

PORT OF SEATTLE

# OCEAN ACIDIFICATION ACTION PLAN

## Executive Summary

The Port of Seattle, located on the ancestral lands of the Coast Salish people, is situated within the Puget Sound, in the southern portion of the Salish Sea. Founded in 1911 by a vote of the people as a special-purpose government, the Port of Seattle’s mission is to promote economic opportunities and quality of life in the region by advancing trade, travel, commerce, and job creation in an equitable, accountable, and environmentally responsible manner. The Port consists of three operating divisions, which include Maritime, Aviation, and Economic Development and Central Services. In 2020, the Port was the first port in the world to join the International Alliance to Combat Ocean Acidification (OA Alliance.) In doing so, the Port formally recognized the many ways in which ocean acidification (OA) impacts the maritime sector and made a commitment to address OA within the Port’s capacity through the creation of an OA Action Plan.

Due to its impact on marine species and ecosystems, OA threatens key natural resources, communities, and associated industries that are core to the Port’s mission and operations. Thus, addressing OA aligns with the Port’s [mission](#) and [Century Agenda](#) goals. The maritime industry in the Puget Sound region has both cultural and economic significance. Commercial fishing supports more than 11,000 jobs representing more than half a billion dollars in payroll and the shellfish industry contributed \$100 million to the economy in 2017 alone. Tribes have harvested shellfish for generations from this region and salmon are of critical importance to Coastal Salish people. OA has already begun to impact aquaculture in Washington, resulting in lost income for businesses and individuals in the maritime industry. Therefore, protecting these resources is both economically and culturally important to the Puget Sound region.

This action plan summarizes current Port initiatives and efforts to combat OA and includes recommendations for further action. Each of the current initiatives is connected to at least one of the six action goals as called for by the [OA Alliance](#):

1. Reduce atmospheric emissions of CO<sub>2</sub>
2. Advance scientific understanding of climate-ocean impacts, locally and globally
3. Reduce local pollution that exacerbates OA
4. Protect the environment and coastal communities
5. Expand public awareness
6. Sustain international support

All three Port operating divisions are represented in the initiatives described in this document.

Initiative	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6
<b>Century Agenda</b>	•	•	•	•	•	
<b>Northwest Port Clean Air Strategy</b>	•	•	•	•		•
<b>Maritime Climate and Air Action Plan</b>	•	•	•	•	•	
<b>Seattle Waterfront Clean Energy Strategic Plan</b>	•			•		
<b>Sustainable Aviation Fuels (component of Airport Master Plan)</b>	•		•			
<b>SEA Emissions Reduction Initiatives</b>	•		•		•	
<b>Habitat Restoration Program Initiatives</b>		•	•	•	•	
<b>Smith Cove Blue Carbon Pilot Project</b>		•	•	•	•	
<b>Duwamish River Floating Wetlands Projects</b>		•			•	

<b>Stormwater Initiatives</b>		•	•	•	•	
<b>Exhaust Gas Cleaning Discharge Ban</b>			•	•		
<b>Alternative Bankline Stabilization Program</b>			•	•		
<b>Duwamish Valley Community Benefits Commitment</b>				•	•	
<b>Duwamish River Green Jobs Program</b>				•	•	

Through membership in the OA Alliance, the Port can exchange OA knowledge and goals with peer organizations throughout the world and leverage collaboration to drive action in Washington and globally.

## Land Acknowledgement

The Port of Seattle exists on Indigenous land; as such, the Port acknowledges the ancestral homelands of this territory, of the Native peoples who identify as the Duwamish, Suquamish, Snoqualmie, and Puyallup, as well as the tribes of the Muckleshoot, Tulalip, other Coast Salish peoples, and their descendants. The Port is grateful to respectfully live and work as guests on these lands with the Coast Salish and Native people who call this home.

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## Introduction

The [International Alliance to Combat Ocean Acidification \(OA Alliance\)](#) convenes jurisdictions across the globe to combat ocean acidification (OA) and other climate related changing ocean conditions that pose an immediate and critical threat to coastal economies and ocean ecosystems. National, subnational, regional, and Tribal governments are proactively responding to impacts as they create OA Action Plans (action plans) that effectively promote solutions and advance knowledge into action.

The OA Alliance supports members in their development and advancement of OA action plans through information exchange of science, monitoring, and modeling strategies for identifying local risks and vulnerabilities, and sharing best practices for local adaptation and resilience-building strategies. By developing a plan for action, members also commit to confronting the main drivers of OA, which include atmospheric carbon dioxide emissions. Members include government entities at the national, state, provincial, county, and city levels, along with Tribes and First Nations. Affiliate members include universities, non-governmental organizations (NGOs), industry associations, and businesses. The OA Alliance convenes governments and organizations from across the globe dedicated to taking urgent action to protect coastal communities and livelihoods from the threat of OA and other climate-ocean impacts. In 2020, the Port of Seattle (the Port) was the first port in the world to join the Alliance, recognizing the many ways that ocean acidification impacts the maritime sector and acknowledging the important role ports can play in leading on climate and ocean action.

### What is ocean acidification?

Ocean acidification, like other impacts of climate change, is caused by emissions of carbon dioxide into the atmosphere. The planet's oceans naturally sequester a significant amount of atmospheric carbon as part of the carbon cycle. In fact, our global ocean absorbs approximately 30% of the carbon dioxide (CO<sub>2</sub>) released into the atmosphere. However, as atmospheric carbon levels increase due to actions such as the combustion of fossil fuels and changes in land use, the oceans absorb more carbon.

Adding carbon to seawater changes ocean chemistry, causing seawater to become more acidic and reducing the number of carbonate ions that many forms of sea life need to build their shells and skeletons. This chemical reaction also results in decreasing the seawater's pH. We call this process "ocean acidification" or OA. Increasing acidification combined with other climate-change driven changes in ocean conditions, including warmer temperatures and reduced oxygen levels, is already having significant, adverse impacts on fisheries, aquaculture, and marine ecosystems. If the present rate of CO<sub>2</sub> emissions continues, ocean acidity is predicted to double by this century's end, creating devastating impacts for marine environments and communities.<sup>1</sup>

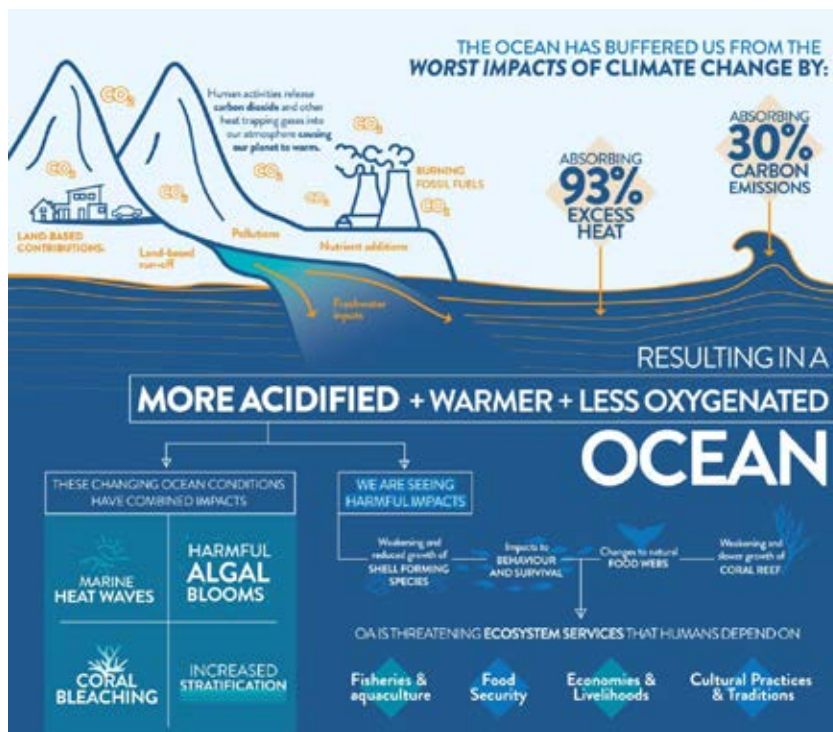
The transition of land use from forest to agriculture results in a reduction of carbon capture capacity, thus increasing atmospheric CO<sub>2</sub>. Forest loss and development exacerbate erosion and facilitates the transport of nutrients to adjacent bodies of water and contribute to the ocean and coastal acidification. Other sources of nutrients that exacerbate ocean and coastal acidification include sewage and

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<sup>1</sup> Washington Sea Grant. (n.d.). Ocean Acidification in Washington State. Retrieved March 12, 2021, from <https://wsg.washington.edu/wordpress/wp-content/uploads/outreach/ocean-acidification/washington-sea-grant-ocean-acidification-brochure.pdf>

wastewater plant effluent, which stimulate algae growth. When algae die, CO<sub>2</sub> is released back into the water and further contributes to the ocean and coastal acidification as well as oxygen depletion.<sup>2</sup>

Figure #1: Ocean Acidification Infographic



Source: International Alliance to Combat Ocean Acidification  
<https://www.oaalliance.org/2020/08/21/what-is-ocean-acidification/>

### Impacts of ocean acidification in our region

OA has cascading consequences for many calcifying organisms like shellfish and can impact the marine food web which in turn, impacts the maritime economy, recreation, cultural practices, and livelihoods of those dependent on coastal marine resources. OA causes undersaturation of calcium carbonate minerals which are the building blocks for the skeletons and shells of many marine organisms, resulting in adverse impacts on calcifying species including shellfish, crustaceans, and some plankton, which are important food sources for salmonids.<sup>7</sup> Changes in ocean chemistry—alongside ocean warming and reduced oxygen levels -- can influence the habitat and lifecycles of many types of organisms, including finfish, invertebrates, and algae. Under conditions of severe acidification, shells and skeletons can dissolve. Another impact of acidic waters is the reduced ability of some fish species to detect predators

<sup>2</sup> Environmental Protection Agency. (2019, August 23). Understanding the science of ocean and coastal acidification. Retrieved March 12, 2021, from <https://www.epa.gov/ocean-acidification/understanding-science-ocean-and-coastal-acidification>

and find habitat. Young Coho salmon exposed to elevated CO<sub>2</sub> disrupted the fishes' ability to smell danger.<sup>3</sup>

The maritime industry is culturally and economically significant to the Puget Sound region. For example, the commercial fishing fleets based in Seattle sell seafood globally and contribute to the economies of the Pacific Northwest (PNW) and Alaska. This industry supports more than 11,000 jobs representing more than half a billion dollars in payroll. The region is also home to a robust shellfish industry that contributed over \$100 million to the economy in 2017, with over half of that value generated from shellfish in the South Puget Sound. Tribes have harvested shellfish for generations from Puget Sound and coastal areas, and the recreational harvest of clams and oysters has become an important tradition for many families. OA has already begun to impact these fisheries, resulting in lost income for businesses and individuals in the shellfish industry. For example, between 2006 and 2008 PNW oyster growers lost more than 80 percent of their larvae and many nearly declared bankruptcy.<sup>4</sup> As of 2015, seed mortality in commercial nurseries became more widespread each season since 2008, and adaptation strategies employed by the shellfish industry are largely seen as temporary solutions to a growing problem.<sup>5</sup>

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<sup>3</sup> Burns, J. (2018, December 24). Study: Northwest salmon not immune to ocean acidification. Retrieved March 12, 2021, from <https://www.opb.org/news/article/study-northwest-salmon-ocean-acidification-disrupt-odor-predator/>

<sup>4</sup> Ocean Conservancy. (2020, November 09). Confronting Ocean Acidification. Retrieved March 12, 2021, from <https://oceanconservancy.org/ocean-acidification/>

<sup>5</sup> Barton, A., G.G. Waldbusser, R.A. Feely, S.B. Weisberg, J.A. Newton, B. Hales, S. Cudd, B. Eudeline, C.J. Langdon, I. Jefferds, T. King, A. Suhrbier, and K. McLaughlin. 2015. Impacts of coastal acidification on the Pacific Northwest shellfish industry and adaptation strategies implemented in response. *Oceanography* 28(2):146–159, <http://dx.doi.org/10.5670/oceanog.2015.38>.



## Ocean Acidification and the Port of Seattle's Century Agenda

Goals and objectives in the Century Agenda align with addressing both causes and impacts of OA, prompting the Port to join the OA Alliance on June 9, 2020 — the first port in the world to do so. Adopted in 2012 marking the 100th anniversary of the Port, the [Century Agenda](#) provides direction for the Port's initiatives under six broad goals for the organization.

The Century Agenda goals, especially three and four, align with Port initiatives to combat OA. Goal three encourages responsible investment, specifically through innovation, strategic investment, and capable management of Port facilities. Investment in OA mitigation and adaptation are critical to protecting the important marine resources, such as fisheries, that are part of the Port's and the region's maritime economy and history. Goal four promotes the pursuit of renewable energy sources and reduction of air pollution and carbon emissions with the aim of being carbon neutral or carbon negative by 2050.

**Because carbon dioxide emissions are the number one driver of OA, the achievement of the Port's GHG reduction goals will help mitigate OA and subsequent impacts.**

As the first port to participate in the OA Alliance, the Port hopes to encourage other Ports to recognize the far-reaching effects of OA and serve as a model for OA action in the maritime industry.

### Century Agenda Goals

**Goal 1:** Position the Puget Sound region as a premier international logistics hub

**Goal 2:** Advance this region as a leading tourism destination and business getaway

**Goal 3:** Responsibly invest in the economic growth of the region and all its communities

**Goal 4:** Be the greenest and most energy efficient port in North America

**Goal 5:** Become a model for equity, diversity and inclusion

**Goal 6:** Be a highly effective public agency

## Regional Action on Ocean Acidification

Washington State is a leader in climate and ocean action. Observed impacts of OA on oyster hatchery production in the early 2000s led to the creation of the Blue-Ribbon Panel<sup>6</sup> on OA and the subsequent OA Action Plan<sup>7</sup>. This leadership is further demonstrated by the strong representation of Washington-based government and affiliate members within the OA Alliance. Washington-based government members of the OA Alliance include the state of Washington, City of Seattle, Makah Tribe, Nisqually Indian Tribe, Quileute Tribe, Quinault Indian Nation, and the Suquamish Tribe. Washington-based affiliate members include Puget Sound Restoration Fund, Seattle 2030 District, Seattle Aquarium, Northwest Indian Fisheries Commission, Northwest Straits Commission, Pacific Coast Shellfish Growers Association, Taylor Shellfish Farms, Washington Ocean Acidification Center, and the Marine Conservation Institute (headquartered in Seattle).

Within the [Washington State OA Action Plan](#), strategies and actions to address OA are divided into six categories: 1) reduce emissions of carbon dioxide; 2) reduce local land-based contributions to ocean acidification; 3) increase our ability to adapt and remediate the impacts of ocean acidification; 4) invest in Washington's ability to monitor and investigate the effects of ocean acidification; 5) inform, educate, and engage stakeholders, the public, and decision-makers in addressing ocean acidification; and 6) maintain a sustainable and coordinated focus on ocean acidification. Actions within the Washington State plan that are aligned with Port activities include:

- **Action 4.1.1** Work with international, national, and regional partners to advocate for a comprehensive strategy to reduce carbon dioxide emissions
- **Action 4.1.4** Enlist key leaders and policymakers to act as ambassadors advocating for carbon dioxide emissions reductions and protection of Washington's marine resources from acidification
- **Action 4.2.1** Identify and share key findings from reducing emissions of carbon dioxide with ocean acidification communicators to support outreach and communication efforts designed to raise public awareness of ocean acidification
- **Action 5.1.2** Support and reinforce current planning efforts and programs that addresses the impacts of nutrients, sediment loading, and organic carbon
- **Action 5.3.1** Identify and share key findings from local land-based contributions actions with ocean acidification communicators to support outreach and communication efforts designed to raise public awareness of ocean acidification
- **Action 6.1.3** Study the use of shells in targeted marine areas to remediate impacts of local acidification on shellfish
- **Action 6.1.4** Identify and support research and implementation of activities to increase the marine ecosystem's ability to preserve carbon stored in sediments and capture and store additional carbon from atmospheric sources

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<sup>6</sup> <https://ecology.wa.gov/About-us/Our-role-in-the-community/Partnerships-committees/Ocean-acidification-Blue-Ribbon-panel>

- **Action 6.3.1** Preserve Washington’s existing native seagrass and kelp populations and, where possible, restore these populations
- **Action 6.4.1** Identify and share a summary of key findings from adaptation and remediation actions with ocean acidification communicators to support outreach and communications efforts designed to raise public awareness of ocean acidification
- **Action 8.1.1** Identify key findings for use by the governor, Panel members, and others who will act as ambassadors on ocean acidification
- **Action 8.1.4** Provide a forum for agricultural, forestry, business, and other stakeholders to engage with coastal resource users and managers in developing and implementing solutions
- **Action 8.1.6** Develop and periodically update an ocean acidification outreach and communications strategy and an annual list of key messages and key findings
- **Action 9.1.3** Coordinate Washington’s efforts to address ocean acidification with those of other regional, domestic, and international groups

These actions represent relevant resources and collaboration opportunities for the Port as state agencies continue to address OA in Puget Sound.



## Port Initiatives to advance OA Alliance Goals

Building on Washington’s OA Action Plan, the OA Alliance sets forth the following call to action:

### “Highlight OA as an imminent threat to coastal economies and ocean ecosystems”

1. Reduce atmospheric emissions of CO<sub>2</sub>
2. Advance scientific understanding of climate-ocean impacts, locally and globally
3. Reduce local pollution that exacerbate OA
4. Protect the environment and coastal communities
5. Expand public awareness
6. Sustain international support

The Port has numerous current initiatives across all Port operations that fulfill each of these action goals. As a special purpose local government, most relevant initiatives fall into action goals one through five. However, many of the Port’s local initiatives are helping to achieve international goals. As a port engaged in global commerce, the Port of Seattle is connected with other ports across the world and engages in international conversations through the International Maritime Organization (IMO) and the International Association of Ports and Harbors. The Port also collaborates internationally with Canadian counterparts to reduce air and greenhouse gas emissions in the Georgia Basin-Puget Sound airshed.

This section provides an overview of the cross-cutting initiatives of the Port that combat OA. These projects and programs cross all operating divisions of the Port and include specific initiatives from the Maritime Environment and Sustainability department, Aviation Environmental, and External Relations. Many of these initiatives advance multiple goals of the OA Alliance simultaneously, and collectively they advance all the goals outlined above.

Initiative	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6
Century Agenda	•	•	•	•	•	
Northwest Port Clean Air Strategy	•	•	•	•		•
Maritime Climate and Air Action Plan	•	•	•	•	•	
Seattle Waterfront Clean Energy Strategic Plan	•			•		
Sustainable Aviation Fuels (component of Airport Master Plan)	•		•			
SEA Emissions Reduction Initiatives	•		•		•	
Habitat Restoration Program Initiatives		•	•	•	•	
Smith Cove Blue Carbon Pilot Project		•	•	•	•	
Duwamish River Floating Wetlands Projects		•			•	
Stormwater Initiatives		•	•	•	•	
Exhaust Gas Cleaning Discharge Ban			•	•		
Alternative Bankline Stabilization Program			•	•		
Duwamish Valley Community Benefits Commitment				•	•	
Duwamish River Green Jobs Program				•	•	

## Reduce Atmospheric Emissions of CO<sub>2</sub>

Carbon dioxide (CO<sub>2</sub>) emissions alter the chemistry of seawater causing a long-term increase in ocean acidity; as such, the OA Alliance prioritizes actions that reduce CO<sub>2</sub> emissions, citing them as the most important to mitigate ocean acidification.<sup>8</sup> Across both Maritime and Aviation Divisions, the Port has ambitious initiatives in place to reduce greenhouse gas emissions which are driven by the Port's Century Agenda.

### Port of Seattle Emission Reduction Targets

The Port's Century Agenda sets emission reduction targets based on scope. The concept of emissions scopes was introduced in [The Greenhouse Gas Protocol](#), a set of comprehensive global standardized frameworks to measure and manage greenhouse gas (GHG) emissions, created in partnership with the World Resource Institute and the World Business Council for Sustainable Development.<sup>9</sup> The Protocol defines three different scopes of GHG emissions:

- *Scope 1:* Direct GHG emissions that come from sources owned or controlled by the organization
- *Scope 2:* Indirect GHG emissions from the generation of purchased electricity, steam, and district heating/cooling consumed by the organization
- *Scope 3:* All other indirect GHG emissions. Emissions that are a consequence of activities of the organization but come from sources not owned or controlled by the organization

The following are the Port's Century Agenda emissions reduction targets:

Scopes 1 and 2	Scope 3
<ul style="list-style-type: none"><li>• 15 percent below 2005 levels by 2020</li><li>• 50 percent below 2005 levels by 2030</li><li>• Carbon neutral by 2050 or carbon negative by 2050</li></ul>	<ul style="list-style-type: none"><li>• 50 percent below 2007 levels by 2030</li><li>• 80 percent below 2007 levels by 2050</li></ul>

These targets are Port-wide, meaning they include both airport and seaport operations.

### Emissions Tracking

To help ensure we are meeting emissions reduction goals and targets, the Port conducts two separate GHG emissions inventories, one for GHG emissions associated with the Seattle-Tacoma International Airport (SEA) and a Maritime GHG emissions inventory. Both inventories follow the [GHG Protocol Corporate Accounting and Reporting Standard](#) and are conducted annually. The SEA GHG Emissions

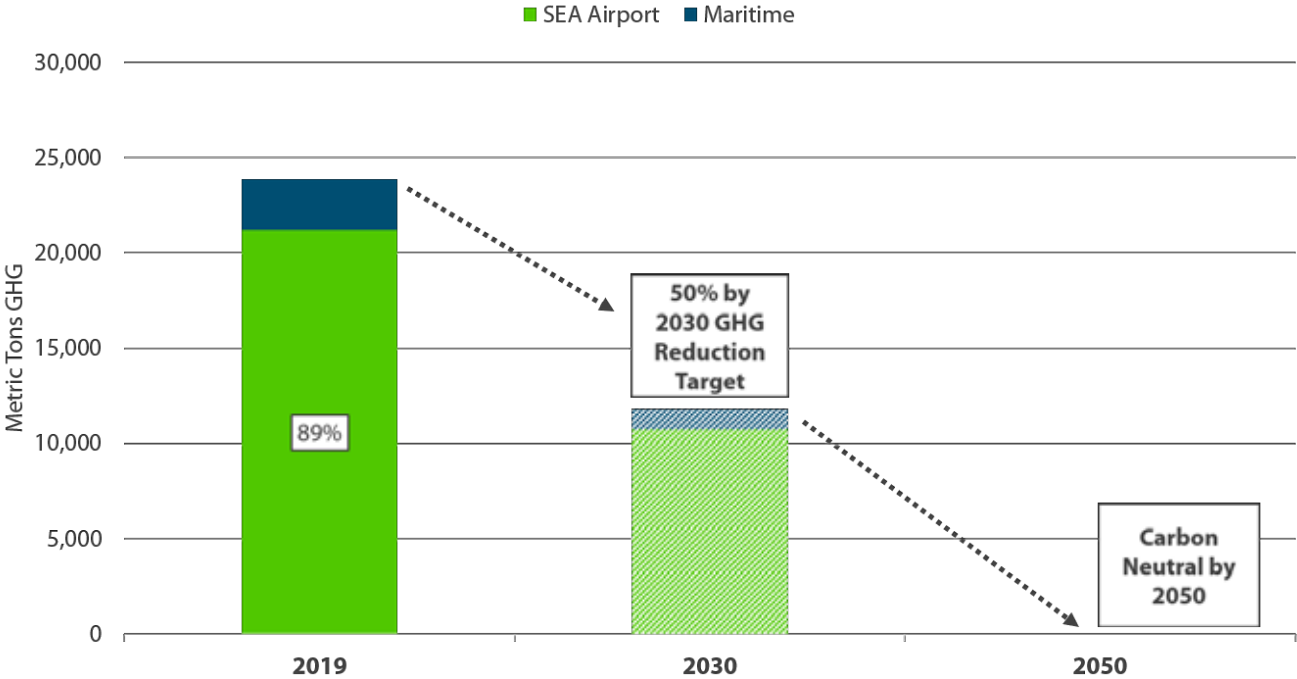
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<sup>8</sup> International Alliance to Combat Ocean Acidification (n.d.) About us. Retrieved March 12, 2021, from <https://www.oaalliance.org/>

<sup>9</sup> Greenhouse Gas Protocol (n.d.) About us. Retrieved March 12, 2021, from <https://ghgprotocol.org/about-us>

Inventory is verified by the Airport Carbon Accreditation Program. The Port is also part of a regional inventory to measure and track maritime-related air pollutants and GHG emissions. The Puget Sound Maritime Air Emissions Inventory is conducted every five years by the [Puget Sound Maritime Air Forum](#), a voluntary association of private and public maritime organizations, ports, air agencies, environmental and public health advocacy groups, and other parties with operational or regulatory responsibilities related to the maritime industry.

Figure #2: 2019 Port-Wide Scope 1 and 2 GHG Emission Reduction Targets by Operation





The [Northwest Ports Clean Air Strategy](#) (the Strategy), is a longstanding collaborative effort between the Port of Seattle, Port of Tacoma, Northwest Seaport Alliance (joined in 2015), and Vancouver Fraser Port Authority in British Columbia, to reduce maritime air emissions. The Strategy sets emissions reduction targets that exceed goals set in the Century Agenda. **This increase in ambition reflects both the Port's commitment to GHG emission reductions, as well as the update to the Paris Climate Agreement and most recent science calling to limit global temperature rise to 1.5°C.** The strategy covers six sectors of port activity: oceangoing vessels, cargo handling equipment, trucks, harbor vessels, rail, and port administration. The Northwest Ports have worked in collaboration with several agencies since 2008 to implement the Strategy, including the U.S. Environmental Protection Agency, Washington State Department of Ecology, Puget Sound Clean Air Agency, Environment Canada, British Columbia Ministry of Environment and Climate Change Strategy, and Metro Vancouver, and have achieved significant results. The 2013 Strategy set targets to reduce the emissions intensity (greenhouse gas emissions per ton of cargo) of diesel particulate matter (DPM) and greenhouse gas (GHG) emissions by 80 percent and 15 percent, respectively, relative to 2005 emissions intensity levels. The Northwest Ports achieved both targets four years early according to the 2016 Puget Sound Maritime Emissions Inventory. The 2020 Strategy puts forward an ambitious new vision for the Ports to phase out seaport-related air and GHG emissions and move toward zero-emission operations in each sector by midcentury.



In order to implement this vision and the objectives set forth by the Strategy, the Port of Seattle has developed its own implementation plan for climate and air action in maritime operations called Charting the Course to Zero: Port of Seattle's Maritime Climate and Air Action Plan (MCAAP). This plan describes the strategies and actions that the Port will take to reduce GHG emissions to 50 percent of baseline levels by 2030 and maintain a course to meet the Northwest Ports Clean Air Strategy vision to phase out emissions by 2050. The MCAAP 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 emissions 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 MCAAP encompasses the future carbon sequestration potential of the Port's shoreline and habitat restoration programs.

Examples of near-term emission reduction actions described in the MCAAP are the Seattle Waterfront Clean Energy Strategic Plan, installing shore power for cruise ships, and exploring renewable energy through solar pilot projects:

- **The Seattle Waterfront Clean Energy Strategic Plan** is a collaborative effort with Seattle City Light, Northwest Seaport Alliance, and industry to develop a roadmap to zero-emission maritime operations. This means planning for new technologies, fuels, infrastructure, and jobs for Seattle's working waterfront.



- Port of Seattle is the largest cruise port on the West Coast, with 1.2 million passengers and over 200 cruise ship calls in a given season. **Providing shore power connections to cruise vessels** allows ships to turn off diesel engines while at berth, which reduces greenhouse gas emissions that contribute to climate change and OA. Each cruise ship that plugs into Seattle’s clean electricity can save an average of 34 tons of carbon emissions each visit. That’s equivalent to driving a car from Seattle to New York City over 30 times.<sup>10</sup> The Port of Seattle was the first cruise port in the world to offer shore power at two cruise berths at Terminal 91 and plans to install a new shore power connection at a third cruise terminal by 2023.
- Finally, the Port has implemented **four solar arrays** on maritime properties, producing a total of 271,746 kWh (as of March 2021) since the first array at Fishermen’s Terminal came online at the end of 2017. Solar arrays offer increased energy resilience and opportunities to couple solar production with energy storage to offset peak loads.

#### Sustainable Airport Master Plan: GHG Emissions Reduction Initiatives



At Seattle-Tacoma International Airport (SEA), there are several initiatives to reduce GHG emissions and advance sustainability. The Sustainable Airport Master Plan (SAMP) is the blueprint for changes at SEA to meet future demand in alignment with the Port’s sustainability and energy efficiency goals. The SAMP considered forecasted passenger and cargo demand, as well as taking stock of current facilities,

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<sup>10</sup> Environmental Protection Agency (2021, March) Greenhouse Gas Equivalencies Calculator. Retrieved April 9, 2021, from <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

infrastructure, and operations. SAMP assessed existing conditions and identified needs for additional buildings and infrastructure for the future. SAMP considered where to build, how to build, and operational needs in the context of current and future needs and GHG reduction goals. SAMP is currently undergoing review through the State Environmental Policy Act and the National Environmental Policy Act, specifically for the Near-Term Projects. The Long-Term Vision, those projects identified beyond 2027, require additional planning and environmental review. These project and planning efforts will look for opportunities to minimize GHG emissions and evaluate potential impacts through additional planning and the appropriate environmental review.

#### Current SEA Emissions Reductions Strategies



One part of SAMP is that SEA collaborates with tenant airlines, service providers, and the community to reduce emissions. SEA employs four major initiatives to reduce scope 1, 2, and 3 emissions: renewable natural gas, electric ground support equipment, options for greener transportation, and pre-conditioned air and ground power for aircraft. **SEA is the first airport in the country to purchase thermal renewable natural gas (RNG), which is a low-carbon natural gas alternative that can be produced from a variety of sources including landfills, dairy farms, and wastewater treatment plants.** RNG is used to heat the airport and power the Port's bus fleet. RNG produces no new carbon emissions because it replaces fossil fuels and adds no new carbon to the atmosphere. Signed in April 2020, the RNG purchase agreement will enable the Port to reduce its scope 1 and 2 emissions by 50 percent in 2021, a full nine years ahead of the 2030 carbon reduction goal.

For the electric ground support equipment (EVSE) initiative, SEA has installed nearly 300 electric ground support equipment charging locations throughout the passenger terminal ramps and intends to install

charging equipment at the remaining ramp locations by 2021. EVSE charging stations allow airlines to use electrically powered ground support equipment rather than petroleum-fueled equipment. SEA has installed pre-conditioned air and ground power at each gate to reduce energy costs for airlines, improve air quality, and increase energy efficiency throughout the airport

In order to promote greener transportation options, SEA has partnered with several ground transportation (GT) providers to require greener choices like high fuel efficiency taxis and rideshare options including Lyft and Uber. These rideshare services must meet similar environmental standards such as the requirement that all taxi fleet vehicles serving SEA must have gas mileage of at least 45 miles per gallon. Taxi vehicles can achieve the same environmental benefits through other options like ride pooling and fleet-wide averages. Additionally, airport shuttles and door-to-door van services use alternative fuels and high mileage vans in their fleets. The Port also adopted new, even more aggressive [GT goals](#) in 2019 to: reduce carbon emissions from passengers driving to and from SEA, decrease congestion on the airport roadways, and reduce the use of single-occupancy vehicles at SEA's curbside. SEA is developing new strategies to meet these goals including increasing transit services, promoting EVs in our TNC services, and designing new bike lanes and sidewalks throughout the SEA campus.

Lastly, in 2019, the Port began implementing the [Sustainable Project Framework](#) initiative to ensure that capital development projects identify opportunities to reduce carbon emissions. The Framework requires large capital projects to analyze their potential carbon emissions and design options to reduce those emissions, including embodied carbon from producing construction materials such as concrete, asphalt, and steel.

#### Sustainable Aviation Fuel



Sustainable aviation fuel (SAF) reduces CO<sub>2</sub> emissions by 50-80 percent compared to fossil fuel.

**In addition to current initiatives in place at SEA, one forward-looking initiative includes setting a goal to power every flight fueled at SEA with at least a 10 percent blend of SAF by 2028. The Port is investing in infrastructure, building partnerships, financing research, and advocating for policies that reduce barriers and help create incentives for SAF at the local, state, and federal level. In terms of**

infrastructure, the Port partnered with Alaska and Boeing in 2016 to investigate the best locations to store and blend SAF into the airport's fueling systems. The report identified some key locations on and off the airport's property and determined that the Port may have access to land to support locations for blending or production facilities. Additionally, the Port hosted the first Washington State SAF Summit in March of 2019, convening advocates, producers, business leaders, and elected officials to raise awareness and identify opportunities for collaboration. In February of 2020, the Port published a report in partnership with Washington State University (WSU) that evaluated the availability of regional feedstocks to meet the Port's SAF goal. The report found that there are enough waste sources and several technology options to convert sources into sustainable jet fuel. Finally, the Port is in a unique position to help create incentives for SAF through advocacy, through avenues such as advocating for a state-wide clean fuel standard. The Port is a leader in SAF, with the Port Commission setting the most aggressive goals of any airport for the implementation of SAF. SAF reduces CO<sub>2</sub> emissions by 50-80 percent compared to fossil fuel.

#### Connection to OA

As stated above, CO<sub>2</sub> emissions are the primary driver of changes in ocean acidity; implementing emissions reductions strategies essential to mitigate OA. The ocean absorbs about one-quarter of the CO<sub>2</sub> that is emitted into the atmosphere each year, contributing to the changing chemistry of seawater and leading to OA.<sup>11</sup> One impact of OA is that it causes undersaturation of calcium carbonate minerals which are the building blocks for the skeletons and shells of many marine organisms, resulting in adverse impacts on calcifying species including shellfish, crustaceans, and plankton, which are important food sources for salmonids.<sup>7</sup> As stated earlier in the report salmon and shellfish hold both cultural and economic significance in Puget Sound Region. The steps that the Port is taking to reduce GHG emissions will impact the course of OA and the Puget Sound ecosystem.

#### Partnerships

**Northwest Ports Clean Air Strategy:** Northwest Seaport Alliance, Port of Tacoma, Vancouver Fraser Port Authority, Puget Sound Clean Air Agency, the U.S. EPA, Environment Canada, Washington State Department of Ecology, industry and community partners

**Seattle Waterfront Clean Energy Strategic Plan:** Seattle City Light, Northwest Seaport Alliance, maritime industry representatives

**SAMP:** Federal Aviation Administration

**SEA Emissions Reductions Initiatives:** Tenant airlines, service providers, community partners

**Sustainable Aviation Fuel:** Washington State University, industry leaders, state policymakers

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<sup>11</sup> Pacific Marine Environmental Laboratory (n.d.) Ocean Acidification: The Other Carbon Dioxide Problem. Retrieved March 12, 2021, from <https://www.pmel.noaa.gov/co2/story/Ocean+Acidification>

## Advance Scientific Understanding

The Port of Seattle is involved in multiple pilot studies to advance scientific understanding of the impact of local interventions and remediations related to OA. The Port is exploring and evaluating several nature-based solutions, including designs for floating wetland modules in the Duwamish River and researching kelp, eelgrass, and oyster enhancement techniques at Smith Cove, near Terminal 91, north of downtown Seattle.

### Duwamish River Floating Wetlands Projects

Figure #3: Photo of GFL's First Edition Biobarge



The Port of Seattle is piloting the installation of floating wetlands or biobarges to evaluate their potential for providing critical aquatic and shoreline natural resource benefits in confined locations where existing urban/industrial/commercial infrastructure impedes the use of active, physical landscape restoration and rehabilitation techniques. These self-contained, modular wetland surrogates are of interest as a potential tool for habitat improvement in heavily industrialized areas like the Lower Duwamish River where opportunities for restoration are limited.

*Floating Wetlands Pilot Study with the University of Washington*

**In collaboration with the University of Washington's [Green Futures Research & Design Lab \(GFL\)](#) and King County, the Port has provided funds and logistical support to research methods to restore emergent wetland habitat function to urbanized shorelines, to improve water quality, and to provide other ecosystem services by integrating science, prototype development, and stakeholder participation.** This partnership explored methods to improve aquatic area conditions in constrained

environments, testing the use of floating platforms planted with emergent and wetland vegetation. GFL designed and fabricated four biobarges, consisting of rigid rectangular wood frames supported by tubular buoyancy cells, for moorage and monitoring in two estuarine locations in spring/summer 2019 at Terminal 105 and Terminal 108 in the Duwamish Waterway (approximately river mile 0.6 to 0.9). Each of the four bio-barge floats was fitted with four wetland plant module “baskets.” Following growth and onsite monitoring, the module baskets were removed from the float frames for detailed analysis at the University of Washington. For the 2020 season, replacement wetland plant modules were installed in the float frames and the biobarges were re-deployed, moored upstream at two locations in the Duwamish River, approximately river mile 3.3 and 6.7, to avoid disruptive vessel wakes in the waterway and to test wetland plant response to more variable marine freshwater conditions. The 2020 modules have been removed for analysis, while the reusable float frames are moored at Terminal 102, available for future module testing, including potential marine aquatic area locations.

#### *Ongoing Floating Wetlands Pilot Installations*

As a result of collaboration with GFL, the Port has fabricated and deployed two alternative design floating wetlands consisting of logs salvaged from the Corps of Engineers’ “Navigation Hazard Removal” program. In January 2020, two log-float platforms were assembled, planted with wetland vegetation, and moored at the south margin of the port’s Fishermen’s Terminal facility. Fishermen’s Terminal, located in the Lake Washington Ship Canal, was selected as the log raft floating wetland test site since: (1) the ship canal environment is entirely committed to commercial and industrial uses and activities; (2) the ship canal area provides little or no potential for altering/converting operating development sites for use in aquatic habitat restoration; and (3) the ship canal supports little or no emergent vegetation between the navigation locks and the Fremont Bridge, approximately 3.6 miles. Log raft wetland vegetation was monitored throughout the 2020 growing season. In contrast to floating wetlands tested in estuarine, Duwamish Waterway locations, the Fishermen’s Terminal log floats remained in place throughout 2020 and plant growth will be evaluated in 2021, as the vegetation emerges from dormant conditions. In 2021, two additional log raft design prototypes have been deployed at Salmon Bay Marina and Terminal 91.

#### Smith Cove Blue Carbon Pilot Project

Figure #4: Photo of Oyster Bags Ready for Deployment at Smith Cove



The Smith Cove Blue Carbon Pilot Project is located on Port-and City-owned aquatic lands near Terminal 91. **The goal of the project is to evaluate the potential benefits of marine habitat enhancement of kelp, eelgrass, and oysters on carbon sequestration, water quality (amelioration of seawater acidification), and habitat productivity.** The Port of Seattle, along with partners at the Washington State Department of Natural Resources (DNR) and the Department of Ecology (Ecology) are monitoring the site over three years for potential benefits in and around the site and includes a community-based science initiative. Kelp spores and young kelp stipes were placed at Smith Cove in June 2020 while the eelgrass was transplanted in 2018. Kelp enhancement in 2020 included placement of approximately 300 tons of cobble substrate amendment and five temporary concrete pyramids to act as seed anchors for the new kelp. The placement of additional oysters was scheduled for spring 2020, however, due to COVID-related delays, the oyster placement occurred in April 2021.

Oysters are master filter feeders that can pull heavy metals like zinc and copper out of the water which can harm fish and other aquatic species. One live oyster can filter up to 50 gallons of water per day. When the Smith Cove Blue Carbon Pilot Project is finished, the oyster bed could support more than one million oysters in the future, filtering 50 million gallons of water in Elliott Bay every day.

#### Connection to OA

Both the Smith Cove Blue Carbon Pilot Project and the Duwamish River Floating Wetlands Project expand knowledge regarding carbon sequestration potential, offering one potential pathway for mitigation of effects of OA. The presence of marine plants can alter water pH, buffering acidification and providing habitat for species sensitive to pH changes. Benefits for these projects also include reduction of aquatic pollutants and water temperature; increased oxygen and food chain reconnections; habitat improvement; and shoreline beautification and protection.

#### Partnerships

**Floating Wetlands Pilot Study:** University of Washington Green Futures Research & Design Lab, King County

**Smith Cove Blue Carbon Pilot Project:** Puget Sound Restoration Fund, Washington State Department of Natural Resources, Washington State Department of Ecology.

## Reduce Pollution that Exacerbates OA

Initiatives in this section aim to reduce local pollution that can exacerbate OA and compound stressors in the waters of Puget Sound. These initiatives include the work of the Maritime Stormwater Utility, implementation of Green Stormwater Infrastructure, Salmon-Safe Certification, Dock Scrubber Programs, and cruise ship Exhaust Gas Cleaning System Discharge Ban.

### Marine Stormwater Utility

Stormwater management is an important OA issue because excess nutrients delivered to the ocean through runoff contribute to OA. The Port created the [Marine Stormwater Utility \(SWU\)](#) in 2014 to advance its environmental goals and better support Port properties in complying with stormwater permit conditions. The Port SWU manages its own stormwater infrastructure and holds a Phase I municipal stormwater permit for Port-owned properties within the City of Seattle and King County. SWU provides services, facilities, systems, and programs for surface water and stormwater management and pollution control. Drainage fees collected through the SWU support innovative stormwater treatment and best management practices that go beyond permit requirements (see 'Green Stormwater Infrastructure,' below). By 2019, the SWU completed an assessment of all 70 miles of Port stormwater infrastructure to collect asset condition data, and by 2035, plan to rehabilitate 75 percent of the stormwater system.

### Aviation Stormwater Management

SEA Airport is responsible for 1,600 acres of drainage area that flow into four local streams and the Puget Sound. The airport stormwater management systems have been retrofitted to meet stringent environmental standards. The airport has implemented numerous best management practices (BMPs) to remove pollutants and reduce flooding. Many source control measures such as prohibiting the use of urea as surface deicer have significantly reduced nutrient loading. Through these improvements and practices, runoff containing high concentrations of deicing fluids is captured and treated before discharge to Puget Sound. Metals and other pollutants have been reduced to safe levels before entering local streams and Puget Sound.

SEA is pursuing opportunities for rainwater harvesting. STIA recently completed a feasibility assessment for rainwater capture and reuse included in the Utility Master Plan for the Airport in 2019. A rainwater harvesting system is included in the North Satellite Terminal Modernization Project. Rainwater collected will be used for flushing toilets in restrooms and is projected to save almost 750,000 gallons of water annually. The expansion and renovation of the nearly half-century-old facility are expected to be complete in 2021.

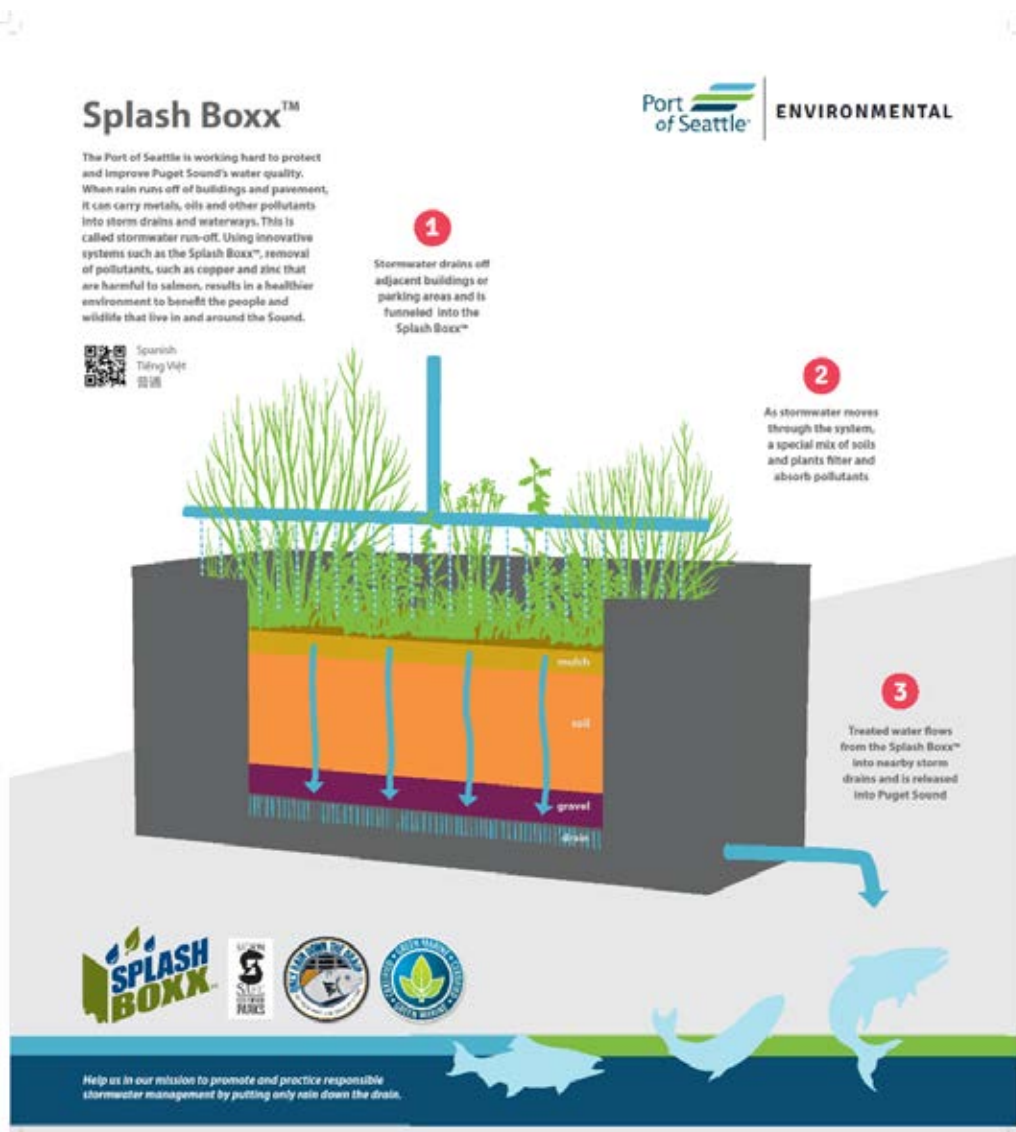
### Maritime Green Stormwater Infrastructure

Investment in green stormwater infrastructure (GSI) has been one SWU innovation that exceeds stormwater permit requirements. In 2014, the Port installed Splash Boxx Systems as part of a two-year pilot program called *Moving Green Infrastructure Forward*. The boxes were moved to new locations in 2019 to continue treating runoff from a roof at Maritime Industrial Center and parking lot at Marine Maintenance Horton Street facility. These bio-infiltration units reduce zinc, copper, and turbidity concentrations in runoff that eventually discharges to Puget Sound. The Port's Splash Boxx systems use a mix of sand, wood chips, and either activated carbon, biochar, or oyster shells as treatment media. Mulch and soil are used in the top layer to support plants that contribute to aesthetic value. Stormwater runoff is filtered through the system, and initial results reflect 60 to 70 percent reductions in copper and



85 to 90 percent reductions in zinc. Average reductions in turbidity for longer-established systems were 70 percent. The Splash Boxx Systems continue to be used as of January 2021.

Figure #5: Splash Boxx Photos & Infographic



Another SWU innovation is downspout barrels containing oyster shells to filter heavy metals (copper and zinc) and turbidity from stormwater discharge. Marine Maintenance began using oyster shells to treat stormwater in catch basins at a maintenance yard in 2011, based upon research conducted by SEA, and the project has since expanded. Oyster shell barrels are connected to roof downspouts at several Port locations and have reduced zinc and copper, which are known to harm salmon, orca, and other marine life. For the current application, the oyster shells are typically effective for approximately one year, at which time they are replaced. The Port is piloting methods for refreshing used oyster shells for re-use in the barrels. Pollutants are significantly reduced by this treatment, with an average reduction of 30 to 50 percent for metals and 50 percent for turbidity.

Figure #6: Photo of Oyster Barrel.



SWU has also installed a bio-infiltration retention facility (i.e., rain garden) along the Centennial Park trail near Terminal 86. The rain garden complies with the City of Seattle's low-impact development standards and treats 50 percent of the stormwater flow for a two-year storm. The rain garden treats a basin area of about half an acre and is approximately 556-square-feet with two feet of rain garden soil mix placed on native soil, allowing for a one-foot ponding depth planted with native species.

#### Salmon-Safe Certification

SWU has continued and expanded the Port's involvement with the [Salmon-Safe Certification](#) program. As of 2021, both the Port Maritime and Aviation Divisions participate in Salmon-Safe Certification.

Port Maritime parks and public access areas were first certified by Salmon-Safe in 2008. Salmon-Safe certification provides high-value insight and independent verification for environmental practices protecting water quality and habitat and is a priority for the Port because it supports our goal of exceeding regulatory requirements. Initiatives stemming from SWU's involvement in Salmon-Safe include implementing Integrated Pest Management (IPM) techniques to reduce pesticide use, fertilizer management plan, water conservation plan, and assessment and installation of opportunities for innovative stormwater treatment and shoreline habitat restoration projects.

At SEA, the Salmon-Safe Certification has prompted or improved the following initiatives: supporting LID strategies to reduce stormwater runoff, potable water conservation, rainwater capture, and reuse, water recycling, installing high-efficiency fixtures, and habitat and protection projects. Seattle-Tacoma International Airport received Salmon-Safe Certification (Industrial Standards) in 2016.

SEA developed a Low Impact Development (LID) Guideline using FAA-acceptable LID BMPs that meet or exceed the minimum requirements for stormwater discharging from airport facilities. LID BMPs are evaluated on a project-by-project basis due to FAA restrictions to compaction requirements and wildlife attractants. Approximately 275 acres are treated by LID BMPs on SEA properties.

#### Dock Scrubber Program

The Port's Marine Maintenance department invented a Dock Scrubber method that minimizes discharge to receiving waters. Pressure washing docks can result in the discharge of sediment, dirt, bird feces, and other pollutants directly into receiving waters. The Dock Scrubber is composed of a scrubbing and vacuum system that collects wash water for proper disposal in a decant facility. For a full day of dock washing, approximately 500 to 800 gallons of wash water are collected and prevented from entering the Puget Sound. This has been adopted as a best management practice by the Washington Department of Ecology and is included in the 2019 Stormwater Management Manual for Western Washington.

#### Exhaust Gas Cleaning System Discharge Ban for Cruise Ships



In 2017, the Port and the other [Cruise Memorandum of Understanding](#) (Cruise MOU) signatories — Washington Department of Ecology and Cruise Lines International Association-Northwest and Canada — conducted a review of peer-reviewed and industry-sponsored literature on exhaust gas cleaning system (EGCS) wash water discharges and the associated environmental impacts. The Cruise MOU is a voluntary agreement to prohibit wastewater discharges into Washington State waters from all cruise ships (except discharges treated with advanced wastewater treatment systems), allowing the Department of Ecology to inspect the wastewater treatment systems on each vessel, and requiring cruise lines to sample and monitor wastewater discharges from their ships. All current homeport cruise vessels opt to maintain zero wastewater discharge. In addition to the voluntary MOU, Ecology adopted the Vessel Sewage No Discharge Zone for the Puget Sound and certain adjoining waters in April of 2018. While EGCS discharges are still under consideration by MOU signatories for inclusion in the MOU, the Port of Seattle decided to ban all EGCS wash water discharges from cruise ships at berth at Port of Seattle facilities effective January 1, 2020. This decision was made by the Port out of an abundance of caution and for the protection of Puget Sound’s delicate and unique marine habitats and included in its Terminal Tariff Number 5.

EGCS are systems that remove sulfur from engine exhaust gases before they are emitted out of the ship's smokestack. The North American Emissions Control Area (ECA), which established a sulfur emissions limit of 0.1 percent in 2015 permits the use of EGCS as an approved method for ships to achieve compliance. There are several types of EGCS — open loop, closed loop, and hybrid, which can switch between open and closed loop and zero discharge mode — but all of them use a fine spray of either seawater or freshwater treated with buffering chemicals to remove sulfur oxides and other pollutants before the “scrubbed” exhaust is emitted into the atmosphere. The water that is used to “wash” the exhaust is either discharged into the ocean in an open loop system, recirculated, filtered, and bled off in closed loop systems, or stored onboard when an EGCS is operating in zero discharge mode. For systems operated in an open loop, the wash water pH is adjusted as needed to meet regulatory compliance standards before discharge. Like other vessel discharges, EGCS wash water is regulated and monitored for pollutants. The International Maritime Organization (IMO) Marine Environment Protection Committee adopted [guidelines for EGCS](#) in 2015 through Resolution MEPC.259(68), which sets global limits for the amount of polycyclic aromatic hydrocarbons (PAH), turbidity, a measure of exhaust and other particulates in the wash water and pH. Of greatest importance to ocean acidification are the limits set for the pH of discharged wastewater. The IMO resolution states that wastewater should have a pH of no less than 6.5 at the ship overboard discharge point. According to the EPA, wash water just after mixing with exhaust but before buffering, can have a pH two standard units lower than the surrounding seawater. If not adequately diluted with seawater or caustic soda, wash water discharges may exceed the pH limit set by the IMO. A review of literature and EPA’s records of ship EGCS discharges in North American waters show that some bodies of water have inadequate buffering qualities or EGCS occasionally malfunction and which results in occasional instances of discharges that exceed IMO’s pH limits. Banning EGCS discharges into the Puget Sound by cruise ships at berth is one step the Port is taking to help protect our region’s sensitive marine ecosystems and help prevent further acidification of Washington waters.

#### Connection to OA

Local pollution compromises the ecological integrity of Puget Sound and can exacerbate OA. Specifically, eutrophication, which can cause excess production of algae, occurs when nutrients are deposited into

the ocean through local pollution and can contribute to increased acidification.<sup>12</sup> Through microbial consumption of the excess algae, oxygen levels are lowered; then through microbial respiration carbon dioxide is produced thus compounding the effects of atmospheric carbon on OA.<sup>9</sup> Reducing local pollution through initiatives like implementing green stormwater infrastructure, dock scrubbers, and banning exhaust gas cleaning system discharge prevent compounding stressors in the waters of Puget Sound.

#### Partnerships

**Splash Boxx:** King Conservation District, Sustainable Seattle, Geologica LLC, Rain Dog Designs LLC

**Oyster Barrels:** Environmental Coalition of South Seattle (ECOSS)

**Exhaust Gas Cleaning System Discharge Ban:** Washington State Department of Ecology, Cruise Lines International Association.

#### Protect Environment and Coastal Communities

The initiatives described in this section address OA impacts in several ways. The Port's Maritime PORTfolio Habitat Program protects the environment and coastal communities through adaption and resilience-building strategies which may ameliorate the impacts of coastal acidification. The Habitat Program's work results in the enhanced adaption capacity and species biological resilience in and around where restoration projects take place, helping to buffer the impacts of OA.

The Port is working to protect the environment and coastal communities through a set of interrelated initiatives described in this section. The Port's Maritime PORTFOLIO Habitat Restoration Program builds resilience into ecological systems impacted by OA. Assessments of Port properties such as the PORTfolio Carbon Sequestration Assessment and Maritime Tree Inventory establish a baseline status of the Port's resources which shows the need for Port investment in PORTFOLIO restoration work. The Joint Umbrella Wetland Mitigation and Habitat Conservation Bank expands on funding sources so additional habitat restoration work may be pursued. The Alternative Bankline Stabilization Program is a program that proactively identifies opportunities to replace armored shorelines with green infrastructure to both stabilize bankline areas and enhance shoreline habitat.



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<sup>12</sup> Cai, WJ., Hu, X., Huang, WJ. et al. (2011, October 23). Acidification of subsurface coastal waters enhanced by eutrophication. Retrieved March 12, 2021, from [nature.com/articles/ngeo1297?report=reader](https://www.nature.com/articles/ngeo1297?report=reader)

## Maritime PORTfolio Habitat Restoration Program

Figure #7: Photo of Turning Basin Number Three Restoration Project



While the [Maritime PORTfolio Habitat Restoration Program](#) was officially established in 2016, the Port began habitat restoration projects in the early 1990s. As a significant landowner and lessor in the area, the Port has the direct ability to identify, implement, and sustain habitat restoration and creation projects. The Port also has a legal responsibility in some cases to offset the unavoidable adverse impacts of Port operations.

As integral parts of major infrastructure projects, the Port of Seattle has:

- Restored or enhanced over 105 acres of marine, freshwater, and estuarine habitat at numerous sites in the Green-Duwamish River Watershed, Elliott Bay, and Puget Sound
- Improved light penetration in shallow water areas. These close-to-shore waters are particularly crucial for juvenile salmon, as they allow them to migrate in areas inaccessible to large predators. These young salmon depend on the vegetation in these waters for food and protective cover and these plants need light to grow and thrive. The Port has increased light penetration by replacing solid piers with grated structures, removing overwater structures, and removing or reducing the number of pilings supporting docks
- Removed in-water barriers to migrating juvenile fish including a derelict ferry and sunken marina
- Removed and/or replaced more than 10,000 creosote (petroleum-treated) wooden pilings that contaminated fish habitats with fewer numbers of concrete and steel pilings. New, stronger pilings are installed with greater amounts of spacing, allowing more light to reach these under-pier waters
- Cleaned up contaminated sediments. The Port continues to lead in the cleanup of contaminated sediment in Elliott Bay and the Duwamish Waterway. 2014 dredging in the East Waterway removed more than 100,000 tons of contaminated sediments

- Enhanced two miles of stream habitat

#### *PORTfolio Carbon Sequestration Assessment*

Undertaken in 2018, the PORTfolio Carbon Sequestration Assessment evaluated the carbon sequestration potential of projects identified in the PORTfolio restoration plan. The assessment indicated the projects will have a positive sequestration benefit and contribute to the Century Agenda carbon-neutral goal. The Port of Seattle's 2016 PORTfolio Restoration Plan builds on the 2009 Lower Duwamish River Habitat Restoration Plan and identifies over 90 acres of potential habitat restoration sites in the Lower Duwamish River and Elliot Bay. This assessment found total restoration sites have the potential to sequester 33.74 tons of carbon per year, offsetting the equivalent of roughly 13,953 gallons of gasoline consumed per year.

#### *Multi-Site Wetland Mitigation and Habitat Conservation Bank*

The Port is in the process of establishing a Multi-Site Wetland Mitigation and Habitat Conservation Bank (Bank) within the Green-Duwamish River Watershed to rehabilitate ecological functions and restore priority habitat while facilitating sustainable growth and development throughout the region. As described in the June 2019 Wetland Mitigation and Habitat Conservation Bank Prospectus, the Bank will provide a mechanism to expand the Port's habitat restoration work. The goal of the joint wetland mitigation and conservation Bank is to provide a range of high-quality, long-term habitats that can be used to offset unavoidable impacts to aquatic resources and fish habitat due to development, redevelopment, and repair/maintenance actions in the Lower Green River, Duwamish Estuary, Elliott Bay, and the Nearshore sub-watershed.

#### *Habitat Restoration Site: Spotlight Duwamish River People's Park and Shoreline Habitat (Formerly T-117)*

Figure #8: Photo of Terminal 117 Restoration Project under construction (2020-2021)



The Duwamish River People's Park and Shoreline Habitat (Formerly Terminal 117 or T-117) is the Port's most recent habitat restoration project. With anticipated completion in fall 2021, the T-117 project includes restored fish and wildlife habitat along the Duwamish River in Seattle's South Park

neighborhood. This former industrial site underwent a years-long cleanup and reflects the most significant habitat restoration on the Duwamish River in over 10 years. The T-117 park will include a 185 feet long viewpoint pier, 1000 linear feet of barrier-free shoreline pathways, elevated viewpoints, and a pathway opportunity to enter restored habitat in the north portion of the site, for close-up, “hands-on” observation, and environmental learning. The project creates a combined total of approximately 14 acres and approximately 3150 linear feet of productive shoreline and aquatic areas including rehabilitation of critical estuarine natural resource functions and restoration of priority habitat for Chinook salmon and other imperiled species in the Duwamish River.

#### Maritime Tree Inventory

In 2019, Port of Seattle’s Maritime division inventoried trees spanning 28 facilities and 940 acres. The data is intended for use in evaluating: (1) effective actions for maintaining and improving existing trees and (2) the potential for area-wide tree and tree canopy enhancements, including activities for expansion of the beneficial presence of native trees and associated vegetation as important environmental assets. Trees and tree canopy areas are acknowledged as important environmental assets for storm-water runoff reduction, improved air quality, carbon dioxide absorption/carbon sequestration, and as a habitat for wildlife, often in combination with other vegetation and habitat conditions. These beneficial environmental effects apply to all upland locations, with particularly significant beneficial effects due to tree presence in shoreline areas. Existing port marine industrial, commercial, and public use area shorelines provide substantial benefit, which has the potential for expansion and enhancement.

Of the 940 acres included in the tree survey, 4.3 percent include tree canopy. The City of Seattle has established a goal that industrial lands should include 10 percent tree cover by 2037. Accordingly, the Maritime Division will continue to evaluate actions to increase tree canopy on Port property.





Alternative Bankline Stabilization Program

Figure #9: Soft Shore Stabilization Implementation at Terminal 108



Currently, 93 percent of the Port's 15.1 miles of shoreline are hard armored, presenting an opportunity to enhance shorelines with alternative techniques that both stabilize the shoreline and provide environmental benefits. Thus, the Alternative Bankline Stabilization Program establishes a systematic process for the enhancement of environmental functions while maintaining the structural integrity and stability of Port-controlled shorelines. This initiative, now in its early phases, undertakes inspections of the overall conditions of 15.1 miles of marine, estuarine and freshwater shorelines under Port of Seattle stewardship with the goal to increase the use of alternative stabilization features. Alternative bank-line stabilization consists of transforming shorelines that have been historically armored with rip-rap, vertical bulkheads, or other "hard" structures, to living green shorelines that both enhance habitat while also stabilizing the shoreline. The Port hopes to transition armored shorelines which are in poor or failing conditions into greener, carbon-rich habitats. These riparian environments have been found to have a high potential for carbon sequestration and important macroinvertebrate habitat.

The Alternative Bankline Stabilization Program is currently in development with inspections beginning in April 2021. All 15.1 miles of Port-owned shorelines will be inspected through this program with sections inspected on a three-year rotation. Approximately one-third of banklines will be assessed annually, with immediate or one-year deferred re-inspections as necessary based on assessed condition.

#### Connection to OA

The initiatives described in this section address OA impacts in several ways. The Port's Maritime PORTfolio Habitat Program protects the environment and coastal communities through adaption and resilience-building strategies which may ameliorate the impacts of coastal acidification. The Habitat Program's work results in the enhanced adaption capacity and species biological resilience in and around where restoration projects take place, helping to buffer the impacts of OA.

#### Partnerships

**Maritime PORTfolio Habitat Restoration, Multiple Sites:** DIRT Corps, Muckleshoot Tribe (T105), Washington Department of Ecology

#### Expand Public Awareness

Partnership with the community is a major component of the [Port's mission and vision](#). All the initiatives listed in this action plan contain a public-facing component and rely on public awareness and community participation. Although the Port does not currently have any programs that are specifically geared towards educating the public on OA alone, the Port has initiatives that increase public awareness around environmental issues and pathways to green jobs. In addition to these programs, the Port attends and presents at many conferences, generating a broader awareness of the Port's environmental programs. Additionally, the Port has programs to address the disproportionate environmental impacts on near-port communities and many of these impacts are driven by the same pollution sources that drive increased OA in the region.

## Duwamish Valley Community Benefits Commitment



The [Duwamish Valley Community Benefits Commitment](#) is a policy directive adopted in 2019 that guides the implementation of the [Duwamish Valley Community Equity Program](#) and other Port operations that impact the Duwamish Valley Community. This policy and program were created based on the “Cumulative Health Impacts Analysis” co-authored by [Just Health Action](#) and the [Duwamish River Cleanup Coalition/Technical Advisory Group](#) which found that a range of health exposures and impacts disproportionately affect people in the Duwamish Valley. In recognition of the disproportionate environmental impacts that some near-port communities like the Duwamish Valley experience and the lack of equitable access to the Port’s benefits in the region, the Port of Seattle and Duwamish Valley community members launched a pilot project in 2017. This pilot project was started with a [U.S. EPA Environmental Justice Pilot Project technical assistance grant](#) and focused on improving engagement with near-port communities that experience environmental justice issues. Upon completion of the pilot project, the Port passed a motion to build the ongoing Duwamish Valley Community Equity Program. Three shared goals of the program are: community-Port capacity building, healthy environment and communities, and economic prosperity in place. The Duwamish Valley is notably impacted by air pollution and stormwater runoff, two things that also contribute to OA. The Duwamish River is connected to the Puget Sound and provides critical habitat to chinook salmon. Addressing these environmental impacts will provide benefits beyond salmon, supporting human health, safety, rights, and justice. Through the Community Benefits Commitment, the Port is committing to engaging near-port communities around environmental justice, which can lead to ensuring that Port initiatives to combat OA are not just science-minded but also community and justice-minded.

## Duwamish River Green Jobs Program

In 2018, the Port's Maritime Environment and Sustainability team partnered with [DIRT Corps](#) and the [Duwamish River Cleanup Coalition](#) to create a pilot program to train local youth and adults as stewards of the Port's habitat restoration sites. DIRT Corps is a small business that increases access to green jobs and fosters healthy communities by providing on-the-job training for adult workers, specifically encouraging women, people of color, LGBTQIA individuals, and veterans to build careers in the



environmental and sustainability field. In 2020, the Port created a four-year contract to expand the pilot to eight different sites in partnership with DIRT Corps, Duwamish River Cleanup Coalition, ([Duwamish Tribal Services](#), [ECOSS](#)), and a racial equity trainer, SM Watts LLC. The program seeks to empower those that live nearest to the Duwamish River to gain the workforce skills and experience needed to participate in and lead the formation of the inclusive green economy required to restore this critical area of Puget Sound. Habitat restoration projects will also include work for the blue carbon program described in this action plan.

## Community Science Components

The Duwamish River Floating Wetlands Community Science Program conducted outreach through organizations around project sites to engage community members, ensure equity and access to research data. Duwamish wetland platform monitoring was conducted by technical experts, University of Washington students, and community participants and during 2019 and 2020, collecting and recording field data. Additional engagement included hosting field trips and participating in the Duwamish River Festival.

The Smith Cove Blue Carbon Pilot Project monitoring efforts will include community science efforts for monitoring of the State's Acidification Nearshore Monitoring Network (ANEMONE) sensors at Smith Cove. This portion of the project is still in its planning stages and monitoring will begin soon.

## Connection to OA

The Duwamish River is connected to the Puget Sound and is critical habitat for chinook salmon. The Duwamish Valley community is notably impacted by both air pollution and stormwater runoff, so steps that are taken to educate the community on pollution and help address pollution also benefit OA. Through engaging the public around environmental justice and local pollution, the Port ensures the initiatives it is pushing forward around combatting OA are not just science-minded, but also community-minded.

Partnerships

**Duwamish Valley Community Benefits Commitment:** Duwamish Valley community, Just Health Action

**Green Jobs Program:** DIRT Corps LLC, Duwamish River Cleanup Coalition, Duwamish Tribal Services, ECOSS, SM Watts LLC

**Floating Wetlands Pilot Study:** University of Washington Green Futures Research & Design Lab, King County

**Smith Cove Blue Carbon Pilot Project:** Puget Sound Restoration Fund, Washington State Department of Natural Resources, Washington State Department of Ecology



# The Path Forward

## Next Steps and Recommendations

Through joining the OA Alliance, the Port has committed to continually advancing efforts to combat OA as an organization and in partnership with regional and international partners. As demonstrated by the initiatives highlighted in this Action Plan, the Port is committed to addressing OA through a diverse set of actions. Communities, ocean-dwelling organisms, and the economy in the Puget Sound Region rely heavily on a healthy ocean ecosystem. While the Port has been acting on OA for many years, this Action Plan catalogs the range of efforts underway and serves as a baseline assessment for continued action around combatting OA and climate ocean change.

Many of the projects and programs highlighted in this Action Plan operate on a variety of reporting timelines. This includes providing implementation updates and results of pilot studies. Reporting timelines and results of studies can be found on the Port's [website](#).

Along with continued reporting on the progress of these initiatives, the Port is committed to sharing knowledge gained and lessons learned as well as expanding activities into the future. This includes exploring new opportunities that go beyond the initiatives described in this plan. Some possible initiatives that the Port may consider include:

1. **Expanding public awareness of OA:** The Port uses many strategies for keeping the public informed. Possible strategies to expand public awareness include developing a blog and social media content, public webinars, and website content.
2. **Incorporating OA into current, appropriate community engagement efforts:** As demonstrated by the Community Benefits Commitment, Green Jobs Program, and the community science initiatives, there are many opportunities to incorporate OA education into community engagement. One possible example is to build OA education into the Smith Cove Blue Carbon community monitoring volunteer training.
3. **Continuing implementation of existing efforts to combat OA:** Many of the initiatives included in this action plan are strategic planning efforts like the GHG reduction efforts, stormwater mitigation, and habitat restoration. It is important to continue the implementation of these initiatives.
4. **Continue exploring opportunities for additional studies on carbon capture and OA benefits:** Currently, the Port is studying carbon capture through the Smith Cove Blue Carbon Pilot Study. The Port can consider additional opportunities for carbon capture based on the results of the pilot study.
5. **Initiating a kelp restoration limiting factors study** to characterize the conditions under which kelp beds thrive in Elliott Bay to inform potential future kelp restoration efforts.
6. **Incorporation of OA metrics into future habitat restoration monitoring plans**
7. **Pursue opportunities to amplify the work the Port and others are undertaking on OA,** for example with the Seattle Aquarium, state-level kelp initiatives, among others.

The Port will provide updates on the progress of the initiatives outlined in this plan and will revise the action plan to include new initiatives as projects and programs arise.

As a member of the OA Alliance (and as indicated by this action plan) the Port is helping to lead and inform discussions across climate and ocean policies, ensuring that commitments and communications accurately reflect their interdependence. This action plan will support Port, local and regional decision-makers in better understanding climate impacts to marine resources and further implement actions that will increase biodiversity, adaptative capacity, and resiliency now and in decades to come.



# APPENDIX



## Appendix

### Appendix A: Glossary & Acronyms/Abbreviations

**Carbon dioxide (CO<sub>2</sub>):** Carbon dioxide, the primary greenhouse gas that traps heat in the atmosphere. Carbon dioxide enters the atmosphere through the burning of fossil fuels used for energy and transportation, from the burning of solid waste and other organic materials, and certain chemical reactions. CO<sub>2</sub> is one type of greenhouse (GHG) emission.

**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.

**International Alliance to Combat Ocean Acidification (OA Alliance):** An international group that brings together governments and organizations from across the globe dedicated to taking urgent action to protect coastal communities and livelihoods from the threat of ocean acidification and other climate-ocean impacts.

**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.

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

**Ocean Acidification (OA):** An effect of climate change that is caused by increased concentrations of the GHG carbon dioxide (CO<sub>2</sub>) in the atmosphere and results in the reduction of the ocean's pH over time making seawater more acidic and reducing the number of carbonate ions within it.

**The Port:** The Port of Seattle.

**Thermal Renewable Natural Gas (RNG):** A low-carbon natural gas alternative that can be produced from a variety of sources including landfills, dairy farms, and wastewater treatment plants which produces no new carbon emissions because it replaces fossil fuels and adds no new carbon to the atmosphere.

**SEA:** Seattle-Tacoma International Airport

**STIA:** Seattle-Tacoma International Airport

**Sustainable Airport Master Plan (SAMP):** The blueprint for changes at Seattle-Tacoma International Airport (SEA) to meet future demand.



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