Port Houston
2025 Clean Air Strategy Plan (CASP) Progress Report

Prepared for:

PORT HOUSTON℠

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Prepared by:

STARCREST CONSULTING GROUP, LLC

ENVIRONMENTAL MANAGEMENT • AIR QUALITY • CLIMATE • SUSTAINABILITY

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ACRONYMS & ABBREVIATIONS

AIS	automatic identification system
ASCE	American Society of Civil Engineers
BMP(s)	Best Management Practice(s)
BNSF	Burlington Northern Santa Fe
BVCM	Beyond Value Chain Mitigation
CAA	U.S. Clean Air Act
CASP	Clean Air Strategy Plan
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CPP	Clean Ports Program
ECM	electronic control module
ELD	Electronic Logging Device
EPA	U.S. Environmental Protection Agency
ES2G	Environmental, Social, Safety, and Governance
FMCSA	Federal Motor Carrier Safety Administration
GHG	greenhouse gas
GMEI	goods movement emissions inventory
H-GAC	Houston-Galveston Area Council
HGB	Houston-Galveston-Brazoria ozone nonattainment area
HSC	Houston ship channel
IEA	International Energy Agency
ITS	Intelligent Transportation Systems
MOVES	Motor Vehicle Emission Simulator
NAAQS	National Ambient Air Quality Standards
N_2O	nitrous oxide
NO_x	oxides of nitrogen
OCEA	Outstanding Civil Engineering Achievement Award
PM	particulate matter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PTRA	Port Terminal Railroad Association
SAT	Sustainability Action Team
SIPs	State Implementation Plans
SO_2	sulfur dioxide
TCEQ	Texas Commission on Environmental Quality
TEU	twenty-foot equivalent unit
tonnes	metric tons
TXDOT	Texas Department of Transportation
U.S.	United States
UP	Union Pacific
VOCs	volatile organic compounds
WEDA	Western Dredging Association

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Executive Summary

Background

In alignment with Port Houston's Strategic Plan and its air quality improvement objectives, Port Houston (or "the Port") updated its Clean Air Strategy Plan (CASP) in 2021 to guide emission-reduction efforts from 2022 through 2026. The CASP establishes clear goals and strategies for reducing emissions from port-related mobile sources, including cargo handling equipment, ocean-going vessels, harbor craft, locomotives, and heavy-duty vehicles (trucks). This Progress Report provides a detailed account of the successes and challenges encountered as Port Houston implements the plan's 16 tactics across these sectors. As the Port continues to expand its operations, the information presented here should be understood as a snapshot in time. An evaluation of long-term progress toward CASP goals and development of updated or new tactics, will occur in a future CASP update or similar strategic planning effort.

The U.S. Clean Air Act and Pollutants of Concern

Federal air quality standards and community health considerations provide important context for Port Houston's clean air strategy. Within this context, Port Houston has chosen to take a leadership role in reducing port-related emissions and advancing air quality improvements across the region. The eight county Houston-Galveston-Brazoria (HGB) area is designated as "serious nonattainment" for the federal health-based ozone standards defined under the Clean Air Act. Ozone-forming pollutants, including nitrogen oxides (NO_x), must be reduced region-wide to support progress toward attainment of national air quality standards. Port Houston recognizes its pro-active, but limited role within this broader airshed and has voluntarily aligned its planning and investments to support regional air quality goals.

Port Houston has proactively addressed fine particulate matter ($PM_{2.5}$) emissions and continues to prioritize strategies targeting this pollutant. While the HGB area meets the federal $PM_{2.5}$ air quality standard ("in attainment"), emerging research highlights the importance of continued attention to particulate matter due to its respiratory and public health impacts. Port Houston has incorporated these considerations into its long-term planning to ensure operations remain protective of both community health and environmental quality.

Accordingly, the strategies and goals outlined in the 2021 CASP Update reflect Port Houston's deliberate decision to focus on reducing NO_x and $PM_{2.5}$ emissions.

The Goods Movement Emissions Inventory

Progress made toward CASP air quality goals is measured in a periodic Goods Movement Emissions Inventory (GMEI) that assesses emissions from maritime-related goods movement activities associated with Port Houston's public terminals. Released in 2025, the most recent GMEI evaluates mobile source emissions related to Port Houston's marine facilities for calendar year 2023 and compares them to the previous 2019 GMEI. Mobile sources evaluated in the GMEI

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include ocean-going vessels, harbor vessels, cargo handling equipment, on-road heavy-duty trucks, and locomotives. It is important to clarify that Port Houston does not own or operate most mobile source emissions. Instead, these emissions are managed by third parties that use our facilities.

The GMEI does not estimate all mobile source emissions from the Port of Houston, which includes more than 200 public and private facilities and spans the upper half of the 52-mile Houston Ship Channel. It concentrates on emissions from the eight public terminals that are owned, operated, or leased by Port Houston. This targeted approach allows Port Houston to track CASP progress more effectively, as the plan focuses primarily on reducing mobile source emissions associated only with Port Houston's terminals.

For Port Houston stakeholders, it is important to understand mobile source emissions within the broader context of overall activity along the 52-mile Houston Ship Channel. Emissions from mobile sources directly associated with Port Houston operations represent only a small portion of total ship channel emissions. For instance, in 2023, NO_x emissions from ocean-going vessels not associated with Port Houston facilities were more than 1.5 times greater than those from Port Houston facilities.

Progress Toward 2021 CASP Emission Reduction Targets

The 2021 CASP Update established quantifiable emission reduction goals for all mobile sources associated with Port Houston facilities to be met by end of 2026, as described below:

<u>Comparing emissions to 2019 GMEI</u>:

- ⇓ Reduce NO_x emissions by 4%
- ⇓ Reduce $PM_{2.5}$ emissions by 9%

<u>Comparing emissions to 2007 GMEI:</u>

- ⇓ Reduce NO_x emissions by 25%
- ⇓ Reduce $PM_{2.5}$ emissions by 75%

The 2023 GMEI results show that Port Houston has made meaningful progress toward its clean air goals, even though there was record breaking cargo and container activity. Cargo tonnage at Port Houston's facilities increased by 16% and container throughput by 28% between 2019 and 2023; however, NO_x emissions from mobile sources fell by 7%, surpassing the 2021 CASP Update goal of a 4% reduction. $PM_{2.5}$ emissions also improved, decreasing by 4% over the same period.

Because the 2021 CASP Update outlines strategies and emission reduction goals for 2022–2026, the 2023 GMEI results represent significant early progress. Progress made after 2023 and final

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evaluation of whether Port Houston meets its NO_x and $PM_{2.5}$ goals relative to the 2019 GMEI will be determined in future inventories developed after 2026.

Notably, the calculation of the 2007 GMEI could not be updated in the 2023 GMEI using current methods, so it is not possible to accurately compare the two. However, Port Houston has provided a comparison of the original 2007 emissions to the 2023 emissions in Chapter 1 to demonstrate its commitment to transparency and sharing the best available information.

Implementation of CASP Tactics

The 2021 CASP Update used a data-driven approach to find effective ways to reduce NO_x and $PM_{2.5}$ emissions from Port Houston operations, considering economic and operational limits as well as opportunities for industry collaboration. It identified 16 emission-reduction tactics that balance technical, operational, and financial feasibility with Port Houston's economic goals, available funding for incentives, partnerships with industry, and stakeholder input.

To assess progress in implementing the 2021 CASP Update since its adoption, targeted interviews were conducted with leaders and subject-matter experts across Port Houston divisions. Four focused engagement sessions were held in October 2025. Advancements were identified, particularly in securing grant funding and transitioning cargo handling equipment to cleaner technology. Operational and financial constraints were described while on-going cleaner air initiatives at Port Houston were identified such as the EPA Clean Ports Program (CPP). These conversations also provided essential context regarding capital planning, equipment transition challenges, and broader market conditions that affect both near-term feasibility and long-term ambition.

Chapter 2 of this Progress Report provides detailed information on each of the 16 tactics and progress toward successful implementation. In general, each tactic is either underway with progress made or complete. Major milestones achieved since CASP adoption include:

- Port Houston has secured $44 million in state and federal funding to advance its clean air initiatives.
- The Sustainability Action Plan was finalized and published in 2021.
- In 2021, after a pilot program, the Greater Houston Port Bureau—a non-profit trade organization representing over 240 member companies—entered a five-year partnership with PortXchange to adopt and further develop its proprietary PortXchange system.[1] PortXchange is a platform that improves vessel tracking and terminal schedule

[1] *https://port-xchange.com/portxchange-and-greater-houston-port-bureau-embark-on-five-year-digitalization-partnership/*

transparency, helping optimize the timing of ship port calls and reduce the amount of time vessels spend in port.

- According to the 2023 GMEI, 50% of the trucks serving Port Houston utilize 2010 engine model year trucks or newer, compared to 34% in 2019. This is largely due to carriers and trucking companies' voluntary adoption of truck age limits and sustainability goals. The 2015 Federal Motor Carrier Safety Administration (FMCSA) Electronic Logging Device (ELD) mandate was also a major contributor to truck fleet turnover.
- Port Houston operates 57 hybrid rubber-tired gantry (RTG) cranes, with 16 additional units arriving to Bayport in late 2025/early 2026, bringing the total hybrid fleet to 73. Port Houston has 147 total RTGs as of December 2025 and will have 163 once the current order of 16 is received and commissioned.
- The 2023 GMEI reports modest emission reductions from locomotives serving Port Houston between 2019 and 2023—with NO_x emissions down 7% and $PM_{2.5}$ emissions down 16% despite a 28% increase in container throughput.[2]
- Harbor craft-related emissions at Port Houston terminals were greatly reduced between 2019 and 2023. NO_x and $PM_{2.5}$ decreased by 79% and 78%, respectively. The 2023 GMEI attributes the emission reductions to cleaner engine technology.
- Port Houston has prepared an electrical infrastructure master plan for shore power deployment at container terminals. Currently, the demand for shore power does not warrant deployment.
- In 2023, the Kirby Corporation demonstrated the first barge-to-ship methanol bunkering in the U.S. Gulf Coast at the Port of Houston.[3] This marked an important first step to introducing marine alternative fuels into the Port of Houston.
- In 2024, Port Houston introduced the Express Pass program, allowing trucking companies to complete trucker transactions before arriving at the container terminals. Express Pass streamlines operations by reducing ingate transaction times to 15 seconds or less, eliminating the need for operator interactions, minimizing trouble tickets and turn times, and improving Port forecasting.
- In 2025, Port Houston completed its portion of the dredging work for the Houston Ship Channel Expansion Project, known as Project 11.[4] Widening of the Houston Ship Channel through Galveston Bay, from 530 feet to 700 feet, represents a physical transformation that allows for improved safety, greater efficiency, and increased economic benefit of this critical economic artery of the region, state, and nation.

[2] *https://porthouston.com/wp-content/uploads/2025/09/FINAL-Port-Houston-2023-GMEI-Report-17-Sept-25.pdf*
[3] *https://maritime-executive.com/article/first-us-gulf-barge-to-ship-methanol-bunkering-completed-in-houston*
[4] *https://porthouston.com/wp-content/uploads/2025/10/Port-Houston-Completes-its-Portion-of-Project-11-Dredging.pdf*

  - When fully complete, the improved efficiencies produced by Project 11 are expected to yield reductions in vessel-related nitrogen oxide emissions of three to seven percent annually.
  - In addition, the dredges contracted for the first three segments of the project were equipped with either Tier 3 or Tier 4 engines or scrubbers, which efficiently remove pollutants from exhaust gases.
  - Project 11 has been recognized with multiple engineering and environmental-based awards, including the 2025 Environmental Excellence Award from the Western Dredging Association (WEDA), 2025 Texas American Society of Civil Engineers (ASCE) Outstanding Civil Engineering Achievement Award (OCEA), 2025 National ASCE OCEA Honor Award, and 2025 Construction Management Association of America (Houston Chapter) Project of the Year Award for Transportation greater than $100M.
- Port Houston continues to collaborate with, but not limited to, organizations such as ION, Greentown Labs, Texas universities, the Blue Sky Maritime Coalition, the Center for Houston's Future and the Greater Houston Partnership. Engagement with community and environmental advocates has also grown.
- Port Houston was announced as a recipient of the historic EPA CPP grant for climate and air quality planning.[5] As part of this effort, Port Houston has launched a robust stakeholder engagement program that will involve targeted outreach to communities along the Houston Ship Channel as well as community and stakeholder engagement through the Port Commission Community Advisory Council and the Healthy Port Communities Coalition. Over the next three years, The CPP grant will be used to develop several major sustainability initiatives such as a: full inventory of Scopes 1, 2, and 3 greenhouse gas (GHG) emissions; Climate Action Plan; Truck Route Analysis; Trucking Industry Collaborative; and Port Equipment Transition and Cost Assessment.[6]

[5] *https://www.epa.gov/newsreleases/biden-harris-administration-announces-over-74-million-clean-ports-investments-texas*
[6] *https://porthouston.com/wp-content/uploads/2025/09/Port-Houston-Emissions-Reduction-Initiatives-Are-Delivering-_-Port-Houston-Commission-Mtg-September-2025_-Final-with-photos.pdf*

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These successes were achieved even with notable challenges outlined in the Progress Report that include:

- The Federal Administration is no longer prioritizing investments in lower emitting technologies and infrastructure for fleets, limiting the availability of incentives to encourage early adoption of cleaner models. Zero-emission technology, in particular, is significantly more expensive than diesel models and requires major operational changes to accommodate fueling or charging. Further, zero-emission truck technologies require a robust network of regional, public, and private infrastructure.
- The equipment fleet has had to expand to accommodate significant growth in cargo throughput. To help address equipment-related emissions, Port Houston piloted two pieces of zero-emission equipment generating mixed results. Issues experienced during implementation of the pilot projects include reduced equipment reliability and limited infrastructure availability. Challenges like this must be addressed before a large-scale transition to zero-emission technology can occur at Port Houston.
- Port Houston does not own or operate locomotives or harbor vessels; therefore, the Port does not have direct control over operator decisions related to purchases, repowers, or retrofits.
- Addressing truck emissions at Port Houston terminals, which accounted for approximately 20% of total NO_x emissions and 29% of total $PM_{2.5}$ emissions in 2023, remains a challenge because Port Houston does not have direct control over truck-related purchases or operations. Transitioning to zero-emission truck technology is complex, as zero-emission trucks cost substantially more than traditional diesel vehicles and large-scale electrification of both public and private infrastructure is required. The outlook for federal funding support in this regard is uncertain, creating further challenges regarding the transitioning of trucks that use Port Houston facilities.
- Uncertainty in vessel decarbonization requirements and timing adds complexity to scheduling investments in both dual-fuel vessels as well as new fuel manufacturing and bunkering facilities.
- The HyVelocity Project, a partnership focused on clean hydrogen production, distribution, and mobility, received funding through the U.S. Department of Energy's Regional Clean Hydrogen Hubs Program in 2023. As a key organizing partner, Port Houston provided in-kind resources, helped shape the proposal and hub direction, and facilitated connections with regional communities. However, in 2025, federal funding for the HyVelocity Project was canceled.

2021 CASP Update Alignment with Other Port Houston Strategies and Goals

Port Houston's 2021 CASP Update exists within a network of interrelated strategic efforts, internal programs, and grant-funded projects. Chapter 3 of this Progress Report highlights efforts underway and future work that could influence the success of the 2021 CASP Update and

subsequent updates. It also emphasizes the importance of aligning the CASP with new CPP initiatives, including the GHG emissions inventory and the Port Equipment Transition Assessment.

Review of Best Management Practices at North American Seaports

The 2021 CASP Update featured a wide-ranging collection of Best Management Practices (BMPs) utilized by 11 North American seaports to reduce emissions from port-related mobile sources. These practices were presented as an appendix to provide a portfolio of options for Port Houston to consider incorporating within its own operational and environmental strategies in the future. Following consultations with Port Houston, the approach to BMP research and compilation for the 2025 CASP Progress Report was refined to enhance both usability and accessibility of the results. This revised methodology, described in further detail in Chapter 4, ensures that stakeholders can readily understand and apply the findings.

Conclusion

Port Houston has demonstrated significant progress in implementing the 2021 CASP Update tactics and in meeting its NO_x and $PM_{2.5}$ goals. However, Port Houston and the Houston Ship Channel expect continued growth, as outlined in staff's recent 2026 Operating and Capital Budget Presentation to the Port Commission in November 2025.[7] This expected growth and related activity levels will continue to drive the need to address emission reductions. Larger vessels and turnover in other equipment fleets will be helpful in reducing emissions and achieving the NO_x and $PM_{2.5}$ targets by the end of 2026 and is possible through continued implementation of the 16 tactics in the 2021 CASP. Looking ahead, new and revised strategies developed by Port Houston will be essential to long-term success, especially given the expected growth in cargo at Port Houston.

[7] *https://porthouston.com/wp-content/uploads/2024/11/PHA_OperatingBudget_2025_Approved_2024-1112.pdf*

CHAPTER 1

Progress Demonstrated in the 2023 GMEI

Consistent with industrial and commercial activity in the Greater Houston Area, goods movement and Port Houston (or "the Port") operations depend heavily on diesel engines, which are highly efficient, reliable and produce air emissions. Importantly, these emissions have long been regulated by the U.S. Clean Air Act (CAA).

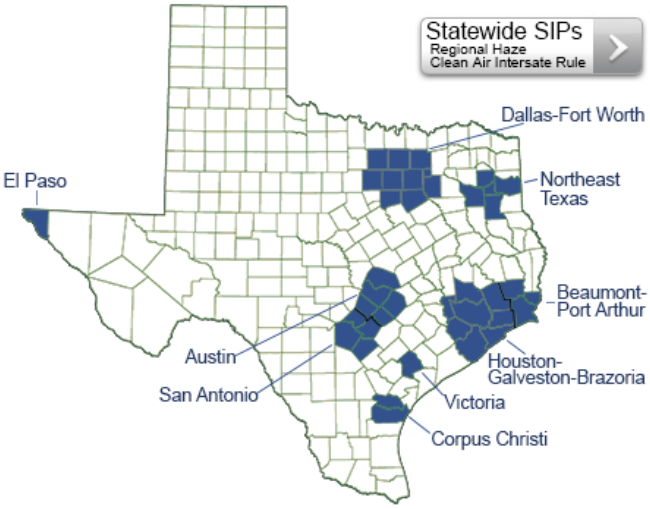
The U.S. Clean Air Act and Pollutants of Concern

Although emissions from these engines are regulated, which requires manufacturers to meet specific emission standards, federal and state air quality regulations do not require the Port to reduce emissions from vehicles, equipment, vessels, or locomotives. Nonetheless, Port Houston recognizes that it can play a leadership role in reducing emissions associated with its operations. These reductions are achieved through implementation of tactics defined in Port Houston's CASP and measured in a periodic Goods Movement Emissions Inventory (GMEI) that assesses emissions from marine-related goods movement activities at Port Houston public terminals.

The CAA is the primary federal law in the United States that regulates air emissions from stationary and mobile sources to protect public health and the environment. Under the CAA, the EPA is responsible for establishing and enforcing the National Ambient Air Quality Standards (NAAQS), which are limits on the concentrations of key air pollutants, such as ozone, particulate matter, carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead. The EPA sets the NAAQS based on scientific research, and states are required to develop State Implementation Plans (SIPs) outlining how they will achieve and maintain compliance with these standards. The EPA reviews and approves SIPs, monitors air quality data, and can take enforcement actions or impose sanctions if a state fails to meet or maintain the standards. Through this framework, the CAA ensures a cooperative federal–state effort to improve and maintain clean air nationwide.

Port Houston is located within the federally defined Houston-Galveston-Brazoria (HGB) area, which consists of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties. The Texas Commission on Environmental Quality (TCEQ) has prepared a SIP that covers the entire state of Texas, inclusive of the HGB area.

Figure 1: Texas Implementation Plan



(Image from *https://www.tceq.texas.gov/airquality/sip/texas-sip*)

According to TCEQ, the HGB area is designated as "severe non-attainment" for the 2008 ozone standard and "serious" for the 2015 8-hour ozone standard.[8] Ozone-forming pollutants, including nitrogen oxides (NOx), must be reduced region-wide to support progress toward attainment. Port Houston recognizes its role within this broader airshed and has voluntarily aligned its planning and investments to support regional air quality goals.

Port Houston has proactively addressed fine particulate matter ($PM_{2.5}$) emissions and continues to prioritize strategies addressing particulate matter. While the HGB area currently meets the federal $PM_{2.5}$ air quality standard ("in attainment"), emerging research highlights the importance of continued attention to particulate matter due to its respiratory and public health impacts. Port Houston has incorporated these considerations into its long-term planning to ensure operations remain protective of both community health and environmental quality.

Accordingly, Port Houston has focused on reducing NO_x and $PM_{2.5}$ by voluntarily developing a CASP in 2011 that was updated in 2021 and is referred to as the "2021 CASP Update" or "latest CASP" for the remainder of this Progress Report. It is focused on reducing NO_x and $PM_{2.5}$ emissions related to Port Houston operations. Minimizing combustion-related emissions will likely reduce other air quality pollutants as well. For this reason, the 2023 GMEI evaluates the following pollutants[9]:

[8] *https://www.tceq.texas.gov/airquality/sip/hgb/hgb-status*
[9] *https://porthouston.com/wp-content/uploads/2025/09/FINAL-Port-Houston-2023-GMEI-Report-17-Sept-25.pdf*

Criteria pollutants, surrogates, and precursors – reported in short tons (tons)

- **Nitrogen oxides (NO_X)**
- Sulfur dioxide (SO_2)
- **Particulate matter (PM)** (10-micron, 2.5-micron)
- Volatile organic compounds (VOCs)
- Carbon monoxide (CO)
- Greenhouse gases (GHGs) – reported as CO2 equivalent ($CO2_e$) in metric tons (tonnes)
- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)

By consistently monitoring air quality pollutants with periodic GMEIs, Port Houston can measure and track progress made toward Port Houston emission reduction goals. Further description of the air quality pollutants measured in the GMEI can be found in Appendix A.

Scope of the GMEI

The GMEI plays a key role in assessing Port-related emissions and tracking progress toward the goals outlined in Port Houston's latest CASP. Released in 2025, the most recent GMEI evaluates emissions related to Port Houston's marine facilities for calendar year 2023 and compares them to the 2019 GMEI.

The GMEI is an activity-based inventory that is narrowly focused on emissions from mobile sources related to goods movement. Emissions are estimated for ocean-going vessels, harbor vessels, cargo handling equipment, on-road heavy-duty trucks, and locomotives. It is important to clarify that Port Houston does not own or operate most mobile source emissions. Instead, these emissions are managed by third parties that use our facilities.

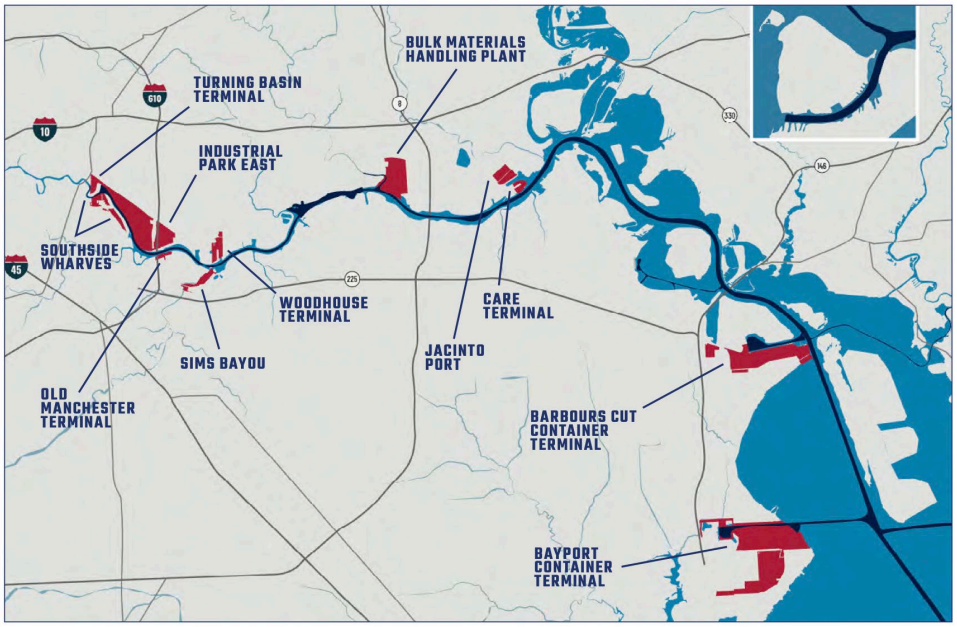
Except for ocean-going vessel and harbor craft emissions the GMEI does not estimate all mobile source emissions from the Port of Houston, which includes more than 200 public and private facilities and spans the upper half of the 52-mile Houston Ship Channel. Instead, it concentrates on emissions associated with activity that occur at the public terminals that are owned, operated, or leased by Port Houston. This targeted approach allows Port Houston to track CASP progress more effectively, as the plan focuses primarily on reducing mobile source emissions related to Port Houston's operations.

Facilities that are owned by Port Houston and are either operated by Port Houston or a tenant of Port Houston include:

- Bayport Container Terminal
- Barbours Cut Container Terminal
- Jacintoport Terminal
- Care Terminal
- Bulk Materials Handling Plant
- Sims Bayou
- Woodhouse Terminal
- Sims Bayou
- Old Manchester Terminal
- Southside Wharves
- Industrial Park East
- Turning Basin Terminal

Port Houston owned facilities are shaded in red in Figure 2 below.

Figure 1: Port Houston Facilities



For Port Houston stakeholders, it is important to understand the extent of the GMEI based mobile source emissions within the broader context of overall activity along the 52-mile Houston Ship Channel. Emissions from mobile sources directly associated with Port Houston operations represent only a small portion of total ship channel emissions. For instance, in 2023, NO_x emissions from ocean-going vessels not associated with Port Houston were more than 1.5 times greater than those from Port Houston facilities. Similarly, $PM_{2.5}$ emissions from non-Port Houston commercial harbor vessels were substantially higher, producing 44 times more $PM_{2.5}$ than harbor craft activity linked to Port Houston operations.

Progress Toward 2021 CASP Emission Reduction Targets

The 2021 CASP Update established quantifiable emission reduction goals for all mobile sources associated with Port Houston facilities to be met by end of 2026, as described below:

Comparing emissions to the 2019 GMEL:

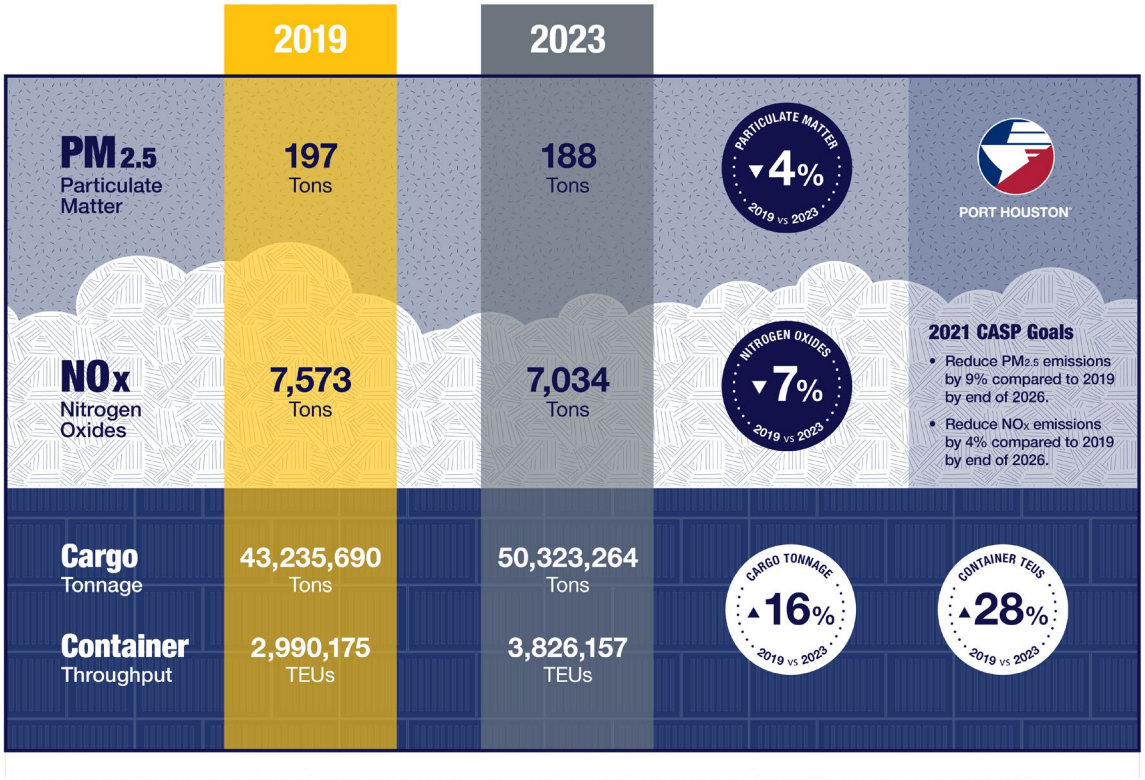
- Reduce NO_x emissions by 4%
- Reduce $PM_{2.5}$ emissions by 9%

Comparing emissions to the 2007 GMEI:

- Reduce NO_x emissions by 25%
- Reduce $PM_{2.5}$ emissions by 75%

The 2023 GMEI results displayed in Figure 3 show meaningful progress toward Port Houston's clean air goals, even with major growth in activity. Cargo tonnage at the public facilities increased by 16% and container throughput by 28% between 2019 and 2023; nonetheless, NO_x emissions from mobile sources decreased by 7%, surpassing the 2021 CASP Update goal of a 4% reduction. $PM_{2.5}$ emissions also improved, decreasing by 4% over the same period.

Figure 3. Comparison of Port Houston NO_x and $PM_{2.5}$ Emissions in 2023 Compared to 2019

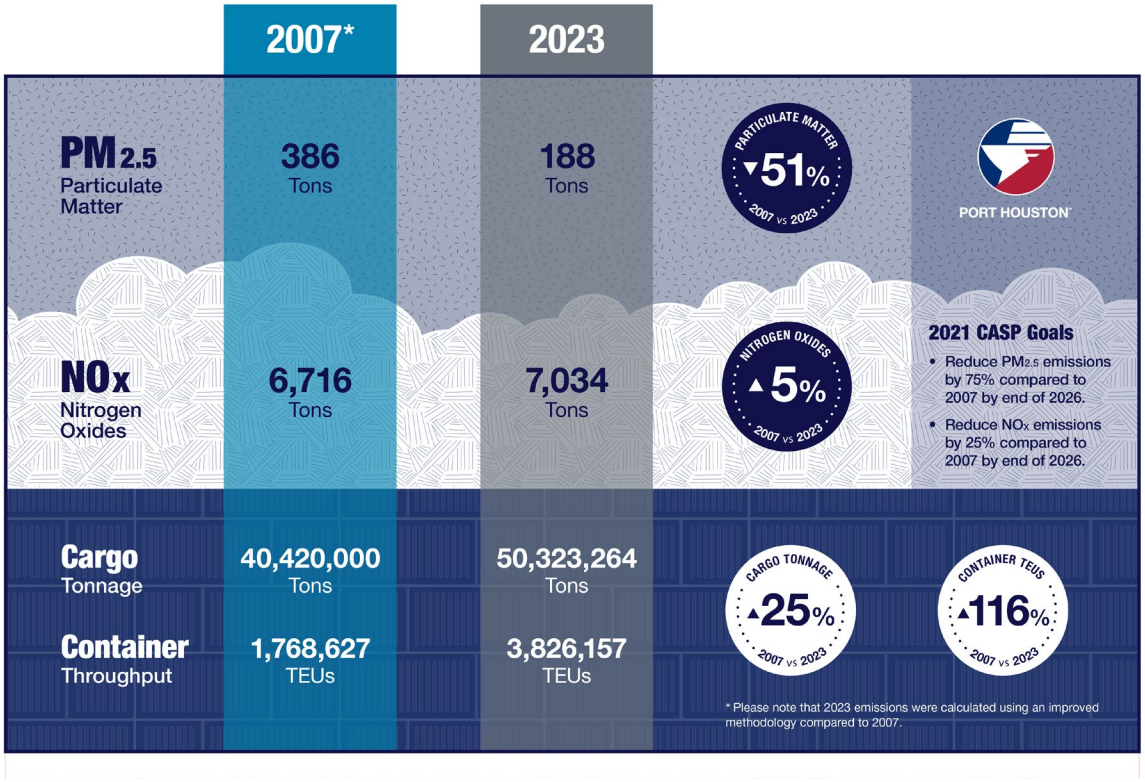


Because the 2021 CASP Update outlines strategies and emission reduction goals for 2022–2026, the 2023 GMEI results represent significant early progress. However, since Port Houston is planning to integrate emissions reduction efforts with sustainability and strategic planning efforts,

which will be informed and developed from the results of EPA CPP planning grants, the goals in the CASP will more than likely be revised.

Notably, the 2023 GMEI did not update the calculations from the 2007 GMEI using current emission estimation methods because 2019 and 2023 ocean-going vessel emissions are based on AIS data, which was not available for 2007. However, Port Houston has provided a comparison of the original 2007 emissions to the 2023 emissions in Figure 4 below to demonstrate its commitment to transparency and sharing the best available information.

Figure 4. Comparison of Port Houston NO_x and $PM_{2.5}$ Emissions in 2023 Compared to 2007



CHAPTER 1

A summary table of all pollutants measured in the 2023 GMEI and how they compare to 2019 emissions is provided in Table 1 below. For a comprehensive discussion of the 2023 GMEI results, please review Port Houston's 2023 GMEI report posted on the Port website.

Table 1: 2023 versus 2019 Port Houston Emissions Comparison

	NO_X	PM_{10}	$PM_{2.5}$	VOC	CO	SO_X	CO_2E
	tons						tonnes
2023							
Ocean-going vessels	4,536	70	65	143	365	178	268,613
Commerical harbor vessels	103	3	3	3	32	0.1	12,136
Cargo handling equipment	475	56	53	48	248	0.4	105,993
Locomotives	548	14	13	26	154	0.6	53,525
Heavy-duty vehicles	1,372	60	55	93	548	1.1	304,519
Total	**7,034**	**202**	**188**	**313**	**1,348**	**180**	**744,786**
2019							
Ocean-going vessels	4,730	72	67	148	370	183	276,730
Commerical harbor vessels	496	12	12	12	113	0.4	39,805
Cargo handling equipment	365	41	39	36	138	0.3	72,159
Locomotives	587	16	16	27	153	0.6	53,329
Heavy-duty vehicles	1,395	70	64	96	498	0.9	233,748
Total	**7,573**	**211**	**197**	**319**	**1,272**	**185**	**675,771**
Change between 2023 and 2019 (percent)							
Ocean-going vessels	-4%	-3%	-3%	-4%	-1%	-3%	-3%
Commerical harbor craft	-79%	-78%	-78%	-77%	-72%	-69%	-70%
Cargo handling equipment	30%	36%	36%	31%	79%	42%	47%
Locomotives	-7%	-14%	-16%	-2%	1%	-1%	0%
Heavy-duty vehicles	-2%	-14%	-14%	-3%	10%	25%	30%
Total	**-7%**	**-4%**	**-4%**	**-2%**	**6%**	**-3%**	**10%**

Port Houston and Regional Emissions

Figures 5 and 6 illustrate how emissions associated with Port Houston operations compare to the overall emissions profile of the HGB region. Note that HGB regional emissions for non-road mobile sources and on-road mobile sources are calculated using a methodology similar, but not identical, to that used in the GMEI. Both the GMEI and the HGB regional inventories rely on EPA's Moter Vehicle Emission Simulator (MOVES) model, though they use different versions of the model.

Figure 5: 2023 Port Houston NO_x Emissions Contribution to HGB Regional Emissions

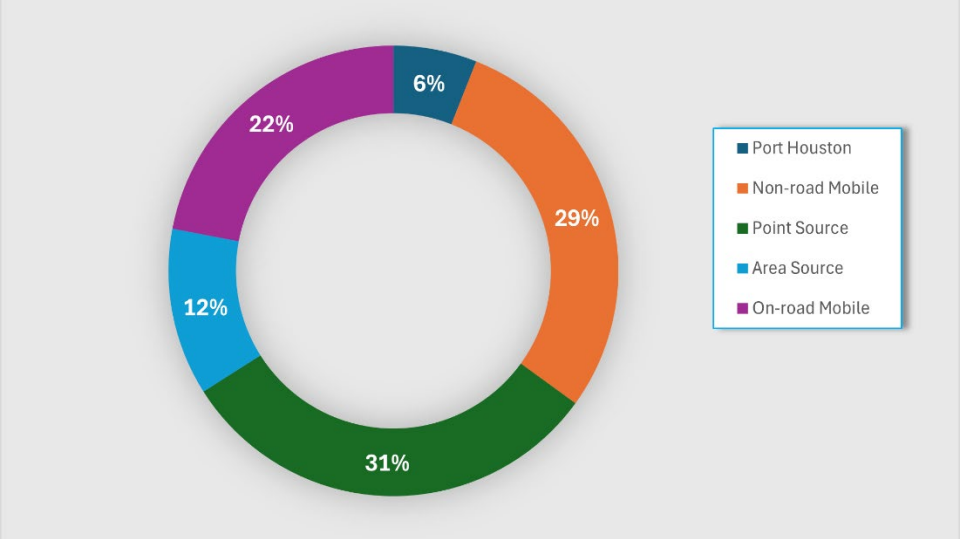
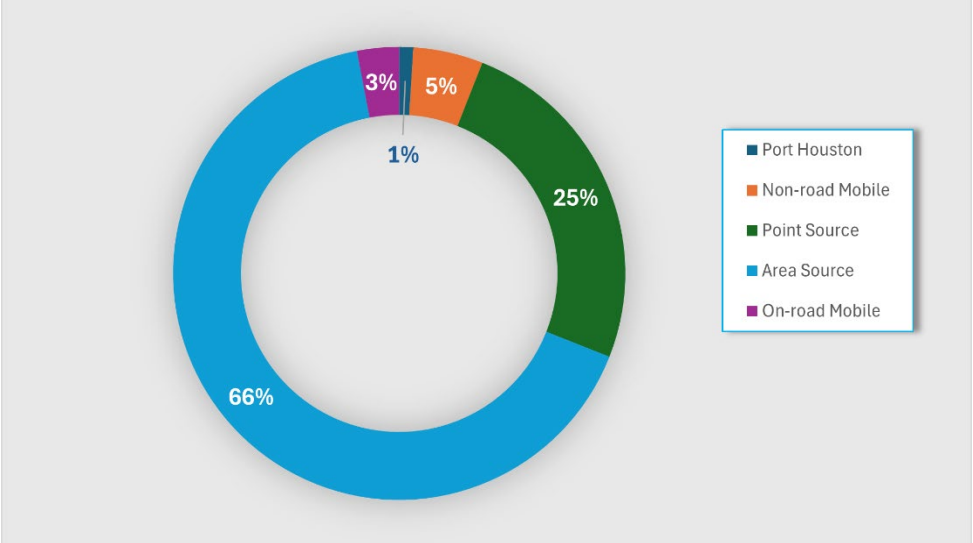


Figure 6: 2023 Port Houston $PM_{2.5}$ Emissions Contribution to the HGB Regional Emissions



Port Houston-related NO_x emissions make up 6.3% of the regional NO_x emissions which could be considered significant in the regional context. While Port Houston-related $PM_{2.5}$ emissions make up only 0.6% of regional $PM_{2.5}$ emissions and could be considered insignificant, it is still important for Port Houston to address $PM_{2.5}$ emissions due to public health concerns.

CHAPTER 2

Implementation of 2021 CASP Update Tactics

Approach to Determining CASP Implementation Progress

The 2021 CASP Update used a data-driven approach to find effective ways to reduce NO_x and $PM_{2.5}$ emissions from Port Houston operations, considering economic and operational limits as well as opportunities for industry collaboration. It identified 16 emission-reduction tactics that balance technical, operational, and financial feasibility with Port Houston's economic goals, available funding for incentives, partnerships with industry and stakeholder input.

While this chapter of the report describes the progress made in reducing emissions in alignment with the 16 CASP tactics, it is important to note that the future emission-reduction efforts outlined in Chapter 3 will likely lead to updated plans and strategies that may not fully correspond with these original tactics. For the purposes of this Progress Report, however, all completed emission-reduction activities are still presented in relation to the original 16 tactics.

Port Houston's stakeholder engagement process for the CASP Progress Report brought together leaders and subject-matter experts across Port Houston's Strategy, Operations, Maintenance, Finance, Sustainability, and Industry Relations divisions to assess progress in implementing the 2021 CASP Update since its adoption. Four focused engagement sessions were held in October 2025.

Through these sessions, Port Houston reflected on the 16 tactics in the CASP and the status of implementation. Significant advancements were identified, particularly in securing grant funding and transitioning cargo handling equipment to cleaner technology. Operational and financial constraints were defined and Port Houston determined where alignment with new or emerging initiatives such as the EPA CPP and the forthcoming Climate Action Plan is most critical. These conversations also provided essential context regarding capital planning, equipment transition challenges, and broader market conditions that affect both near-term feasibility and long-term ambition.

Across all four engagement sessions, participants emphasized that Port Houston remains committed to reducing criteria pollutants, particularly NO_x and $PM_{2.5}$, while balancing operational requirements and economic considerations. Internal stakeholders consistently noted that the Port's growing cargo volumes, major capital expansions, and evolving federal guidance on alternative fuels create a dynamic context for decision-making. Several participants highlighted that hybrid cargo handling equipment remains one of the most viable near-term opportunities given infrastructure limitations, while large-scale electrification faces significant hurdles related to grid capacity, equipment downtime, and workforce readiness. Port Houston staff noted uncertainty in the federal policy landscape and funding availability, which affects the timing and scale of future investments in zero-emission equipment and alternative fuels. The Operations Division highlighted the importance of efficiency improvements, such as gate optimization and traffic management, as cost-effective pathways for near-term emission reductions. Discussions also

reinforced the need to ensure that any future CASP update aligns with emerging decarbonization planning activities and avoids conflicting recommendations.

Delivering the 16 CASP Tactics

The 16 tactics defined in the 2021 CASP Update and the successes and challenges identified during implementation are provided in Table 2 below. Notably, Port Houston's EPA CPP grant includes additional sustainability planning initiatives that do not neatly fit into the CASP tactics, but are worth noting, including:

- Development of a GHG emissions inventory that covers scope 1, 2, and 3 emissions. The GHG inventory will leverage the 2023 GMEI and will establish a baseline for future assessments to measure GHG and NO_x, $PM2_{.5}$ emission reduction measures
- Resiliency planning will include the development of terminal-specific equipment roadmaps to transition Port Houston terminals to cleaner operations. New and replacement equipment options will be identified based on operational needs, financial budget, and decarbonization/cleaner air goals, which can be used to inform future equipment purchases. Additionally, the Port will analyze risks from flooding, storm surge, and sea-level rise, and develop mitigation plans for its terminals and nearby communities.

Table 2: Successes and Challenges in CASP Implementation

Strategy 1 – Upgrade Equipment and Technology to Reduce Emissions
Tactic 1 - Promote Heavy Duty Truck Population to Newest Emissions Standards and Support New Fuels and Technology Adoption for Lower Emissions Drayage Trucks
Successes: Many Port Houston carriers and trucking companies have adopted self-imposed truck age limits and sustainability goals, leading to a natural shift toward cleaner, newer vehicles over time. The TCEQ has supported this transition by offering financial incentives for replacing older trucks. Another factor encouraging fleet modernization is the 2015 Federal Motor Carrier Safety Administration (FMCSA) Electronic Logging Device (ELD) mandate.[10] Intended to improve roadway safety, this rule requires commercial trucks to use electronic logging devices that automatically record driving time and other hours-of-service data by connecting directly to the vehicle's engine. Because ELDs require an electronic control module (ECM) to function, older trucks without ECMs cannot comply with the mandate and have gradually been phased out of operation.

[10] *https://eld.fmcsa.dot.gov/*

In 2024, Port Houston received an EPA CPP planning grant that includes establishment of a Trucking Industry Collaborative focused on advancing innovation and efficiencies in the truck freight industry. This collaborative supports the integration of clean air technologies and partnerships with the trucking community. Its scope includes development of a clean truck transition roadmap and action plan through facilitated engagement with truck freight industry stakeholders, creation of policy frameworks to support the transition to emerging clean truck technologies, and production of a comprehensive final report and stakeholder presentations.

According to the 2023 GMEI, 50% of the trucks serving Port Houston utilize 2010 engine model year trucks or newer, compared to 34% in 2019.

Challenges: The Federal Administration is no longer prioritizing investments in lower emitting truck technologies and infrastructure, limiting the availability of incentives to encourage early adoption of cleaner trucks. Zero-emission trucks, in particular, are significantly more expensive than diesel models and require major operational changes to accommodate fueling or charging. Further, zero-emission truck technologies require a robust network of regional, public and private infrastructure.

Tactic 2 – Replace Port Houston Owned Tier 0 and Tier 1 Cargo Handling Equipment with Tier 4

Successes: As of this writing, Port Houston operates 57 hybrid RTGs, with 16 additional units arriving to Bayport in three separate delivery batches, bringing the total hybrid fleet to 73. Port Houston has 147 total RTGs as of December 2025 and will have 163 once the current order of 16 is received and commissioned.

TCEQ has also awarded approximately $3.5 million to Port Houston to transition 48 aging terminal tractors, forklifts, and RTGs to significantly lower emitting technology.

In 2024, Port Houston received EPA CPP planning grant funds. As part of this grant, terminal-specific equipment roadmaps will be developed to transition the terminals to cleaner operations. New and replacement equipment options will be identified based on operational needs, financial budget, and decarbonization/cleaner air goals, which can be used to inform future equipment purchases.

Challenges: Overall emissions from cargo handling equipment increased in 2023 compared to 2019, primarily due to the expansion of the equipment fleet needed to accommodate significant growth in cargo throughput. Port Houston has piloted two zero-emission terminal tractors with mixed results. Challenges such as equipment reliability and limited infrastructure must be addressed before a large-scale transition to zero-emission technology can occur. Further, the Federal Administration is no longer prioritizing investments in lower emitting cargo handling equipment or supporting infrastructure, thereby limiting potential incentives to encourage early adoption of zero-emission technologies.

Tactic 3 – Encourage the Port Terminal Railroad Association (PTRA) and Class 1 Railroads to Replace and Upgrade Locomotives
Successes: The 2023 GMEI reports modest emission reductions from locomotives serving Port Houston between 2019 and 2023—with NO_x emissions down 7% and $PM_{2.5}$ emissions down 16% despite a 17% increase in total cargo throughput. **Challenges:** Port Houston does not own or operate locomotives. The locomotive technology used by PTRA and Class 1 railroads is dependent upon the current lease arrangements between the operators and the locomotive providers. Additionally, the 2023 GMEI highlights data gaps for locomotives given historical reluctance by railroad operators to provide detailed lists of locomotives operating in any particular area given their wide range of operations.
Tactic 4 – Support Harbor Vessel Tug and Tow Operators to Continue Upgrading Fleets
Successes: Harbor craft-related emissions at Port Houston terminals were greatly reduced between 2019 and 2023. NO_x and $PM_{2.5}$ decreased by 79% and 78%, respectively. The 2023 GMEI attributes the emission reductions to cleaner engine technology. Additionally, Port Houston supported one of its harbor craft operators in securing a grant for the repower of two assist tugs to Tier 4 engines. Port Houston is a member of the Blue Sky Maritime Coalition, which acts to accelerate the U.S. and Canada maritime value chain's pathway to net zero greenhouse gas emissions.[11] Through the Blue Sky Maritime Coalition, Port Houston continues to promote adoption of emerging technologies capable of reducing harbor craft related emissions. **Challenges:** Port Houston does not own or operate harbor vessels and cannot directly control harbor craft operator decisions related to vessel purchases, repowers, or retrofits.
Strategy 2 – Implement Operational and Technological Efficiencies
Tactic 5 – Maintain Industry Leading Truck Turn Times and Minimal Idling by Improving Terminal Gate Capacity, Cargo Position Detection Systems and Truck Entry and Exit Processing Technologies
Successes: In 2024, Port Houston introduced the Express Pass program, allowing trucking companies to complete trucker transactions before arriving at the container terminals. By making a reservation by 6 p.m. the day before arrival, drivers gain access to dedicated Express Pass lanes and an automated terminal entrance. The Express Pass streamlines operations by reducing ingate transaction times to 15 seconds or less, eliminating the need for operator interactions, minimizing trouble tickets and turn times, and improving Port forecasting. Beginning December 2, 2024, the Express Pass became

[11] *https://www.bluesky-maritime.org/about*

mandatory for all lanes at both the Barbours Cut and Bayport Container Terminals. According to the 2023 GMEI, approximately 84% of truck trips associated with the Port are made by container trucks that almost exclusively service Barbours Cut Container Terminal and Bayport Container terminal, highlighting the significance of the Express Pass program.

Beginning summer 2026, Port Houston will launch a new customer service portal to replace Lynx, providing expanded functionality to further enhance the Port's appointment system. This transition will phase into a true appointment model that meters trucks per hour to ensure efficiency and minimize congestion both inside the terminal and on surrounding roadways as part of the Trucker Traffic Plan. This system will remain the mandatory appointment requirement for truckers accessing Port Houston's container terminals and will continue to allow trucking companies to initiate transactions before arrival, enabling faster terminal entry and supporting Yard Planning efforts to promptly service drivers.

Challenges: Truck activity at Port Houston terminals in 2023 accounted for approximately 20% of total NO_x emissions and 29% of total $PM_{2.5}$ emissions. Trucks remain a significant source of port-related emissions.

Tactic 6 – Explore Opportunities to Move Container Cargo Increasingly to Rail and Other Alternative Transport Modes/Intelligent Transportation Systems

Successes: A Traffic Mobility Study was completed in January 2024 that identified several Intelligent Transportation Systems (ITS) projects that would benefit Barbours Cut and Bayport terminals. In June 2023, Burlington Northern Santa Fe (BNSF) Railroad and Union Pacific (UP) Railroad added new rail services at Barbours Cut Container Terminal to meet growing demand and to improve operational efficiencies.[12] The added rail services connect Port Houston to Denver, Salt Lake City, El Paso/Santa Teresa, Dallas/Fort Worth, Los Angeles, and Oakland. In November 2023, UP announced additional markets available via Barbours Cut Container Terminal, including Chicago Global 4, Kansas City, Memphis, and Port Laredo.[13]

Challenges: Market forces and the economic viability of providing rail at Barbours Cut Container Terminal and also the Bayport Container terminal in the future could limit access to rail.

Tactic 7 – Coordinate Partnerships for At-Berth Ship Emission Reductions

Successes: Port Houston has prepared electrical infrastructure master plans that consider electrical demand from shore power deployment at container terminals in the future.

Challenges: Vessel activity at berth accounted for approximately 38% of vessel related NO_x pollution and 61.5% of vessel related $PM_{2.5}$ emissions in 2023. However, grant funding is essential to the success of large-scale electrification projects, which demand substantial upfront capital investment and can significantly increase operating costs. The elimination and

[12] *https://porthouston.com/new-intermodal-services-at-barbours-cut-container-terminal/*
[13] *https://www.up.com/news/service/houston-ondock-rail-it-231128*

reduction in federal air quality grants will limit the availability of the upfront capital needed to make this type of project successful.

Tactic 8 – Optimize Application of Clean Technology in Dredging Operations

Successes: In 2025, Port Houston completed its portion of the dredging work for the Houston Ship Channel Expansion Project, known as Project 11.[14] Widening of the Houston Ship Channel through Galveston Bay, from 530 feet to 700 feet, represents a physical transformation that allows for improved safety, greater efficiency, and increased economic benefit of this critical economic artery of the region, state, and nation. As vessels continue to grow in length, beam, and tonnage across a variety of vessel types, the widened Galveston Bay reach will help keep the facilities relying on the channel competitive and dynamic, both today and into the future. The improved efficiencies produced by the fully completed Project 11 are expected to yield reductions in vessel-related nitrogen oxide emissions of three to seven percent annually. In addition, the dredges contracted for the first three segments of the project were equipped with either Tier 3 or Tier 4 engines or scrubbers, which efficiently remove pollutants from exhaust gases. Project 11 has been recognized with multiple awards, including the 2025 Environmental Excellence Award from the Western Dredging Association (WEDA) and the 2025 Texas American Society of Civil Engineers (ASCE) Outstanding Civil Engineering Achievement Award (OCEA).

Challenges: The continuing demand for dredging equipment for other port and harbor dredging in the U.S. may result in the availability of dredges with newer and cleaner engines to be limited.

Tactic 9 – Reduce Emissions from Idling Vehicles

Successes: Port Houston received EPA CPP funding in 2024 for planning activities related to the implementation of the 2021 CASP. As part of the CPP work, Port Houston is preparing a Truck Route Analysis that will assess the effects of drayage and container truck routes accessing Port Houston terminal facilities, with a focus on near-port communities. The objective is to identify and quantify truck volumes, cut-through patterns, and related community burdens, and then develop actionable recommendations to minimize truck traffic through residential streets, reduce associated emissions and safety risks, and enhance freight efficiency.

Challenges: Port Houston does not control all emission sources operating at its terminals, including locomotives and over-the-road container trucks. The effectiveness of any anti-idling program depends partly on investments in anti-idling technologies and on voluntary participation by drivers.

Strategy 3 – Promote Partnering and Collaborative Alignment with Stakeholders

[14] *https://porthouston.com/wp-content/uploads/2025/10/Port-Houston-Completes-its-Portion-of-Project-11-Dredging.pdf*

Tactic 10 – Develop Grant Programs to Pursue State and Federal Funding to Reduce Mobile Source Emissions
Successes: Since adopting the 2021 CASP, Port Houston has secured $44 million in state and federal funding to advance its clean air initiatives. Awarding agencies include the EPA, the Federal Highway Administration, the TCEQ and the Texas Department of Transportation. This success reflects the Port's investment in building a strong internal grants team dedicated to developing detailed, competitive applications for emission reduction projects that deliver significant economic, air quality, and community benefits. Through these grant efforts, Port Houston has also strengthened its partnerships with labor groups, industry stakeholders, community organizations, and public agencies. **Challenges:** While Port Houston will continue to pursue funding opportunities to support emission reduction efforts, it anticipates that federal funding for air quality improvement projects will be limited over the next few years.
Tactic 11 – Promote Freight Mobility Projects Which Improve Road and Rail Traffic Conditions, and Invest in Related Projects Connected to Port Properties
Successes: Port Houston's advocacy efforts focus on strengthening regional freight mobility by engaging key stakeholders and promoting critical projects. These initiatives include coordinating with regional partners on major freight mobility initiatives, highlighting capital projects that support long-term growth, and aligning with transportation plans that inform future investment needs **Challenges:** Potential future federal funding for critical roadway projects will require lengthy project development processes. To help streamline this work and maintain alignment on priorities, Port Houston is collaborating closely with the TXDOT Houston District and the Houston-Galveston Area Council (H-GAC). For several smaller-scale projects, Port Houston is developing a phased funding approach that allows project development to begin in compliance with federal standards, ensuring these projects are ready for construction funding when federal funds become available.
Tactic 12 – Support Area-Wide Vessel Scheduling Optimization
Successes: In 2021, after a pilot program, the Greater Houston Port Bureau—a non-profit trade organization representing over 240 member companies—entered a five-year partnership with PortXchange to adopt and further develop its proprietary PortXchange system.[15] PortXchange is a platform that improves vessel tracking and terminal schedule transparency, helping optimize the timing of ship port calls and reduce the amount of time vessels spend in port. Over 20 local companies, the Houston Pilots, and Port Houston participated in a pilot of the system in 2020. Following a 12-month trial, PortXchange will fully integrate the Port Bureau's existing HarborLights Vessel Tracking System into its platform. These improvements

[15] *https://port-xchange.com/portxchange-and-greater-houston-port-bureau-embark-on-five-year-digitalization-partnership/*

are expected to enhance efficiency, reduce terminal and scheduling costs, and lower emissions.

Additionally, the Greater Houston Port Bureau released a white paper titled, "Berth Optimization: Reducing Time Alongside" that describes the importance of collecting data and establishing key performance indicators to optimize vessel berthing at Port of Houston. The white paper highlights significant opportunity for efficiency improvements without substantial investments in new tools, infrastructure, and systems. For more information, visit their website here: *https://www.txgulf.org/port-efficiency*.

Challenges: There is no single entity that schedules ship transits in the Houston Ship Channel so vessel scheduling optimization will continue to be a challenge.

Tactic 13 – Promote Development of Alternative Fuel Production and Distribution Infrastructure for Vessels and Trucks, and Carbon Capture and Supporting Infrastructure in the Port Area

Successes: In 2023, the Kirby Corporation demonstrated the first barge-to-ship methanol bunkering in the U.S. Gulf Coast at the Port of Houston.[16]

Challenges: Uncertainty in vessel decarbonization requirements and timing adds complexity to timing of investments in both dual-fuel vessels and new fuel manufacturing facilities.

Tactic 14 – Align Emissions Reduction Goals with Suppliers, Operators, and Other Parties' Sustainability Goals Including Partnerships and Application of Clean Technology

Successes: Port Houston continues to collaborate with organizations such as Ion District, Greentown Labs, Texas universities, the Blue Sky Maritime Coalition, the IEA World Hydrogen Ports Coalition, and the Center for Houston's Future and Greater Houston Partnership. Engagement with community and environmental advocates has also grown. In 2021, Port Houston conducted extensive outreach to port stakeholders and residents during the development of its 2021 Sustainability Action Plan.

Port Houston is a grant recipient of the EPA's CPP for climate and air quality planning. As part of this effort, Port Houston has launched a stakeholder engagement program that will involve targeted outreach to communities along the Houston Ship Channel as well as community and stakeholder engagement through the Port Commission Community Advisory Council and the Healthy Port Communities Coalition. Over the next three years, Port Houston plans to develop several major sustainability initiatives. These include a full inventory of Scopes 1, 2, and 3 GHG emissions, a Climate Action Plan, a Truck Route Analysis, a Trucking Industry Collaborative, a Port Equipment Transition and Cost Assessment, and the website development for Port Houston's Partners in Maritime Education, a non-profit organization.

[16] *https://maritime-executive.com/article/first-us-gulf-barge-to-ship-methanol-bunkering-completed-in-houston*

Challenges: Port Houston has implemented several plans, each setting its own air quality and operational goals. Any new plans or updates to existing plans will be designed to align goals and strategies across all initiatives, revising them as needed to maintain consistency and effectiveness.

Tactic 15 – Advocate for Local, State, and Federal Policies Which Support Emissions Reduction

Successes: The Port Houston Government Relations department continues to act as the liaison between Port Houston and its local, state, and federal government stakeholders. The department informs and educates elected and appointed officials and regulatory agencies on issues that affect the Port and the Houston Ship Channel by hosting briefings and tours and responding to requests. The Government Relations team also collaborates with various industry groups in their efforts to craft public policy on issues relevant to our operations, channel users and community stakeholders.

Upon receiving the remaining federal dollars in the 2026 Presidential Budget, Project 11 is funded to completion. This is a win for environmental efforts underway at the Port, reducing air emissions and building bird islands and oyster reefs to protect the ecosystem of our Texas Coast. Port Houston was awarded $25 million from the Reducing Truck Emissions at Port Facilities federal grant program in January of 2025, with the support of many Congressmembers. $7.8 million was also secured from the TXDOT Seaport Connectivity Program in August of 2025 for the Bayport Southern Access Road—Phase 1 efficiency project effectively reducing idle time for trucks accessing the Bayport container terminal.

Challenges: Port Houston continues to advocate for increased federal and state dollars to fund necessary inside and outside the gate projects to increase efficiency and reduce idle time for trucks and equipment. The Texas Legislature fell short in replenishing the Maritime Infrastructure Program funding in the 89th Legislative Session. The Port is broadening its advocacy, partnering with various transportation and industry groups to secure funding for this program in the next session (2027). Ongoing maintenance dredging of the Houston Ship Channel is a continual need. Approximately $117 million is needed in the 2026-2027 cycle to keep the channel dredged to its authorized depth, which in turn reduces air emissions from idle ships, decreases transit times for cargo, improves safety, and reduces vessel collision probabilities.

Tactic 16 – Develop and Implement the Sustainability Action Plan

Successes: The Sustainability Action Plan was finalized and published in 2021.

Challenges: None identified.

CHAPTER 3

2021 CASP Update Alignment with Other Port Houston Strategies and Goals

Port Houston's 2021 CASP Update exists within a network of interrelated strategic efforts, internal programs, and grant-funded projects. This chapter highlights efforts underway and future work that could influence the success of the 2021 CASP Update and subsequent updates. It also emphasizes the importance of aligning the CASP with new initiatives, including the GHG emissions inventory and Climate Action Plan slated for development under Port Houston's EPA CPP award.

Strategic Plan

Port Houston's most recent Strategic Plan, amended in November 2025, details the organization's mission, vision, goals, objectives, and implementation framework. It guides overall priorities and provides context for operational decisions and infrastructure improvements.[17] From a CASP perspective, this matters because emission-reduction goals and emission reduction strategies are more effective and resilient when they are embedded in the Port's broader strategic agenda rather than treated as stand-alone efforts. The Strategic Plan's environmental stewardship and sustainability commitments include several performance indicators that align closely with CASP tactics. These indicators include total emissions intensity (carbon intensity per TEU) and the percentage of container-handling equipment procured, replaced, or retrofitted with cleaner technology. Looking ahead, ongoing evaluation of performance indicators would help maintain a strong foundation for integrating air-quality and emission-reduction considerations into future infrastructure and terminal development planning.

Roadmap to Carbon Neutrality

Port Houston has committed to achieving carbon neutrality (net-zero GHG emissions) by 2050, with an interim target of reducing 80% of carbon emissions by 2040.[18] The Port developed a Roadmap for achieving these goals that includes purchase of hybrid-electric cargo handling equipment and heavy-duty vehicles, as well as utilizing solar and wind power generation. It also identifies potential Beyond Value Chain Mitigation (BVCM) strategies, such as encouraging supply chain partners to transition to low- or zero-emissions ships, harbor vessels, and locomotives.

[17] -- https://porthouston.com/wp-content/uploads/2025/12/Strategic_Plan_Amended_2025Update_FINAL_2025.11.11.pdf
[18] *https://porthouston.com/stewardship/environment/air-quality/*

As of this writing, the Port is currently re-evaluating the strategies and goals in light of the CPP grant, as the resulting work products will inform whether those goals and strategies need to be updated. However, the Roadmap, in whatever form it takes, has goals and strategies that significantly intersect with the CASP. While the CASP focuses primarily on criteria pollutants like NO_x and $PM_{2.5}$, the Carbon Neutrality Roadmap expands the scope to include GHGs and broader system change, beyond what the Port directly controls. Ensuring the success of future emission reductions efforts, any future plan will require that Port Houston's strategies deliver benefits for both criteria pollutants and GHGs. Consistency across these strategies is essential; without it, Port Houston could end up reducing criteria pollutants while increasing GHG emissions, or vice versa.

Sustainability Action Plan

The Sustainability Action Plan, developed through the Sustainability Action Team (SAT) workshops, identified 27 potential opportunities to advance environmental stewardship.[19] These initiatives define Port Houston's role in their implementation and focus on clean energy, air quality, circular economy, community strengthening, and transparency. For the CASP, the air quality-focused initiatives are most relevant. These include:

- cargo handling equipment electrification and repowers
- freight mobility projects
- dockside emissions reduction
- grant pursuits
- operational efficiency improvements through PortXchange
- collaboration with the City of Houston to align Port Houston's sustainability efforts with the City's regional Climate Action Plan
- advocating for enhanced air quality monitoring by the TCEQ .

These initiatives are supportive of the emission reduction efforts in the CASP and should be considered in future emissions reduction plans.

2024 Corporate Sustainability Report

The 2024 Corporate Sustainability Report describes recent grant awards for emission reduction projects, the Port's collaboration with tenants to improve air quality, and ongoing efforts to partner with Houston residents. It emphasizes safety, community engagement, and sustainable business practices as core priorities.[20] The report follows the same Environment, Social, Safety, and Governance (ES2G) structure used in previous years, organizing updates under each ES2G pillar.

[19] *https://porthouston.com/wp-content/uploads/2022/11/SAT-Workshops-Final-Report_20210830_V2.pdf*
[20] *https://porthouston.com/wp-content/uploads/2025/05/Corporate-Sustainability-Update_2024_Final.pdf*

CHAPTER 3

Unlike the strategies, action plans, and roadmaps discussed earlier, the Corporate Sustainability Report summarizes annual activities and achievements rather than establishing new strategies or goals. These annual reports are valuable because they provide Port Houston stakeholders with regular updates on how environmental initiatives are being implemented and what results they are delivering. The 2024 publication partially supports the CASP goals by reinforcing stakeholder engagement, highlighting areas where additional information or action is needed, and promoting a balanced approach to corporate growth and sustainability.

EPA Clean Ports Program

Port Houston is a grant recipient of the EPA's CPP for climate and air quality planning.[21] As part of this effort, Port Houston has launched a robust stakeholder engagement program that includes targeted outreach to communities along the Houston Ship Channel as well as community and stakeholder engagement through the Port Commission Community Advisory Council and the Healthy Port Communities Coalition. Over the next three years, Port Houston plans to develop several major sustainability initiatives. These include a full inventory of Scopes 1, 2, and 3 GHG emissions, a Climate Action Plan, a Truck Route Analysis, a Trucking Industry Collaborative, a Port Equipment Transition and Cost Assessment, and the website development for Port Houston's Partners in Maritime Education, a non-profit organization.[22]

GHG Inventory

Port Houston's CPP project was initially designed to focus exclusively on GHG emissions in contrast to the CASP, which builds on the GMEI by prioritizing goals and strategies that target NO_x and $PM_{2.5}$. GHG emissions inventory development is scheduled for 2026, followed by an equipment transition study that will create a comprehensive inventory of port equipment across all terminals. Expanding the GHG emissions inventory and related efforts to consider NO_x and $PM_{2.5}$ will promote consistency, help to preserve emissions benefits already obtained, and enable Port Houston to holistically assess progress.

Climate Action Plan

Many of the goals in the CASP align closely with the CPP project, especially in the areas of stakeholder engagement and collaborative problem-solving. The CPP-funded Climate Action Plan will provide valuable new resources and opportunities to establish to address resilience, mitigation, and adaptation measures. It should be closely aligned with the CASP to reflect any newly funded projects and to tie CASP goals. Coordinating the CASP and the CPP efforts through a Climate Action Plan combined with a Port Equipment Transition Assessment will strengthen consistency and improve the likelihood of measurable, long-term success.

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[21] *https://www.epa.gov/newsreleases/biden-harris-administration-announces-over-74-million-clean-ports-investments-texas*

[22] *https://porthouston.com/wp-content/uploads/2025/09/Port-Houston-Emissions-Reduction-Initiatives-Are-Delivering-_-Port-Houston-Commission-Mtg-September-2025_-Final-with-photos.pdf*

Establishing one guiding framework with realistic near-, mid- and long-term targets will also strengthen stakeholder and community trust by reinforcing Port Houston's commitment to holistic air-quality improvement. Similarly, the targets and strategies identified in the Sustainability Action Plan, Strategic Plan, and Roadmap to Carbon Neutrality should be revisited and incorporated, as appropriate, with CASP strategies to develop future plans that address criteria pollutants and GHG pollutants.

Ultimately, any sustainability-focused planning effort must be forward-looking and adaptable. This ensures that Port Houston's tactics and objectives can evolve in response to changing industry trends and shifting state and federal priorities, keeping both the Port's air quality and sustainability commitments relevant.

CHAPTER 4

Review of Best Management Practices at North American Seaports

Streamlining for Usability in 2025

The 2021 CASP Update featured a wide-ranging collection of BMPs utilized by 11 North American seaports to reduce emissions from port-related mobile sources. These practices were presented as an appendix to provide a portfolio of options for Port Houston to consider incorporating within future operational and environmental strategies. As explained below, the BMPs are being updated and presented differently, but they are still included as possible strategies for the Port to consider analyzing for future implementation.

Following consultations with Port Houston, the approach to BMP research and compilation for the 2025 CASP Progress Report was refined to enhance both usability and accessibility of the results. This more focused methodology ensures that stakeholders can readily understand and apply the findings.

Updates to the List of Ports Evaluated

The original 2021 list of ports slated for evaluation underwent minor modifications. These changes were implemented to include ports utilizing innovative approaches that may be suitable for Port Houston's context. As a result, the updated list for the 2025 CASP better reflects emerging best practices and industry trends that Port Houston may want to consider.

CHAPTER 4

Table 3 below provides a comparison between the ports evaluated during the 2021 CASP Update and those included in the 2025 CASP Progress Report, highlighting the evolution in the selection process and the emphasis on innovative management strategies.

Table 3: Comparison of Ports Selected for BMP Assessment in 2021 versus 2025

Ports reviewed for BMPs in the 2021 CASP	**Ports reviewed for BMPs in the 2025 CASP Progress Report**
Port Authority of New York and New Jersey	Port Authority of New York and New Jersey
Port of Hueneme	Port of Hueneme
Port of Long Beach	Port of Long Beach
Port of Los Angeles	Port of Los Angeles
Port of San Diego	Port of San Diego
Port of Miami	Port of Miami
Northwest Ports (Seattle, Tacoma)	Northwest Ports (Seattle, Tacoma)
Port of Richmond	Georgia Ports Authority
Port of New Orleans	Port of Corpus Christie
Port Houston	Port of Stockton
Port of Oakland	

Presentation of Best Management Practices by Emission Source

To enhance the usefulness of this progress report for Port Houston and its stakeholders, the BMPs are now organized by the specific emission sources they are intended to address. For each pollution source, the report lists the ports that have implemented or are in the process of implementing each BMP. This structure is designed to support more informed investment planning and to facilitate targeted implementation of effective emission reduction strategies. Unlike the 2021 CASP Update, which assigned each BMP to only one seaport, the revised approach streamlines the appendix and makes it easier for reviewers to see how widely each BMP has been adopted across ports in North America.

A collection of other cross-cutting, stakeholder engagement and collaborative BMPs is included at the end of the table, to separate these softer strategies from more emission-specific operational and technology reduction strategies.

The 2025 BMP information is presented in Appendix D.

CHAPTER 5

Conclusion

Port Houston has demonstrated significant progress in delivering the 2021 CASP Update tactics and in meeting its NO_x and $PM_{2.5}$ goals. However, Port Houston and the Houston Ship Channel expect continued growth, as outlined in staff's recent 2026 Operating and Capital Budget Presentation to the Commission in November 2025.[23] This expected growth and related activity levels will continue to drive the need for emission reductions. Larger vessels and turnover in other equipment fleets will be helpful in reducing emissions and achieving the NO_x and $PM_{2.5}$ targets by the end of 2026 is possible through continued implementation of the 16 tactics in the 2021 CASP. Looking ahead, new and revised strategies developed by Port Houston will be essential to long-term success, especially given the expected growth in cargo at Port Houston.

[23] *https://porthouston.com/wp-content/uploads/2024/11/PHA_OperatingBudget_2025_Approved_2024-1112.pdf*

APPENDIX A
AIR QUALITY POLLUTANTS

Appendix A. Air Quality Pollutants

Nitrogen Oxides (NOx)	NOx is a generic term for nitrogen oxides (NO and NO2; nitric oxide and nitrogen dioxide, respectively). In an internal combustion engine, combustion of a mixture of air and fuel produces temperatures high enough to yield various oxides of nitrogen. In areas of high motor vehicle traffic, such as in large cities, the amount of NOx emitted into the atmosphere can be quite significant. These oxides are poisonous, and can react with the oxygen in the air to produce ground level ozone and acid rain.
Particulate Matter (PM)	PM refers to tiny particles found in the air and can include dust, dirt, soot, smoke, and liquid droplets. Some PM is large and dark enough to be seen, such as soot and smoke; other particulate matter is so fine that it can be detected only with a microscope that examines air. PM is in emissions from cars, trucks, buses, factories, construction sites, tilled fields, unpaved roads, stone crushing, and burning wood. PM is formed indirectly when emissions from burning fuels -- especially emissions from motor vehicles, electric power plants, and other industrial processes -- react with sunlight and water vapor. It is also formed by grilling food on charcoal or gas, burning leaves and brush, and burning wood in a fireplace or wood stove.
Sulfur Dioxide (SO2)	SO2 is one of a group of highly reactive gasses known as “oxides of sulfur” and is linked with a number of adverse effects on the respiratory system. SO2 is a colorless gas with a pungent and suffocating odor, similar to a just-struck match. Most SO2 in the air comes from the burning of coal and oil at electric power plants. Other sources of sulfur dioxide in the air are industrial facilities that use coal or oil, petroleum refineries, cement

	manufacturing, metal processing, paper pulp manufacturing, and copper smelting. Trains, large ships, and some diesel equipment burn high sulfur fuel, which releases sulfur dioxide into the air.
Volatile Organic Compounds (VOCs)	VOCs are released from burning fuel, such as gasoline, wood, coal, or natural gas. They are also released from solvents, paints, glues, and other products that are used and stored at home and at work. Many volatile organic compounds are also hazardous air pollutants. VOCs when combined with NOx react to form ground-level ozone, or smog, and contribute to climate change. Examples of VOCs are gasoline, benzene, formaldehyde, solvents such as toluene and xylene, and perchloroethylene (or tetrachloroethylene), the main solvent used in dry cleaning. Many volatile organic compounds are commonly used in paint thinners, lacquer thinners, moth repellents, air fresheners, hobby supplies, wood preservatives, aerosol sprays, degreasers, automotive products, and dry cleaning fluids.
Carbon dioxide (CO2)	CO2 is colorless, and acts as an asphyxiant and an irritant and is considered very unhealthy at levels above 5,000 ppm. CO2 is produced by burning fossil fuels, such as coal, oil, gasoline, and natural gas, used for electricity generation, transportation vehicles, cement, or lime manufacturing, waste burning, and natural gas flaring. Uses of CO2 include refrigeration, carbonation, and production of other chemicals such as fertilizers, aerosol propellants, aspirin, and inflating devises. In the atmosphere, CO2 is part of the global carbon cycle between the atmosphere, oceans, land, marine life, and mineral reservoirs. Considered a "greenhouse gas" because CO2 absorbs heat in the atmosphere, sending some of the

	absorbed heat back to the surface of the earth and contributing to climate change.
Carbon Monoxide (CO)	CO is a colorless, odorless, and tasteless gas which is highly toxic to humans and animals in higher quantities CO is produced by the incomplete burning of natural gas, gasoline, liquefied petroleum gas, oil, kerosene, coal, charcoal, or wood. Sources of CO include unvented kerosene and gas space heaters; leaking chimneys and furnaces; gas stoves; back-drafting from furnaces, gas water heaters, fireplaces and engine exhaust. CO is used to separate metals from their ores and make other chemicals, including phosgene and is used in blast furnaces.

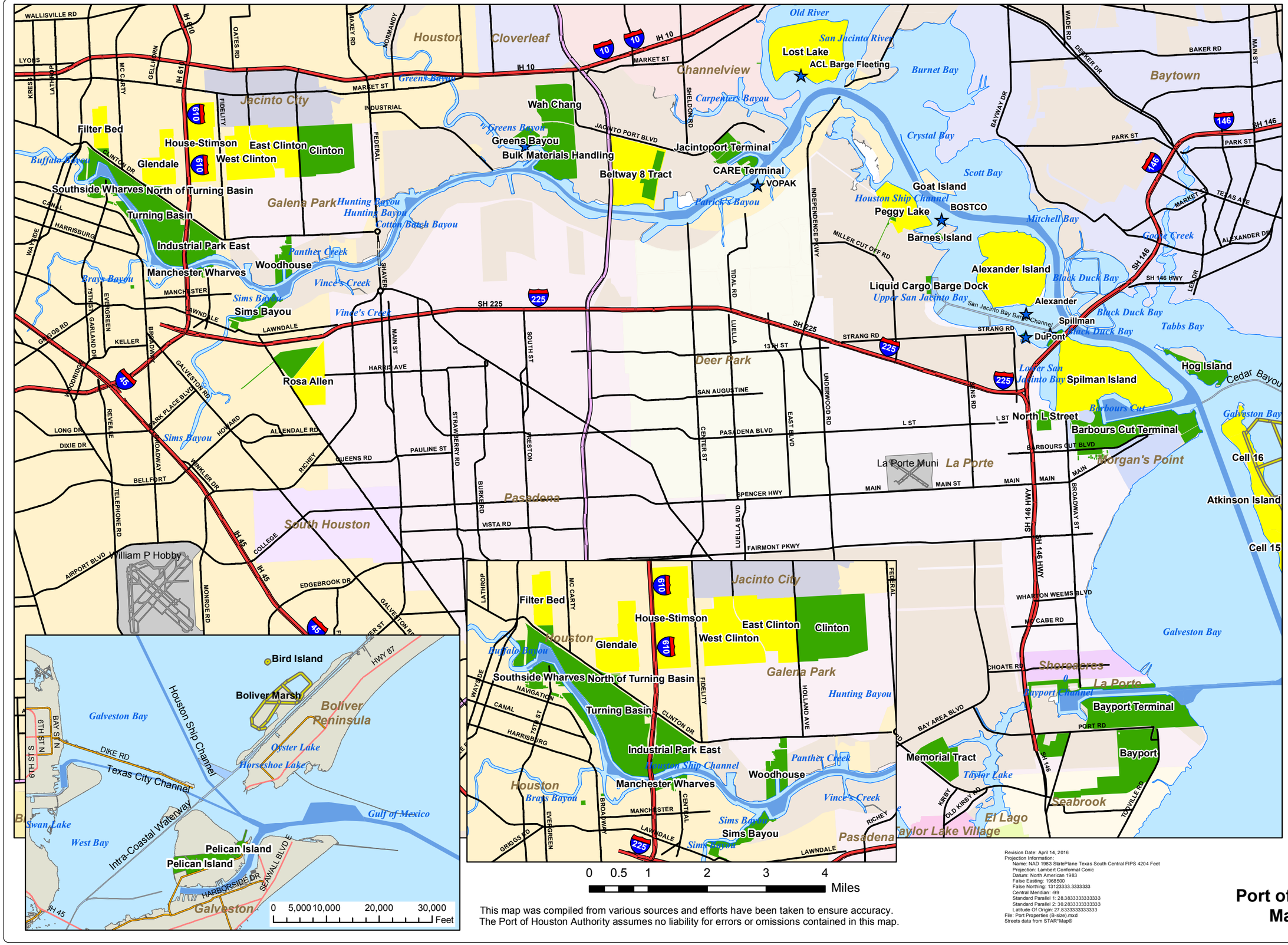
APPENDIX B
EMISSION SOURCE CATEGORIES

Appendix B. Emission Source Categories

Ocean Going Vessels	Ocean Going Vessels (OGVs) calling at port terminals are the largest emissions sources at the Port. Types of OGVs visiting the Port include auto carriers, RoRo (roll on/roll off vessels), reefer (refrigerated vessels), tankers, and general cargo vessels. Marine fuel combustion in the onboard OGV propulsion engines, auxiliary engines, and auxiliary boilers is the source of the emissions generated in OGVs. OGVs contribute significantly to air pollution, primarily in the form of SO2, PM, and NOx. Pollution from OGVs is primarily due to fuel, called "bunker fuel" which is high in SO2 and used globally.
Harbor Vessels	Harbor craft are commercial vessels that operate mostly within or near a port. Harbor craft working in the Port include tugboats, commercial fishing vessels, charter fishing vessels, as well as crew and supply boats. The harbor craft use both propulsion and auxiliary engines in routine operations. Exhausts from onboard main (propulsion) engines, auxiliary engines, and auxiliary boilers are the source of the emissions associated with harbor craft.
Cargo Handling Equipment	Cargo handling equipment (CHE) is equipment used to move cargo (containers, general cargo, and bulk cargo) to and from marine vessels, railcars, and on-road trucks. CHE includes cranes, yard tractors, top and side handlers, forklifts, and other related equipment found in smaller quantities such as loaders, sweepers, backhoes, aerial platform lifts, and generator sets. The equipment typically only operates at marine terminals or at rail yards and does not operate on public roadways. CHE can be diesel, gasoline, alternative fuel, or

	electrically powered. Fuel combustion is the source of emissions from this equipment. Although this equipment is not a large emissions source in the Port, these emissions are generated in proximity to workers and the local community.
Locomotives	Railroad operations are typically described in terms of two different types of operation, line haul and switching. Line haul refers to the movement of cargo over long distances (e.g., cross-country) and occurs within the Port as the initiation or termination of a line haul trip, as cargo is either picked up for transport to destinations across the country or is dropped off for shipment overseas. Switching refers to the assembling and disassembling of trains at various locations in and around the Port, sorting of the cars of inbound cargo trains into contiguous "fragments" for subsequent delivery to terminals, and the short distance hauling of rail cargo within the Port. The Port Terminal Railroad Association provides the switching operation at the Port and BNSF Railway, Union Pacific, and Kansas City Southern Railroad provide long haul service at the Port.
Heavy Duty Trucks	Heavy-duty drayage trucks are diesel-fueled trucks that transport marine cargo, containers, or transport chassis. Refrigerated trailers, built to accommodate the transfer of refrigerated cargo, are the most common type of tractor trailers at the Port. Diesel fuel combustion in truck engines is the source of emissions generated in heavy-duty drayage trucks. Trucks are the second largest source of emissions at the Port.

APPENDIX C
MAP OF PORT HOUSTON AUTHORITY PROPERTIES



Legend

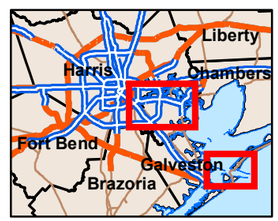
- Lease Submerged Lands
- Offshore Dredge Material Levee
- Ship Channel
- Shallow Channels and IntraCoastal
- Dredged Material Placement Areas
- Port of Houston Authority Property

Street Type

- Freeway
- Tollway
- Major
- Tunnel

N W E S

Location Map



This map was compiled from various sources and efforts have been taken to ensure accuracy.
The Port of Houston Authority assumes no liability for errors or omissions contained in this map.

Revision Date: April 14, 2016
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Streets data from STAR*Map®

Port of Houston Authority Map of Properties

APPENDIX D
NORTH AMERICAN SEAPORT AIR QUALITY BMP REVIEW

Emissions Source	Strategy	Description	Program Type	Port(s)
Ocean Going Vessels (OGV)	Shore power	Planning and infrastructure investments to enable vessels to plug into onshore electrical power while berthed and shut down auxiliary engines. This eliminates local NOx, SOx, and PM emissions from those engines while docked. Only California currently has a State-level requirement for the use of shore power.	Infrastructure Lease Requirement Planning Regulatory	Georgia Ports Authority (planned), Port Authority of New York & New Jersey, Port of Corpus Christi, Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of Miami, Port of San Diego, Port of Stockton, Port of Seattle, Port of Tacoma
OGV	Vessel Technology and Operational Efficiency Incentive Programs	Incentive programs that encourage vessel operators to invest in on-board technologies or efficiency improvements capable of producing emissions benefits while ships are in transit, maneuvering, at anchorage, and/or at berth. Ports may opt to incentivize cleaner engines or use of alternative fuels. When advantageous, port authorities commonly leverage one or more of the many external indexes available to provide incentives. These external programs include, but are not limited to, the IAPH Environmental Ship Index, Clean Ship Index, and RightShip.	Efficiency Fuel Incentives Lease Requirement	Port Authority of New York & New Jersey, Port of Long Beach, Port of Los Angeles
OGV	Vessel Speed Reduction Programs (VSR or VSRP)	Encourage or require vessels to reduce speed to lower emissions and/or lessen impacts on marine mammals. Environmental goals, speeds, seasonal implementation and other conditions vary by location and environmental priorities.	Incentives Lease Requirement Policy	Port Authority of New York & New Jersey, Port of San Diego, Port of Los Angeles, Port of Long Beach, Ports of Seattle & Tacoma/ NWSA

				For additional information on existing programs: Port Authority of New York and New Jersey Clean Vessel Incentive Program Port of Long Beach Green Flag Program Port of Los Angeles Vessel Speed Reduction program Protecting Blue Whales and Blue Skies Program The Quiet Sound Program World Shipping Council's Whale Chart
OGV	Green Shipping Corridors	Routes where ports, ocean carriers, and other stakeholders collaborate to accelerate the reduction of greenhouse gas emissions through the use of alternative fuels and other activities.	Fuel Incentives Planning Policy	Port of Long Beach, Port of Los Angeles, Port of Seattle, Port of Tacoma
OGV	Lay berths	Use of lay berths to improve vessel movement efficiency and reduce idle time.	Efficiency Infrastructure	Georgia Ports Authority
OGV	Deploy or demonstrate emission capture and control technology	Deploy or demonstrate technology alternative to shore power that is capable of reducing emissions while vessels are at berth. Examples include the barge systems used in California ports.	Equipment Lease Requirement	Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of San Diego

OGV	Clean fuels regulation	State-level requirements for the use of fuels cleaner than required by the North American Emission Control Areas, such as the California OGV Fuel Rule (Note also the California At-Berth Regulation for Shore Power, above).	Fuel Regulatory	Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of San Diego, Port of Stockton, and other California ports.
OGV	Technology advancement program	Vessel related technology demonstrations	Technology Demonstration Infrastructure Lease Requirement	Port of Long Beach, Port of Los Angeles San Pedro Bay Ports Technology Advancement Program
OGV	Infrastructure feasibility assessment for cleaner fuels for vessels	Evaluates available infrastructure within the port capable of handling new fuels.	Fuel Infrastructure Planning	Port of Long Beach, Port of Los Angeles
Emissions Source	**Strategy**	**Description**	**Program Type**	**Port(s)**
Cargo Handling Equipment (CHE)	CHE rebate/fleet modernization incentive program	Port, State, or Federal incentives and rebate programs for terminal operators to upgrade to cleaner Tier IV or zero-emission cargo-handling equipment.	Equipment Incentive	Georgia Ports Authority, Port Authority of New York & New Jersey, Port of Corpus Christi, Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of San Diego, Port of Stockton
CHE	CHE replacement/repower/retrofit	Replace, repower, or retrofit existing cargo handling equipment with cleaner engine technology.	Equipment Lease Requirement Policy	Georgia Ports Authority, Port Authority of New York & New Jersey, Port of Corpus Christi, Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of San Diego, Port of Seattle, Port of Tacoma, Port of Stockton
CHE	Zero-emission cargo-handling equipment	Deployment of zero-emission terminal equipment by purchasing new equipment, or	Equipment Lease Requirement Policy	Port Authority of New York & New Jersey, Port of Corpus Christi, Port of Hueneme, Port of

		retrofitting/repowering existing equipment.		Los Angeles, Port of Long Beach, Port of Miami, Port of San Diego, Port of Seattle, Port of Stockton, Port of Tacoma
CHE	Technology advancement program	Testing and demonstration of emerging technologies in real world operations.	Technology Demonstration	Port Authority of New York & New Jersey, Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of Miami, Port of San Diego, Port of Seattle, Port of Stockton, Port of Tacoma
CHE	Zero-emission infrastructure master plans	Development of preliminary engineering design plans for transitioning marine terminals to fully zero-emission CHE.	Planning	Port of Long Beach, Port of Los Angeles
CHE	Technology feasibility assessments	Evaluation of feasibility of zero-emission cargo handling equipment.	Planning	Northwest Seaport Alliance, Port of Long Beach, Port of Los Angeles
CHE	Use of renewable diesel	CHE utilize renewable diesel.	Incentive Fuel	Port of Long Beach, Port of Los Angeles, Port of Seattle, Port of Tacoma
CHE	Reefer plugs and racks	Install additional reefer plugs and/or reefer racks to reduce on-terminal genset use.	Equipment Infrastructure Regulatory	Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of San Diego, Port of Stockton
Emissions Source	**Strategy**	**Description**	**Program Type**	**Port(s)**
Locomotives	On-dock and near-dock rail expansions	Expanding and optimizing the rail networks to shift cargo from trucks to rail and reduce drayage emissions.	Efficiency Infrastructure	Georgia Ports Authority, Port Authority of New York & New Jersey, Port of Corpus Christi, Port of Long Beach, Port of Los Angeles, Port of Miami, Port of San Diego, Port of Seattle, Port of

				Stockton, Port of Tacoma
Locomotives	Rail-to-barge	Use of barge services to transport cargo locally, offsetting the use of trucks and supplementing rail, thereby reducing emissions.	Efficiency	Port of New York & New Jersey
Locomotives	Zero-emission railcar mover	Battery electric vehicle used to move railcars at the terminal.	Equipment	Port Authority of New York & New Jersey (planned), Port of Stockton
Locomotives	Locomotive replacement/repower/retrofit	Replace, repower, or retrofit existing locomotives with cleaner engines or zero-emission technology.	Equipment Lease Requirement	Port of Long Beach, Port of Los Angeles, Port of Tacoma
Locomotives	Idling reduction technology	Installed idle-reduction technology on locomotives.	Equipment	Georgia Ports Authority, Port of Corpus Christi, Port of Stockton, Port of Tacoma
Locomotives	Use of renewable diesel	Locomotives utilize renewable diesel.	Fuel Incentive	Port of Long Beach, Port of Los Angeles
Emissions Source	**Strategy**	**Description**	**Program Type**	**Port(s)**
Harbor Craft	Use of renewable diesel	State regulatory requirement.	Fuel Regulatory	Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of San Diego, Port of Stockton
Harbor Craft	Shore power	Harbor craft plug into shore-side power.	Infrastructure Regulatory	Port of Corpus Christi, Port of Hueneme, Port of Stockton, Port of Seattle, Port of Tacoma
Harbor Craft	Harbor craft fleet modernization incentive program	Port, State, or Federal incentives and rebate programs for harbor craft operators to upgrade to cleaner engines with DPF, hybrid technology, or zero-emission technology.	Incentives	Georgia Ports Authority, Port of Long Beach, Port of Los Angeles,
Harbor Craft	Lease requirements	Lease requirements that encourage the transition to cleaner harbor craft or	Policy	Port of Long Beach, Port of Los Angeles

		operational changes that reduce emissions. Harbor craft operators focus on specific requirements during negotiation of new leases.		
Harbor Craft	State regulatory requirement for cleaner engines with retrofits	California seaports and harbor craft operators must implement.	Regulatory	Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of San Diego
Harbor Craft	Demonstration of cleaner harbor craft technology considered not yet commercially available	Demonstration of technologies that exceed Tier 4 standards or technologies that can be retrofitted within existing harbor craft and reduces emissions.	Equipment	Port of Long Beach, Port of Los Angeles, Port of San Diego, Port of Stockton
Harbor Craft	Replace, repower, or retrofit harbor craft to cleaner engine or other technology	Upgrade harbor craft to zero-emission technology or the cleanest engines available.	Equipment Lease Requirement Regulatory	Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of San Diego, Port of Stockton
Harbor Craft	Feasibility assessment of harbor craft technology and related infrastructure	Prepare a feasibility assessment that evaluates the cleanest available harbor craft technology, its feasibility, and infrastructure requirements.	Equipment Infrastructure Planning	Port of Long Beach, Port of Los Angeles, Port of San Diego, Port of Seattle
Emissions Source	**Strategy**	**Description**	**Program Type**	**Port(s)**
Heavy-Duty Vehicles (HDV)	Truck fleet modernization incentive program	Port, State, or Federal incentives to replace, repower, or retrofit drayage trucks with newer, cleaner engines and other technology.	Incentives Equipment	Port Authority of New York & New Jersey, Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of Miami, Port of San Diego, Port of Seattle, Port of Stockton, Port of Tacoma
HDV	Replace, repower, or retrofit HDV to cleaner engine or other technology.	Replace, repower, or retrofit existing HDVs with cleaner engines or zero-emission technology.	Equipment	Port Authority of New York & New Jersey, Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of Miami, Port of San Diego, Port of Seattle, Port of

				Stockton, Port of Tacoma
HDV	Truck Registration/Entry Requirements	Drayage trucks must register with the Port to access marine terminals, improving access control and reducing idling. Entry requirements prevent new entry of older model year trucks into port drayage operations.	Tariff Requirements	Port Authority of New York & New Jersey, Port of Long Beach, Port of Los Angeles
HDV	Waive drayage truck registration fees for zero- or low emission trucks	Provides a monetary incentive for use of cleaner trucks.	Regulatory	Port of Long Beach, Port of Los Angeles
HDV	Appointment systems and expanded gate hours	Truck appointment systems, extended/24-hour operating windows and truck service center improvements reduce congestion, dwell time and idling emissions.	Efficiency	Port Authority of New York & New Jersey, Port of Long Beach, Port of Los Angeles
HDV	Zero-emission infrastructure for trucks	Deployment/finance of hydrogen fueling or truck charging stations to support zero-emission drayage trucks.	Fuel Incentives Infrastructure Lease Requirement	Port of New York & New Jersey, Port of Hueneme, , Port of Long Beach, Port of Los Angeles, Port of Stockton, Port of San Diego, Port of Seattle, Port of Tacoma
HDV	Idle-reduction policies and enforcement	Policies to limit unnecessary idling of trucks and equipment while on-terminal, enforced through terminal rules and access controls.	Lease Requirement Policy Regulatory	Port Authority of New York & New Jersey, Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of Miami, Port of San Diego, Port of Stockton
HDV	Truck Technology Assessments	Studies designed to identify the cleanest available truck technologies and their feasibility in port operations.	Planning	Port Authority of New York & New Jersey, Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of Miami, Port of San Diego, Port of Seattle, Port of Stockton, Port of Tacoma

HDV	Improve traffic flow through road design, roundabouts, and other congestion and traffic management strategies	Improved safety and traffic flow for the commercial vehicles and workers entering and exiting port facilities and reduce HDV related pollution.	Efficiency Infrastructure	Georgia Ports Authority, Port Authority of New York & New Jersey, Port of Corpus Christi, Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of San Diego, Port of Seattle, Port of Tacoma, Port of Stockton
HDV	Chassis Pool	Port managed chassis pool to provide interchangeable chassis for trucking companies. This allows for greater efficiency and consistency in port operations by ensuring a sufficient, safe, and readily available fleet of chassis.	Equipment	Georgia Port Authority
HDV	Environmental rate charged to beneficial cargo owners or their agents for containers entering or existing on trucks that produce tailpipe emissions	Funds collected are re-invested in projects and programs that support the transition to zero-emission trucks.	Incentive Policy	Port of Long Beach, Port of Los Angeles
HDV	Public charging and fueling assessment	Creates a framework for evaluating Port property for the purpose of public charging and/or fueling of trucks.	Fuel Infrastructure Planning	Port of Long Beach
HDV	Pilot a large-scale demonstration of zero-emission trucks	50-100 zero-emission truck demonstration, allowing participating fleets to gain experience with larger scale deployments.	Equipment Infrastructure Technology Advancement	Port of Long Beach, Port of Los Angeles
HDV	Support State adoption of a heavy-duty vehicle maintenance, repair and inspection program	Participate in a pilot program for a "smog check" program targeting Port-related trucking. Participation includes providing Port property for the State to set up a pilot checkpoint. This strategy helps to address issues with after-	Equipment Policy Regulatory	Port of Long Beach, Port of Los Angeles

		treatment devices and trucks in need of maintenance or repair, which may be producing emissions greater than described in engine certifications.		
HDV	Clean Truck Express Lane	Express lane for trucks ~~Program~~ equipped with zero-emission technology. By using this lane, qualifying trucks can reduce turn times, which helps lower emissions and improve efficiency.	Efficiency Infrastructure Lease Requirement Policy	Port of Los Angeles
HDV	Near or off dock truck staging area	Near or off dock parking lot where trucks park and turn off their vehicle until the terminal can accept them at the gate. This strategy helps to eliminate public road traffic congestion and reduces idling.	Efficiency	Port Authority of New York & New Jersey, Port of San Diego, Port of Seattle, Port of Stockton, Port of Tacoma
HDV	Gate entry efficiency strategies	Strategies include websites or applications that enable truck operators to understand accessibility to terminal gates in real-time. Some ports or terminals provide video footage of gates, changes to gate hours, and other helpful information that improves the flow of truck traffic at the port.	Efficiency	Georgia Ports Authority, Port Authority of New York and New Jersey, Port of Los Angeles, Port of Seattle, Port of Tacoma
Emissions Source	**Strategy**	**Description**	**Program Type**	**Port(s)**
Other	Local, State or Federal incentive funding for emission reduction or efficiency improvement projects and related planning	Use of local, State, or Federal incentive funding for emission reduction or efficiency improvement projects and related planning	Incentives	Georgia Ports Authority, Port Authority of New York & New Jersey, Port of Corpus Christi, Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of Miami, Port of San Diego, Port of Seattle, Port of Stockton, Port of Tacoma

Other	Lease provisions requiring environmental or sustainability covenants	Lease requirements for tenants that require environmental and sustainability-based performance measures as part of tenancy agreements.	Lease Requirement	Port Authority of New York & New Jersey, Port of Long Beach, Port of Los Angeles
Other	Environmental Certification Programs	Voluntary third-party certification programs assessing conformance with standards of environmental excellence in accordance with the unique program's detailed framework. Examples include EcoPorts and Green Marine	Policy	Georgia Ports Authority, Port of Corpus Christi, Port of Hueneme, Port of Stockton, Port of Seattle, Port of Tacoma, See EcoPorts and Green Marine
Other	Multi-facility emissions inventory and public reporting	An emissions inventory is the systematic evaluation of air pollution and greenhouse gases generated by port-related activities over a defined period. Emissions inventories are used to track progress towards air quality goals and to help assess BMPs across port facilities.	Planning	Port Authority of New York & New Jersey, Port of Corpus Christi, Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of San Diego Port of Seattle, Port of Stockton, Port of Tacoma
Other	Intentional community engagement on port-related air pollution topics, including clean air strategies and related initiatives	Implementation of diverse engagement tactics to improve community knowledge of port-related pollution, clean air strategy development and implementation, and related initiatives	Engagement	Georgia Ports Authority, Port Authority of New York & New Jersey, Port of Corpus Christi, Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of Miami, Port of San Diego, Port of Seattle, Port of Stockton, Port of Tacoma
Other	Air monitoring program	Deploy air monitoring station(s) to collect real time air quality data.	Equipment	Georgia Ports Authority Port of Hueneme, Port of Long Beach, Port of Los Angeles, Port of Seattle

Other	Clean Air Strategy Plan	Plans aimed at reducing air pollution from port-related activities. These plans contain quantifiable emission reduction targets.	Planning	Port of Long Beach, Port of Los Angeles, Port of Hueneme, Port of San Diego, Port of Seattle, Port of Stockton, Port of Tacoma
Other	Progress Reports	Periodic report to stakeholders on environmental and sustainability impacts and progress in implementing clean air strategies.	Engagement	Georgia Ports Authority, Port of Long Beach, Port of Los Angeles, Port of Seattle