions that need clean air and climate action most.

The Port's greenhouse gas reduction targets

In 2017, the Port of Seattle Commission (Port Commission) adopted GHG reduction targets that aligned with the Paris Climate Agreement. The Port's targets include a critical interim goal to cut emissions in half by 2030. The targets also entail a long-range commitment to deeply "decarbonize" maritime activity and make Port operations carbon neutral or carbon negative by 2050 and reduce Port-influenced emissions by 80% by 2050.[13]

SCOPES 1 AND 2: Port-controlled and Port indirect emissions

- 15 percent below 2005 levels by 2020
- 50 percent below 2005 levels by 2030
- Carbon neutral OR carbon negative by 2050

SCOPE 3: Emissions the Port has influence over, but not direct control

- 50 percent below 2007 levels by 2030
- 80 percent below 2007 levels by 2050

Subsequently, the IPCC released a Special Report in 2018 stating that climate change impacts could be significantly reduced by limiting global warming to 1.5°C and demonstrated that carbon neutrality is needed by 2050.[14] The Plan is based on the 2020 Strategy vision for 2050 which incorporates the latest IPCC recommendations.

[12] Harvard T. H. Chan School of Public Health. (2020, May 5). *Air pollution linked with higher COVID-19 death rates*. Retrieved from https://www.hsph.harvard.edu/news/hsph-in-the-news/air-pollution-linked-with-higher-covid-19-death-rates/.

[13] This Plan uses the terms "carbon" and "greenhouse gas" interchangeably, unless otherwise noted.

[14] International Panel on Climate Change, https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf

Vision and guiding principles

The Plan charts a course for how the Port will implement actions to achieve the 2020 Strategy vision:

Phase out emissions from seaport-related activities by 2050, supporting cleaner air for our local communities and fulfilling our responsibility to help limit global temperature rise to 1.5°C.

Achieving this vision will involve:

- Enactment of policies that address climate change and reduce carbon emissions
- Widespread adoption of technology and infrastructure solutions, many of which are not currently market ready
- Monumental investment from industry, ports, and other stakeholders
- Unprecedented levels of collaboration between industry and government to identify constraints, opportunities, and shared investments
- Robust engagement with local communities, Tribal governments, Indigenous groups and non-governmental organizations

The Plan also shares guiding principles with the 2020 Strategy. The following guiding principles inform how the Port will works toward achievement of the vision and the Port's Century Agenda targets:

- **Community Health |** Recognize the importance of reducing the impacts of seaport-related emissions on public health.
- **Climate Urgency |** Seek early achievement of the vision, recognizing the urgency to take action to limit global climate change.
- **Social Equity |** Prioritize action in communities that have been most impacted by port operations.
- **Innovation |** Promote innovative technologies, policies, and practices that drive continuous improvement.
- **Evidence-based Decisions |** Use best available climate change and air quality science to inform decisions.
- **Focused Resources |** Focus action in areas likely to have the highest environmental, social, and economic impact, recognizing the limits of port authority resources and operational control and influence.
- **Leadership |** Take a leadership role to facilitate government and industry support for the policy and actions needed to achieve the vision.
- **Accountability |** Provide clear, transparent, and timely updates on progress toward achieving the vision.
- **Port competitiveness |** Deliver the strategy in a way that supports competitiveness of ports and the prosperity of communities.

Alignment with Port policies

The Plan identifies the strategies and actions needed to carry out the Port's Century Agenda GHG reduction targets, as well as the 2020 Strategy. The Plan is aligned with the Port's overarching policies and commitments to address environmental sustainability, equity, and economic development, as well as the other guiding principles described above.

The Port is committed to sustainability

The Plan builds on the Port's foundation of environmental successes. The Port of Seattle is committed to becoming "the greenest port in North America." This commitment is reflected in the Port's Century Agenda goals and its significant investment in environmental programs. The Century Agenda, adopted in 2012 and periodically updated, is the Port's roadmap to add jobs through economic growth while reducing its environmental footprint. In addition to economic goals, the Century Agenda calls for the port to reduce dependence on fossil fuels, reduce air pollutants, reduce GHG emissions, protect water quality, and restore habitat in Elliott Bay and the Green/Duwamish watershed.

To further advance the Port's Century Agenda goals, the Port Commission adopted a policy directive in January 2020 requiring that a Sustainable Evaluation Framework be applied to all capital projects and key operational decisions. The framework creates a port-wide process to integrate sustainability into capital and operational decisions and increase transparency on how sustainability goals and decisions are being accomplished.

Port of Seattle Maritime Environmental Successes

"Be the greenest port in North America"

- Provided shore power for cruise ships since 2005, and became the first global port to offer shore power at two cruise berths
- Installed solar panels on Port buildings and uses renewable fuels in Port vehicles
- Provided financial assistance for cleaner trucks, ships, and cargo-handling equipment
- Partnered with regional ports to implement the 2020 Strategy and conduct Puget Sound-wide maritime emissions inventories
- Developed comprehensive habitat restoration plan for the Duwamish Waterway to support salmon recovery
- Completed projects to improve water quality and restore shorelines
- Created a stormwater utility to manage critical stormwater infrastructure
- Received Green Marine, Salmon-Safe, and EnviroStars certifications

The Port is committed to equity, diversity, and inclusion

In 2017, the Port and Duwamish Valley community members established a Port Community Action Team, a community advisory committee representing Georgetown and South Park who engage in program decisions and long-term planning. In 2019, the Port Commission adopted Resolution 3767, the Duwamish Valley Community Benefits Commitment. The Community Benefits Commitment is the first policy of its kind at a port authority to partner with a near-port community on environmental justice issues. The Port is also developing a localized tool for evaluating equity impacts of Port decisions and projects. This will inform the development of future equity-based partnerships, resource allocation, and better support for historically under-served and under-represented communities adjacent to Port properties.

The Port also created an Office of Equity, Diversity, and Inclusion in 2019 to address institutional racism and increase equity, diversity, and inclusion in Port policies, programs, and processes. These changes were formalized in a May 2020 update to the Port's Century Agenda to increase focus on promoting prosperity in local communities, and to become a model of equity, diversity, and inclusion. The office developed a strategic plan to translate these commitments and policies into action. These steps will ensure that equity is a focal point when making decisions regarding all Port programs and practices– including the air and climate action initiatives detailed in this Plan.

The Port is committed to economic development and prosperity

The Port Commission updated its Century Agenda economic goal in June 2020. The Port pledges to responsibly invest in the economic growth of the region and all its communities. The goal aims to create opportunities by supporting, sustaining, and advancing port-related industries and industrial lands that are essential to the region's continued growth and prosperity.

The Port operates a robust workforce development program. Recognizing that maritime is one of Washington's biggest and oldest industries, the Port partnered with Washington Maritime Blue to launch the Maritime Innovation Accelerator program in 2019. The program is an intensive, four-month accelerator to help maritime startup businesses network, develop, and secure funding for continued growth.

The Port is committed to being a highly effective public agency

In June 2020, the Port Commission also adopted a new goal to highlight its pledge to accountability, transparency, innovation, safe and healthy communities, and responsible financial stewardship. This newer commitment aligns well with the 2020 Strategy guiding principles and the need to prioritize and focus resources when implementing this Plan.

Community, industry, and government engagement

In developing this Plan and the 2020 Strategy, the Port worked with the other U.S. member ports--the NWSA and the Port of Tacoma--to engage and solicit input from community members, environmental and health advocacy organizations, industry representatives, and Tribal, federal, state, and local government agencies. The groups represent a cross-section of interest and involvement in maritime-related activity. To facilitate in-depth discussion, the ports set up a defined panel of representatives for key interest groups and convened three rounds of engagement.

A panel representing key interest groups discuss updates to the 2020 Strategy in 2019.

Summer 2019

Engagement kick-off to collect feedback on the 2020 Strategy's draft vision targets and objectives. These strategy elements introduced an approach to reduce emissions from all sectors of maritime activity.

Spring 2020

With the emergence of COVID-19, a scheduled in-person workshop transitioned to three sector-specific virtual workshops focused on draft conditions for success, objectives, and port authority actions.

Fall 2020

This third and final round of engagement sought feedback on the full draft of the 2020 Strategy and Port of Seattle's proposed port-specific implementation actions for Maritime Activity.

In each of these rounds of engagement, the U.S. Ports collected feedback through workshops, virtual meetings, individual phone calls, and written comments. U.S. Ports heard broad support for the 2020 Strategy's vision to phase out emissions, and its focus on both criteria air pollutants and GHG emissions. All parties expressed interest in collaboration. There was also strong agreement on the need for ports to provide context on the state of industry, technology, and the other conditions needed for success, as well as the urgent need to address disproportionate impacts on communities.

Participants did not all agree on timelines for achieving zero-emission objectives presented in the second round of engagement. Some were concerned about the cost and readiness of zero-emission technology and the risk of investing in interim solutions that could quickly become obsolete. Others called for urgent action and expedited timelines like those used in California.

Participating government agencies, environmental groups, community members, and some port commissioners stressed the urgency of the climate crisis. This influenced a major change to the 2020 Strategy vision, which was originally written as "Phase out emissions from seaport-related activities as early as possible this century…" The ports added the specificity and increased level of ambition of a 2050 phase-out to recognize the urgency of the climate crisis. The discussion acknowledged that the vision seeks to go further than some established targets, and that the pathway to phase out fossil fuels remains unknown for some sectors. The ports also set interim goals to develop the infrastructure capacity to support the transition to zero-emission technology.

The final engagement workshop reviewed the full draft 2020 Strategy and draft list of implementation actions for each port, including those listed in this Plan. Feedback from the workshop led to changes in the final 2020 Strategy to emphasize the need for significant investment, innovative financing mechanisms, and policy changes to realize the Strategy's vision of a zero-emissions future.

Participants highlighted the importance of ongoing, active engagement with communities in addition to regular reports on progress and they expressed support for the Port's proposed actions to engage Duwamish Valley communities in implementing the Strategy. Participants agreed that it is important to recognize near-zero options with renewable fuels in the interim where zero-emissions not feasible, but

some participants cautioned relying on this strategy too heavily, citing that interim solutions could shift the focus from finding zero-emission alternatives.

Participants also urged the ports to identify interim objectives and faster timelines to phase out emissions. The ports responded with a focus on interim actions in each port's implementation plan. This Plan identifies strategies for the next ten years, including priority actions to implement within 1-3 year and 5-year periods. The ports also added an adaptive management approach to Strategy implementation, which is reflected in the monitoring and reporting framework for this Plan. This adaptive approach allows the ports to update the Strategy objectives and timelines as the technology, funding, or policy environment evolves.

SECTION 2 | THE PORT'S MARITIME EMISSIONS

Where do port-related air pollutant and GHG emissions come from?

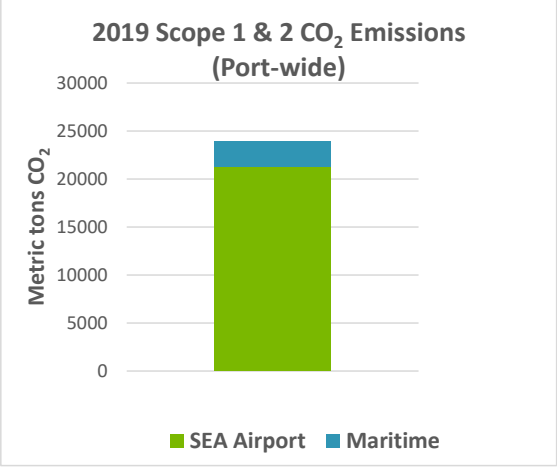
As hubs of transportation activity, ports move people and goods using vehicles, vessels, equipment, buildings, and facilities that are mostly powered by fossil fuels. These energy-intensive operations contribute to air pollutant and GHG emissions in the region. Diesel exhaust is a leading source of toxic air pollution in the region, and most vessels, locomotives, and trucks serving ports use diesel engines. For these reasons, DPM is used as the key indicator of maritime-related air pollution in this Plan.

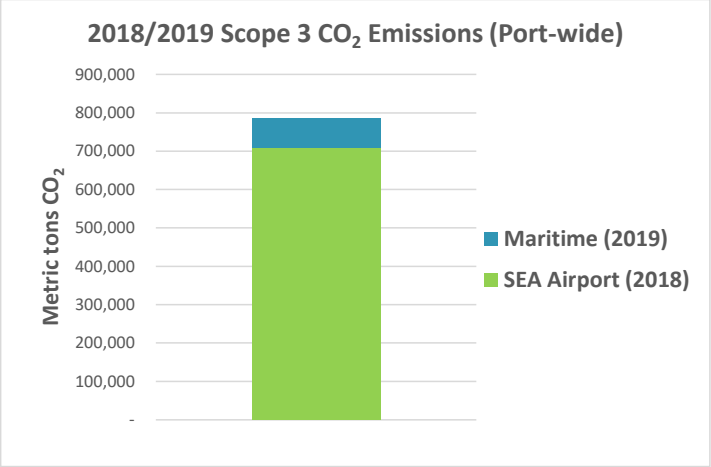
The Port's lines of business include the cruise, grain, commercial fishing, recreational boating, and other maritime industries, which are the focus of this Plan. In addition, the Port also operates Seattle-Tacoma International Airport (SEA Airport) and is a partner in the NWSA which operates container cargo terminals in Elliott Bay. Emissions from SEA Airport and NWSA are not covered by this Plan, and the discussion below explains the relationship between these entities and their emissions.

Port of Seattle maritime emissions in context with SEA Airport emissions

Looking at the Port's total emissions profile, emissions are broken into those associated with Maritime and Aviation branches of the Port. The Port's maritime-related emissions (the focus of this Plan) are about 10% of the Port's total emissions. SEA Airport emissions are addressed separately in the Sustainable Airport Master Plan.[15]

Figure 2. Port-wide GHG emissions: Port of Seattle Maritime and SEA Airport. *The Port's maritime emissions (covered by this Plan) represent 11% of Scopes 1 and 2 emissions and 10% of Scope 3 emissions. The remaining emissions come from SEA Airport sources, which are not addressed in this Plan.*





Port of Seattle maritime emissions in context with NWSA North Harbor emissions

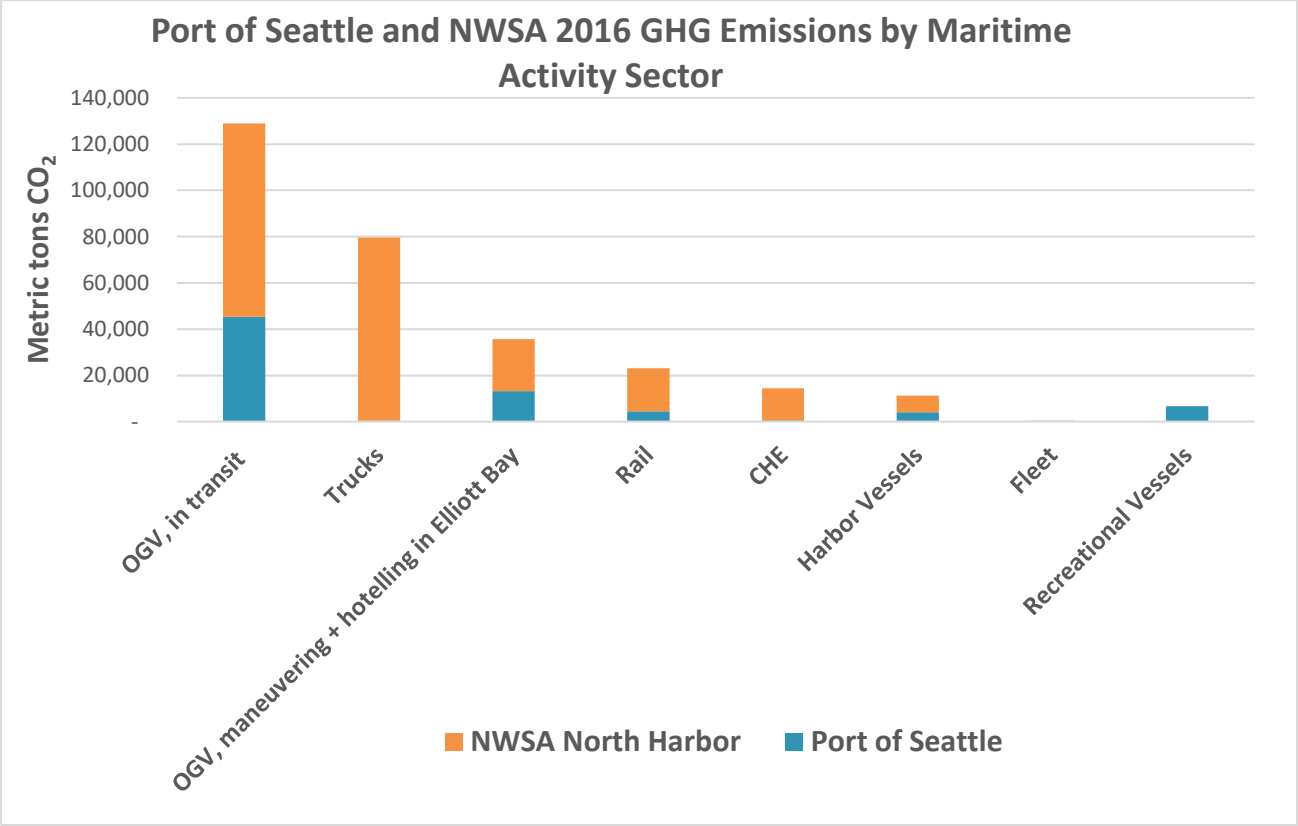
The Port is a partner in The Northwest Seaport Alliance, a separate port development authority that manages the container cargo terminals in Elliott Bay (referred to as the NWSA North Harbor). Although

[15] https://www.portseattle.org/plans/sustainable-airpor-master-plan-samp

the two ports have aligned goals through the 2020 Strategy and collaborate regularly, each port operates as a separate organization and plans and budgets for emission reduction efforts separately. NWSA will develop its own implementation plan to address its share of climate and air emissions from maritime sources in the North Harbor. NWSA North Harbor emission sources include container ships, cargo-handling equipment used on container terminals, container trucks, and locomotives. Looking at both the Port and NWSA North Harbor gives a more complete picture of maritime emissions from Seattle-based ports.

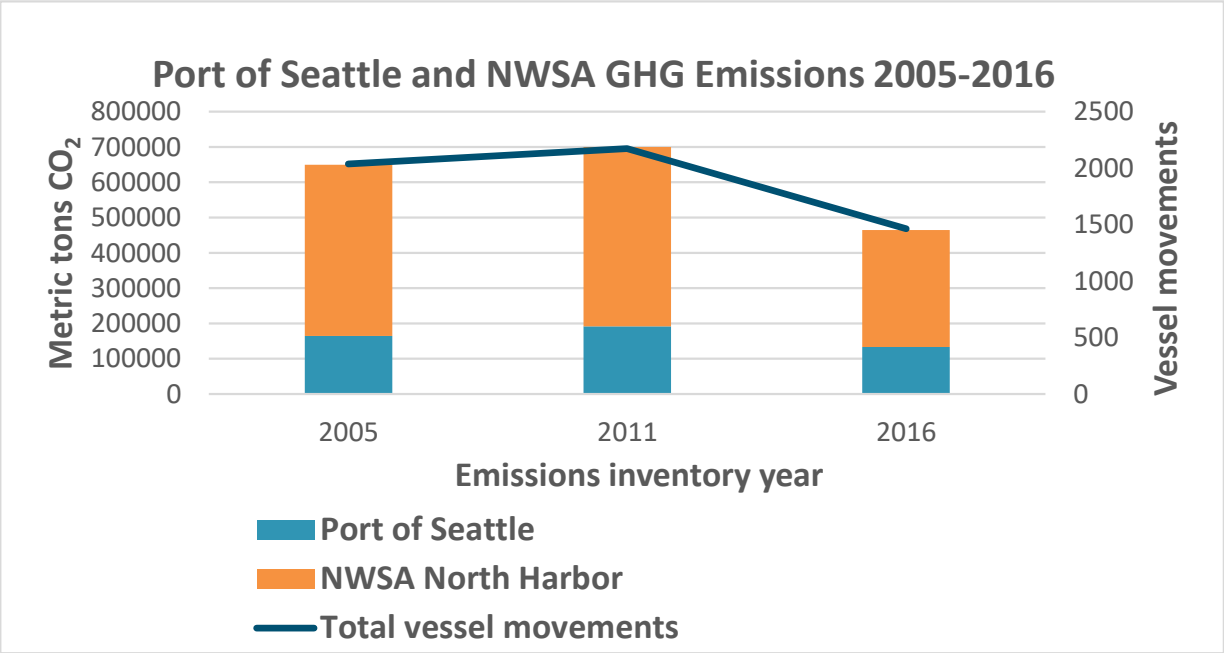
GHG emissions from NWSA operations contribute the bulk of Seattle-based maritime GHG emissions from ocean-going vessels (OGV), trucks, cargo-handling equipment (CHE), rail, and harbor vessels. Absolute GHG gas emissions from the Port and NWSA North Harbor combined declined 27% from 2005 to 2016. Total vessel movements for Port of Seattle and NWSA's North Harbor declined 28% over the same period.[16]

Figure 3. Port of Seattle and NWSA North Harbor GHG emissions by maritime activity sector (2016). *On an airshed-wide basis, ocean-going vessels and container trucks accounted for most of the maritime-related GHG emissions generated by the two seaports. NWSA sources contributed the bulk of emissions from these two seaports.*



[16] The number of vessel movements is used as an indicator of activity moving through the ports to capture activity from both marine cargo and cruise. Total vessel movements include individual vessel arrivals, shifts between berths or anchorages, and departures within Puget Sound.

Figure 4. Total GHG emissions from Port of Seattle maritime and the NWSA North Harbor sources 2005 – 2016. *Port of Seattle maritime emissions account for about 25% of the two seaports' GHG emissions. The 2016 decline in GHG emissions mirrored a decline in total vessel movements.*



DPM emissions can travel long distances, but concentrations are highest closest to the source; therefore, emissions occurring on or near port terminals are the most critical to protect the health of near-port communities.

Between 2005 and 2016, absolute emissions of local DPM in Seattle from the Port and NWSA North Harbor activities combined have declined 68%. This reflects a lower level of vessel movements in 2016 as well as widespread adoption of lower-sulfur fuels by ocean-going vessels, vehicles, and equipment over this period. Since then, the NWSA's Clean Truck Program has required container trucks to have newer engines that reduce DPM emissions by over 70%. The impact of this and other more recent emission reduction initiatives will not be measured until the release of the next inventory for the year 2021.

Figure 5. Local DPM emissions for Port of Seattle Maritime and NWSA North Harbor (2016). *Local emissions were approximated by including OGV hoteling/maneuvering (near or at berth) and regional emissions of locomotives and container trucks. (Estimates of near-port emissions from these sources is not available.)*

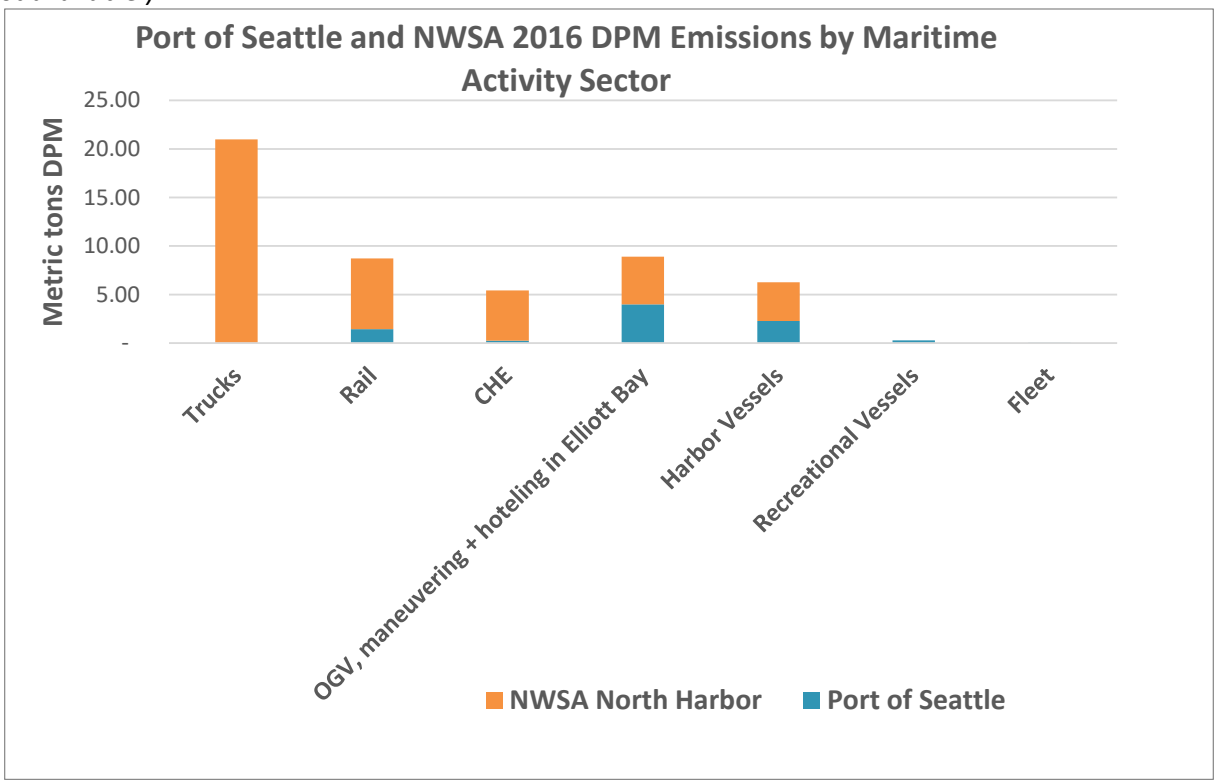
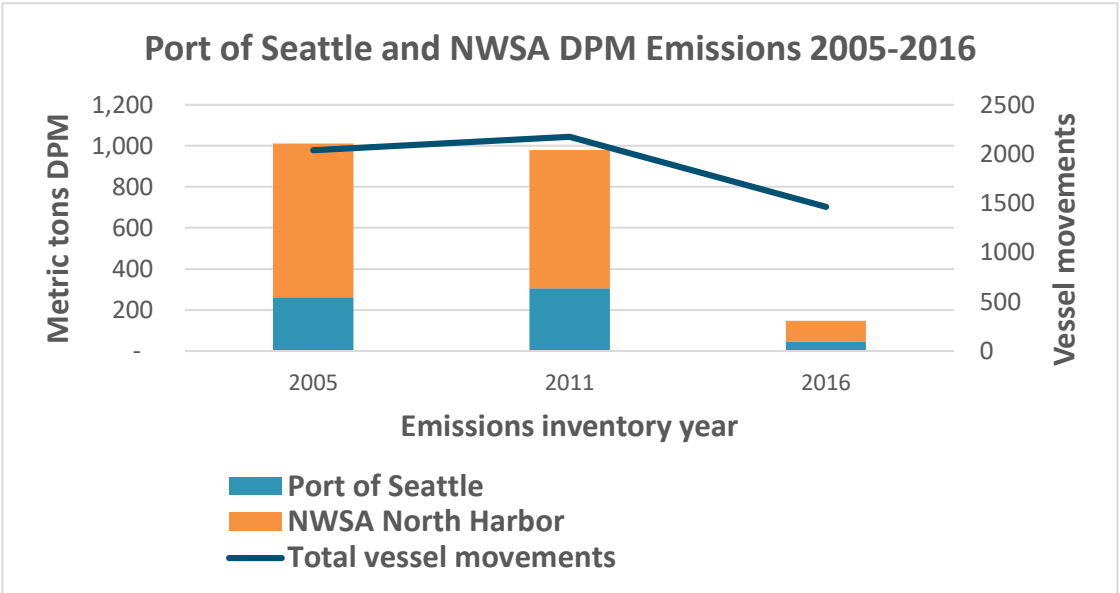


Figure 6. Local DPM emissions from Port of Seattle maritime and NWSA North Harbor sources 2005 – 2016. *Local emissions were approximated by including OGV hoteling/maneuvering (near or at berth) and regional emissions of locomotives and container trucks. (Estimates of neighborhood-scale emissions from these sources is not available). In 2016, DPM emissions declined significantly due to a lower number of vessel movements, as well as use of cleaner fuels.*



Characterizing the Port's maritime GHG and DPM emissions

The Port owns and operates some sources of GHG emissions, like fuel used in its fleet vehicles or energy used in its buildings, but does not own or directly control the ships, harbor craft, and rail locomotives that operate on Port properties and move people and cargo through the port. These sources account for most of the emissions in the Port's sphere of influence.

To characterize varying levels of control over emissions sources, GHG reporting protocols define three types of GHG emissions, referred to as "scopes."[17] The Port set targets in line with the Paris Climate Agreement to reduce emissions within each scope and uses the scope designations to track progress.

- **Scope 1 GHG emissions** are direct emissions from sources that are owned or controlled by the Port (such as fuel consumption by the Port's vehicle fleet).
- **Scope 2 GHG emissions** are indirect emissions from sources that are controlled by the Port (such as electricity purchased by the Port).
- **Scope 3 GHG emissions** are from sources not owned or directly controlled by the Port (such as emissions from tenant energy use, and fuel consumption by cruise and grain ships).

This Plan addresses all three scopes, but sorts emissions into two main categories which overlay the scope designations: **Port Maritime Administration** and **Maritime Activity.** This framework better reflects the Port's level of control for each emission source and provides a more logical alignment with how the Port structures emission reduction projects and programs. For example, some strategies to reduce building energy use apply to both Port-managed and tenant-managed spaces, even though they fall into different GHG emission scopes.

Port Maritime Administration Emissions Sources

[17] GHG Protocol Corporate Accounting and Reporting Standard

Table 1. Port maritime emission sectors by level of control (GHG scope).

Category/Sector	% of Scopes 1 and 2 emissions	% of Scope 3 emissions	% of Total Emissions (2019)
Port Maritime Administration			
Building and Campus Energy – assigned to Port	51%		2%
Building and Campus Energy – assigned to Tenant	16%	1%	1%
Fleet Vehicles and Equipment	32%		1%
Employee Commuting		1%	1%
Solid Waste			<1%
Maritime Activity			
Ocean-going Vessels		77%	74%
Harbor Vessels		14%	14%
Cargo-handling Equipment		<1%	<1%
Trucks		<1%	<1%
Rail		6%	6%

Port Maritime Administration sectors produce Scopes 1, 2, and 3 GHG emissions

Port Maritime Administration sources stem from the Port's maritime and economic development operations, and include Port-owned buildings and campuses, Port-owned fleet vehicles and equipment, employee commuting, solid waste management, and staff business travel (business air travel has been rendered carbon neutral since 2016 through purchase of carbon offsets.) Port Maritime Administration sources made up 6% of the Port's total maritime-related GHG emissions in 2019. Port Maritime Administration sectors produce a mix of Scopes 1, 2, and 3 emissions but the Port has direct control or can influence these operations.

The Plan focuses on these Port Maritime Administration sectors:

- Building and Campus Energy
- Fleet Vehicles/Equipment
- Employee Commuting*
- Solid Waste*
- Habitat Restoration/Carbon Sequestration*

*These sectors are outside the scope of the 2020 Strategy, but are relevant to the Port's specific operations.

While the sectors named above emit GHGs, the Port's habitat restoration efforts may have the opposite effect by "sequestering" (capturing) carbon in vegetation, soil, sediments, and water. The Port does not currently quantify carbon sequestration of restored habitat and has not included carbon sequestration in the Plan's emission forecasts. However, carbon capture benefits may be quantifiable in the future and could contribute to the Port's net-zero carbon goals. Habitat restoration is an additional element that supports the Plan's vision. Furthermore, if global emissions continue to rise, carbon capture and storage strategies will continue to grow in importance to stem the effects of climate change.

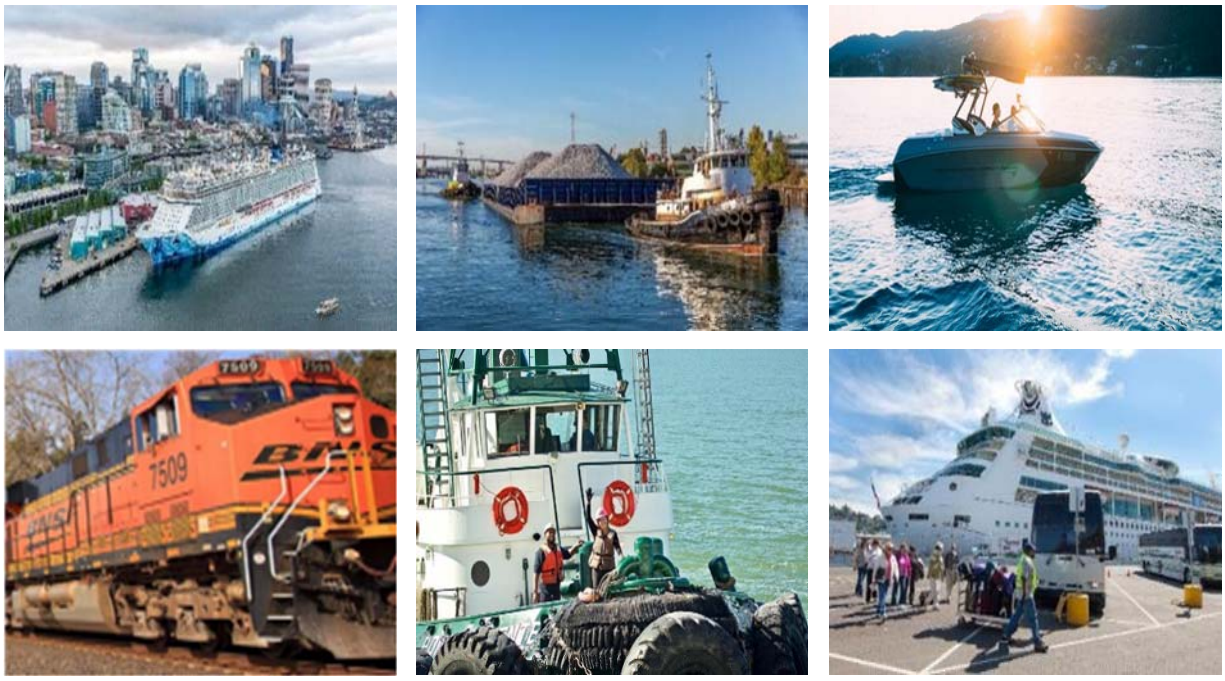
THE PLAN FOCUSES ON THESE MARITIME ACTIVITY SECTORS:

- Waterside sectors:
  - Ocean-going Vessels
  - Harbor Vessels
- Landside sectors:
  - Cargo-handling Equipment
  - Trucks
  - Rail

Maritime Activity sectors produce Scope 3 GHG emissions and DPM emissions

Maritime Activity sources include ships (referred to as ocean-going vessel or OGV), harbor vessels (tugs, commercial fishing vessels, recreational vessels), locomotives, trucks (including cruise-related buses and trucks supporting cruise and commercial fishing supply chain[18]), and cargo-handling equipment. These vessels, vehicles, and equipment are not Port-owned, but operate on and around Port properties, including cruise terminals, grain terminal, marinas, and industrial properties.

Maritime Activity Emissions Sources



[18] Truck sector emissions estimated for the Port in previous emissions inventories have included only emissions from buses that serve the cruise terminal. The Port aims to evaluate additional truck sources in future tracking and climate initiatives, such as medium- and heavy-duty trucks supporting the cruise and fishing industries but does not currently have data on how much these trucks contribute to emissions.

Because the Port has some influence, but not direct operational control, over Maritime Activity sectors, the associated GHG emissions are classified as Scope 3. The GHG from these activities combined made up 94% of the Port's maritime-related GHG emissions in 2019.

OGV contributed the largest share of air pollutant and GHG emissions compared to other Maritime Activity sectors. DPM emissions data from **Port Maritime Administration** sources is limited. The Puget Sound Maritime Air Emissions Inventory (discussed in the next section) estimates DPM for heavy-duty fleet equipment owned by the Port every five years. The Port-owned fleet vehicles emitted less than 0.1 metric tons (MT) per year of DPM as of the 2016 Inventory. No estimates are available for employee commute trips, solid waste, or natural gas. DPM emissions from all **Maritime Activity** sectors totaled about 9 MT per year in the 2016 Inventory from local sources, and 24 MT per year if including oceangoing vessels in transit. Local sources exclude oceangoing vessels in transit to focus on sources of DPM that are closer to local communities, as DPM emissions from oceangoing vessels in transit are measured for vessel journeys across the airshed. See Appendix B for more details on air emissions from these sources.

Figure 7. 2019 profile of Port Maritime GHG emissions in MT CO_2. *Port Maritime Administration sources make up 6% of total emissions and Maritime Activity comprises 94% of total emissions.*

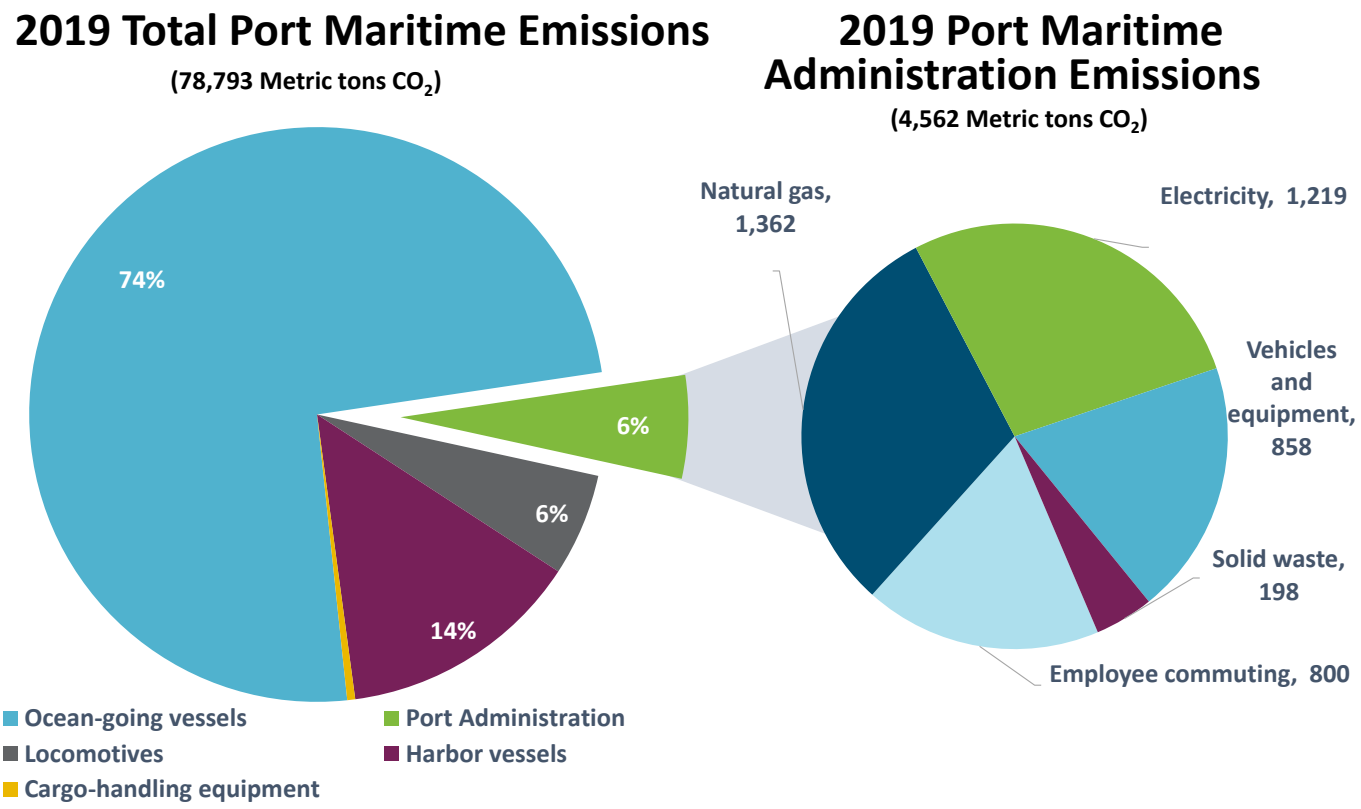
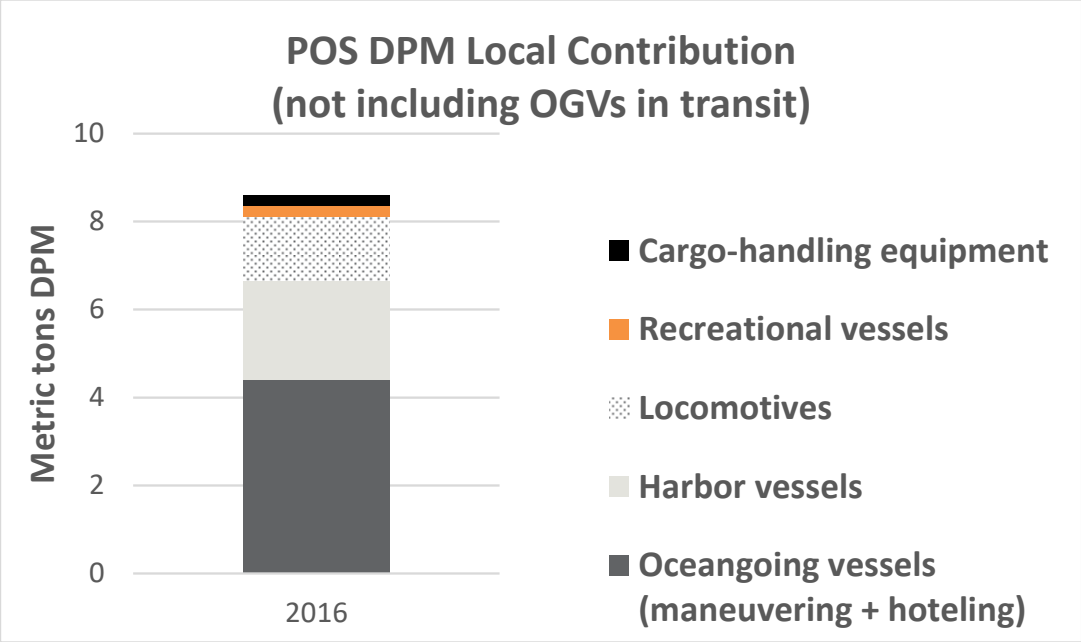


Figure 8. 2016 profile of Maritime Activity local DPM emissions. *In 2016, local DPM emissions from ocean-going vessels (maneuvering and hoteling) accounts for 19% of the total Port Maritime DPM. Ocean-going vessel DPM emissions for transiting account for 67% of the total, but are excluded from this graphic to highlight sources that impact local communities.*



How does the Port measure emissions?

The Port measures emissions from Port Maritime Administration and Maritime Activity sectors through two separate emission inventory processes: annual GHG emissions inventories of **Port Maritime Administration** sources, and a broader inventory of air pollutant and GHG emissions from **Maritime Activity** sources that occurs on a five-year cycle. Each inventory provides critical data needed to understand how much GHG or air pollutants are emitted.

Port Maritime Administration sources are inventoried annually for GHG emissions

The Port conducts inventories each year to estimate GHG emissions from **Port Maritime Administration** sources. GHG inventories were developed for milestone years for the Port's Century Agenda: 2005 and 2007 (baseline years per the Port's GHG reduction targets), 2011 (the year the Century Agenda was adopted), and annually starting in 2015. Emissions are reported in metric tons of CO_2 per year.[19] The results are used to track progress toward meeting GHG reduction targets and help set priorities for GHG emission reduction initiatives. The Port's inventory methodology does not estimate air pollutant emissions from Port Maritime Administration sources; however, in some cases the Plan's climate strategies will reduce air pollutant emissions as well as GHG emissions related to these sources.

[19] Some emissions modeling gives results in CO_2 equivalents (CO_2e) which include other GHGs such as methane and nitrous oxide emissions weighted by their global warming potential. Because the Port uses CO_2 as the indicator for GHG emissions, and CO_2 accounts for over 99% of CO_2e from maritime sources, the Port uses CO_2e values as surrogates for CO_2 values.

Maritime Activity sources are inventoried every five years for GHG and air pollutant emissions

The Port of Seattle collaborates with other ports, agencies, and organizations to conduct a voluntary, regional inventory of emissions called the Puget Sound Maritime Air Emissions Inventory (Inventory). The Inventory is completed every five years, starting with the baseline in 2005, with follow-up inventories covering 2011 and 2016.[20] The next Puget Sound-wide inventory will cover the year 2021.

The Inventory focuses on pollutants from **Maritime Activity** throughout the Puget Sound airshed – an area encompassing the waters of the Straits of Juan de Fuca and Puget Sound and the land between the Olympic and Cascade mountain ranges. Results are broken down by port and by source. The Inventory estimates the emission of GHG, DPM and other particulates, sulfur dioxide, and other air pollutants in U.S. (short) tons per year. The results provide critical data that informs the Port's and the region's environmental programs and policy decisions. More detail on the Port's emission inventories, including methodology and data gaps, can be found in Appendix B.

How have the Port's maritime emissions changed over time?

Port Maritime Administration GHG emissions are trending upward

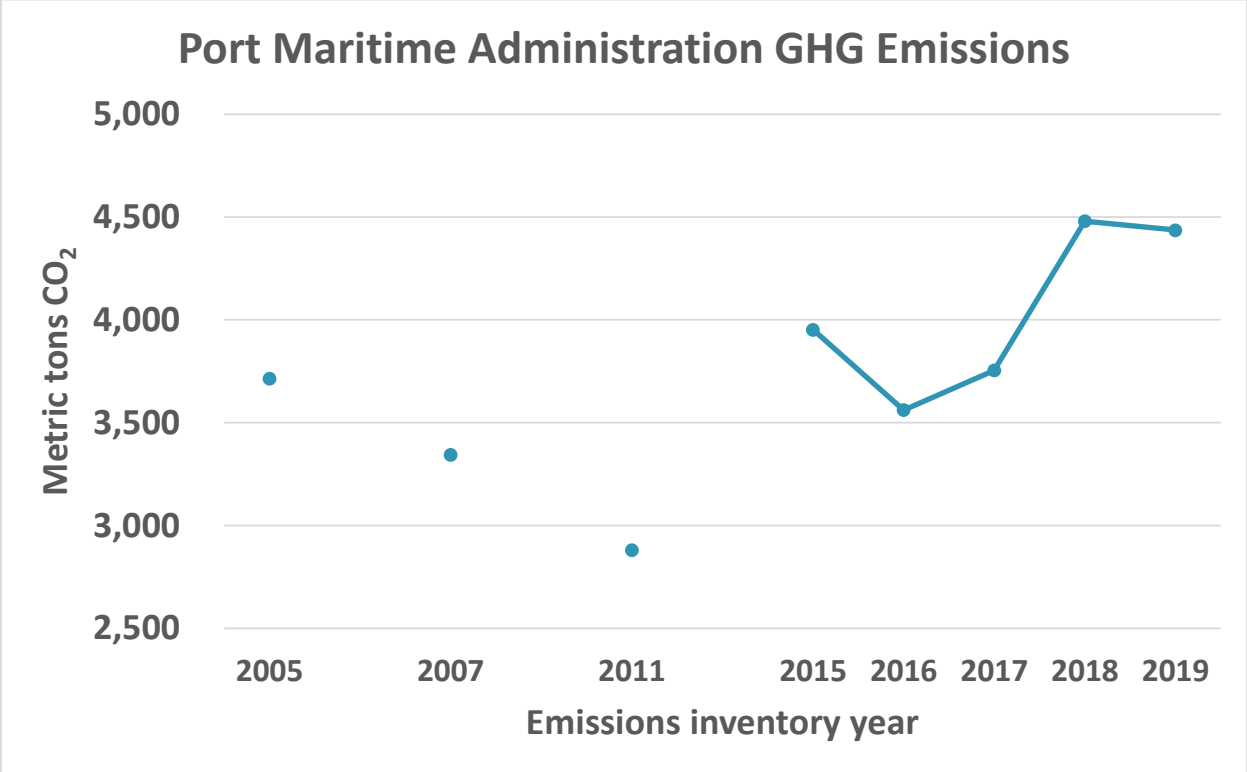
GHG emissions from all **Port Maritime Administration** sources combined were 9% higher in 2019 than in 2005. Emissions are clearly not on a trajectory to meet the Port's 2030 emission target, despite the many steps the Port has taken to conserve energy, decarbonize fuels, and maximize use of renewable energy. Energy conservation efforts include improvements in lighting, building insulation, and heating, ventilation, and air conditioning (HVAC) systems. Fuel decarbonization projects include early adoption of biodiesel-blended fuel for port vehicles and equipment. The Port is using renewable electricity via solar panels installed on several buildings and began using renewable diesel in fleet vehicles in late 2019. Air miles from business travel have been offset through the purchase of carbon credits since 2016.

Two key trends driving recent increases in GHG emissions from Port Maritime Administration sectors are increased use of natural gas in buildings, and fluctuations in electricity emission factors from year-to-year variation in Seattle City Light's energy mix. Natural gas consumption has increased significantly over the past five years. Some variability in annual emissions is expected as conditions change, such as

[20] Starcrest Consulting Group, LLC, 2018. *Puget Sound Maritime Air Emissions Inventory, Revised October 2018*.

weather-related heating and cooling needs and tenant occupancy rates. Tenant-occupied spaces use the most natural gas, and often multiple tenants are served by the same gas meter. The lack of individual meters makes it difficult to pinpoint consumption patterns and introduce solutions. (The Plan's strategies to improve metering and conduct energy audits will address these issues.) In addition, GHG emission factors for electricity provided by Seattle City Light have fluctuated over time, reflecting annual changes in the utility's energy portfolio. While Seattle City Light typically gets more than 90% of its electricity from hydropower, variations in weather and other events like droughts or major wildfires can result in more or less fossil sources of energy needed to supplement the cleaner hydropower. This influences the GHG calculation from electricity. In 2011, for example, electricity usage was on par with other years, but the corresponding emission factor was about 60% lower, substantially reducing 2011 GHG emissions.

Figure 9. Annual GHG emissions from Port Maritime Administration sources 2005 – 2019 in MT CO_2. *Emissions were inventoried for the Port's Century Agenda milestone years: 2005, 2007, and 2011, and annually since 2015.Note: the scale along the vertical axis has been narrowed to highlight the small changes in recent years.*



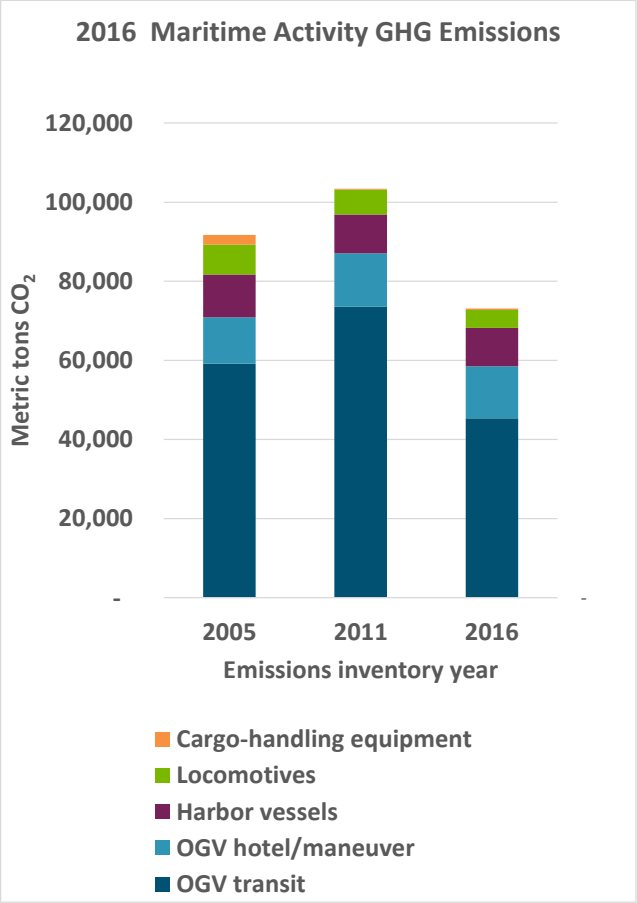
Maritime Activity air pollutant and GHG emissions have decreased

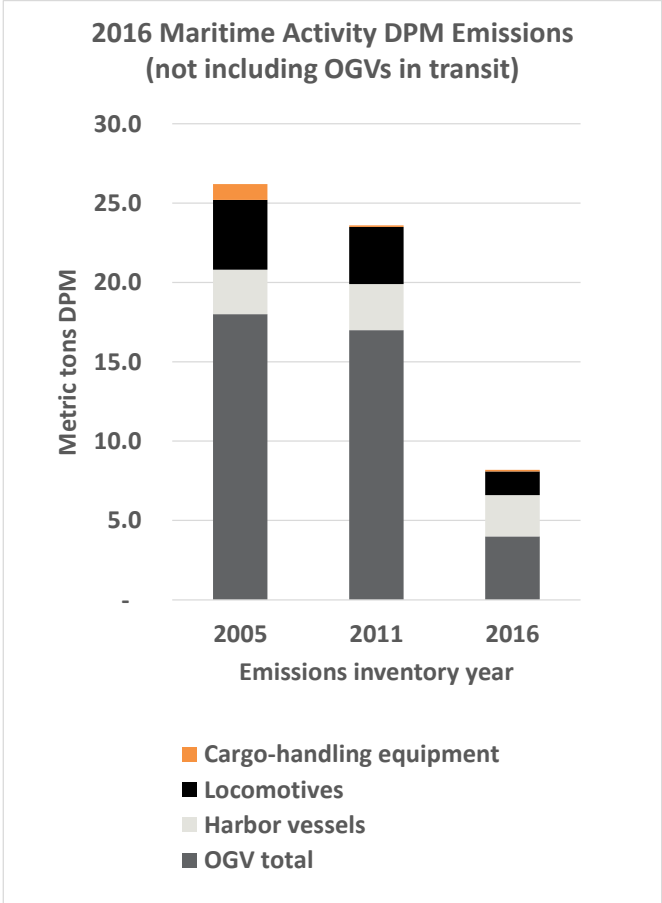
Maritime Activity emissions were lower for all air pollutants and GHG in 2016 compared to 2005. DPM emissions from Maritime Activity sectors dropped by 82% over this period. Emissions of other air pollutants fell by 25% – 96%, depending on pollutant, and GHG emissions were 20% lower in 2016 compared to 2005. In 2011, emissions were higher than in 2005 or 2016 because total vessel movements and cargo volume—two indicators of overall activity—were higher that year, and lower sulfur fuel was not yet required for vessels.

The steep reductions in DPM and other air pollutants were due to regulatory changes requiring the use of low sulfur fuel and more advanced pollution controls on newer vessels, vehicles, and equipment that went into effect over this period. Voluntary investments by the Port, maritime industry, and government agencies in cleaner equipment and fuels, as well as improved operational efficiency, also played a role in reducing emissions. The Port provided financial incentives to promote early adoption of cleaner fuels by ocean-going vessels calling at the Port from 2008 – 2015, for example.

Regulatory changes requiring low sulfur fuel and advanced pollution controls on diesel-powered engines target conventional air pollutants but have minimal effect on GHG emissions. GHG emissions declined due to lower cargo throughput, improved vessel efficiency, and broad adoption of cleaner and electric cargo-handling equipment on the cruise terminals.

Figure 10. Annual GHG and DPM emissions from Maritime Activity sources 2005 – 2016. *Emissions were inventoried in the Puget Sound Maritime Air Emissions Inventories for years 2005, 2011, and 2016.*





How will the Port's maritime emissions change in the future?

Seaport-related trade is projected to grow in the coming decades. To account for growth, the Plan's emissions forecast incorporates estimated annual growth as well as the emission reduction potential of air and climate action strategies in 2030.

Business-as-usual forecast

To estimate future emissions, a business-as-usual or "no action" scenario was used to forecast emissions to 2030. This scenario includes projected business growth and assumes that the Port will continue operations without implementing any additional emission reduction strategies.

For **Port Maritime Administration** sources, an annual growth rate was developed for each sector using historic emission trends from 2005 – 2019 GHG inventory data, yielding annual growth rates ranging from 1 – 2%. For **Maritime Activity** sources, a composite annual growth rate of 1.9% was developed based on industry forecasts for the cruise, grain, commercial fishing, and recreational boating sectors. The analysis makes a conservative assumption that GHG emissions will increase proportionate to the rate of business growth. Based on these projections, business-as-usual emissions will grow by 23% between 2019 and 2030. As additional years' data is collected and market projections change, the forecasts can be adjusted.

Action scenario forecast

In contrast, an "action" scenario was developed to forecast emissions if the strategies identified in Plan are implemented. Expected emission reductions were subtracted from the business-as-usual totals to show the effectiveness of strategy adoption in 2030.

COVID-19 impacts are not included in these forecasts

Note that these forecasts do not include impacts of the COVID-19 pandemic or recovery. These projections will be reassessed and adjusted as the impacts of the pandemic are better understood.

For **Port Maritime Administration** sectors, the Plan includes estimated potential emission reductions on a strategy-by- strategy basis. The potential reduction in emissions was calculated using Port-specific knowledge and data, as well as publicly available literature. The analysis included factors such as activity levels, energy usage, and timing of strategy implementation. When a strategy required substituting one energy source for another, the estimate reflects the net decrease in emissions.

For **Maritime Activity** sectors, the Plan includes potential emission reductions in the ocean-going vessel sector from planned shore power capability at the Port's cruise terminals, based on Port-specific knowledge and data, as well as publicly available literature. In addition, the action scenario includes vessel efficiency improvements resulting from regulatory mandates that are in force or being developed by the International Maritime Organization (IMO). However, for other Maritime Activity strategies, the analysis assumed a theoretical straight-line reduction to zero emissions by 2050 that is needed to meet the goal set in the 2020 Strategy. Pathways and timeframes to phase out fossil fuels from other vessels, vehicles, and equipment that are not under Port control have not yet been determined.

Figure 11. Annual GHG emissions from Port Maritime Administration projected to 2030 in MT CO_2. *Annual emissions from Port Maritime Administration 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. The strategies identified in this Plan can reduce Port Maritime Administration emissions by 50% to meet the Port's 2030 GHG reduction target.*

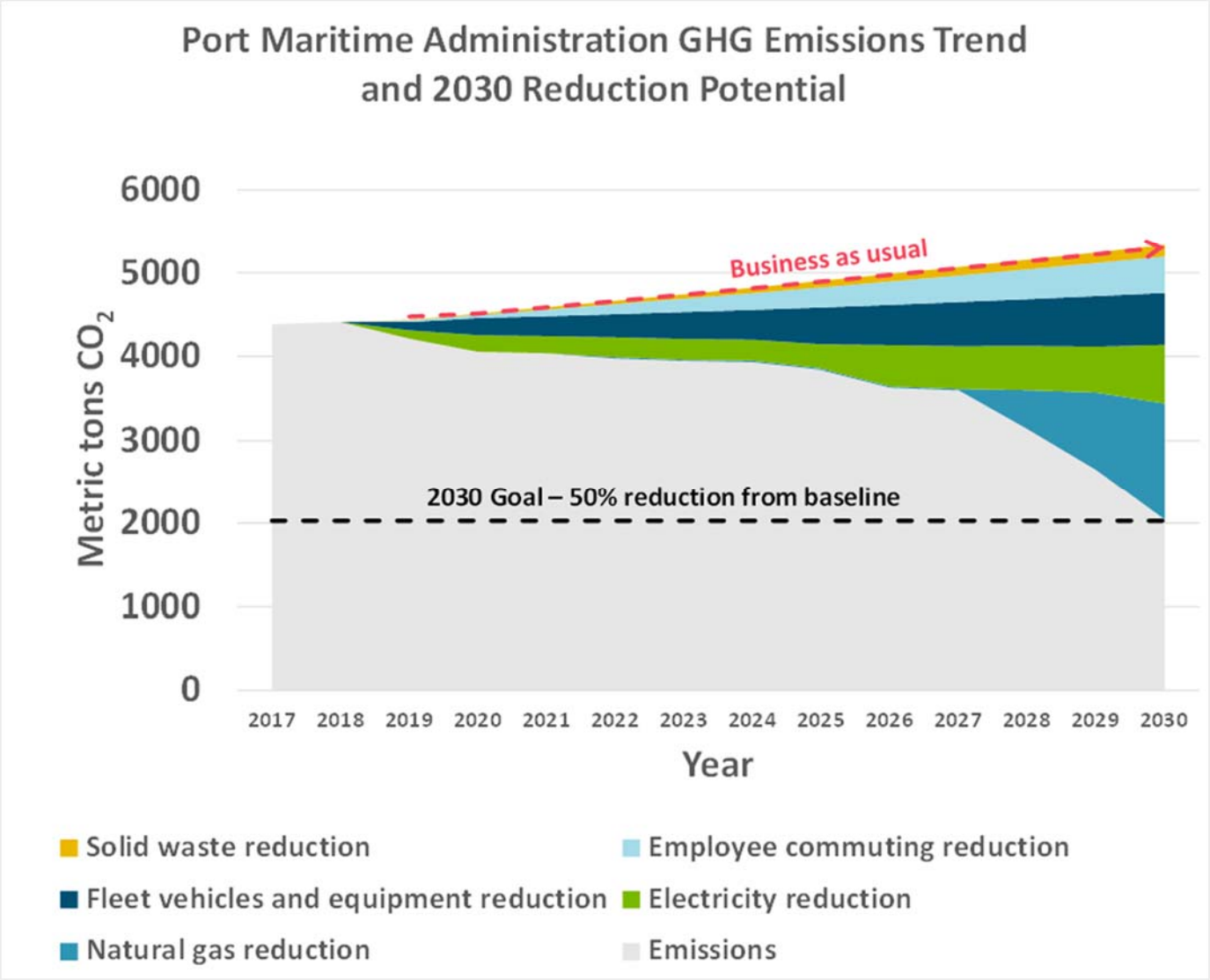


Figure 12. Annual GHG emissions from Maritime Activity projected to 2050 in MT CO_2. *Annual emissions from Maritime Activity will continue increasing through 2050 under a business-as-usual scenario that includes projected growth and assumes that no further emission reduction actions are taken. The strategies identified in this Plan can reduce Maritime Activity emissions by approximately half. 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.*

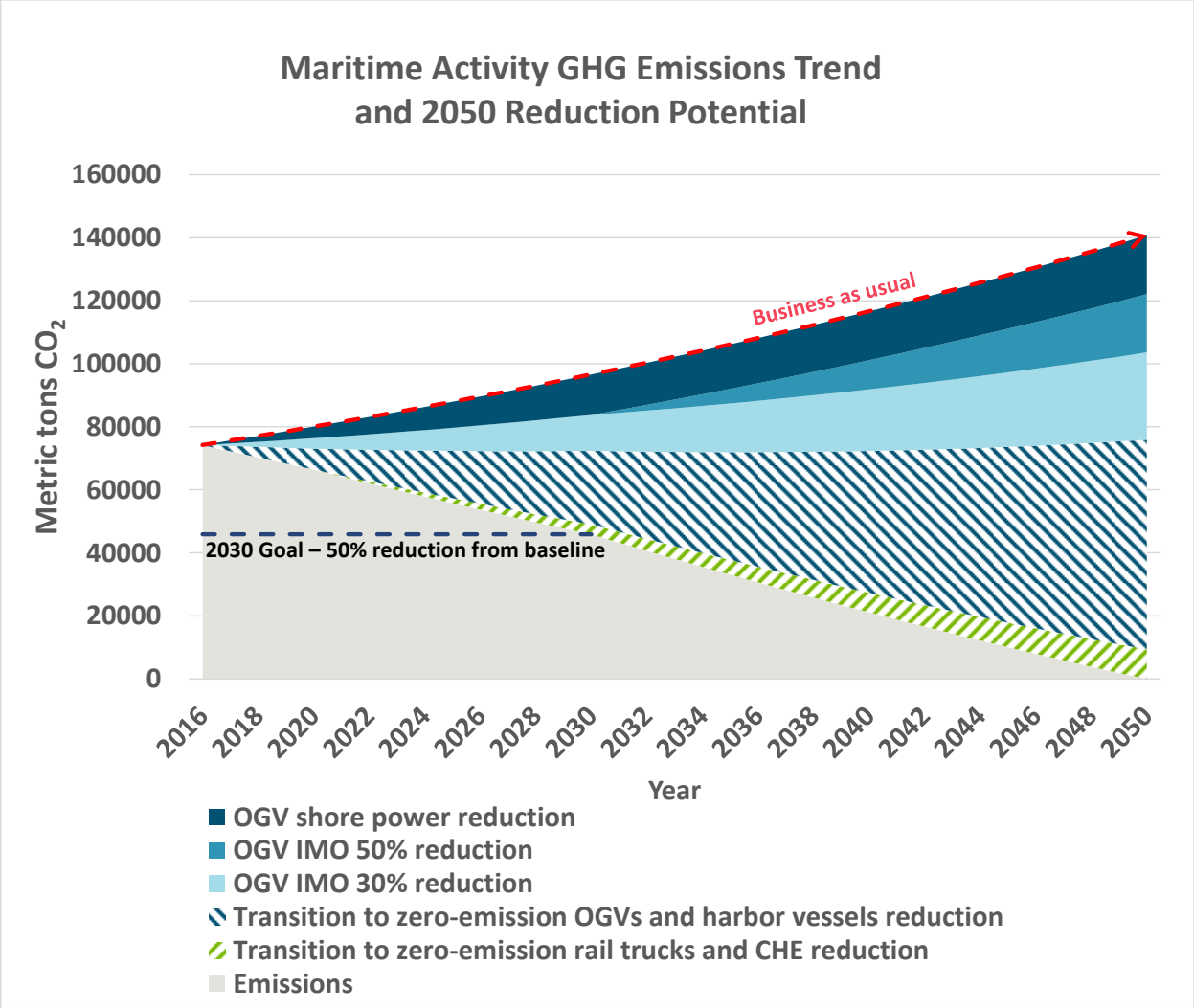
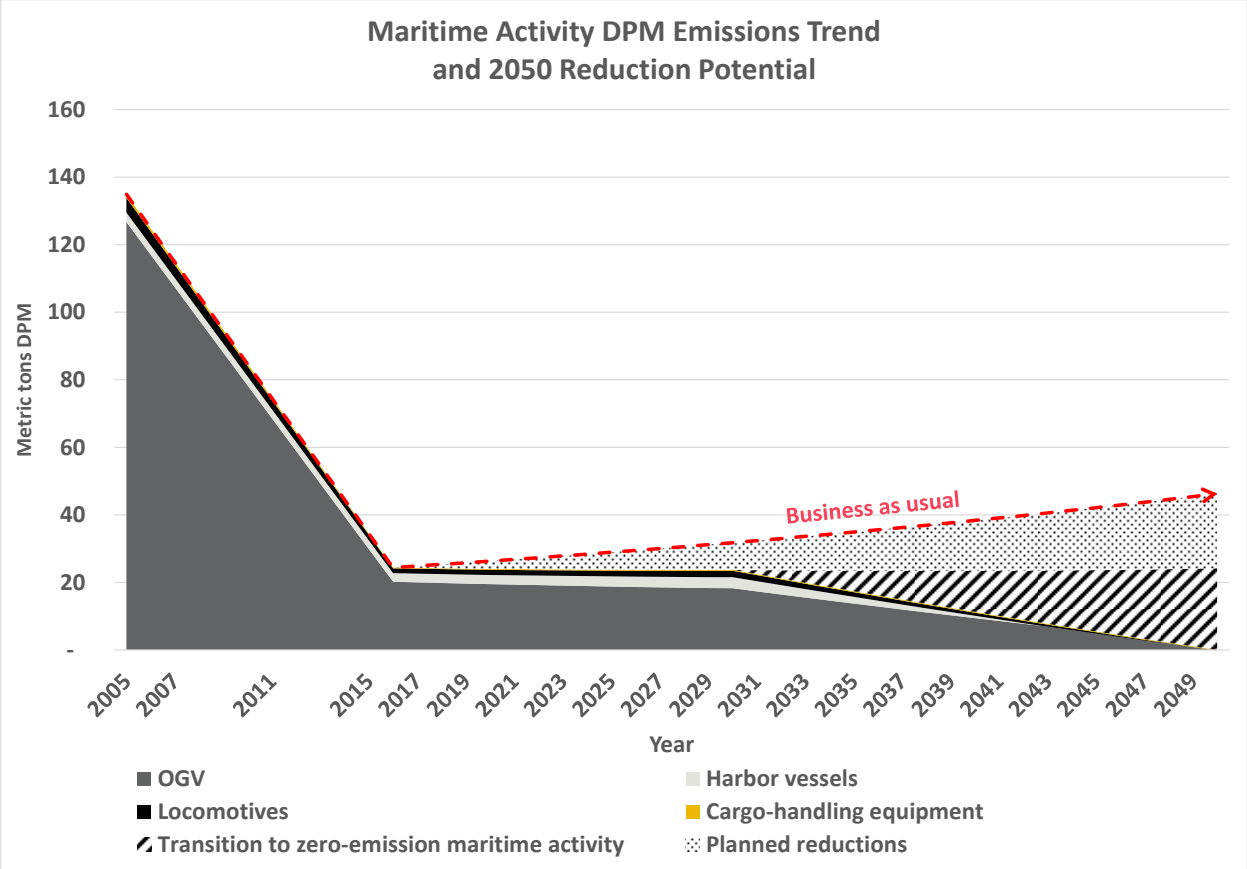


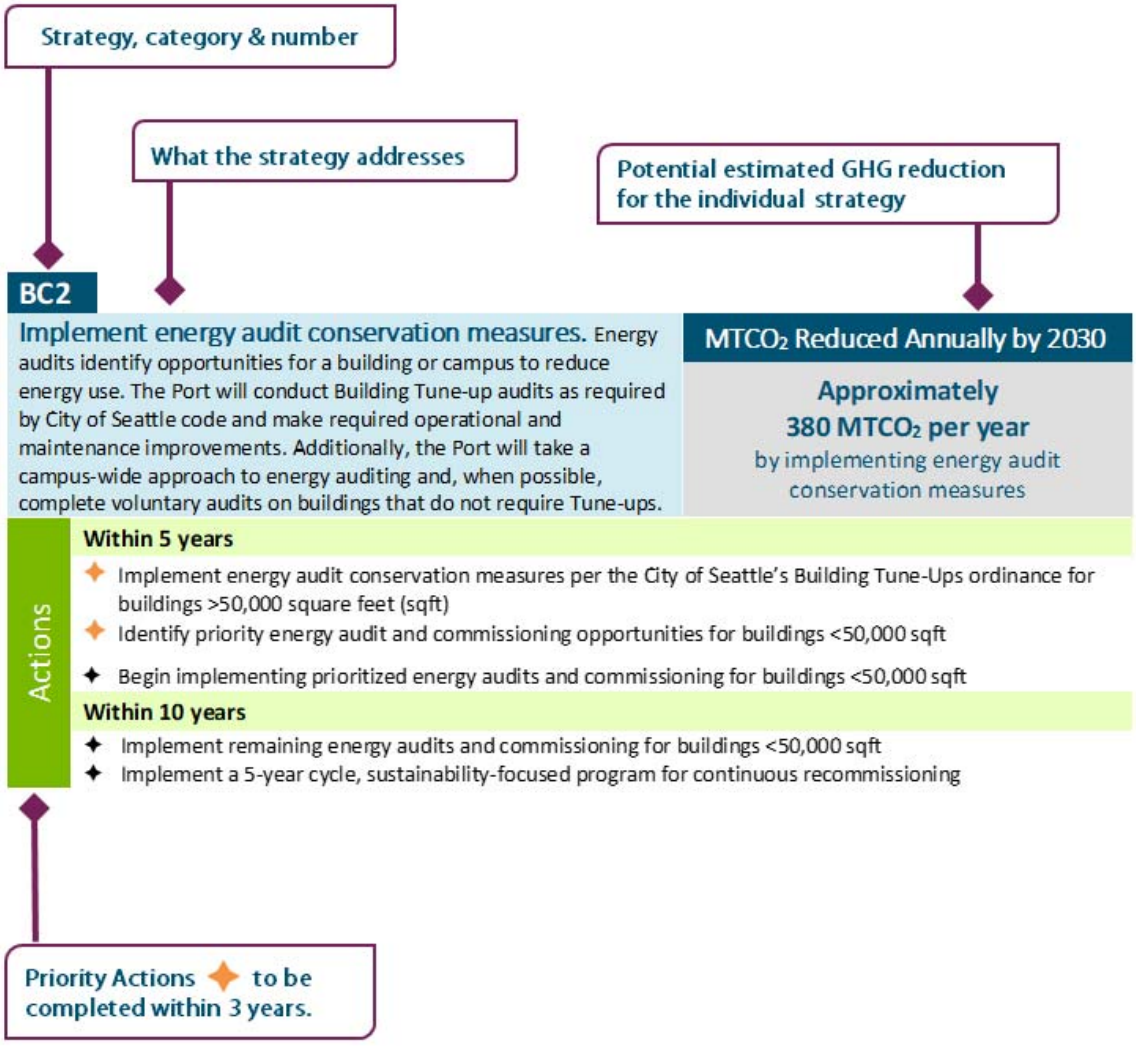
***Figure 13. Annual DPM emissions from Maritime Activity projected to 2050 in MT**. Annual DPM emissions from Maritime Activity will continue increasing through 2050 under a business-as-usual scenario that includes projected growth and assumes that no further emission reduction actions are taken. The strategies identified in this Plan can reduce Maritime Activity DPM emissions by approximately half. 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.*



How will the Port reduce emissions?

The Plan identies a set of ambitious, timely strategies and actions to be taken by 2030 for both Port Maritime Administration and Maritime Activity sectors to decrease GHG and air pollutant emssions. These represent one path to achieve the 2030 goal of 50% GHG reduction and will be refined as more information becomes available, and to keep on track for the 2050 goal of zero-emissions.

Strategies and actions to reduce emissions are detailed in Section 3 of the Plan for Port Maritime Administration sources, and in Section 4 for Maritime Activity sectors. The following is a key to reading these sections.


Strategy, category & number
What the strategy addresses
Potential estimated GHG reduction for the individual strategy
BC2
Implement energy audit conservation measures. Energy audits identify opportunities for a building or campus to reduce energy use. The Port will conduct Building Tune-up audits as required by City of Seattle code and make required operational and maintenance improvements. Additionally, the Port will take a campus-wide approach to energy auditing and, when possible, complete voluntary audits on buildings that do not require Tune-ups.
MTCO2 Reduced Annually by 2030
Approximately 380 MTCO2 per year
by implementing energy audit conservation measures
Actions
Within 5 years
Implement energy audit conservation measures per the City of Seattle's Building Tune-Ups ordinance for buildings >50,000 square feet (sqft)
Identify priority energy audit and commissioning opportunities for buildings <50,000 sqft
Begin implementing prioritized energy audits and commissioning for buildings <50,000 sqft
Within 10 years
Implement remaining energy audits and commissioning for buildings <50,000 sqft
Implement a 5-year cycle, sustainability-focused program for continuous recommissioning
Priority Actions to be completed within 3 years.

SECTION 3 | STRATEGIES TO REDUCE IMPACTS: PORT MARITIME ADMINISTRATION

Port Maritime Administration sectors can meet the 2030 GHG reduction target by implementing 23 strategies

The Port has control and/or can guide emissions reductions from **Port Maritime Administration** sources, especially from GHG Scopes 1 and 2 (building and campus energy, fleet vehicles and equipment). It can guide and influence Scope 3 sources (employee commuting and solid waste).

The action scenario identifies 23 strategies across five sectors that collectively can reduce Port Maritime Administration emissions by 2030 to half of their 2005 levels.

Strategies are focused on three key themes:

- Reduce energy and fuel use
- Shift from fossil-based energy to renewable energy
- Leverage habitat restoration projects to sequester carbon.

Because Seattle's electricity comes mainly from hydropower and will be fully renewable by 2045, the strategies lean heavily toward electrifying vehicles, equipment, and building systems, and moving away from fossil fuels and fossil natural gas.[21] In addition to electrification, strategies focus on maximizing use of renewable fuels in vehicles and renewable energy, including solar power which provides zero-emission power and reduces loads on the utility grid. Efficiency gains achieved through building retrofits, upgrades to building system controls, and replacing existing lighting with light emitting diode (LED) technology, among others, can further reduce emissions.

First steps toward deeper decarbonization must begin immediately since technologies to achieve net-zero energy buildings and zero-emission light-duty vehicles are rapidly becoming more available and affordable.

[21] The Washington State Clean Energy Transformation Act (E2SSB 5116, 2019) commits Washington state to provide an electricity supply free of GHG emissions by 2045, https://www.commerce.wa.gov/growing-the-economy/energy/ceta/

Building and Campus Energy

Strategies

BC1	Eliminate fossil natural gas use
BC2	Implement energy audits
BC3	Install energy efficient lighting
BC4	Reduce plug loads and upgrade controls
BC5	Maximize renewable energy
BC6	Streamline and advance energy data management
BC7	Apply high performance lease terms
BC8	Strengthen energy conservation communications and education

Emissions: Scopes 1, 2, and 3

3%

of Port Maritime GHG 2019 emissions

80

Buildings across 10 major campuses occupied by tenants and Port

Properties include marine terminals, commercial and recreational marinas, conference centers, offices, industrial facilities, warehouses, shops, restaurants, parking structures and public access parks. All campuses use electricity, and about half use natural gas.

BUILDINGS AND CAMPUS ENERGY

Context

The Port has ten major Maritime campuses that include grain and cruise marine terminals, marinas, conference centers, offices, industrial facilities, warehouses, retail shops, restaurants, parking structures, and parks. All campuses use electricity, and seven use natural gas.

As a "landlord port," the Port holds a wide variety of lease types, some of which have long terms and limited opportunities for renewal or amendments. The Port owns and occupies land and buildings, and leases land and buildings to tenants. Port-managed properties are either occupied by Port staff and operations or may be leased directly to tenants but remain primarily under Port management. Port-managed properties allow the Port more control over implementing energy conservation measures. Tenant-managed properties include buildings or land leased by tenants from the Port or where the lease terms or agreements limit the Port's control and ability to implement energy conservation measures. In some cases, buildings are owned by tenants through ground leases and the Port may have no control over the building or operations whatsoever.

In addition to variation in control over property management, the Port also has a wide variety of utility meters and submeters throughout its buildings and facilities and complex relationships around how energy use and costs are distributed between the Port and its tenants. In some cases, direct energy use by tenants is not available or unknown and is therefore attributed to the Port, per GHG inventory protocol. This represents a gap in data accuracy in how emissions are allocated between scopes in the Port's annual inventories.

Emissions from energy usage has varied from year to year but is not decreasing despite energy efficiency projects completed over this period. The upward trend is due to higher energy demand, especially for natural gas. GHG emissions have also fluctuated and are heavily influenced by the emission factor for electricity which changes annually based on Seattle City Light's portfolio mix. About 5% of the increase comes from refinements to GHG inventory data in recent years. Emissions from building and campus energy must be curtailed to help meet the Port's GHG goals, particularly its reduction targets for Scope 1 and Scope 2 emissions.

Figure 14. Annual Building and Campus energy usage. *Energy usage has trended upward with electricity usage leveling out, while natural gas usage continues to grow.*

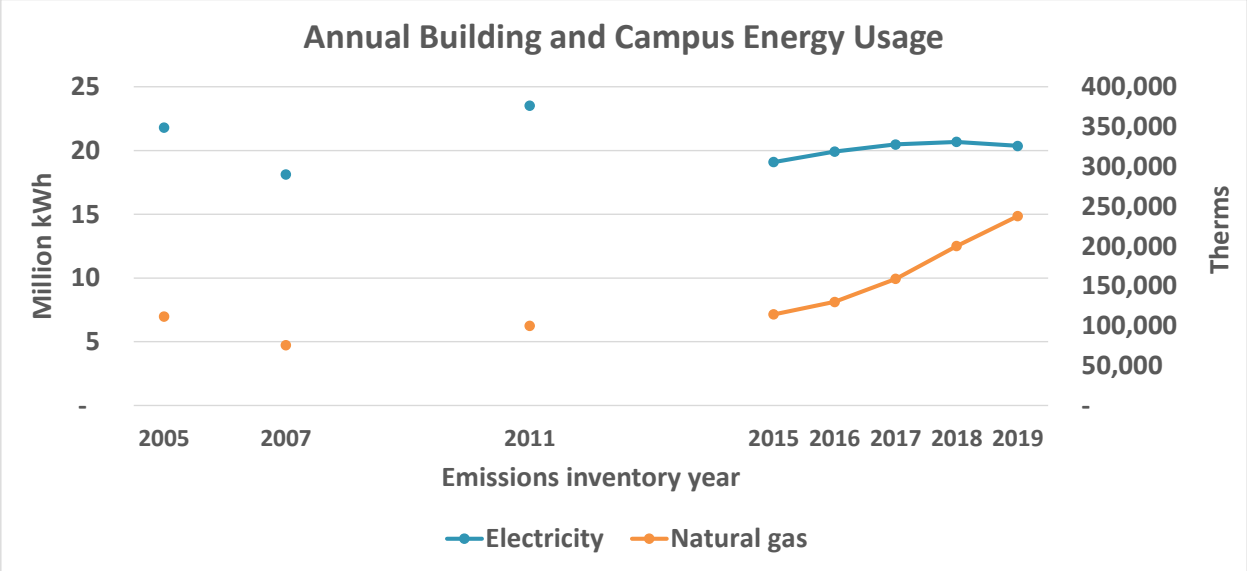
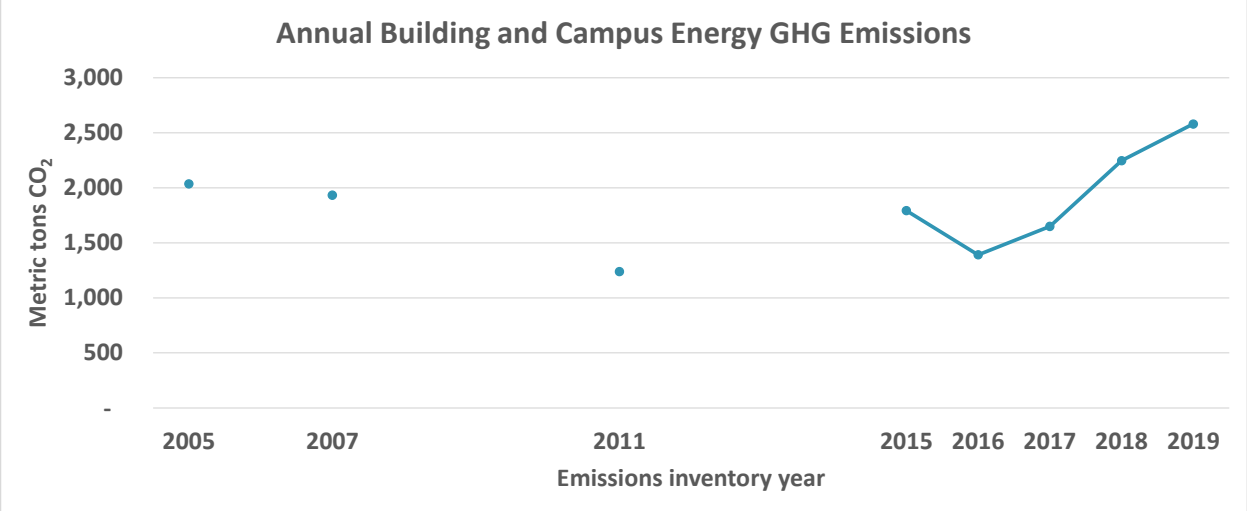
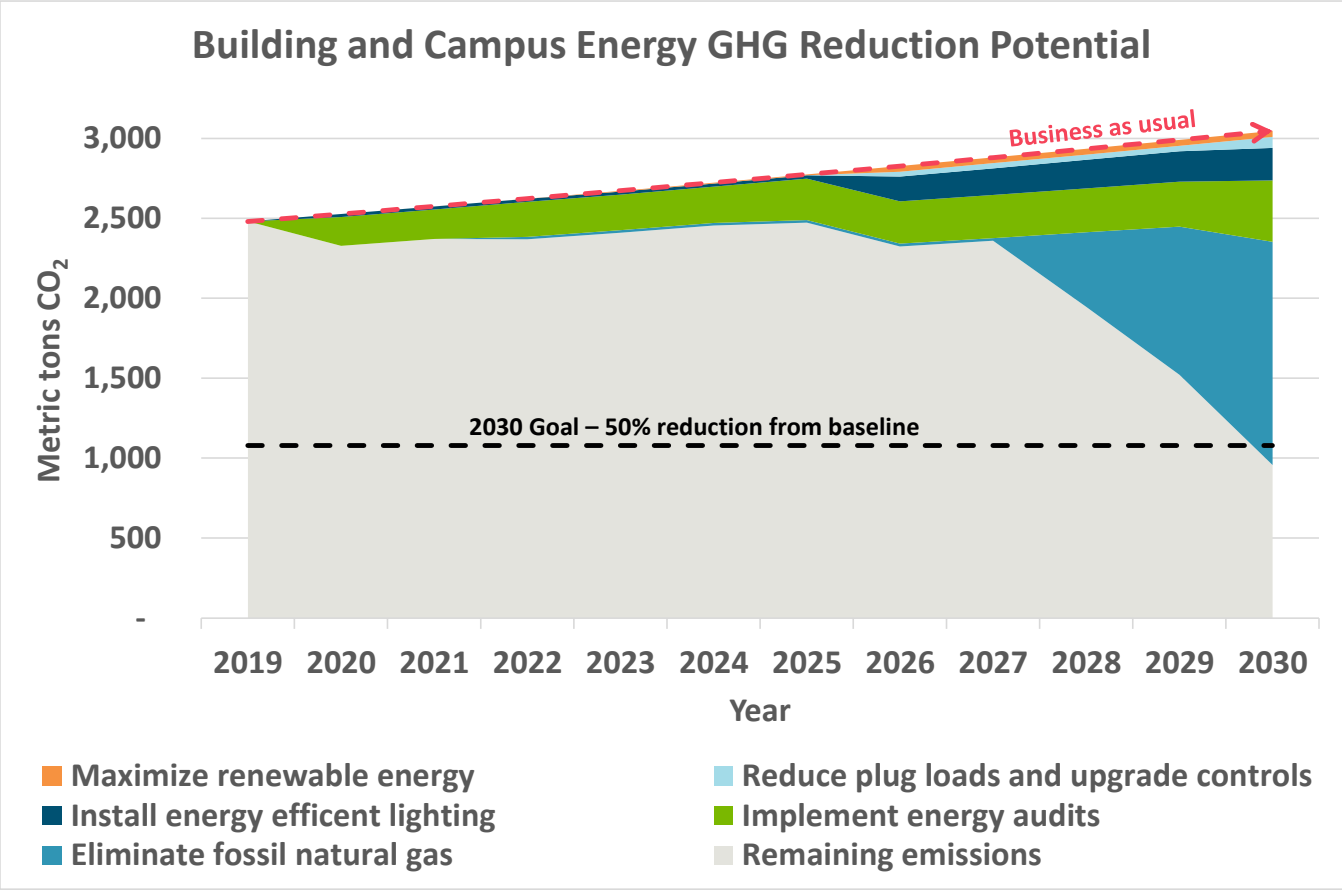


Figure 10. Annual GHG emissions from Building and Campus Energy in MT CO_2. *Emissions have trended upward in recent years.*



Strategies

Figure 15. GHG reduction potential of Building and Campus Energy strategies by 2030. *The strategies identified for this sector can reduce emissions from Building and Campus Energy by 50% from baseline, meeting the 2030 GHG reduction target.*



Success Story: Lighting Improvements

The Port has focused on lighting improvements, such as replacing bulbs with LED lights at Bell Harbor Marina and other Port campuses. Other energy efficiency projects include upgrading HVAC systems and controls and installing building insulation.

BC1

Eliminate fossil natural gas. HVAC systems are typically a building's largest source of energy use. HVAC and other natural gas systems like domestic hot water (DHW) heaters that reach the end of their useful life can be replaced with higher efficiency electric systems. Alternatively, use of renewable natural gas and other mechanisms can be used as transition strategies to reduce GHG emissions.

MT CO_2 Reduced Annually by 2030
Approximately 1,400 MT CO_2 per year by maximizing use of high efficiency systems and renewable energy

Actions

Within 5 years

- ✦ Complete inventory of Port fossil natural gas systems
- ✦ Discontinue installation of fossil natural gas systems for new construction and retrofits
- ✦ Complete asset planning for all Port-managed fossil natural gas system end-of-life replacements and upgrades
- ✦ Pursue electrification of Port-managed HVAC and DHW systems when cost and performance effective
- ✦ Install the highest efficiency electric or renewable energy-powered HVAC and DHW heating systems feasible in all retrofits and new construction
- ✦ Launch HVAC and DHW system replacement/upgrade program that supports tenants in implementing strategies that eliminate fossil natural gas emissions at tenant managed properties
- ✦ Evaluate alternative fuel sources such as renewable natural gas, and other pathways to eliminate fossil natural gas emissions.

Within 10 years

- ✦ Complete the elimination of fossil natural gas in Port-managed properties
- ✦ Develop long-term plan to eliminate fossil natural gas at all Port properties as soon as possible or by 2050.

BC2

Implement energy audit conservation measures.

Energy audits identify opportunities for a building or campus to reduce energy use. The Port will conduct Building Tune-up audits as required by City of Seattle code and make required operational and maintenance improvements. Additionally, the Port will take a campus-wide approach to energy auditing and, when possible, complete voluntary audits on buildings that do not require Tune-ups.

MT CO_2 Reduced Annually by 2030

Approximately 380 MT CO_2 per year by implementing energy audit conservation measures

Actions

Within 5 years

- Implement energy audit conservation measures per the City of Seattle's Building Tune-Ups ordinance for buildings >50,000 square feet (sqft)
- Identify priority energy audit and commissioning opportunities for buildings <50,000 sqft
- Begin prioritized energy audits and commissioning for buildings <50,000 sqft.

Within 10 years

- Implement remaining energy audits and commissioning for buildings <50,000 sqft
- Implement a 5-year cycle, sustainability-focused program for continuous recommissioning.

BC3

Install energy efficient lighting and controls.

Lighting makes up a significant portion of the Port's overall energy load. Accelerating installation of high efficiency LED lamps and advanced lighting controls will conserve energy, reduce GHG emissions, utility costs, and maintenance. This strategy covers improvements that are independent of whole-building energy audits addressed in BC2.

MT CO_2 Reduced Annually by 2030

Approximately 200 MT CO_2 per year through installation of high efficiency lighting and lighting controls

Actions

Within 5 years

- Complete lighting audits at all Port-managed buildings and campuses
- Identify high efficiency performance standards and specifications for lighting components and controls
- Complete 75% of LED lighting retrofits on Port-managed properties
- Audit lighting control functions and begin implementing smart lighting controls in Port-managed properties
- Launch a sustainable lighting program for Port tenants to support adoption of LED or high efficiency lighting and controls on tenant-managed properties.

Within 10 years

- Complete 100% of LED lighting retrofits at all Port-managed and tenant-managed properties, leveraging the tenant sustainable lighting program
- Complete implementation of smart lighting controls at Port-managed properties.

BC4

Reduce plug loads and upgrade building controls. Domestic hot water systems, lighting, heating, ventilation and cooling (HVAC) systems, and plug loads (energy used by equipment plugged into outlets) are key elements of a building's overall power consumption. Audits and site assessments will identify opportunities to adjust control settings, upgrade or add controls, and reduce plug loads which will improve efficiency and reduce overall energy consumption.	MT CO_2 Reduced Annually by 2030 **Approximately 70 MT CO_2 per year** by reducing plug loads and maximizing system controls

Actions

Within 5 years

- Audit select control systems and building equipment operational settings (focus on HVAC and DHW) in Port-managed buildings
- Evaluate and Implement advanced controls upgrades and inclusion of variable speed motors, as feasible, when building systems are replaced, upgraded, or modified
- Evaluate plug load reduction opportunities in Port-managed buildings including equipment purchasing protocols, operational settings, and employee and tenant behavioral guidelines
- Implement plug load reduction opportunities in Port-managed buildings
- Launch a voluntary plug load and controls efficiency program for tenants.

Within 10 years

- Continue implementing advanced controls upgrades in Port-managed buildings
- Continue implementing plug load reduction practices in Port-managed properties
- Evaluate opportunities to centralize building and campus system controls to streamline operations and maximize efficiency.

BC5

Maximize use of renewable energy. Renewable energy sources include wind, solar, geothermal, biomass, biofuels, renewable natural gas, renewable hydrogen, and wave, ocean, or tidal power. The Port will evaluate options to increase the use of renewable energy on a building-by-building basis and large-scale renewable energy projects.

MT CO_2 Reduced Annually by 2030

Approximately 40 MT CO_2 per year
by maximizing renewable energy use

Actions

Within 5 years

- Identify opportunities for new solar and other types of renewable energy generation both on- and off-site
- Provide real-time solar energy monitoring and reporting for all Port-owned solar arrays
- Expand solar energy generation across Port-managed and leased properties, where feasible
- Evaluate a large-scale renewable energy and storage pilot project at a Port-managed or tenant-managed property
- Evaluate Power Purchase Agreements, off-site large-scale renewable opportunities, and utility renewable energy programs to minimize and eventually eliminate GHG from campus energy use.

Within 10 years

- Transition to 100% use of clean electricity and renewable energy in Port-owned/leased facilities
- Implement a large-scale renewable energy and storage pilot project at a Port or tenant facility to maximize energy efficiency and increase resilience.

Success Story: Solar Array Installation

The Port installed solar panels on a net shed at Fishermen's Terminal in 2017, rendering it a "net zero" energy building. In 2019, the Port installed a solar array on Pier 69, the Port headquarters building, that generates about 120,000 kilowatt-hours (kWh) of electricity annually and saves over $10,000 in annual energy costs. Pier 69's solar panels generate enough electricity to power nearly ten average American homes.

BC6

Advance energy data management and planning. Accurate, readily available data on current and historical building and campus energy and fuel use is critical to make informed, sustainable investments and operational improvements. Effective energy data management will enable the Port to comply with state and city regulatory requirements, identify opportunities to implement renewable energy and smart technologies, and to track and communicate performance over time.

MT CO_2 Reduced Annually by 2030
No direct GHG reduction potential, but strategy is critical to support other efforts

Actions

Within 5 years

- ✦ Complete utility meter and Port submeter inventory at all Port properties
- ✦ Implement energy data and asset management tools to enable Port-wide visibility on energy performance and evaluate building and campus energy performance
- ✦ Evaluate real-time energy management and reporting opportunities at Port-managed properties
- ✦ Develop smart meter deployment plan; collaborate with utilities to streamline collection of billing and energy use data
- ✦ Complete smart meter deployment to fill gaps in energy information
- ✦ Develop building and campus-specific master energy plans
- ✦ Evaluate opportunities to incorporate "smart building" technologies and the internet of things (IOT) into data management and planning processes.

Within 10 years

- ✦ Integrate energy data and campus master energy plans into budget and asset management processes
- ✦ Implement building and campus-specific master energy plans at prioritized sites
- ✦ Implement smart building projects at select locations, as feasible.

BC7

Apply high performance lease terms. By incorporating energy efficiency elements into standard lease terms, the Port will promote energy efficiency updates and programs in tenant-managed buildings. (This is one element of Maritime Activity strategy XS2 – Leverage green lease terms.)

$MTCO_2$ Reduced Annually by 2030
No direct GHG reduction potential, but strategy is critical to support other efforts

Actions

Within 5 years

- ✦ Conduct inventory of lease terms relevant to energy efficiency and conservation
- ✦ Incorporate high performance lease terms in all new and renewed leases
- ✦ Implement high performance leasing programs to support and encourage energy efficiency and conservation.

Within 10 years

- ✦ Integrate Port building energy reduction strategies into tenant operations.

BC8

Strengthen energy conservation communication and education. Frequent reporting on energy usage and energy efficiency projects will raise awareness among Port staff and tenants. Education can encourage behavior change to support energy efficient operations.	$MTCO_2$ Reduced Annually by 2030
	No direct GHG reduction potential, but strategy is critical to support other efforts

Actions

Within 5 years

- ✦ Establish employee-focused resource conservation program
- ✦ Provide reports and communications on building and campus energy performance for employees, leadership, and public
- ✦ Establish educational materials and engagement opportunities for employees and tenants.

Within 10 years

- ✦ Sustain and improve communications, reporting, and education activities
- ✦ Measure and report on efficacy of employee and tenant engagement

Performance Metrics

Metrics & Targets	Information Only

• Absolute GHG emissions – zero by 2050
• Therms of fossil natural gas
  o Compared to baseline year
  o Annual percent change
• kWh electricity
  o Compared to baseline year
  o Annual percent change
• kWh renewable energy generated and percent of total energy use in MMBtu
• Total estimated kWh or therms reduced from conservation measures
• Annual change in Energy Use Intensity by building type for buildings over 20,000 sqft.
	• Updates and number of energy audits conducted beyond compliance requirements
	• Updates and number of high-efficiency lighting projects completed
	• Updates on key energy efficiency projects and estimated energy savings
	• Updates on implementation of energy data management software
	• Updates on key green lease terms added to eligible leases
	• Updates on communications and education programs and events

Fleet Vehicles and Equipment

Strategies

FV1	Use drop-in renewable fuels
FV2	Transition to electric vehicles
FV3	Right-size vehicles and fleet
FV4	Use technology to gather data and improve efficiency
FV5	Educate Port drivers on eco-driving and fleet use practices

Emissions: Scope 2

1%

of Port Maritime GHG 2019 emissions

400

Maritime fleet vehicles and equipment assets

Roughly two-thirds of the fleet is powered by gasoline, and one-third by diesel. Assets include 30+ hybrid electric vehicles and equipment (e.g., forklifts and carts) powered by electricity or propane.

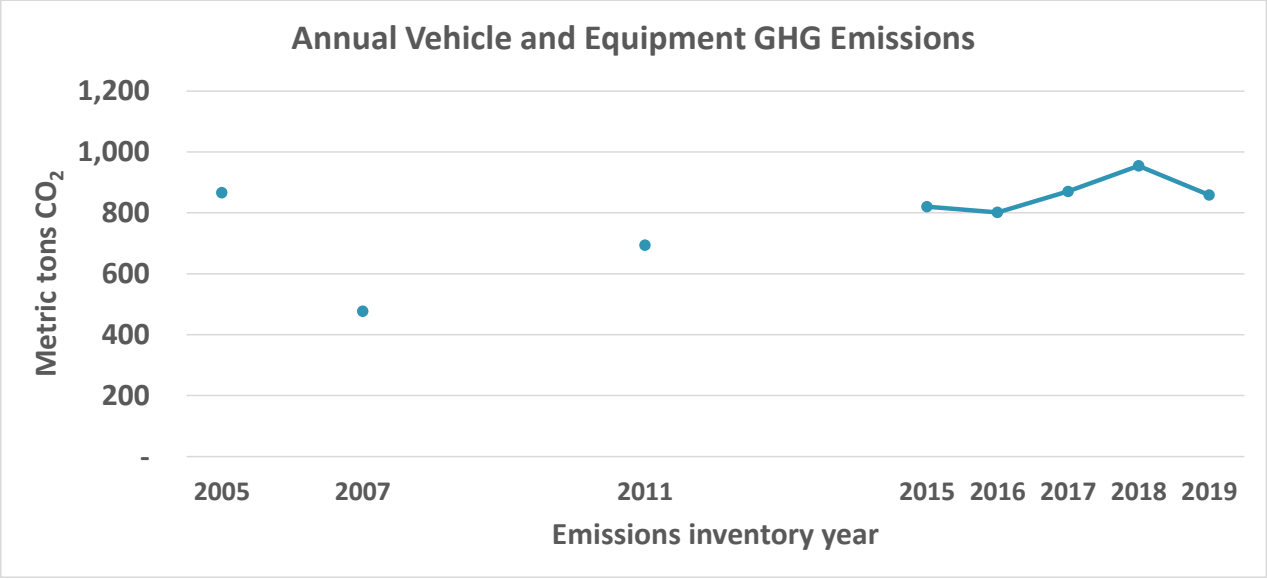
FLEET VEHICLES AND EQUIPMENT

Context

The Port's fleet includes cars, vans, trucks, specialized heavy-duty equipment, small boats, and cargo-handling equipment. Roughly two-thirds of the fleet is powered by gasoline, and one-third by diesel. Assets include about 30 hybrid electric vehicles and equipment units (e.g., forklifts and carts) powered by electricity or propane.

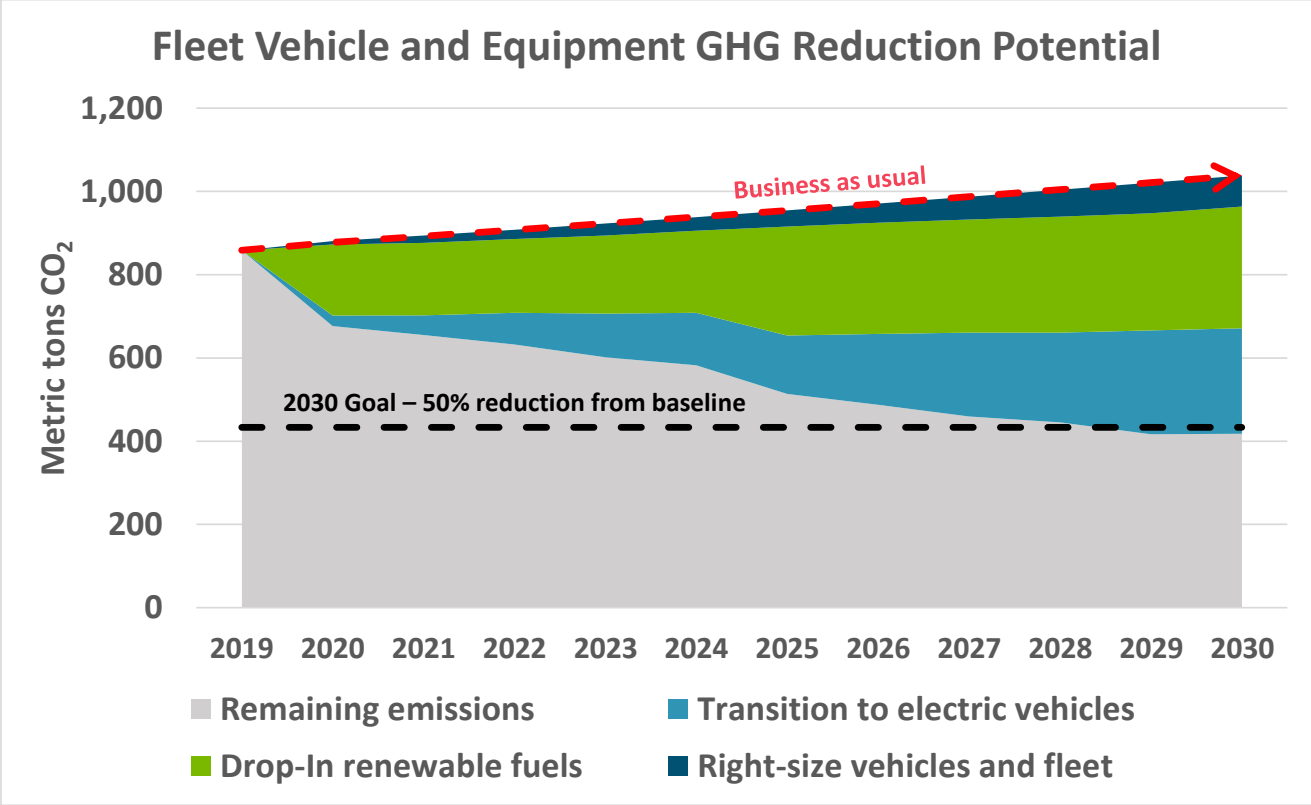
The fleet's fuel use and associated GHG emissions have not declined since 2005. Fuel use has varied from year to year, generally trending upward since 2015. Growth in gasoline use accounts for most of the increased emissions. The demand for diesel fuel, used in larger trucks and heavy equipment, has not decreased, but diesel emissions per gallon have declined as the Port replaced fossil diesel with bio-based blends and renewable diesel. Recognizing the need to address emissions from fleet vehicles, in 2019 the Port developed sustainable fleet recommendations to reduce fleet emissions.

Figure 16. Annual GHG emissions from Fleet Vehicles and Equipment in MT CO_2. *Emissions have trended upward in recent years.*



Strategies

Figure 17. 2030 GHG emission reduction potential of Fleet Vehicle and Equipment strategies in MT CO_2. *Strategies this sector can reduce emissions from Fleet Vehicles and Equipment by 50% from baseline, meeting the 2030 GHG reduction target.*



FV1

Use drop-in renewable fuels. The Port fleet can achieve immediate emission reductions by switching to drop-in renewable fuels, which are nonpetroleum-based fuels like renewable diesel and renewable gasoline, made from sources such as waste cooking oil, grease, tallow, or other renewable feedstocks. A drop-in renewable fuel is lower carbon compared to fossil diesel or gasoline and does not require engine modifications. Because renewable diesel is more readily available than renewable gasoline, the Port will focus on renewable diesel in the near-term for diesel vehicles that fuel onsite. Passage of a low carbon fuel standard in Washington will increase the availability of low carbon fuels and drive cost parity between these fuels and conventional fossil fuels.

MT CO_2 Reduced Annually by 2030
Approximately 300 MT CO_2 per year by switching to drop-in renewable fuels

Actions

Within 5 years

- Dispense renewable diesel at the Port's fleet fueling stations
- Expand use of renewable fuels as a fossil fuel replacement, such as renewable gasoline
- Evaluate employee fuel purchase card use and encourage on-site fueling at Port fueling stations that dispense renewable fuels.

Within 10 years

- Continue to evaluate and expand use of new, lower carbon renewable fuel sources.

Success Story: Use Renewable Diesel

In 2008, the Port replaced diesel dispensed on-site with less-carbon intensive biodiesel (B20) and replaced some gasoline powered vehicles with hybrid sedans and SUVs. In December 2019, the Port began piloting the use of renewable diesel (RD99) for on-site diesel fueling. With the same molecular makeup as petroleum diesel, renewable diesel is made from non-petroleum renewable resources such as agricultural waste products, oils, or fats. Renewable diesel can be used in diesel vehicles and equipment without engine modifications, does not emit new carbon emissions into the atmosphere, and can reduce air pollution.

FV2

Transition to electric vehicles. Replacing fossil fuel vehicles with electric vehicles at the end of their useful life can reduce fuel use while providing an emission reduction benefit. Vehicle electrification will focus first on light-duty vehicles where electric models are available or are anticipated in the next few years. Fleet managers will continue to monitor and evaluate the development of electric or hybrid-electric technology for trucks, heavy duty vehicles and specialized equipment. Fleet electrification will also require the installation of charging stations across maritime facilities for use by fleet vehicles, employees, and visitors.

MT CO_2 Reduced Annually by 2030
Approximately 250 MT CO_2 per year by replacing traditional fleet vehicles with electric at time of replacement

Actions

Within 5 years

- Expand electric vehicle charging stations at key locations to enable fleet electrification
- Continue investment in electric vehicles as replacement for conventionally fueled fleet sedans
- Pilot use of non-sedan electric vehicles and equipment
- Track technology developments in heavy-duty electric vehicles as relevant to Port fleet applications.

Within 10 years

- Expand vehicle electrification efforts to include light trucks and other vehicles as available
- Pilot heavy-duty electric vehicles, as relevant to Port fleet applications.

Success Story: Electric Vehicle Charging Stations

The Port has installed electric vehicle charging stations at Fishermen's Terminal and Shilshole Bay Marina, and additional stations are planned. The stations give travelers, customers, tenants, and employees the ability to charge their vehicle while visiting port-owned locations.

FV3

Right-size vehicles and fleet. The Port's fleet includes some older, under-utilized vehicles. Right-sizing can be applied by replacing older vehicles with newer, more fuel-efficient models, by eliminating under-utilized vehicles from the fleet, and by pooling vehicles to maximize use per asset.	MT CO_2 Reduced Annually by 2030
	Approximately 75 MT CO_2 per year by right-sizing vehicles

Actions

Within 5 years

- ✦ Accelerate replacement of older, less efficient vehicles that are beyond their useful life
- ✦ Implement asset selector list for fleet managers to standardize and right-size new vehicle purchases
- ✦ Assign life cycle limits to vehicle types and classes
- ✦ Maximize vehicle utilization with expanded pooling of vehicles and equipment, reducing 1:1 vehicle assignment, and optimizing pool size
- ✦ Standardize and right-size new vehicle purchases.

Within 10 years

- ✦ Manage fleet within useful life cycle limits.

FV4

Use technology to gather data and improve efficiency. Fleet technology, such as telematics and other software, will enable the right-sizing process. Technology will make existing vehicles more efficient by limiting engine idling and providing data on how vehicles operate, including speed, location, and fueling events. Anti-idling technology is available for most vehicle types.	MT CO_2 Reduced Annually by 2030
	GHG reduction potential is low, but strategy is critical to support other efforts

Actions

Within 5 years

- ✦ Pilot telematics on a portion of the fleet
- ✦ Implement new fleet management software
- ✦ Expand telematics to all appropriate assets
- ✦ Install anti-idling technology on targeted assets with high idle uses
- ✦ Use motor pool software and hardware to manage pools for efficiency
- ✦ Incorporate telematics data into fleet management approaches to optimize utilization and maintenance.

Within 10 years

- ✦ Update fleet data management software and capabilities
- ✦ Leverage data to inform fleet management decisions.

FV5

Educate Port drivers on eco-driving and fleet use practices. As new types of vehicles enter the fleet, including electric vehicles, drivers must be trained to operate them safely and sustainably. Telematics data can be used to target specific training needs. Staff will be informed of new right-sizing guidance on motor pool use.	MT CO_2 Reduced Annually by 2030
	GHG reduction potential is low, but strategy is critical to support other efforts

Actions

Within 5 years

- ✦ Incorporate eco-driver training into Port employee training modules, including how to charge and drive electric fleet vehicles
- ✦ Establish outreach program for sustainable driver education
- ✦ Use telematics to target training topics and needs
- ✦ Provide department-specific driver training focused on specific vehicle types and use cases
- ✦ Continue employee and public engagement on sustainable fleet issues

Within 10 years

- ✦ Measure and report on efficacy of ongoing driver training
- ✦ Continue educating port drivers and equipment operators on how to drive and charge electric fleet vehicles.

Performance Metrics

Metrics & Targets	Information Only
• Absolute GHG emissions – 0% by 2050 • Gallons of fuel dispensed by fuel type • % renewable fuel of total gallons dispensed • # electric vehicles purchased • % of fleet vehicles that are electric or use renewable fuels – 100% by 2030 • % of entire fleet (including all vehicles, equipment, and vessels) that are zero emissions – 100% by 2050 • % of drivable fleet (cars, SUVs, light-duty trucks and vans) older than 15 years (the average useful life of a fleet vehicle) • % of eligible vehicles or equipment with telematics installed	• Updates on eco-driving program and driver education

Employee Commutes

Strategies

EC1	Encourage use of alterative work arrangements
EC2	Update employee commute benefits
EC3	Expand employee communication and enhance education
EC4	Continue to advocate for better transportation access

Emissions: Scope 3

1%

of Port Maritime GHG 2019 emissions

53% Of commutes made while driving alone

18% City's target "Drive Alone Rate" for the Belltown neighborhood

Pier 69 is required to have a commute trip reduction plan to keep commuting routes moving and reduce carbon emissions per the Washington State Commute Trip Reduction law. The Port offers a wide range of commuter benefits, but is not currently achieving commute trip reduction targets.

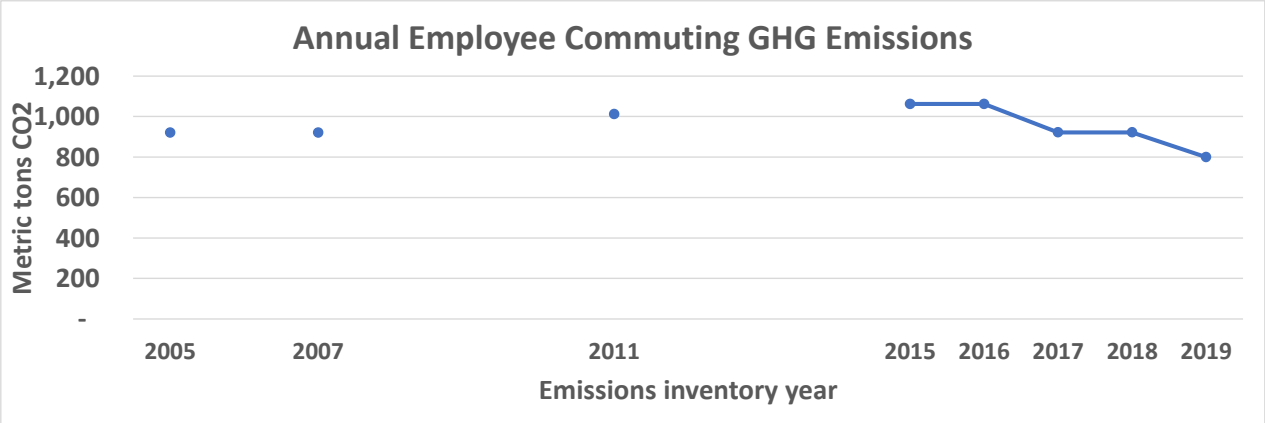
EMPLOYEE COMMUTING

Context

To comply with a statewide Commute Trip Reduction (CTR) program administered by Washington State Department of Transportation (WSDOT), the Port conducts an employee commuting survey every two years for work locations with 100 or more employees. The Port's Pier 69 headquarters is the only Port maritime building covered by this Plan that meets the WSDOT CTR threshold.

The Pier 69 drive alone rate in 2019—54%—remained relatively stable compared to previous CTR surveys. However, the rate is well above the drive alone target for commute trips within Belltown/Denny Triangle, where Pier 69 is located. This target decreased to 18% in the City of Seattle's 2019-2023 Strategic Plan. A significant decline in drive alone trips is needed to meet the city target and reduce employee commuting emissions.

Figure 18. Annual GHG emissions from Employee Commuting to/from Pier 69 and Port facilities in City of Seattle in MT CO_2. *Emissions have trended downward in recent years.*

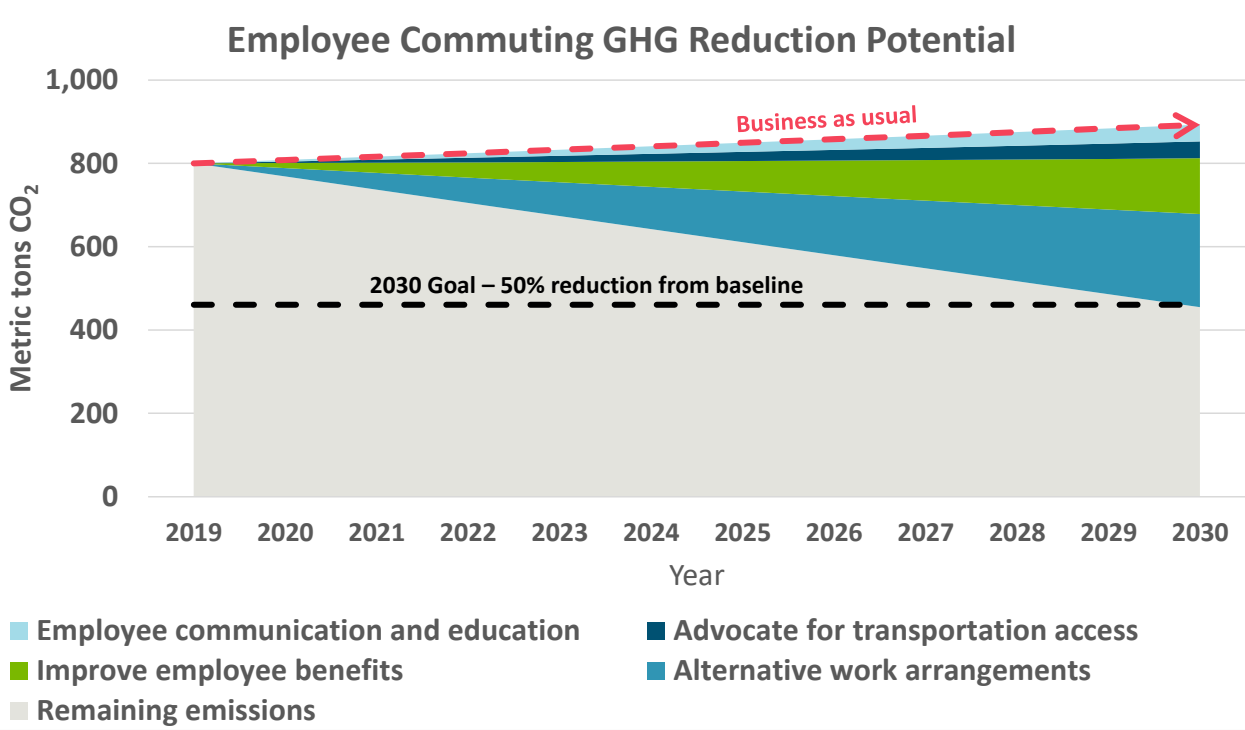


Success Story: Commuter Benefits

The Port offers a wide range of employee commuter benefits including bike storage and showers; heavily subsidized transit passes; a guaranteed ride home; vanpool and van share subsidies; and flexible work arrangements including telework, flextime, and compressed work week options for some employees with management approval.

Strategies

Figure 19. 2030 GHG emission reduction potential of Employee Commuting strategies in MT CO_2. *The strategies identified for this sector can reduce emissions from Employee Commuting by 50% from baseline, meeting the 2030 GHG reduction target.*



EC1

Encourage use of flexible work arrangements.	MT CO_2 Reduced Annually by 2030
Flexible work arrangements include teleworking or compressed work weeks to reduce the number of days employees must commute to work. Flexible work arrangements are the most direct way to reduce GHG emissions from commute trips by reducing the number of commute trips taken.	**Approximately 220 MT CO_2 per year** by maximizing various alternative work arrangements

Actions

Within 5 years

- ✦ Continue to identify options to encourage the use of telework and compressed work weeks
- ✦ On an annual basis, evaluate options for providing financial support to teleworking employees who use home office equipment
- ✦ Improve tracking of flexible work arrangements and set target participation levels
- ✦ Continue monitoring utilization of flexible work arrangements and adjust as warranted
- ✦ Evaluate need and options to provide financial support to teleworking employees on an on-going basis.

Within 10 years

- ✦ Continue regular monitoring and enhancement of alternative work week policies.

EC2

Update employee commute benefits as new opportunities emerge to expand lower-emission commute options.	MT CO_2 Reduced Annually by 2030
A comprehensive commute benefits program can improve employee recruitment and retention, minimize commute stress, and make lower-emission commuting choices more attractive. While the Port offers several commute benefits, like subsidized transit passes, the provision of free parking near work locations remains a barrier to reducing emissions in this sector. Expanding commuter benefits for alternative modes of transport, which could include enhanced first and last mile connections to transit stops, subsidized vanpool and bikeshare, or organized carpooling could expand employee commute options.	**Approximately 130 MT CO_2 per year** by improving benefits that encourage use of mass transit options

Actions

Within 5 years

- ✦ Incorporate the Port's greenhouse gas reduction goals into the Employee Commuter Benefits Strategic Plan under development in 2020
- ✦ Identify and assess options for gathering and analyzing employee commute pattern data to support future program decisions
- ✦ Implement an Employee Commuter Benefits Strategic Plan to systematically assess the current Employee Commuter Benefits Program against program goals, identify gaps in the program, and identify, analyze, and recommend potential enhancements to the program
- ✦ Assess potential impacts of a revised employee parking benefit on employee engagement, retention, attraction, and commuting preferences.

Within 10 years

- ✦ Reassess and refresh the Port Employee Commuter Benefits program on an ongoing basis.

EC3

Expand communication and enhance employee education about commute options beyond driving alone. Employees need to be aware of the Port's commuter benefits to take advantage of commute options beyond driving alone. Communication can clarify available programs, highlight management support for employee participation, and market key services that support lower-emission commuting.	MT CO_2 Reduced Annually by 2030
	Approximately 40 MT CO_2 per year through enhanced employee education and communication

Actions

Within 5 years

- Develop and implement an employee education and promotion program to educate employees about commuting options and how to utilize them
- Review and identify opportunities to enhance employee onboarding and new employee orientation information and materials to include the Employee Commuter Benefits Program and how it aligns with Port values and goals.

Within 10 years

- Review and adjust employee education and promotion programs about commute options to maintain relevance and effectiveness
- Continue to maintain and update employee onboarding and new employee orientation information regarding the Employee Commuter Benefits Program.

EC4

Continue to advocate for more accessible multimodal transportation options for Port Maritime worksites. The Port's control over commute options is limited to employee benefits and offering infrastructure on Port property. To secure transportation options beyond driving, coordination with regional transportation agencies is needed. The Port has struggled to increase use of transit specifically as waterfront construction has pushed transit stops further away from the Port's Seattle headquarters at Pier 69 in recent years. Ensuring safe, connected, and accessible multi-model infrastructure through the region is critical to improve access to Port locations.	MT CO_2 Reduced Annually by 2030
	Approximately 40 MT CO_2 per year through improved access to mass transit options

Actions

Within 5 years

- Continue advocating for safer and more accessible multi-model transportation access to Pier 69 and other work sites with local transit and transportation agencies (Seattle Department of Transportation, King County Metro, and Sound Transit).

Within 10 years

- Continue advocating for safer and more accessible multi-model transportation access with local transit and transportation agencies.

Performance Metrics

Metrics & Targets	Information Only
• Absolute GHG emissions • % of employees utilizing telework or flexible work arrangements at CTR-affected worksites (P69 and Marine Maintenance S Horton Street) (compiled every two years via WSDOT survey) • Drive alone rate at CTR-affected worksites (P69 and Marine Maintenance S Horton Street from WSDOT CTR survey (conducted biannually)	• Updates on implementation of employee communication and education programs • Updates on changes to multi-model transportation access at Port work locations in Seattle

Solid Waste

Strategies

SW1	Maximize diversion of common recyclables and organics
SW2	Minimize solid waste generation
SW3	Expand specialized items recycling
SW4	Increase communications with employees and tenants

Emissions: Scope 2

< 1%

of Port Maritime GHG 2019 emissions

1,300 Tons of garbage generated by the Port and Port tenants in 2019

1,100 Tons of material diverted 2019, yielding a waste diversion rate of 45%

Nearly 70% of the waste is generated at Shilshole Bay Marina and Fishermen's Terminal. Both campuses are occupied by tenants and open to the public. The Port has influence, but not direct control, over waste disposal at these sites.

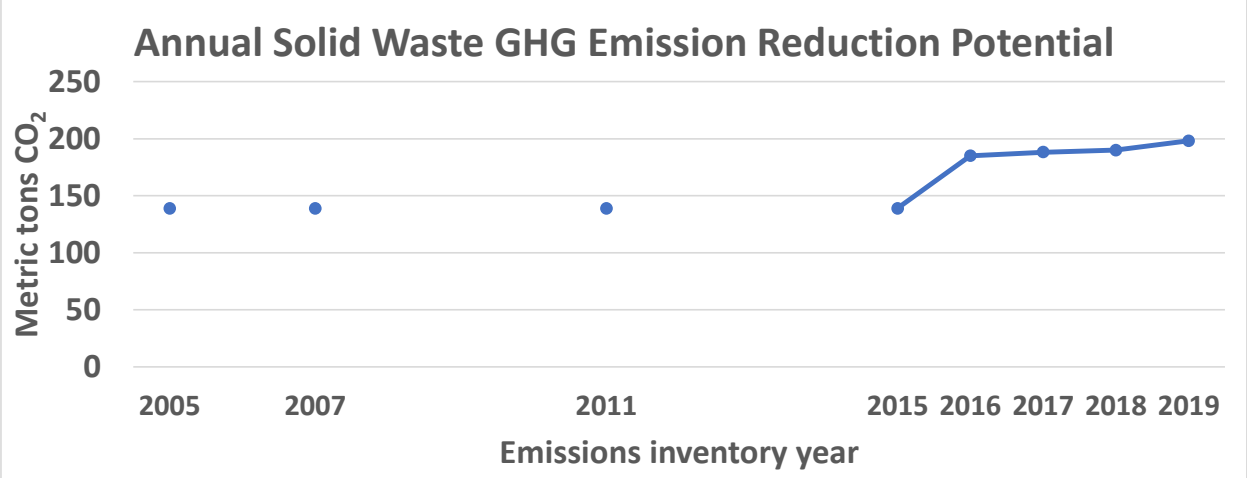
SOLID WASTE

Context

This sector includes solid waste generated at Port Maritime campuses, which is the focus of the Port's Maritime Solid Waste Management Plan. Nearly 70% of the waste is generated at Shilshole Bay Marina and Fishermen's Terminal—two large sites that are occupied by tenants and open to the public. The Port aims to divert 60% of materials from the waste stream through recycling or composting. In 2019, 45% of materials was diverted.

Historical data on solid waste volumes and GHG reductions is limited. Since tracking began in 2015, GHG emissions from solid waste landfilling have increased each year. The data below does not include construction waste generated by contractors which is tracked separately on a project-specific basis.

Figure 20. Annual GHG emissions from Solid Waste in MT CO_2. *Emissions have trended upward in recent years.*



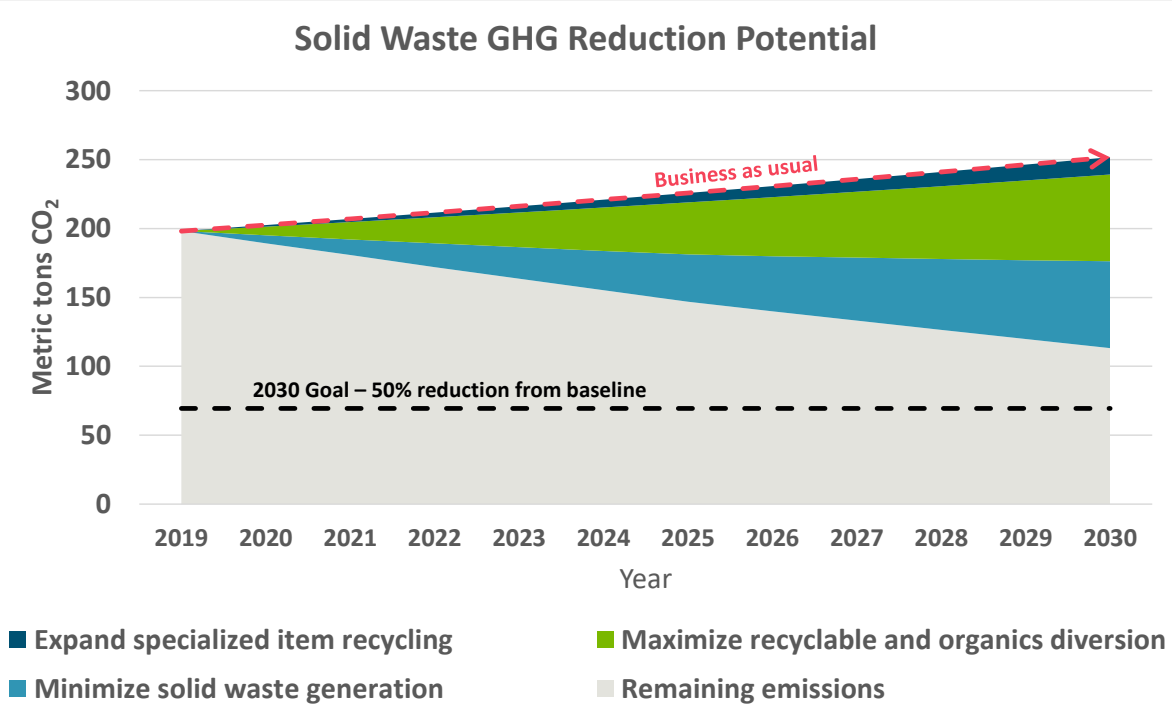
Success Story: Solid Waste Management

To reduce garbage volumes and GHG emissions, the Port implemented a Maritime Solid Waste Management Plan in 2016 that has improved solid waste practices.

- Improved waste collection systems, signage, education, and event guidelines to ensure that City of Seattle recycling ordinances are followed
- Conducted waste audits at over half of the Port's maritime campuses
- Developed site-specific implementation plans with tenant and staff input for Marine Maintenance, and Shilshole Bay Marina.

Strategies

Figure 21. 2030 GHG emission reduction potential of Solid Waste strategies in MT CO_2. *The strategies identified for this sector will reduce GHG emissions, but the solid waste sector will not independently achieve the 2030 reduction target.*



SW1

Maximize diversion of common recyclable and organic materials. Garbage service in Seattle includes recycling of paper, cardboard, plastics, glass, and metal, and composting of organics, compostable packaging, and plant material. Waste audits will be conducted on a 3-year cycle to assess proper waste disposal. The Port will work with staff and tenants to identify and address diversion barriers (e.g., proper sorting of recyclables and organics) and develop site-specific waste reduction plans.

MT CO_2 Reduced Annually by 2030
Approximately 60 MT CO_2 per year by maximizing common recyclable and organics diversion

Actions

Within 5 years

- ✦ Complete first round of waste audits at all Port campuses
- ✦ Develop and implement facility-specific waste reduction plans
- ✦ Re-audit each site every three years
- ✦ Update facility-specific waste reduction plans every three years.

Within 10 years

- ✦ Continue to re-audit each site every three years
- ✦ Continue to update facility-specific waste reduction plans every three years.

SW2

Minimize solid waste generation. In addition to recycling and composting practices, other waste minimization practices are needed to reduce the amount of waste produced each year. Updating the Port's purchasing practices to increase focus on sustainability is a critical first step.	MT CO_2 Reduced Annually by 2030
	Approximately 60 MT CO_2 per year by minimizing amount of total waste generated at the Port

Actions

Within 5 years

- ✦ Update the Port's environmental purchasing policy and procedures
- ✦ Monitor waste generation for all Port-controlled sites.

Within 10 years

- ✦ Develop a metric for tracking environmental purchasing policy success.

SW3

Expand specialized items recycling. Waste audits will identify specialized items that are potentially recyclable but are not accepted by the City's recycling program. Examples include scrap metals, building materials, electronics, and furniture. Customized recycling programs can be added for these items when feasible.	MT CO_2 Reduced Annually by 2030
	Approximately 15 MT CO_2 per year through expansion of recycling for special items (e.g., batteries)

Actions

Within 5 years

- ✦ Identify specialized items with recycling needs via waste audits
- ✦ Begin tracking specialized waste items.

Within 10 years

- ✦ Continue to evaluate waste audits for additional specialized items that can be recycled.

SW4

Enhance communication and education with employees and tenants. Targeted communications and education will increase general awareness of waste management and provide clear instructions for employees and tenant on proper waste sorting.	MT CO_2 Reduced Annually by 2030
	GHG reduction potential is low, but strategy is critical to support other efforts

Actions

Within 5 years

- ✦ Develop new solid waste training module for employees using the Port's internal online Learning Management System
- ✦ Train new employees, and provide updates to all employees at least annually regarding waste minimization and recycling and composting efforts
- ✦ Engage with tenants to widen the impact of the Port's recycling and composting efforts.

Within 10 years

- ✦ Continue training program for staff
- ✦ Continue tenant engagement to widen the impact of the Port's waste minimization efforts.

Performance Metrics

Metrics & Targets	Information Only
• Absolute GHG emissions • Absolute waste tonnage reported annually • % of solid waste tonnage recycled or composted • Percent change from previous years' tonnage	• Updates on progress to expand specialized items recycling • Updates on site audits and development of site-specific solid waste plans • Updates on employee and tenant communications

Habitat Restoration and Carbon Sequestration

Strategies

HR1 Complete Smith Cove Blue Carbon Benefits Study

HR2 Continue shoreline restoration projects

212 Acres of freshwater, estuarine, and marine habitat in the Green-Duwamish and Puget Sound watersheds that the Port has enhanced or restored

Habitat restoration work supports a range of species, and restored areas can include public shoreline access for communities. Habitat restoration can "sequester" or capture carbon from the air and water and store it in plants, algae, sediments, and soil—helping the Port work toward its carbon neutral goal.

HABITAT RESTORATION AND CARBON SEQUESTRATION

Context

As part of the Port's Century Agenda, the Port set an objective to restore, create, and enhance 40 additional acres of habitat in the Green/Duwamish Watershed and Elliott Bay. Numerous habitat restoration and monitoring projects are in progress, both small and large, including up to 11 acres of riparian and marsh restoration to be completed in 2021. Native riparian and aquatic plants create important habitat for fish and wildlife. Restoration projects bring back these critical habitats and the natural resource values they offer, such as promoting salmon recovery. In addition, these restored habitats absorb and sequester carbon from the atmosphere and dissolved carbon from the aquatic environment.

Habitat restoration is included in this Plan as part of a long-term, holistic approach to emission reduction. The Port does not currently quantify the atmospheric carbon sequestration of restored riparian and marsh habitat and has not included habitat-related carbon sequestration in measuring progress toward its GHG reduction goals. However, the carbon capture benefits may be quantifiable in future years, contributing substantially to the Port's net-zero carbon goals. If global emissions continue to increase, carbon sequestration strategies such as those described below will become critical measures to address climate change.

Strategies

HR1

Complete Smith Cove Blue Carbon Benefits Study. The Port launched a "blue carbon" pilot study at Smith Cove in 2018 by planting oyster shells, kelp, and eelgrass in a 23-acre plot. The Port will continue to monitor the test plot, quantify carbon captures, and apply lessons learned to other areas.	MT CO_2 Reduced Annually by 2030
	Not quantified

Actions

Within 5 years

- Continue to investigate referred methods for blue carbon in Smith Cove based on results of test plots and initial installation of kelp, eelgrass, shellfish
- Continue to plan for restoration of native riparian habitat to complement the Smith Cove blue carbon benefits
- Add interpretive signage to future Smith Cove Park to raise awareness of the project
- Continue long-term monitoring and evaluation, including evaluation of changes to water chemistry, biomass, and habitat functions
- Capture lessons learned and identify opportunities to scale this project to other areas.

Within 10 years

- Incorporate larger-scale blue carbon habitat components in existing and planned restoration projects depending on results of Smith Cove Blue Carbon Benefits Study.

Success Story: Smith Cove Blue Carbon Pilot Project

The Smith Cove Blue Carbon Pilot Project is exploring the idea of "blue carbon" – CO_2 captured and stored in ocean and nearshore habitats. Kelp, eelgrass, and marsh plants are important elements of the blue carbon habitat in Elliott Bay. They remove carbon from seawater as they grow, storing it in the plants and sediments.

HR2

Continue shoreline restoration projects. The Port will map shoreline areas and landcover along 15 miles of shoreline. The Port will also complete construction of two additional shoreline parks and begin to quantify the carbon capture capacity of restored native riparian and aquatic plants at these sites.

MT CO_2 Reduced Annually by 2030
Not quantified

Actions

Within 5 years

- Evaluate shoreline areas and landcover along 15 miles of shoreline managed by the Port's Maritime Division and Economic Development Division
- Continue to advance a Multi-Site Mitigation Bank through regulatory entitlement process
- Complete construction of the shoreline habitat restoration and public shoreline access at the Duwamish River People's Park (formerly T117) and quantify anticipated carbon sequestration benefit
- Complete construction of the Park and Shoreline Habitat restoration project (formerly 8th Ave South Street End) and quantify anticipated carbon sequestration benefit
- Continue to evaluate feasibility of candidate sites for habitat restoration, including blue carbon components.

Within 10 years

- Design and construct the 34-acre Auburn Wetlands habitat restoration project and quantify anticipated carbon sequestration benefits.

Success Story: Alternative Bankline Stabilization Program

Seawalls and rocks were historically used to keep shorelines from eroding in Elliott Bay and the Duwamish Waterway. These features create carbon-poor environments that are not ideal for optimal fish and wildlife habitat function. The Port's Alternative Bankline Stabilization Program will identify opportunities to convert "hard armoring" on the shorelines to greener, carbon-rich areas. The program will use anchored large-wood, plant-based erosion control materials, recycled soil, and native plants to stabilize the banklines while creating habitat and capturing carbon.

Success Story: Floating Wetlands

Partnering with the University of Washington, the Port has installed several floating wetland units in the Duwamish River and at Fishermen's Terminal. A floating wetland island is a raft packed with dense wetland plantings. They are used in areas where space limitations prevent conventional restoration methods. These units will provide fish and wildlife habitat while also taking up contaminants from the water column.

Performance Metrics

Metrics & Targets	Information Only
• # acres habitat restored toward Century Agenda goal of 40 acres	• Updates on Smith Cove Blue Carbon Benefits Study progress

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% of the Port's total maritime emissions. The Port may provide tenants with guidance and 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 and objectives. These strategies align with the following themes highlighted in the 2020 Strategy:[22]

- **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.

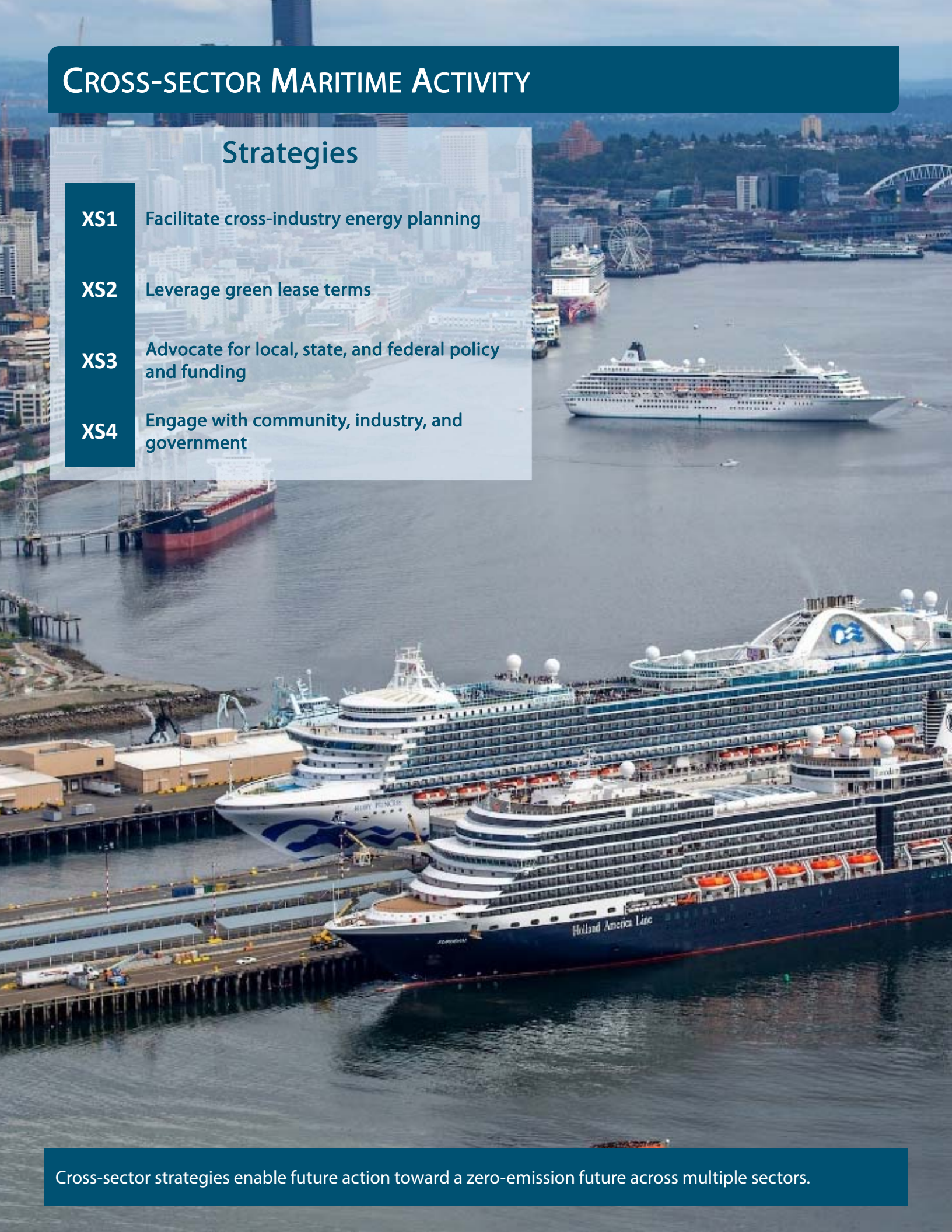
In addition to sector-specific strategies that address these three themes, the Plan includes cross-sector strategies that will enable future action across the board. These strategies are foundational to achieving deep decarbonization in Port activities, focusing on cross-industry energy planning; green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

[22] For more detail, see the draft Northwest Ports Clean Air Strategy: https://www.nwseaportalliance.com/environment/clean-air/northwest-ports-clean-air-strategy

Cross-sector Maritime Activity

Strategies

XS1	Facilitate cross-industry energy planning
XS2	Leverage green lease terms
XS3	Advocate for local, state, and federal policy and funding
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

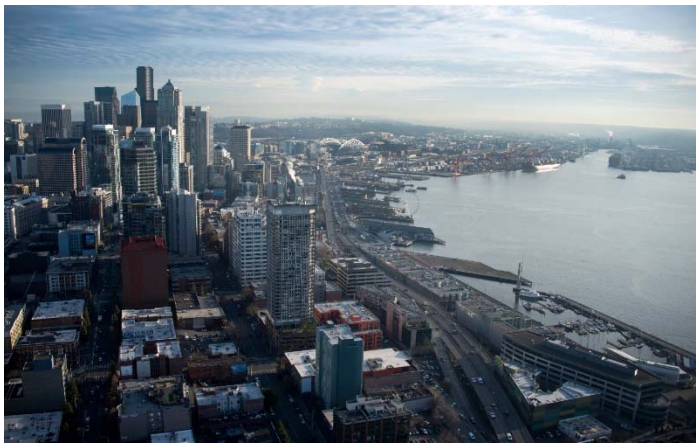
Context

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 cross-sector strategies that will enable future action. These cross-sector 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.

Strategies

XS1

Facilitate cross-industry planning. The Seattle Waterfront Clean Energy Strategic Plan (SWCESP) 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 SWCESP impacts all sectors addressed in the Plan and represents a critical early planning action toward phasing out emissions by 2050.



Actions

1 – 3 years

- ✦ Complete the Seattle Waterfront Clean Energy Strategic Plan
- ✦ Engage Port tenants and maritime industry on barriers to zero-emission infrastructure and equipment adoption
- ✦ Evaluate lifecycle emissions of alternative fuels used in seaport application

10 years

- ✦ Collaborate with waterfront industry, government, and utilities to develop and implement recommended strategies to achieve waterfront electrification of Port properties.

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. Port of Seattle 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

1-3 years

- ✦ Update green lease terms and inventory maritime property leases

5 years

- ✦ Engage tenants and pilot green lease terms where opportunities arise with new leases

10 years

- ✦ Incorporate green lease terms into all new and renewed landside leases

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.

Actions

Ongoing

- Continue advocating for a Washington State Low Carbon Fuel Standard
- Collaborate on state and federal environmental ports initiatives such as EPA's Ports Initiative, American Association of Port Authorities, and Washington Public Ports Association
- Continue participating in Green Marine (a voluntary environmental certification program for the marine industry, including ports) and maintain or exceed 2020 performance score

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

- 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.
- 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 Port of Seattle annually and improve equity indicators to measure and inform implementation
- Publicly communicate sustainability measures (e.g., shore power use, equipment replacements, efficiency measures), and implementation progress annually via Port channels.

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 vessels
OGV3	Support continual increase in vessel efficiency and emission reduction
HV1	Provide infrastructure for zero-emission vessels by 2030
HV2	Support accelerated turnover of harbor vessels to zero emissions
HV3	Support continual advancement in harbor vessel efficiency and emission reduction

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%

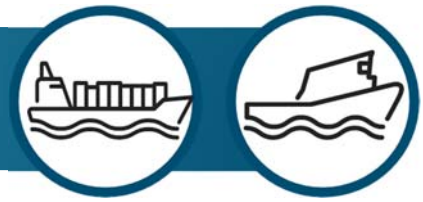
Harbor vessels 11%

211 Cruise sailings from the Port in 2019

58 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 AND 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.

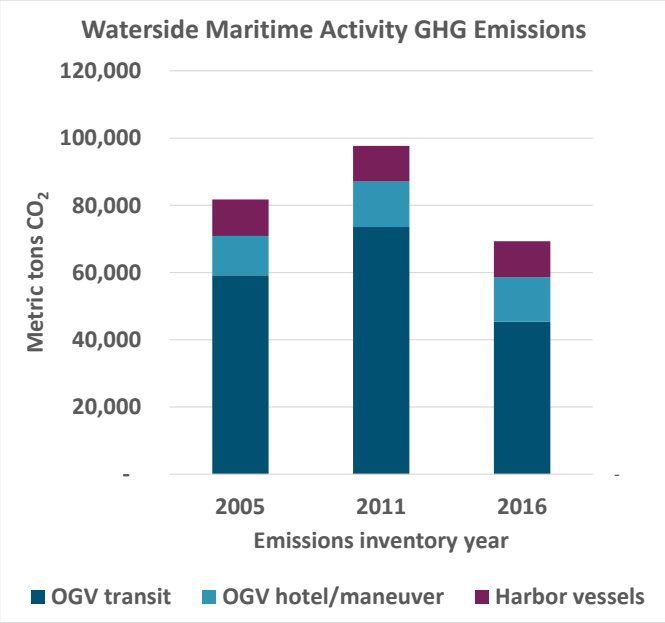
GHG emissions from waterside sectors were higher in 2011 than in 2005 due to a higher number of vessel calls. In 2016, GHG emissions from ocean-going vessels decreased due to more efficient, larger-capacity cruise ships and fewer grain calls. DPM emissions from waterside sectors declined steeply in 2016 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.

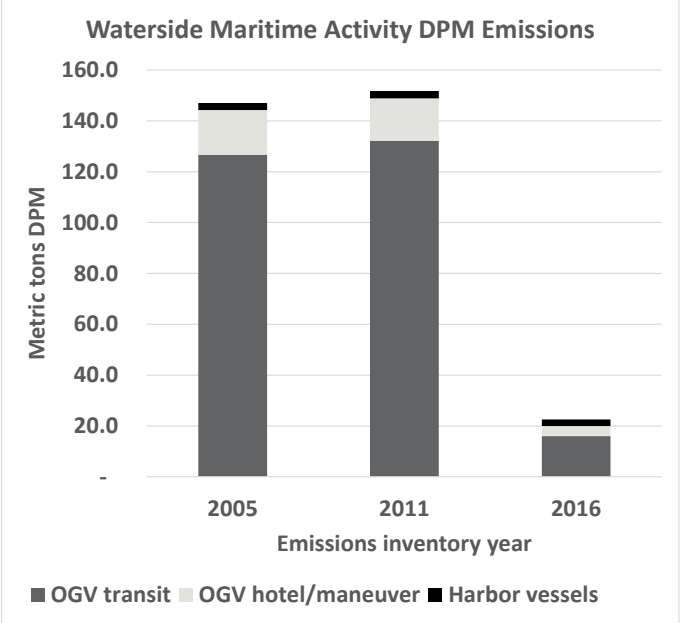
LOW CARBON FUEL STANDARD: MARITIME INDUSTRY BENEFITS

Adopting a Low Carbon Fuel Standard (LCFS) in Washington State is critical to help the maritime industry reduce GHG emissions and improve air quality in near-port communities. Under an LCFS, fuel suppliers would be required to lower the carbon intensity of fossil-based fuels, or purchase credits generated and sold by low carbon fuel producers in the market. This drives the cost of low carbon fuels to price parity with conventional fossil fuels. Studies show that electricity and low carbon fuels like biodiesel and renewable diesel reduce GHG emissions by 15 to 80 percent, and DPM pollution by 34 to 70 percent.* An LCFS also benefits the maritime industry by spurring innovation in clean technologies, creating new revenue opportunities for the maritime industry, and ensuring that Washington's maritime industry remains cost competitive with California, Oregon, and British Columbia which have LCFS programs.

**Western Washington Clean Cites. Renewable Diesel in Washington Fact Sheet.*

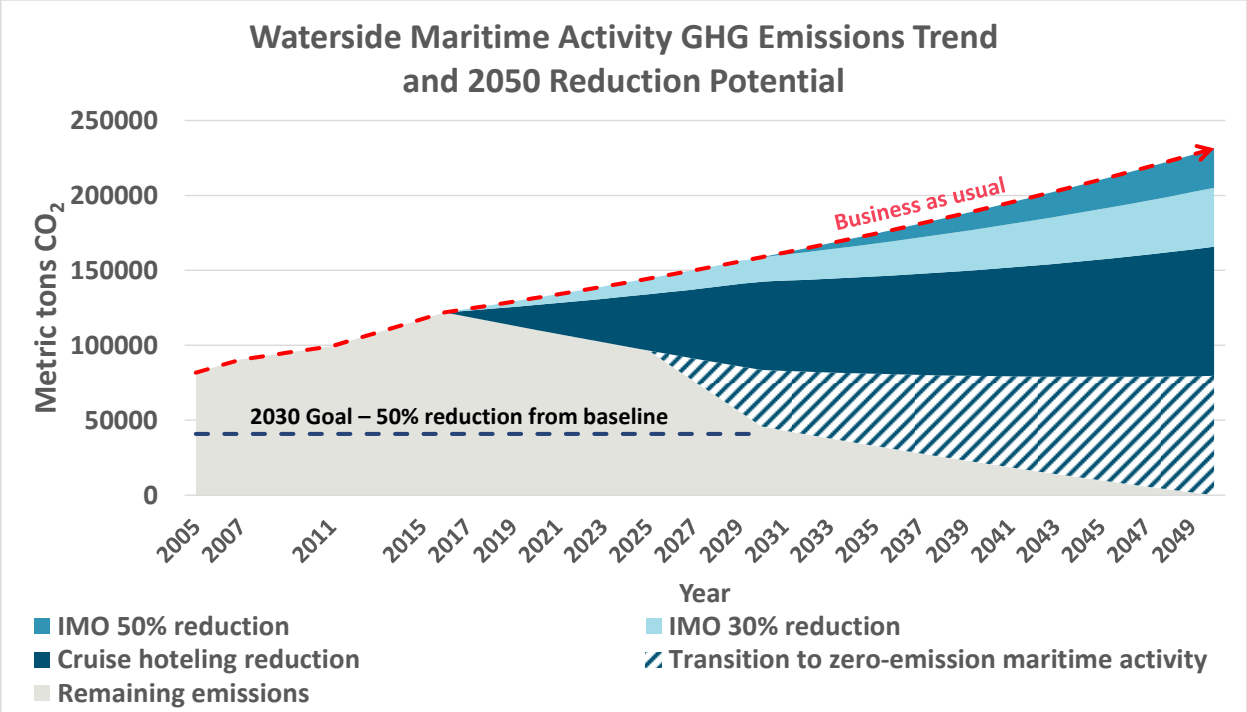
Figure 22. Annual GHG and DPM emissions from Maritime Activity waterside sources 2005 – 2016. *Emissions were inventoried in the Puget Sound Maritime Air Emissions Inventories for years 2005, 2011, and 2016.*





Strategies

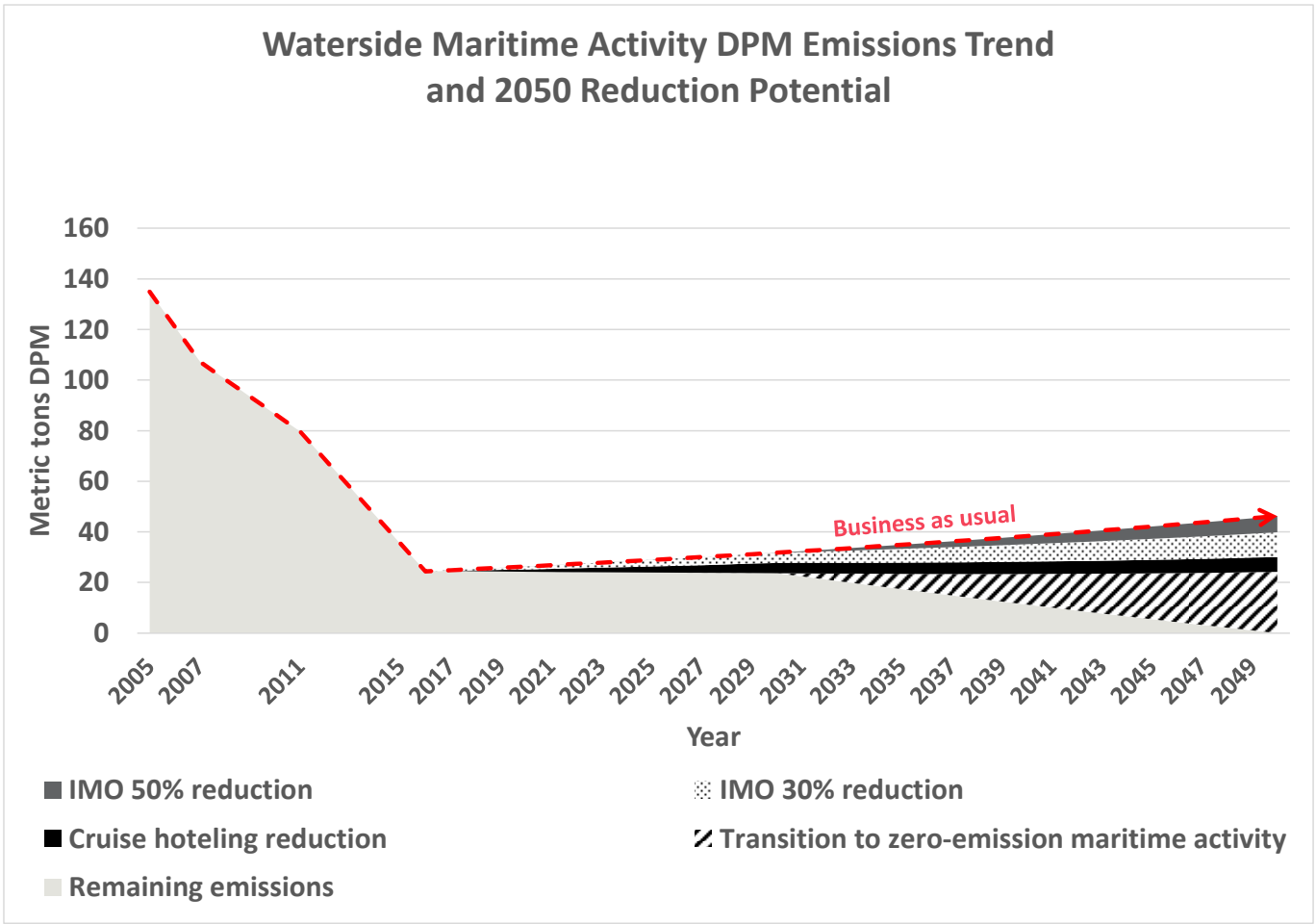
Figure 23. Annual GHG emissions from Maritime Activity waterside sectors projected to 2050 in MT CO_2. *Annual emissions will continue increasing through 2030 under a business-as-usual scenario that includes projected growth and assumes that no further emission reduction actions are taken. Mandated vessel 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 metric tons of CO_2 in just one season.

Figure 24. Annual DPM emissions from Maritime Activity waterside sectors projected to 2050 in MT.
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 CO_2 and 8 MT DPM per year
by installing additional shore power and maximizing connections

Actions

Within 1 – 3 years

- Install shore power at Pier 66 Cruise Terminal by 2023 and pursue funding to offset infrastructure costs
- Evaluate shore power delivery options and rate structures at Port facilities, working with cruise lines and utility providers
- Require shore power use by shore power-equipped homeport cruise ships at Terminal 91[23]

Within 5 years

- 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)

Within 10 years

- Collaborate with cruise lines to increase the number of annual shore power equipped calls at Port of Seattle with a goal to reach 100% shore power-equipped homeport calls and a 100% 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

- Collaborate with cruise lines annually to report on shore power utilization, best practices, and avoided emissions

[23] 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 for domestic and international policies to support zero-emission vessels by collaborating with port and industry associations and supporting a zero-emission demonstration project.

Actions

Within 5 years

- ✦ Implement the International Association of Ports and Harbors' Cruise Emissions Reporting Project at Port of Seattle and collaborate with cruise lines to maximize participation

Within 10 years

- ✦ 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

Within 1 – 3 years

- ✦ Complete Port of Seattle-specific cruise ship emission research and develop recommendations

Within 5 years

- ✦ 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 Port of Seattle 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)

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.

Actions

Within 1 – 3 years

- ✦ 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

Within 5 years

- ✦ Improve tracking and reporting of usage rates with a goal of reporting usage annually

Within 10 years

- ✦ 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.

Actions

Within 1 – 3 years

- ✦ Demonstrate zero-emission outboard engines in Port-owned vessel fleets and communicate results

Within 10 years

- ✦ 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

Within 1 – 3 years

- Engage harbor vessel fuel providers to discuss opportunities and barriers to supplying low-carbon fuels

Within 5 years

- Evaluate incentive programs to accelerate use of low carbon fuels and the transition to zero-emission harbor vessels

Ongoing

- 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

Performance Metrics

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

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.

Landside Maritime Activity

Strategies

CHE1	Provide infrastructure for zero-emissions equipment by 2030
CHE2	Support adoption of zero emissions cargo-handling equipment by 2050
CHE3	Support continual advancement in equipment efficiency and emission reduction
TR1	Provide infrastructure for zero-emission trucks by 2030
TR2	Support adoption of zero-emission trucks by 2050
TR3	Support continual advancement in truck efficiency and emission reductions
RR1	Provide infrastructure for zero-emission on-terminal rail by 2030
RR2	Support adoption of zero-emission on-terminal by 2050
RR3	Support continual advancement in rail efficiency and emission reduction

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, AND 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 "switching locomotives" are used to move railcars within the grain terminal. Line haul locomotives travel throughout the airshed and account for 98% 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 25. 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.

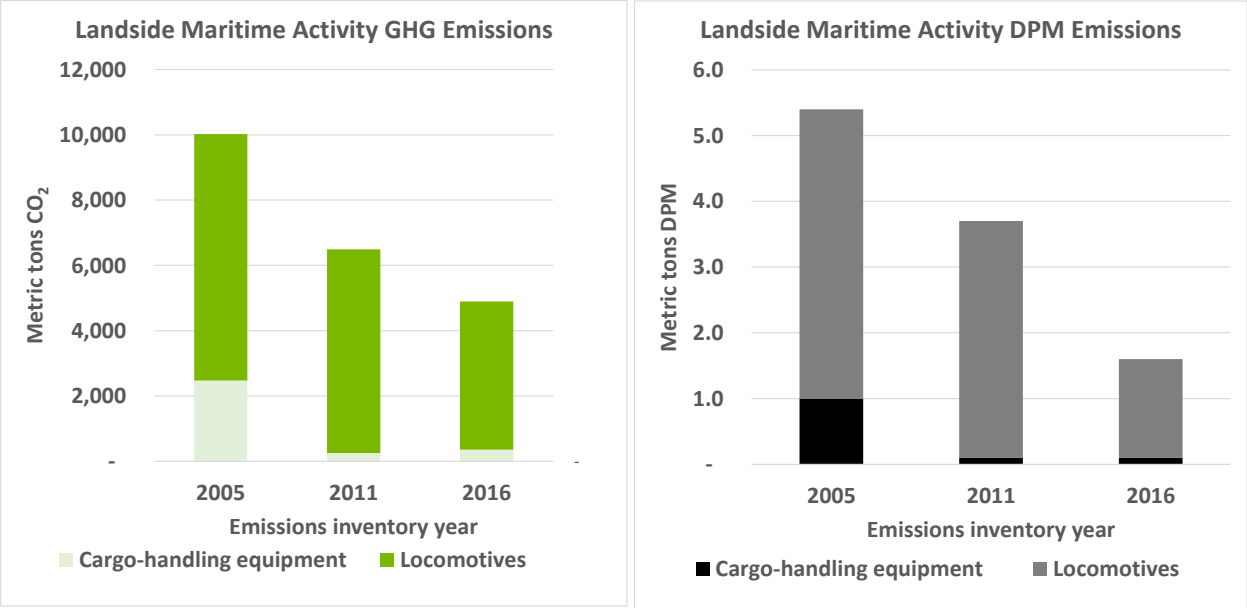


Figure 26. Annual GHG emissions from Maritime Activity landside sectors projected to 2050 in MT CO_2.
Annual emissions will continue increasing through 2030 under a business-as-usual scenario that includes projected growth and assumes that no further emission reduction actions are taken. Mandated vessel efficiency improvements and additional shore power will reduce emissions.

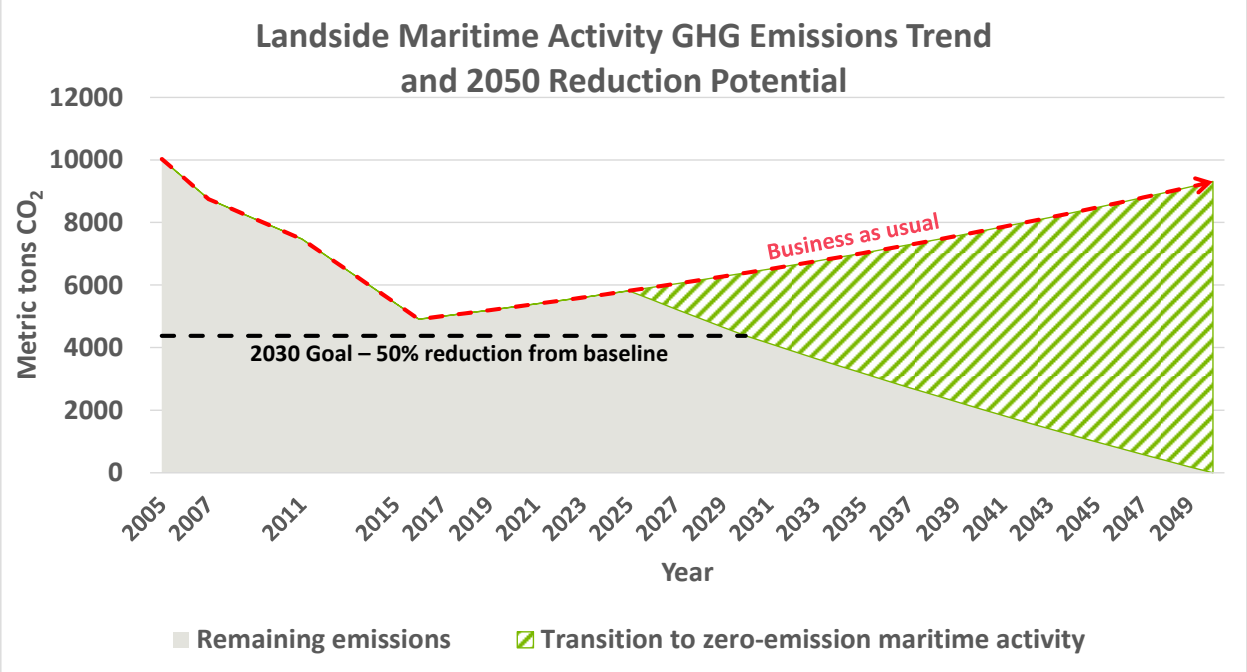
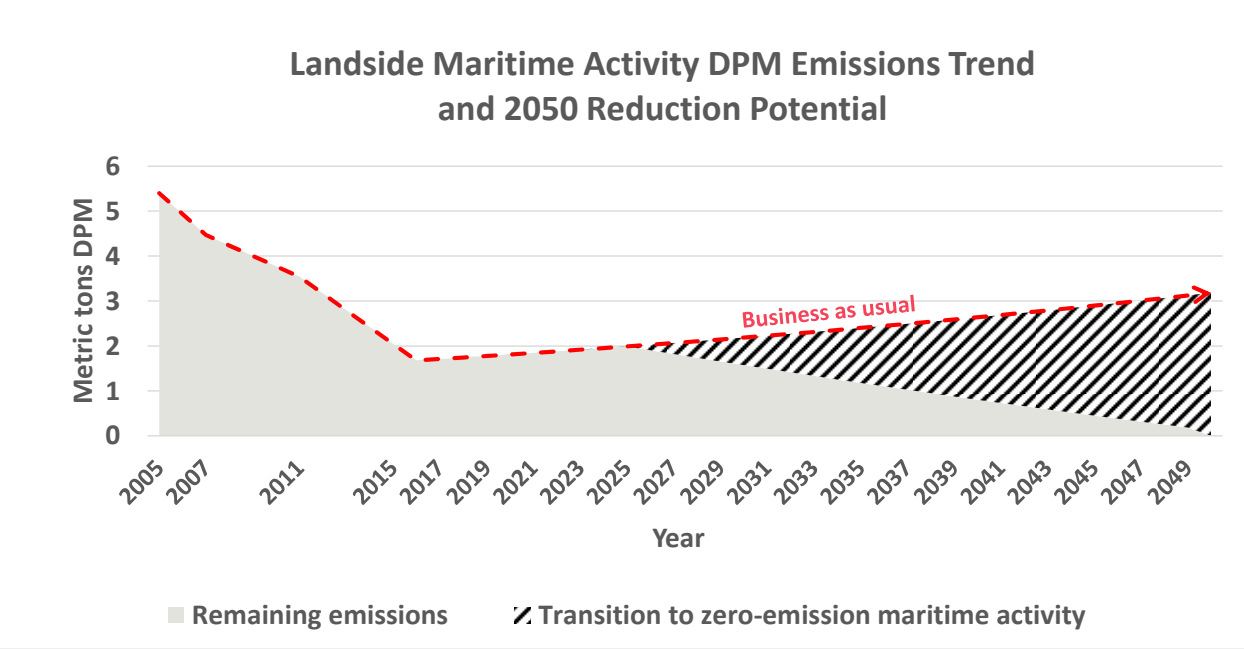


Figure 27. Annual DPM emissions from Maritime Activity landside sectors projected to 2050 in MT CO_2. *Annual emissions will continue increasing through 2030 under a business-as-usual scenario that includes projected growth and assumes that no further emission reduction actions are taken. Mandated vessel 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 Strategic Plan (Maritime Activity strategy XS1.)

Actions

Within 5 years

- ✦ As part of SWCESP 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

Within 10 years

- ✦ Complete planning design and install necessary infrastructure for zero-emission CHE

Ongoing

- ✦ 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

Within 5 years

- ✦ 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

Within 1 – 3 years

- ✦ 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

- ✦ Evaluate environmental incentive programs to accelerate Port tenant and customer CHE upgrades or low carbon fuel use.

TRUCKS

TR1

Provide infrastructure to enable adoption of zero-emission trucks 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

Within 5 years

- ✦ Evaluate opportunities to demonstrate zero-emission infrastructure for 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 truck 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

Within 5 years

- 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. 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

Within 1 – 3 years

- 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 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.

Within 5 years

- 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.

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%.

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

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 Strategic Plan.

Actions

Within 10 years

- ✦ As part of SWCESP 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

Within 10 years

- ✦ 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

Within 1 – 3 years

- ✦ Engage Class I Railroads, in collaboration with ports and partners, to identify emission reduction opportunities in Washington.

Within 5 years

- ✦ 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 CHE that meets Tier 4 emission standards	80% of CHE meets Tier 4i equivalent by 2020
	Percent zero-emission CHE adopted	100% by 2050
	Total cost of ownership of zero-emission CHE relative to diesel CHE	Information only
Trucks	Percent zero-emission trucks adopted	100% by 2050
	Total cost of ownership of zero-emission trucks relative to diesel trucks	Information only
Rail	Percent unregulated engines known to be upgraded	20% are upgraded by 2020, relative to 2013
	Percent switcher engines that use renewable fuels	Information only
	Percent zero-emissions switcher engines adopted	100% by 2050

SECTION 5 | IMPLEMENTATION

Sections 3 and Section 4 lay out the strategies needed to chart the course toward the Port's 2030 GHG reduction targets and the 2020 Strategy vision to phase out emissions by 2050. The journey to implement the strategies will require leadership, focused resources, and accountability. This Section discusses how the Port will implement the Plan given the challenges of the COVID-19 pandemic and the need for collaboration across the Port and throughout the port network. It discusses preliminary cost estimates and the different frameworks the Port will utilize to prioritize action to ensure sustainable, cost-effective, and equitable outcomes are realized. Lastly, it outlines the data and reporting metrics the Port will use to track and share its progress.

Impacts of COVID-19 on implementation

The COVID-19 pandemic immediately changed the Port's day-to-day operations and its lines of business. These changes will influence air pollutant and GHG emissions in varying ways. Some examples include:

- All cruise sailings at the Port were canceled for the 2020 cruise season. At the time of writing, cruise operations may continue to be impacted in 2021. It is unclear how ongoing COVID-19 risk and public health restrictions will impact projected growth in the Seattle-Alaska cruise market.
- Possible long-term impacts to cruise operations would affect emissions forecasts for cargo-handling equipment, trucks, and ground transportation associated with cruise operations. Other areas of Port maritime business, including grain cargo, commercial fishing, and recreational boating remain steady.
- Fewer employees are working onsite in Port buildings and worksites, which will result in reduced fuel use by fleet vehicles, lower solid waste volumes, and reduced plug loads in Port buildings.
- Most telework-eligible employees are working from home at least part-time, which has proven the effectiveness of telework. As a result, the Port will expand its program on flexible work arrangements. However, for employees that do need to commute to a work location, the Port is recommending employees drive single-occupancy vehicles and avoid public transit.
- Increasing the use of flexible work arrangements could result in permanent changes in how the Port uses its buildings and manages it fleet.
- There is an increased focus on building design and operating parameters to protect employee health. Adjustments such as increasing ventilation and outside air levels, extending operating hours, and reducing occupancy pose new challenges for energy conservation.
- With atypical use at Port facilities in 2020 and possibly extending further, the Port has delayed conducting additional waste audits at facilities in the Maritime Solid Waste Management Plan.

The impact of the pandemic on the Port's emission forecasts is unknown. Emissions forecasts and Plan recommendations will be updated as new information becomes available.

More significant is the pandemic's impact on Port revenue and regional economic growth. A prolonged pandemic and recovery could make it harder for the Port and maritime industry to make the investments needed to achieve the Plan's objectives.

Roles, responsibilities, and the need for collaboration

The Port has indirect control over the Maritime Activity emissions associated with ships, harbor vessels, trains, and equipment. While the Port can leverage lease terms and tariffs to require action, collaboration, partnerships, funding support, or joint programs will be essential to achieve the 2050 vision.

The Port's internal roles and responsibilities include:

- **Port Executive Leadership** involvement is critical to advocate for investments and sponsor projects that align with the recommended actions in this Plan.
- **The Maritime Environment & Sustainability Department** will coordinate Plan development, implementation, updates, monitoring, and reporting.
- **Other Port departments** will be instrumental in developing strategies putting them into action, including Marine Maintenance, Seaport Finance, Seaport Project Management, Capital Services, Economic Development, Asset Management and Real Estate, External Relations, Human Resources, Office of Equity, Diversity and Inclusion, and others.

The most important aspect of implementation, however, is collaboration. The Port cannot fully implement the Plan alone. Collaboration throughout the region and with a coalition of partners is essential. The Port will continue to collaborate with the NWSA, Port of Tacoma and Port of Vancouver (Canada) to implement the 2020 Strategy. Collaboration with NWSA is particularly important for coordinated engagement and action on the SWCESP and in the Duwamish Valley where NWSA-operated container cargo terminals in Elliott Bay are a source of local air emissions.[24]

The Port will also continue to engage partners and support partner-led efforts across the port network, including with port tenants, industry, governments, non-governmental organizations, and near-port communities.

Engagement on implementation

As the Port works to implement the strategies and actions identified in the Plan, ongoing engagement with near-port communities, tenants, and industry is critical to successful implementation.

As discussed in the Introduction, near-port communities bear a disproportionate burden of air pollution exposure and environmental health disparities. In Seattle, this disproportionate burden is particularly evident in the Duwamish Valley, where the life expectancy of residents is over a decade shorter than that of wealthier neighborhoods in north Seattle.[25] When implementing the Plan, the Port will work with the Port Community Action Team, community organizations, and others to identify an equitable and accessible process to continue to engage and involve near-port communities, promote community capacity-building, identify community-based performance metrics related to the Port's plans, and build accountability and transparency around actions, investments, and outcomes.

[24] These operations were formerly managed by Port of Seattle but are now overseen by NWSA.
[25] https://www.duwamishcleanup.org/chia

Engagement with Port tenants, terminal operators, and maritime industries is also a key focus of implementation. The Port will work with equipment owners and operators to understand energy requirements, infrastructure needs, and technology constraints. Industry engagement is also an opportunity to identify leaders willing to work with the Port to advance the Plan through zero-emission technology pilots, early investments in clean technologies and by sharing lessons learned with others.

Prioritizing actions for implementation

Actions proposed in the Plan will be evaluated and prioritized for implementation based on equity impacts and benefits, sustainability, and cost, as described below.

Equity Index and other equity tools

The Port's Office of Equity, Diversity, and Inclusion is developing an equity index and other tools to map environmental pollution burdens on socially vulnerable communities by census tract. This tool—which will provide Port-specific information—will be incorporated into the Sustainable Evaluation Framework process and Plan implementation to ensure that equity and environmental justice concerns are addressed as projects develop. Regional information about environmental health disparities and equity factors will also influence where and when the Port prioritizes implementation, especially for projects expected to reduce localized air pollution.

Sustainable Evaluation Framework

The Sustainable Evaluation Framework is a set of criteria for capital project development that the Port adopted in 2020 to assist in achieving its sustainability goals, including the goals of reducing GHG emissions and air pollution. Some actions proposed to meet Plan objectives—specifically those capital projects related to building and campus energy efficiency and future port-led infrastructure development projects will undergo the Sustainable Evaluation Framework review process to consider a range of criteria and develop a sustainable design approach. Consideration of life-cycle costs, co-benefits such as community health, equity, and leadership will also be factored into decision-making.

Port of Seattle Racial Equity Toolkit

The Port of Seattle is training staff to use a Racial Equity Toolkit in project planning to ensure projects advance racial equity. The toolkit covers six steps to identify project outcomes, data, engagement opportunities, and clearly articulate strategies for advancing racial equity within project completion. The Port's Racial Equity Toolkit asks key questions that will be used as part of the Plan's development of implementation actions:

Step 1: What is the proposal and the desired results and outcomes?

Step 2: What is the data and what does the data tell us?

Step 3: How have communities been engaged? Are there opportunities to expand engagement?

Step 4: What are the strategies for advancing racial equity? Other types of equity?

Step 5: What is the plan for implementation?

Step 6: How will you ensure accountability, communicate, and evaluate results?

Cost Estimates and Cost-Benefit Analysis

The strategies identified in this Plan outline the high-level actions, investments, and recommendations the Port must evaluate to achieve its vision. Focused resources will be needed to implement the Plan, including consistent annual funding and capital planning. Implementation will require holistic evaluation of benefits and costs. Per the Port's Sustainable Evaluation Framework policy, cost estimates and cost-benefit will be developed each year for upcoming projects and actions that meet certain thresholds--typically projects with high cost, high sustainability potential, or both. The Sustainable Evaluation Framework incorporates cost and lifecycle analyses into the decision-making process. Other cost-related criteria such as simple payback, lifecycle cost, cost per MT CO_2, or total cost of ownership may also be required to evaluate and prioritize strategies and actions.

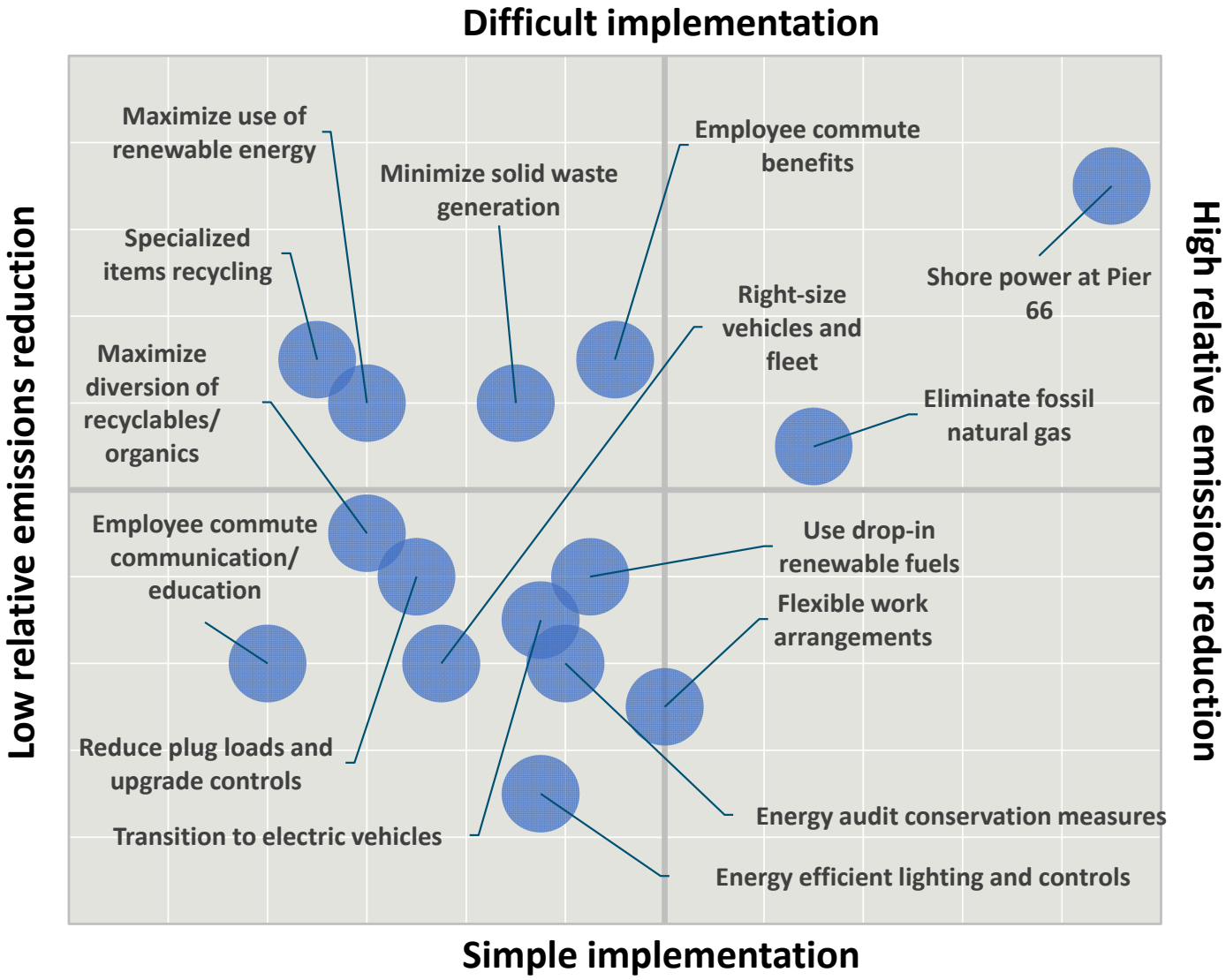
Table 2. **5-Year Implementation Cost Estimates.** *The following table summarizes cost estimates for select projects to implement Plan strategies and actions within the first five years. The capital project cost estimates are projects budgeted in the Port's five-year Capital Improvement Plan. The costs are estimated over five years and do not represent the total cost of investment needed to achieve all of the strategies and actions identified. The estimates do not include the full cost of staff time or external costs to industry or others, and also do not reflect cost savings or cost recovery opportunities from the investments (e.g., saving on energy or fuel costs).*

Project	Plan Strategy	5-Year Cost Est.
Capital Projects		
Shore power at Pier 66 Cruise Terminal by 2023	OGV1: By 2030, install shore power at all major Port of Seattle cruise berths	$17,000,000
Install new shore power capacity for tugs at Harbor Island Marina's "E" Dock	HV1: By 2030, sufficient infrastructure is in place to enable adoption of zero-emission harbor vessels	$485,000
HVAC upgrades Pier 66, World Trade Center West	BC1: Eliminate fossil natural gas	$6,000,000
Planned lighting upgrades on Port properties: • Jack Block Park Lighting Upgrade ($260,000) • Terminal 91 Uplands Lighting Upgrade ($230,000) • Fishermen's Terminal Lighting Upgrade and Controls ($350,000) • Pier 66 Pole Light Upgrade ($45,000) • Marine Maintenance South Yard Light Posts ($40,000)	BC3: Install energy efficient lighting	$925,000
Purchase energy management software	BC6: Streamline and advance energy data management	$400,000

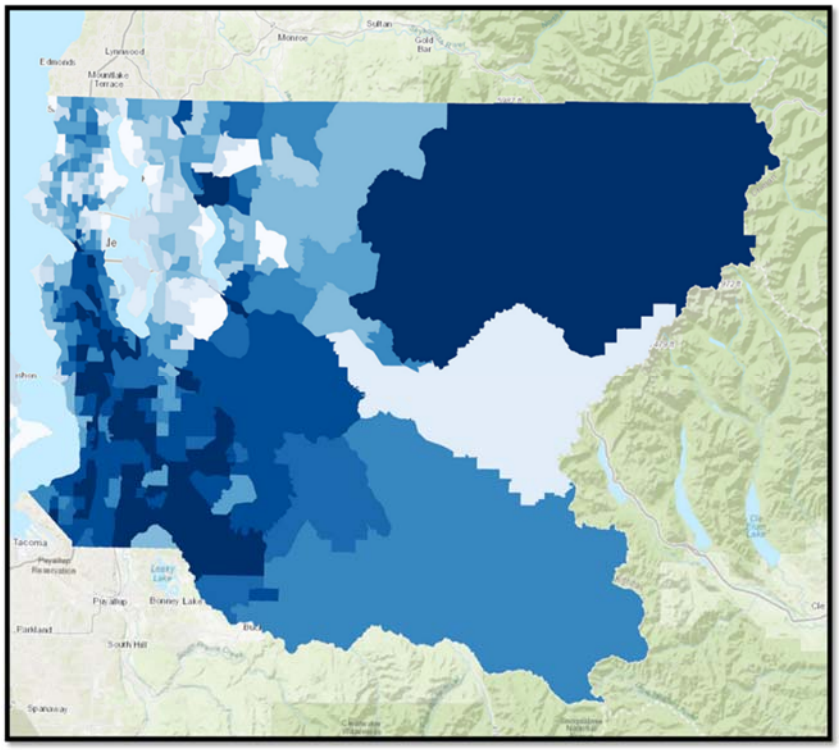
Project	Plan Strategy	5-Year Cost Est.
Installation of electric vehicle charging stations at Bell Street Garage and Marine Maintenance South Office	FV2: Transition to electric vehicles	$450,000
5-year Fleet Replacement for Maritime, Economic Development Division, and Pier 69	FV3: Right-size vehicles and fleet	$9,600,000
Near-term implementation of the Seattle Waterfront Clean Energy Strategic Plan *Estimated capital costs; investments could include pilot projects, studies, or infrastructure upgrades.*	XS1: Seattle Waterfront Clean Energy Strategic Plan	$500,000
	Capital Projects Subtotal	***$35,360,000***
Programmatic Projects		
Completion of the Seattle Waterfront Clean Energy Strategic Plan	XS1: Seattle Waterfront Clean Energy Strategic Plan	$250,000
Funding for outside services not considered capital projects *Programmatic projects may include an inventory of maritime leases and development of green lease terms, cruise emissions research, completing the Puget Sound Maritime Air Emissions Inventory, and community engagement*.	Cross-Sector	$500,000
	Programmatic Subtotal	***$750,000***
TOTAL		**$36,110,000**

Cost-benefit analyses will be used as one of the criteria to prioritize and recommend strategies for implementation. However, the magnitude of GHG reduction, partnership potential, implementation difficulty, co-benefits, equitable distribution on benefits, and technology development will also be considered. For example, employee communication and education can be relatively low cost and easy to implement, but the potential for GHG reduction from education is limited. In contrast, eliminating use of fossil natural gas is relatively expensive and difficult to implement since it requires replacing multiple HVAC systems, but it has the greatest potential to reduce GHG emissions from the Port's building and campus energy sector.

Figure 28. Estimated GHG reductions and implementation difficulty for strategies. *The strategies in the Plan are distributed according to relative emission reduction and implementation difficulty. Implementation difficulty incorporates cost, technology maturity, and the Port's control over the emissions and implementation of the strategy. The implementation and reduction rubrics are discussed in Appendix C.*



Continuous improvement of emissions data



Sample view of Port of Seattle Environmental Equity Map, displaying environmental health and social indicators ranked from least burdened (lighter blue) to most burdened (dark blue).

The Plan relies on emissions inventory data to assess emission trends, progress toward the Port's GHG reduction targets, and estimate the impacts of implementing various emission reduction strategies. As more information becomes known about emission sources, the Port may revise inventory results for the baseline, current, or future years to fill data gaps in past inventories and provide a clearer picture of emission trends and target levels needed to meet its 2030 and 2050 goals. Emissions forecasts will be reanalyzed to include the impacts of the COVID-19 pandemic once more information is available. Emission inventories may also be expanded to include new sources where data was not previously available, such as trucks and buses not previously inventoried, and a more accurate assignment of emissions from building energy used by tenants, or new community-based data sources as determined through engagement.

Performance metrics

The Plan includes a set of performance metrics that will be used to gauge annual progress in meeting targets and objectives for Port Maritime Administration and Maritime Activity sectors. The metrics are listed in Appendix D. Additional metrics may be identified through ongoing engagement with near-port communities to help track and measure progress.

Adaptive management approach to monitoring and reporting

The Port will take an adaptive management approach to monitoring, reporting, and reviewing the Plan, which is consistent with the 2020 Strategy framework. As advancements in technology, changes in policy, and funding opportunities occur, the Port will change course or advance timelines and actions as needed. The adaptive approach also applies to the metrics set in this Plan, which will be reviewed and updated throughout implementation to ensure they remain relevant.

The Port will employ the adaptive management approach to monitor results and identify necessary updates on the following schedule:

Annually

- Conduct internal Maritime GHG inventory of Port Administration sources
- Conduct an annual review of implementation efforts to review progress on each action, identify lessons learned, and update the actions and timeframes as needed
- Report on Plan progress through the 2020 Strategy implementation reporting process and via the Port's business planning, budget processes, and communication channels.

Every five years

- Participate in the Puget Sound Maritime Air Emissions Inventory which covers Maritime Activity emissions of air pollutants and GHGs. The next Puget Sound Maritime Air Emissions Inventory will cover the year 2021.
- Review the 2020 Strategy vision, objectives, and metrics in collaboration with participating ports.

As needed

- Update the GHG inventory baseline as new data is obtained, additional emissions sources become relevant, or when new inventory methodologies or emission factors become available
- Update the Plan using new inventory data, progress to date, new targets, new strategies, and new actions with a longer planning horizon as technology, policy, or funding evolves, or at least every five years.

CONCLUSIONS

When the Port of Seattle developed the 2020 Strategy with Port of Tacoma and Port of Vancouver twelve years ago, it was the first international collaborative effort of its kind in the port community. At the time, the Strategy's aim to put environmental performance above the competitive interests of the ports was a bold step. Yet, more than a decade later, the Strategy has achieved deep reductions in air pollution across the ports' shared airshed. Today, climate change is the challenge of our lifetime. At this critical juncture, transformative changes on a global scale are urgently needed to prevent the devastating effects of a warming planet, and ports have a key role to play in this transformation. The Port, along with the 2020 Strategy partners, is committed to phasing out emissions by 2050, setting a new level of ambition that recognizes the urgency of the climate crisis and the disproportionate impact of local air pollution on near-port communities.

This Plan charts a course for the Port to advance the vision of the 2020 Strategy. GHG emissions from **Port Maritime Administration** sectors--including building and campus energy, fleet vehicles and equipment, employee commutes, and solid waste--are not declining, despite noteworthy progress in some areas. Greatly intensified efforts over the coming decade are needed to reduce emissions. For **Maritime Activity** sectors--ocean-going vessels (cruise and grain ships), harbor vessels, cargo-handling equipment, trucks, and rail–GHG and DPM emissions have declined since 2005. However, additional action is needed to continue the course to zero emissions even as seaport-related trade is projected to grow in the coming years. The strategies and actions identified in the Plan can meet the Port's GHG reduction targets and keep on track to phase out emissions by 2050.

We cannot succeed in our vision alone. The Port has limited influence over the sectors that contribute the most emissions, and zero-emission pathways for some sectors are yet to be determined. Successful implementation will require significant collaboration across the port network. It will require the development and demonstration of new technologies and fuels for maritime applications; investment from ports, industry, government, and external funders; and regulations and policy incentives to foster new markets and drive the transition to zero-emission operations. As we embark on this course to 2050, the Port looks forward to working with other ports, industry, communities, governments, non-profits, and other partners.

APPENDIX A | GLOSSARY AND ACRONYMS/ABBREVIATIONS

Actions: Specific and measurable steps needed to implement emission reduction strategies described in this Plan. Actions are grouped in 5-year increments

Air pollutants: Natural and human-made substances in the air we breathe that negatively impact human or environmental health. Air pollutants of most concern to ports include particulate matter, ozone-forming pollutants (nitrogen oxides and volatile organic compounds) and sulfur oxides.

Biodiesel: Diesel fuel made from waste oils and fats, rather than petroleum

B20: Diesel fuel with 20% biodiesel content and 80% petroleum diesels

Blue carbon: Carbon dioxide captured and stored in ocean and nearshore habitats

Carbon sequestration: The process of trapping or capturing carbon dioxide in plants, sediments, water or underground, thus removing it from the atmosphere

Century Agenda: The Port of Seattle's 25-year strategic plan to stimulate economic development while remaining committed to social and environmental responsibility

CHE: cargo-handling equipment

CO_2: Carbon dioxide, the primary greenhouse gas that traps heat in the atmosphere. Carbon dioxide enters the atmosphere through burning of fossil fuels used in for energy and transportation, from burning of solid waste and other organic materials, and from certain chemical reactions. In this plan, the term CO_2 is generally synonymous with greenhouse (GHG) emissions.

DHW: Domestic hot water used in buildings. The water is heated by electricity, natural gas, or other forms of energy

Emissions Inventory: A detailed estimate of air emissions (either air pollutants or greenhouse gases) that one or more sources produces over a certain period. Port emission inventories usually estimate pollutants in tons or metric tons of pollutant per year.

EV: Electric vehicle

Fossil fuel: Carbon-based fuels from fossil hydrocarbon deposits, including oil, coal, propane, and natural gas

Greenhouse gas (GHG) emissions: Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds.[26] GHGs included in port inventories are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). In this plan, the term GHG is generally referring to CO_2.

HV: Harbor vessels, including assist tugs, commercial fishing vessels, and recreational vessels

[26] https://www.ipcc-data.org/guidelines/pages/glossary/glossary_fg.html

HVAC: Heating, ventilation, and air conditioning for buildings

kWh: Kilowatt-hour; unit of energy used to describe the electricity consumption or production

LED: Light emitting diode, a type of high efficiency light bulb

The Plan: Port of Seattle's Maritime Climate and Air Action Plan (this Plan) which includes actions relating to the Maritime, Economic Development and Corporate divisions and excludes the Northwest Seaport Alliance and the Port of Seattle's Airport Division and its operations and emission sources

Maritime Activity: A category of the Port's maritime emission sectors; includes ships, harbor craft, recreational vessels, locomotives, trucks, and cargo-handling equipment that are not owned by the Port but are used on and around the Port's cruise terminals, grain terminal, marinas, and industrial properties. These are GHG Scope 3 sources.

MT: Metric ton, the unit of measure used to account for climate and air pollution magnitudes

NWSA: The Northwest Seaport Alliance, a separate port authority formed by a marine cargo operating partnership between the Port of Seattle and the Port of Tacoma

Northwest Ports Clean Air Strategy: Northwest Ports Clean Air Strategy (2020 Strategy), a regional, multi-port and multi-agency plan to reduce air pollutant and greenhouse gas emissions from seaport-related sources

OGV: ocean-going vessels

Plug load: Energy used by equipment that is plugged into electrical outlets

Port-managed properties: properties occupied by port staff or leased to tenants, but that remain primarily managed by the port.

Port Maritime Administration: A category of the Port's maritime emission/carbon capture sources that are under direct control or strong guidance of the Port; includes Port-managed and tenant-managed buildings and campuses, fleet vehicles and equipment, remediation projects, habitat restoration, solid waste management, employee commuting, and business air travel. Includes GHG Scopes 1-3 sources.

Priority Actions: Key short-term ready-to-implement actions to be completed in 1-3 years that are first steps to enable or accelerate future actions

Renewable diesel: Renewable diesel; diesel fuel made from plant or animal-based fat. Renewable diesel is chemically the same as fossil diesel and is a "drop-in" fuel capable of replacing fossil diesel without engine modifications. Renewable diesel and biodiesel are made from similar sources but by different chemical processes.

Renewable energy: Any form of energy from solar, geophysical, or biological sources that is replenished by natural processes at a rate that equals or exceeds its rate of use.[27] Examples include sunlight, wind, rain, tides, waves, geothermal heat, and some hydroelectricity.

[27] https://www.ipcc-data.org/guidelines/pages/glossary/glossary_r.html

Scope 1 emissions: GHG emissions from sources that are owned or controlled by the organization, also referred to as direct emissions

Scope 2 emissions: GHG emissions from the consumption of purchased electricity, steam, or other sources of energy (e.g., chilled water) generated upstream from the organization

Scope 3 emissions: GHG emissions that are a consequence of the operations of an organization but are not directly owned or controlled by the organization. These are also referred to as indirect emissions.

Strategies: Recommended approaches to reduce air pollutant or GHG emissions.

SWCESP: Seattle Waterfront Clean Energy Strategic Plan

Tenant-managed properties: properties leased by tenants from the Port or owned by tenants through ground leases where the lease terms limit the port's control over building management, which is primarily in the tenant's control

Zero emissions: For this Plan and the 2020 Northwest Ports Clean Air Strategy, use of technologies and fuels that result in no tailpipe emissions, recognizing that emissions may still occur when looking at the full lifecycle. Tailpipe emissions refers to chemicals released as a result of burning a fuel to operate an engine (e.g., gasoline, diesel, biofuels). Electric- and hydrogen-fueled engines have zero tailpipe emissions.

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.[28] 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 metric tons (MT) per year of the relevant air pollutant. GHG inventories usually report results for individual GHGs, or in carbon dioxide equivalents (CO_2e) per year. CO_2e is a composite measure of various GHG based on their global warming potential, which converts all GHG to the equivalent amount of CO_2.

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: • Ocean-going vessels • Harbor craft (includes tugs, commercial fishing vessels and recreational vessels) • Locomotives • Cargo-handling equipment • Cruise buses on terminals	Sectors: • 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)

[28] GHG Protocol Corporate Accounting and Reporting Standard

Category: Maritime Activity (Scope 3)	Category: Port Maritime Administration (Scope 1, 2, or 3 as noted)
Inventory Method: • 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	Inventory Method: • 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.[29] The Inventory was conducted for calendar years 2005, 2011, and 2016.

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).*

[29] 2016 Puget Sound Maritime Air Emissions Inventory (https://pugetsoundmaritimeairforum.org/2016-puget-sound-maritime-air-emissions-inventory/)

The next Inventory will be conducted for the year 2021. The Inventory quantifies emissions for criteria air pollutants as well as CO_2e and black carbon (soot).[30] Results are 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% 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 CO_2.[31] These inventories follow the Greenhouse Gas Protocol Corporate Reporting Standard but have not been third-party verified.[32]

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 five 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 attributed to the Port. This data limitation results in an overestimation of GHG emissions from campus energy that is attributed to the Port vs. tenants.

[30] The CO_2e emissions reported in the Inventory include CO_2, methane, and nitrous oxide; these are the GHG pollutants associated with maritime industry fuels. Because Port of Seattle uses CO_2 as the indicator pollutant to track progress, the CO_2e values reported in the Inventory are treated as surrogates for CO_2 value in Port reporting.

[31] The Port Maritime internal GHG inventories use is CO_2 as the indicator pollutant. For the solid waste and employee commute sectors, modeling methodologies report results in CO_2e, which the Port applies as a surrogate value for CO_2.

[32] https://ghgprotocol.org/corporate-standard

Table B-2. ***Port of Seattle Maritime GHG emissions 2005 – 2019 in Metric tons CO_2.*** *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).*

	Baseline 2005/ 2007*	2011*	2015	2016*	2017	2018	2019
Maritime Activity**							
Ocean-going vessel transit	59,159	73,573	73,753	45,383	45,383	45,383	45,383
Ocean-going vessel hotel/maneuver	11,732	13,517	13,517	13,156	13,156	13,156	13,156
Harbor craft	2,967	3,726	3,726	4,083	4,083	4,083	4,083
Recreational vessels	7,867	6,854	6,854	6,701	6,701	6,701	6,701
Locomotives	7,545	6,239	6,239	4,540	4,540	4,540	4,540
Cargo-handling equip	3,926	407	407	354	354	354	354
Cruise buses on term.	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	1,217	345	1,188	702	801	1,128	1,219
Building natural gas	593	530	606	689	843	1,061	1,261
Building steam	348	365	0	0	0	0	0
Remediation propane	0	0	0	0	0	0	101
Vehicle fleet	867	694	821	802	871	958	858
Solid waste**	139	139	139	185	188	190	198
Employee commuting**	921	1,012	1,062	1,062	922	922	800
Employee air travel*	100	100	100	86	86	125	125
subtotal	**4,183**	**3,185**	**3,916**	**3,526**	**3,711**	**4,384**	**4,562**
Air travel offsets***	0	0	0	(86)	(86)	(125)	(125)
net Port Admin.	**4,183**	**3,185**	**3,916**	**3,440**	**3,625**	**4,259**	**4,437**
NET EMISSIONS	**97,391**	**107,424**	**108,245**	**77,671**	**77,856**	**78,490**	**78,668**

* Inventory years for the Puget Sound Maritime Air Emissions Inventory

** Emissions from this category were calculated in CO_2e; this is assumed proxy for the CO_2 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.***[33] *Maritime Activity air pollutant emissions for years 2005, 2011, and 2016.*

*	NOx	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:**

NOx: nitrogen oxides

VOC: volatile organic compounds

CO: carbon monoxide

SO_2: sulfur dioxide

PM_{10}: particulate matter 10 micrometers or less in diameter

PM_{25}: particulate matter 2.5 micrometers or less in diameter

DPM: diesel particulate matter

BC: black carbon

[33] Excerpt from Tables 9.59 and 9.60, 2016 Puget Sound Maritime Air Emissions Inventory, https://pugetsoundmaritimeairforum.org/2016-puget-sound-maritime-air-emissions-inventory/

APPENDIX C | EMISSIONS PLANNING ASSUMPTIONS

The Plan includes GHG and DPM emissions forecasts for both a no-action (business-as-usual) scenario and an action (emission reduction) scenario, as discussed below.

It is important to note that neither the business-as-usual (BAU) or action scenarios include the short or long-term impacts of COVID-19 on port operations or the maritime industry. The emissions forecasts should be revisited periodically to ensure that they reflect new information about the impacts of COVID-19, as well as changes in port business trajectories and the development of new technologies, policies, and regulations.

Business-as-usual forecasts

Each emissions forecast includes an emissions projection under a BAU scenario against which the impact of proposed actions is measured. The Port's consultant team reviewed standard GHG emission inventory protocols and did not find an explicit forecasting methodology for projecting BAU emissions. Analysis of fifteen climate action plans or emissions analyses for port or government entities found variation in data and assumptions used to estimate future changes in activity. For example, city or county community-based emissions forecasts tended to be based on population and/or gross domestic product projections, and port maritime emissions forecasts tended to be based on cargo volume projections or data from business plans. Emission forecasts of government operations (analogous to Port Maritime Administration operations described in this Plan) tended to be based on historical trends and/or planned updates to services. Some, but not all, climate action plans included regulatory changes in the BAU forecast, such as mandated low carbon fuels, engine improvements, or increased use of renewables in the energy portfolio that would occur independent of implementation of the plan.

Based on this research, the Plan takes a hybrid approach: Maritime Activity sector BAU emissions (oceangoing vessels, cargo-handling equipment, trucks, harbor vessels, and rail) are forecasted based on industry trends; and Port Maritime Administration sector emissions (building and campus energy, fleet vehicles and equipment, employee commuting, and solid waste) are forecasted based on historical trends. The approach assumes that no additional regulatory changes or emission reduction efforts will be made under the BAU scenario. However, the emission reduction projections do account for the impacts of known or expected policy changes, as discussed below under action scenario forecasts.

Port Maritime Administration BAU forecast

For Port Administration sources, the BAU scenario assumes Port operations will grow linearly according to observed historical GHG emissions trends for each of the sectors between the years 2005-2019. The analysis resulted in the following annual growth forecast for Port Administration BAU emissions from 2019-2030:

- Building and Campus Energy: 1.8%
- Fleet Vehicles and Equipment: 2.2%
- Employee Commuting: 1.0%
- Solid Waste: 2.2%.

The BAU projection does not account for specific future policy changes; it assumes that the Port would continue its historical trajectory without any additional emission reduction efforts. BAU assumptions do, however, incorporate the emission reductions achieved across sectors since the baseline year, such as improvements to buildings, vehicle modernization, policy changes and others. This decision, to project BAU emissions based on historical GHG emission trends, takes a conservative approach to the emissions forecasting and is a methodology consistent with other governments' operational emissions forecasts.

It is also important to note that emissions from Port Administration sources in the Plan are forecasted over a ten-year time horizon from 2020-2030. Over this period, known regulatory changes in state policy, such as the Clean Energy Transformation Act[34], will not yet require reduction in emissions.

Maritime Activity BAU forecast

Most port climate action plans forecast emissions from Port Activity sectors based on cargo throughput projections. Since a cargo throughput metric is not applicable for Port of Seattle's unique emissions portfolio, which includes cruise, grain, commercial fishing and recreational boating, the Plan uses a composite annual growth rate based on research of industry trends in each applicable sector. A composite annual growth rate of 1.9% was used for both the GHG and DPM emissions wedge analyses and developed with guidance from the Port's business units. The composite rate was calculated based on industry growth trends for each sector and weighted by the relative contribution of each sector to GHG and DPM emissions.

The following sources were used to forecast industry growth trends:

- BST Associates, *2017 Marine Cargo Forecast and Rail Capacity Analysis Report* (2017) prepared for the Washington Public Ports Association and the Washington State Freight Mobility Strategic Investment Board provides estimated growth for grain exports through Puget Sound ports.
- BST Associates, PCC 45th Semi-Annual Conference: *What lies ahead? Is your marina preparing for the future or just satisfying today's needs?* (2019) provided the outlook for recreational boating.
- McDowell Group, *Modernization of the North Pacific Fishing Fleet – Economic Opportunity Analysis* (2016), prepared for Port of Seattle and the Washington Maritime Federation, provided the outlook for commercial fishing.
- Port Maritime staff provided a cruise forecast that is subject to change.

The Port Activity BAU forecasts assumes GHG emissions will increase proportionate to the rate of business growth. It does not include an explicit assumption about the impact of new technology or emission standards in the future, such as the emission reduction potential from the natural attrition of older equipment and replacement with newer, cleaner models. In this way, it also represents a conservative, 'worst-case' assumption where the main driver for change in emissions under the BAU scenario is projected growth in port-related industries based on research and consultation with Port business units. For example, the cruise forecast included an increase in the number of cruise calls between 2020-2050.

[34] Under the Clean Energy Transformation Act, all utilities must supply Washington customers with 100% renewable or non-emitting electricity by 2045: https://www.commerce.wa.gov/growing-the-economy/energy/ceta/

Action scenario forecasts

Each emissions forecast also incorporates an action scenario that estimates the emission reduction potential from implementing select strategies identified in the Plan, as discussed below.

Port Maritime Administration action forecast

For Port Maritime Administration sectors, the Plan includes estimated potential emission reductions on a strategy-by-strategy basis. Reductions were calculated using Port-specific knowledge and data, as well as publicly available literature. The analyses include factors such as activity levels, energy usage, and timing of strategy implementation. When a strategy required substituting one energy source for another, the estimate reflects the net decrease in in emissions. The following assumptions were used in estimating emission reductions from 2019- 2030 for each sector:

Building and Campus Energy sector

- Number and timing of energy projects are based on capital plan or typical equipment lifespan
- Eliminating natural gas includes 12% energy equivalent replacement with electricity
- 2019 emissions factor for electricity is assumed to remain constant to 2030.

Fleet Vehicles and Equipment

- Number and timing of vehicles and equipment upgrades to lower-emission models is based on the Port's fleet replacement schedule
- Biogenic-based portion of renewable fuels is treated as zero-emission per GHG inventory protocols.

Employee Commuting

- Progressive increase in telework days and drive-alone trips resulting from strategies identified in the Port's Commute Trip Reduction Plan.

Solid Waste

- Progressive reduction in solid waste being landfilled resulting from strategies identified in the Port's Maritime Solid Waste Management Plan

Maritime Activity action forecast

For Maritime Activity sectors, the Plan includes potential emission reductions based on Port-specific knowledge and data, as well as publicly available literature. In addition, the action scenario includes the impact of vessel efficiency improvements resulting from regulatory mandates that are in force or being developed by the IMO. For other Maritime sectors, the analysis assumed a theoretical straight-line reduction to zero emission by 2050 that is needed to meet the goal set in the 2020 Strategy. The following assumptions were used in estimating emission reductions from 2019 – 2050 for each sector:

Ocean-going vessel sector

- GHG and DPM emission reductions for shore power are based on operational data provided by cruise lines, and emissions data from the Puget Sound Maritime Air Emissions Inventory
- Assumes 100% of homeport vessels are shore power-equipped with a 100% shore power connection rate by 2030
- The current IMO mandate for new ships to be more energy efficient will not be fully realized until 2050, due to long operational life of ocean-going vessels
- An additional IMO strategy to reduce GHG emissions from shipping by 50% by 2050 is expected to begin taking effect by 2030, ramping up by 2050

All other Maritime Activity sectors

- Analysis assumes a theoretical straight-line reduction to zero emissions by 2050 needed to phase out emissions (pathways still be determined)

Strategy ease and effectiveness comparison

Figure 28 in the Plan displays the relative ease and effectiveness of implementing select strategies. (Only strategies with quantified GHG emission reduction potential were included.) The strategies were assigned scores based on their annual emission reduction potential in 2030. They were also assigned scores according to the relative implementation difficulty, which incorporates cost, technology readiness, and the Port's level of control over the emissions. The following strategy evaluation rubric was used to assign ease and effectiveness scores to each strategy.

Annual Emission Reduction Impact by 2030 (-6 is low impact, +6 is high impact)	Value
>10,000 MT GHG reduction and DPM reduction	+6
>10,000 MT GHG reduction with no DPM reduction	+5
5,000 – 9,999 MT GHG reduction and DPM reduction	+4
5,000 – 9,999 MT GHG reduction with no DPM reduction	+3
1,000 – 4,999 MT GHG reduction and DPM reduction	+2
1,000 – 4,999 MT GHG reduction with no DPM reduction	+1
500 – 999 MT GHG reduction and DPM reduction	0
500 – 999 MT GHG reduction with no DPM reduction	-1
300 – 499 MT GHG reduction and DPM reduction	-1.5
300 – 499 MT GHG reduction with no DPM reduction	-2
200 – 299 MT GHG reduction and DPM reduction	-2.5
200 – 299 MT GHG reduction with no DPM reduction	-3
100 – 199 MT GHG reduction and DPM reduction	-3.5
100 – 199 MT GHG reduction with no DPM reduction	-4
50 – 99 MT GHG reduction and DPM reduction	-4.5
50 – 99 MT GHG reduction with no DPM reduction	-5
0 – 49 MT GHG reduction and DPM reduction	-5.5

0 – 49 MT GHG reduction with no DPM reduction	-6

Implementation Difficulty (-4 is low difficulty, +4 is high difficulty)	
Technology readiness	**Value**
No technology impact	-3
Technology commercially available & can be used in existing equipment or infrastructure	-2
Technology commercially available with modification to existing equipment/infrastructure	-1
Preferred technology pathway identified and will be market-ready within 2 years	0
Technology pathways in demonstration	+1
Technology pathways in early demonstration	+2
Technology pathways still being researched	+3
Level of investment needed	**Value**
Strategy will save over $100,000/year	-4
Strategy offers cost savings of up to $100K/year	-3
Strategy is cost-neutral	-2
Strategy cost-competitive w/conventional alternatives	-1
Strategy requires 5-year cost < $1M	0
Strategy requires 5-year cost of $1M - $4.9M	+1
Strategy requires 5-year cost of $ 5M - $9.9M	+2
Strategy requires 5-year cost of $ 10M - $14.9M	+3
Strategy requires 5-year cost of $15M or more	+4
Level of control over emissions	**Value**
Port Maritime Administration, Scope 1 source	-3
Port Maritime Administration, Scope 2 source	-2
Port Maritime Administration, mix of Scope 1, 2, 3 sources	-1
Port Maritime Administration, Scope 3 source	0
Maritime Activity Scope 3, Port owns infrastructure/equipment	+1
Maritime Activity Scope 3, tenants or industry own infrastructure/equipment	+2
Maritime Activity Scope 3, no business relationship with emission source	+3

APPENDIX D | PERFORMANCE METRICS

Northwest Ports Clean Air Strategy Reporting Metrics

Port of Seattle will report on the following metrics identified in the 2020 Strategy as part of the Strategy's annual reporting requirements. These metrics apply to Maritime Activity sectors and a subset of Port Maritime Administration sectors: Building and Campus Energy and Fleet Vehicles and Equipment.

Sector	Metrics	Targets / objectives
Overall emissions^	Absolute emissions (GHG, black carbon, DPM, PM2.5, SOx, NOx, VOC, CO)	Vision: phase out to zero emissions for all GHG and air pollutants by 2050
	Percent change in GHG emissions relative to 2005/2007/2010	Port, federal and state/provincial GHG targets 2030, 2050
Efficiency ^	GHG emissions per MT of cargo moved	Continuous improvement
	Impact of supply-chain efficiency programs on emissions, as available	Information only
Infrastructure	Percent of terminals with sufficient infrastructure in place to support uptake of zero-emission CHE, trucks, rail, harbor vessels	100% by 2030
	Total investments in zero-emission infrastructure	Information only
Ocean-going Vessels	Percent vessel calls with Tier 3 marine engines, cleaner fuel, or other emissions-reduction technologies while underway (e.g., wind or battery assistance)	Continuous improvement
	Percent major cruise and container berths with shore power installed	100% by 2030
	Percent of shore-power-capable ships that plug in and % of total ships that plug in to shore power	Continuous improvement
Cargo-handling Equipment	Percent of CHE that meets Tier 4 emission standards (in progress)	80% of CHE meets Tier 4i equivalent by 2020 *
	Percent zero-emissions CHE adopted	100% by 2050
	Total cost of ownership of zero-emissions CHE relative to diesel CHE	Information only

Sector	Metrics	Targets / objectives
Trucks N/A **	Percent of container trucks that meet or surpass U.S. EPA standards for model year 2007 for particulate matter (in progress)	100% of container trucks meet or surpass U.S. EPA standards for model year 2007 by 2017 *
	Percent zero-emissions container trucks adopted	100% by 2050
	Total cost of ownership of zero-emissions container truck relative to diesel truck	Information only
	Percent renewable fuels adopted	Information only
Harbor Vessels	Percent tugs by tier level	Information only
	Percent commercial vessels with hybrid engines or using renewable fuels	Information only
	Percent zero-emissions commercial vessels	100% by 2050
	Total cost of ownership of zero-emissions tug relative to diesel tug	Information only
Rail	Percent of unregulated engines known to be upgraded (in progress)	20% upgraded by 2020, relative to 2013 *
	Percent switcher engines that use renewable fuels	Information only
	Percent zero-emissions switcher engines adopted	100% by 2050
Admin	Absolute GHG emissions from buildings and lighting	Zero by 2050
	Percent of light-duty passenger fleet vehicles that are zero-emissions or use renewable fuels	100% by 2030
	Percent of entire port authority fleet (including all vehicles, equipment, vessels) that are zero-emissions	100% by 2050

^ Overall emission and efficiency metrics will be reported to coincide with port emission inventories. Currently emission inventories are completed every five years, with the next inventory years planned for 2020 (Vancouver), and 2021 (US Ports).

* Existing metrics that have not yet been met from the 2013 Northwest Ports Clean Air Strategy and remain relevant. Ports will continue to track progress until they are met.

** The 2020 Strategy metrics are limited to container trucks that move cargo to and from marine terminals. Container trucks operating in Seattle-area terminals are associated with the Northwest Seaport Alliance rather than the Port of Seattle, so the metrics listed are not applicable. This Plan expands the definition of trucks to include shuttle vans on cruise terminals, buses providing ground transportation for cruise passengers, and heavy-duty trucks that serve cruise ships and commercial fishing fleet. The Port may establish truck-related metrics after evaluating these sources.

Port Maritime Administration Reporting Metrics

In addition to the metrics above, Port of Seattle will share findings from its annual Maritime GHG Emissions Inventory, which measures emissions annually for Port Maritime Administration sources. As the Plan covers sectors outside of the Admin sector of the 2020 Strategy, the Port has identified additional metrics for reporting specific to the strategies identified for Port Maritime Administration sectors.

Sector	Port Maritime Administration GHG Reduction Strategies	Reporting Metrics
Overall	Annual Maritime GHG Emissions Inventory	Absolute GHG emissions by sector
Building & Campus Energy	BC1: Eliminate fossil natural gas	Therms of fossil natural gas • Compared to baseline year • Annual percent change kWh electricity • Compared to baseline year • Annual percent change kWh renewable energy generated and percent of total energy use in MMBtu. Total estimated kWh or therms reduced from conservation measures Annual change in Energy Use Intensity by building type for buildings over 20,000 sqft Information only: • Updates and number of energy audits conducted beyond compliance requirements • Updates and number of high-efficiency lighting projects completed • Updates on key energy efficiency projects and estimated energy savings • Updates on implementation of energy data management software • Updates on key green lease terms added to eligible leases • Updates on communications and education programs and events
	BC2: Implement energy audit conservation measures	
	BC3: Install energy efficient lighting and controls	
	BC4: Reduce plug loads and upgrade controls	
	BC5: Maximize use of renewable energy	
	BC6: Streamline and advance energy data management	
	BC7: Apply high performance lease terms	
	BC8: Strengthen energy conservation communications and education	

Sector	Port Maritime Administration GHG Reduction Strategies	Reporting Metrics
Fleet Vehicles and Equipment	FV1: Use drop-in renewable fuels	Gallons of fuel dispensed by fuel type % renewable fuel of total gallons dispensed # electric vehicles purchased % of fleet vehicles that are electric or use renewable fuels % of drivable fleet (cars, SUVs, light-duty trucks and vans) older than 15 years[35] % of eligible vehicles or equipment with telematics installed Information only: updates on eco-driving program and driver education
	FV2: Transition to electric vehicles	
	FV3: Right-size vehicles and fleet	
	FV4: Use technology to gather data and improve efficiency	
	FV5: Educate drivers on eco-driving and fleet use practices	
Employee Commuting	EC1: Encourage use of flexible work arrangements	% of employees utilizing telework or flexible work arrangements at CTR-affected worksites (P69 and Marine Maintenance S Horton Street).[36] Drive alone rate at CTR-affected worksites (P69 and Marine Maintenance S Horton Street[37] from WSDOT CTR survey (conducted biannually) Information only: • Updates on implementation of employee communication and education programs • Updates on changes to multi-model transportation access at Port work locations in Seattle
	EC2: Update- improve employee benefits as new opportunities emerge to expand lower-emission commute options	
	EC3: Expand employee communication and education about commute options beyond driving alone	
	EC4: Continue to advocate for more accessible multimodal transportation options for Port Maritime worksites	
Solid Waste	SW1: Maximize diversion of common recyclables and organics	Absolute waste tonnage reported annually

[35] 15 years is average useful life of a fleet vehicle.

[36] Reported every two years with completion of the WSDOT CTR-affected workplace survey.

[37] Reported every two years with completion of the WSDOT CTR-affected workplace survey.

Sector	Port Maritime Administration GHG Reduction Strategies	Reporting Metrics
	SW2: Minimize solid waste generation	% of solid waste tonnage recycled or composted Percent change from previous years' tonnage Information only: • Updates on progress to expand specialized items recycling • Updates on site audits and development of site-specific solid waste plans • Updates on employee and tenant communications
	SW3: Expand specialized items recycling	
	SW4: Increase communications with employees and tenants	
Carbon sequestration	HR1: Complete Smith Cove Blue Carbon Benefits Study	# acres habitat restored toward Century Agenda goal of 40 acres Information only: updates on Smith Cover Blue Carbon Benefits Study progress
	HR2: Continue shoreline restoration projects	