Shore Power Technology Assessment at U.S. Ports

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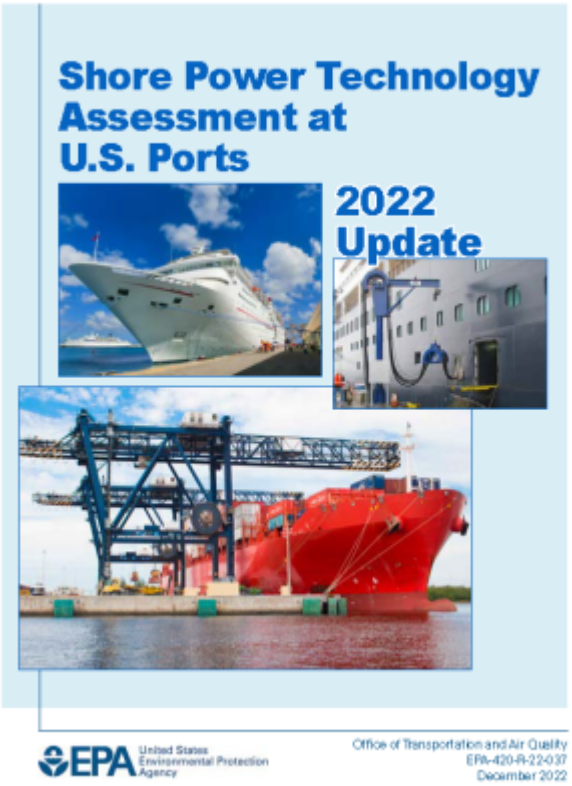
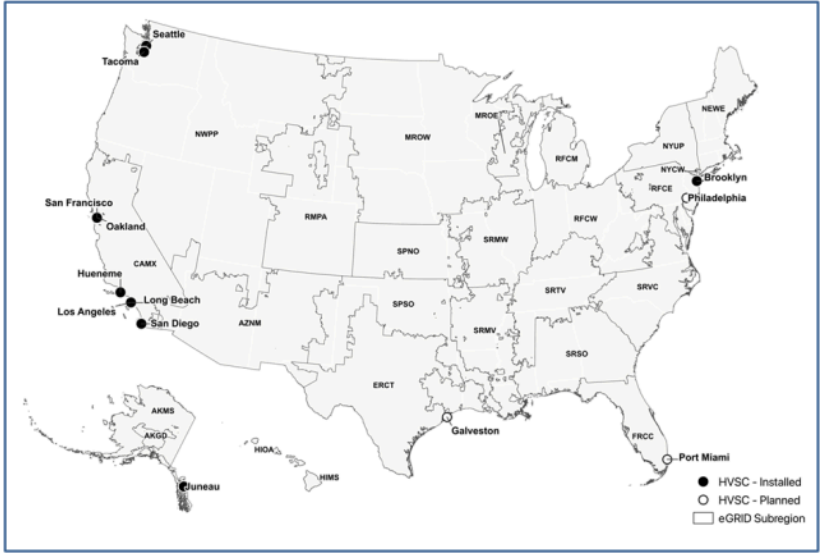
Overview

Ports are gateways of commerce and drivers of the United States (U.S.) economy. At the same time, they are places where large concentrations of diesel equipment can converge and emit significant amounts of air pollution, including particulate matter (PM), nitrogen oxides (NOx), air toxics, and carbon dioxide (CO_2), which affects human health and the environment. Many marine vessels use diesel engines while at berth to power auxiliary systems such as lighting, air conditioning, refrigeration, and crew berths. Shore power infrastructure has the potential to significantly reduce emissions by enabling vessels to turn off their engines, and instead plug into the local electricity grid to power auxiliary systems while at berth. The U.S. Environmental Protection Agency (EPA) developed this report to help port operators, state and local governments, and other stakeholders better understand and evaluate shore power as a potential emissions reduction strategy.



This *Shore Power Technology Assessment at U.S. Ports - 2022 Update* characterizes the technical and operational aspects of shore power systems in the U.S. and shows an approach for comparing shore power and vessel emissions while at berth. This report is based on the 2017 Assessment and has been updated to include:

- Information on new shore power systems in the U.S. since 2017.
- Updates to the California Air Resources Board (CARB) regulations, including new shore power requirements that expands participation.
- Updated information on vessel readiness and real-world costs.
- Practical operational lessons learned from CARB as well as port operators implementing shore power programs at the ports of New York & New Jersey, Seattle, Hueneme, and Los Angeles.



This report also includes further refinement of an approach to calculate emissions benefits from shore power, which has been incorporated into EPA's Shore Power Emissions Calculator (SPEC) updated in May 2022. The May 2022 SPEC includes updated vessel emissions factors from EPA's April 2022 Port Emissions Inventory Guidance, updated power grid emission factors from EPA's latest Emissions & Generation Resource Integrated Database, expanded options for vessel and fuel types, and improved usability.

This report, in conjunction with the calculator, can help port stakeholders – including applicants for Diesel Emissions Reduction Act, Bipartisan Infrastructure Law, and Inflation Reduction Act funding – evaluate whether shore power would be an appropriate means to reduce pollution at a port, and to estimate emissions reductions from installed systems.

Assessment and Calculator

- Shore Power Technology Assessment 2022 Update (pdf) (1.8 MB, December 2022, EPA-420-R-22-037)
- **Use the NEW calculator**
  - Shore Power Emissions Calculator (SPEC) Ver.2023 (xlsx) (2.97 MB, April 2023)
    - The SPEC Version 2023 is substantially similar to Version 2022.a, with the noted exception that it relies on recently updated eGRID 2020 electricity power plant air pollutant emission factors.
- For Reference Only:
  - Previous Shore Power Emissions Calculator (SPEC) Ver.2022a (xlsx) (2.18 MB, May 2022)
  - The May 2022 SPEC version 2022.a includes:
    - Updated eGRID 2018 electricity power plant emission factors, including emission factors for particulate matter (PM).
    - Latest marine vessel emission factors from EPA's Ports Emissions Inventory Guidance for an expanded set of vessel and fuel types to better estimate emissions.

Additional Resource

National Port Strategy Assessment

        - A User Guide Tab and References Tab within the calculator and several other usability improvements.
    - Previous Shore Power Emissions Calculator (xlsx) (3.13 MB, March 2017)

If you have questions about EPA Technology Assessments, please email: The Tech Center (Tech_Center@epa.gov)

If you have questions about Shore Power Assessment, please email: Arman Tanman (tanman.arman@epa.gov)

Key Findings

Key Findings of the Shore Power Technology Assessment- 2022 Update

- **Shore power can effectively reduce ship pollutant emissions at berth. Benefits vary from port-to-port and by vessel type.**
    - Shore power installations typically produce zero onsite emissions. In most cases, emissions from power generation facilities that supply electricity to shore power installations are lower than associated auxiliary engine emissions occurring at berth and are likely to decrease over time as renewable electricity generation increases. Emissions from power generation facilities may or may not be within the confines of the port and can often be located outside the local air shed.
    - The potential emissions reduction is dependent on several factors:
        - Vessel type, auxiliary engine age, and fuel type used at berth.
        - Power demand of vessel auxiliary system.
        - Time vessel spends at berth.
        - Electricity generation fuel mix.
    - EPA's Shore Power Emissions Calculator (SPEC) can be an effective tool to assess emissions benefits of shore power.
    - While shore power can reduce or eliminate auxiliary engine emissions at berth, shore power does not address emissions from boilers or other vessel sources that must be operational while the vessel is at berth. Vessels also continue to emit while in the process of connecting to and disconnecting from shore power.
    - The assessment also describes alternatives to shore power that may reduce emissions at berth.

- **Application of shore power in the United States is expanding to more places and vessel types.**
    - Commercial shore power has grown significantly since the last report. This 2022 Update identifies expansion projects at several ports with pre-existing shore power installations and three planned projects at the ports of Galveston and Miami for cruise ships and Philadelphia for container ships. Additionally, ports have seen an increase in the number of vessels that are equipped with shore power.

- There are currently ten ports using high voltage systems serving cruise, container and refrigerated ("reefer") vessels, and many more ports that use low voltage systems, serving tugs, fishing, and offshore support vessels.
- Most U.S. shore power systems for commercial marine vessels entered into service in the past decade.
- CARB's 2020 At-Berth Regulation continues to drive expansion of shore power at six ports in California by including more vessel types and visits in the program over time, and in the near future will include additional locations in California.
- International shore power standards for high-voltage systems are in place to make it easier for ports to select the proper equipment and to ensure shore-power capable ships can successfully use the systems at ports around the world.
- In addition to the deployment of shore power technology in the commercial sector, shore power has been successfully used by the U.S. Navy for decades and is included in the Navy's Incentivized Shipboard Energy Conservation program.
- Shore power can be most effective when applied at ports with a high percentage of frequently returning vessels.

- **Barriers to shore power include infrastructure and electricity costs.**
  - Shore power can require significant investments in landside infrastructure and vessel modifications.
    - Many ports still do not have the appropriate infrastructure to connect to vessels with shore power components and upgraded connections to the electrical grid are often required.
    - Ships must be retrofitted with vessel-side infrastructure to connect to shore power systems, which can be costly and require thoughtful planning about component placement.
  - The relative cost of using shore power instead of a vessel's onboard fuel sources is more attractive when fuel costs are greater than electricity costs.

- **Lessons learned** from CARB and the port operators in New York and New Jersey, Seattle, Hueneme and Los Angeles include:
  - The **importance of early and frequent interaction and planning between the port, regulatory agencies, and utilities** – to address demands of the commercial waterfront as well as local power needs.
  - **Need for system designs to be flexible** in designating locations of dockside shore power connection vaults and cables to ensure vessels of all sizes and types can connect.
  - **System design should account for future demand** that could include other terminals and nearby berths or electrification of other types of port equipment.
  - **Reliability and availability** of shore power components and power supply to ensure successful shore power operations. Adhering to on-time vessel scheduling, so vessels can consistently and quickly plug in and not delay other vessels and port operations.
  - Having a **ship pre-approval system** to quickly plug in for repeat ships.

- **Public funding sources are critical** for shore power infrastructure development.
- Shore power has helped **deliver emissions reductions for the local community**, and local residents notice when the system is not working.

Last updated on May 6, 2024