Maritime Clean Air Strategy

PORT of SAN DIEGO
Waterfront of Opportunity

October 2021
Draft Final Clean Version

Definitions

For the purposes of the MCAS, the following terms are defined as follows:

Vision Statement: A foundational policy statement that describes what the MCAS, in its entirety, ultimately seeks to achieve.

Goal: The result or achievement toward which effort is directed. A broad statement that guides action, in accordance with the Vision Statement.

Objective: A statement of a desired end or course of action that will help achieve a goal, which tends to be more specific and narrower than a goal, usually for a short- to medium-term time horizon of three to five years.

Strategy: A generic term that encompasses plans, projects, programs, partnerships, and various other efforts and initiatives that will help achieve a goal.

Principle: A comprehensive statement that takes into account values, ethics, and/or other important criteria to help guide decision-making and/or action.

Zero Emission Vehicles (ZEV): Zero emission vehicles may include (a) Battery electric vehicles that run entirely on electricity and can be recharged from the electricity grid, and (b) Hydrogen fuel cell vehicles, that run on electricity produced from a fuel cell using hydrogen gas.

Near-Zero Emission Vehicles (NZE): Near-zero emission vehicles include motor vehicles or pieces of equipment that produce significantly less (at least a 90% reduction) in diesel particulate matter (DPM) and nitrogen oxides (NOx) and uses biofuel to offset greenhouse gas emissions.

Abbreviations and Acronyms

AB 617	Assembly Bill 617 (Community Air Protection Program)
CARB	California Air Resources Board
CEC	California Energy Commission
CERP	Community Emissions Reduction Program
CES 3.0	CalEnviroScreen 3.0
CHE	Cargo Handling Equipment
CST	Cruise Ship Terminal
DPM	Diesel Particulate Matter
GHG	Greenhouse Gas
HC	Harbor Craft
HVIP	State of California Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
LCFS	Low Carbon Fuel Standard
MCAS	Maritime Clean Air Strategy
MIIF	Maritime Industrial Impact Fund
NCMT	National City Marine Terminal
NOx	Oxides of Nitrogen
NZE	Near Zero Emission
OGV	Ocean-Going Vessel
PM	Particulate Matter
SDAPCD	San Diego Air Pollution Control District
SDG&E	San Diego Gas and Electric
TAMT	Tenth Avenue Marine Terminal
ZE	Zero Emission

Contents

S.1 Introduction

For more than a decade the San Diego Unified Port District (Port or Port of San Diego) and its partners have deployed clean air investments and new technologies to improve air quality. Plans like the Clean Air Plan (2007), Climate Action Plan (2013), and the Final Environmental Impact Report for Tenth Avenue Marine Terminal (TAMT) Redevelopment Plan and corresponding TAMT Redevelopment Plan (2016) have all played a part. These plans provided ideas, guidance, and other measures to improve overall air quality and alleviate the environmental burden on surrounding communities. These efforts have steadily increased over the years, with continued investments in solar energy, shore power, and expanded installation of electric vehicle (EV) charging stations and other emerging technologies like a microgrid at TAMT. San Diego Port tenants have also been early adopters of new technologies to reduce emissions. In 2016, the San Diego Port Tenant's Association (SDPTA) received funding to demonstrate and deploy a wide range of zero emission (ZE) trucks and cargo handling equipment (CHE). These efforts have established a solid foundation to position the Port to advance the next level of clean air investments to help chart the course for further investment in and around the Port's tidelands.

Notwithstanding these advancements, Portside Community residents continue to suffer a disproportionate burden of environmental afflictions, including air pollution, and more needs to be done to reduce these impacts. The Portside Community is predominately downwind from industrialized, waterfront uses and activities and includes Barrio Logan, Logan Heights and Sherman Heights in the City of San Diego, and West National City in the City of National City. The confluence of regional transportation networks, like Interstate 5, Coronado Bridge (State Route 75), rail corridors, and industrial uses occurring within and adjacent to the Portside Community, and activity from the U.S. Navy and the Port, all generate emissions that contribute to relatively higher levels of diesel particulate matter and other toxic air pollutants within these communities. In fact, the 12 census tracts that make up the Portside Community rank as having some of the highest diesel particulate matter pollution burden (95th percentile per CalEnviroScreen 3.0) in the State. These pollutants, in turn, contribute to higher rates asthma, cardiovascular disease, and other health-related illness for those living in the Portside Community.

Vision Statement: Health Equity for All

In acknowledgment and in response to these circumstances, on July 13, 2021, the Board of Port Commissioners (Board) identified a vision statement for the Maritime Clean Air Strategy (MCAS): *Health Equity for All*.

More specifically, health equity is achieved when every person has the opportunity to "attain his or her full health potential" and no one is "disadvantaged from achieving this potential because of social position or other socially determined circumstances."[1] While *Health Equity for All* centers around public health, its success may be further advanced through a sustainable environment and thriving seaport. This vision provides a higher resolution lens for crisper and broader sight through which to view the primary and co-benefits of the MCAS. This vision is concise, transformational, and inclusive and acknowledges that the development and operation of a multiple purpose use port like the Port of San Diego benefits all the people of California. It takes a more holistic view of multiple benefits and is part of a paradigm shift occurring across the United States recognizing that marginalized communities, which are predominately resided by people of color, have historically suffered more than their share of the burden. As a steward of Public Trust resources, the MCAS will help the Port build upon past plans and actions with an increased urgency and create a more sustainable future through immediate and sustained action in an effort to achieve short and long-terms goals.

Long-term Goal: 100% Zero Emission Trucks and Cargo Handling Equipment by 2030.

Long-term Goals

As a companion to the vision statement, the Board also identified a long-term goal to advance zero emission truck and cargo handling equipment by 2030, as stated above and further detailed below. Inclusion of this long-term goal is intended to identify a future state that the Port ideally desires to achieve with its partners. Metaphorically, the long-term goal may serve as a North Star for the MCAS and as a way to aspire where the Port would like to be in 2030.

- **Long-term Goal for Trucks**: In advance of the State's goals identified in Executive Order No. N-79-20, attain 100% ZE truck trips by 2030 for all trucks that call to the Ports two marine cargo terminals.
- **Long-term Goal for Cargo Handling Equipment**: In advance of the State's goals identified in Executive Order No. N-79-20, the transition of diesel cargo handling equipment to 100% ZE by 2030.

Additional, complementary long-term goals for other emission sources are listed below:

- **Long-term Goal for Harbor Craft:** Tugboat-related Diesel Particulate Matter (DPM) emissions identified in the Port's Emissions Inventory (2019) will be reduced by half by transitioning to ZE/near-zero emission (NZE) technologies and/or other lower-emitting engines or alternative fuels.
- **Long-term Goal for Port Fleet:** Transition Port-owned fleet of vehicles and equipment to ZE/NZE emission technologies in manner that meets operational needs and reduces emissions, as outlined below:
  - Transition light-, medium-, and heavy-duty vehicles beginning in 2022 to ZE.
  - Transition emergency vehicles to alternative fuels including hybrid, electric, and/or low carbon fuels.
  - Convert equipment, such as forklifts and lawn maintenance equipment, to ZE.
  - Seek opportunities to advance lower emitting solutions for marine vessels.

[1] Center for Disease Control (CDC): https://www.cdc.gov/chronicdisease/healthequity/index.htm.

- **Long-term Goal for Ocean-going Vessels:** Equip marine terminals with shore power and/or an alternative technology to reduce ocean-going vessel emissions for ships that call to the Port.

Long-term success of the MCAS will depend on strong collaborations and partnerships with maritime tenants, operators, and service providers. These tenants, operators, and service providers generate important maritime workforce jobs for the region. The MCAS initiatives, including deployment of clean technology, should not result in the displacement of the existing workforce or be a hindrance to workforce growth. Maritime business can also be very competitive and not all market environments are balanced with one another, with each commodity segment and service type operating in unique market conditions. It is important for the Port and its tenants and operators to maintain market competitiveness to be able to fund and successfully work towards achieving the MCAS' goals. By identifying ambitious, comprehensive strategies, it is the intent of the MCAS to put the Port and its tenants in a more competitive position to acquire the necessary funding and resources to accelerate emission reductions.

Near-term

In pursuit of achieving the 2030 goals, the MCAS establishes several goals and objectives for the next 5-year period (2021 to 2026). If the 2030 goals represent where the Port desires to be in the future, these near-term goals and objectives identify where the work is going to start. These are the initial first steps towards developing the partnerships, knowledge, and institutional capacity that will be necessary to realize a ZE future where there is *Health Equity for All*.

The MCAS is a strategic planning document, identifying both short- and long-term goals and objectives that are consistent with the Board's and Port's vision of health equity and a clean, sustainable, and modern seaport. The MCAS is also intended to guide future decision-making and provide a planning framework for potential future actions that may be implemented to achieve the goals and objectives identified in the MCAS.[2] However, implementation of the MCAS is subject to the Board's future exercise of its legally delegated discretion, including environmental analysis under the California Environmental Quality Act (CEQA), mitigation measures, adoption of a CEQA project alternative, and Statement of Overriding Consideration, if applicable, as well as approval and potential conditioning of said implementation measures.

[2] Any project developed as a result of the Board's action or direction that requires the Port or the Board's discretionary approval resulting in a physical change to the environment will be analyzed in accordance with CEQA prior to such approval. CEQA review may result in the Port, in its sole and absolute discretion, requiring implementation of mitigation measures, adopting an alternative, including without limitation, a "no project alternative" or adopting a Statement of Overriding Consideration, if required. The current Board direction in no way limits the exercise of this discretion.

S.2 Background

As an update to the Port's 2007 Clean Air Program, the MCAS was developed over an approximately 20-month period in close consultation with a broad range of stakeholders. Development of the MCAS was accompanied by a Port-led engagement strategy that complemented the AB 617 Community Emissions Reduction Program (CERP) process[3]. The public engagement process was iterative and associated revisions to the MCAS are reflective of the ongoing input received. The engagement process leveraged the 26-member Assembly Bill (AB) 617 Portside Community Steering Committee to engage with residents, non-governmental organizations, public agencies, and industries. The AB 617 Portside Community Steering Committee established three subcommittees to help guide the development of the MCAS.

The March 2021 MCAS Discussion Draft was circulated for a 4-week public review period, during which time Port staff met with 32 stakeholders and civic groups and facilitated a bilingual community meeting that included between 70 and 80 attendees.

The Draft Revised MCAS was circulated for a 30-day public review in August 2021. Port staff continued stakeholder engagement and received over 30 letters on the Draft Revised MCAS. In response to the two public review periods and on-going public engagement, the MCAS includes updates and revisions that address written comments and that respond to other feedback that was received during the public review periods, as well as Board input.

DEVELOPMENT OF THE PORT'S MARITIME CLEAN AIR STRATEGY

Board Direction to modernize 2007 Clean Air Program with Maritime Clean Air Strategy (June 2019)

Board Updates on MCAS Approach
- March 2020
- July 2020
- February 2021

Policy Development (April 2020 – March 2021)
- Truck Subcommittee – 12 Meetings
- Port Subcommittee – 8 Meetings
- MCAS Subcommittee – 13 Meetings

MCAS Discussion Draft (March – May 2021)
4-week Public Review
- Public Review March 23 – April 20, 2021
- 32 Meetings with Stakeholders / Community Groups
- Virtual Community Meeting – April 7, 2021
- Board Discussion – May 2021

Board Update on Draft Revised MCAS (July 2021)
- Board Discussion – July 2021

Draft Revised MCAS (August 2021)
- 30-day Public Review
- Community Workshop

MCAS Board Consideration (October 2021)

Figure S-1. Development of the Port's MCAS

[3] The California Air Resources Board's (CARB's) Community Air Protection Blueprint (October 2018) explains that CERPs are new, community focused actions that go beyond existing State and regional programs to reduce exposure to air pollution in disproportionately burdened communities throughout the State. The blueprint directs air districts to form local steering committees that are composed of community members who live, work, or own businesses within each community to envision, develop, and implement actions to clean the air.

S.3 Content and Structure of the MCAS

The Port's MCAS recognizes that bold and transformational action is urgently needed to improve the health of the Portside Community. *Health Equity for All* is the guiding vision, and the MCAS's Long-term Goal—100% Zero Emissions Trucks and Cargo Handling Equipment by 2030—is intended to serve and facilitate achievement of that guiding vision.

Background information is provided on seven maritime-related emission sources, as well as three priorities that were identified by stakeholders. For each of these ten areas, the MCAS includes specific, near-term goals and objectives to be accomplished between 2021 and June 30, 2026. Although achievement of the near-term goals and objectives, will require specific future action and/or approvals, the near-term goals and objectives are written to be Specific, Measurable, Achievable, Relevant, Time-bound, Inclusive, and Equitable (or SMARTIE). The MCAS also identifies approximately 34 separate potential initiatives, including partnerships, studies, and potential projects, that may be implemented to facilitate attainment of the enumerated near-term goals. It is also anticipated that technological advances will result in additional options for implementation toward achievement of near-term goals and objectives. In addition to the primary benefit of clean air, the 34 initiatives contemplated in the MCAS will also yield several other co-benefits. Figure S-2 further illustrates the structure and content of the MCAS near-term goals and objectives.

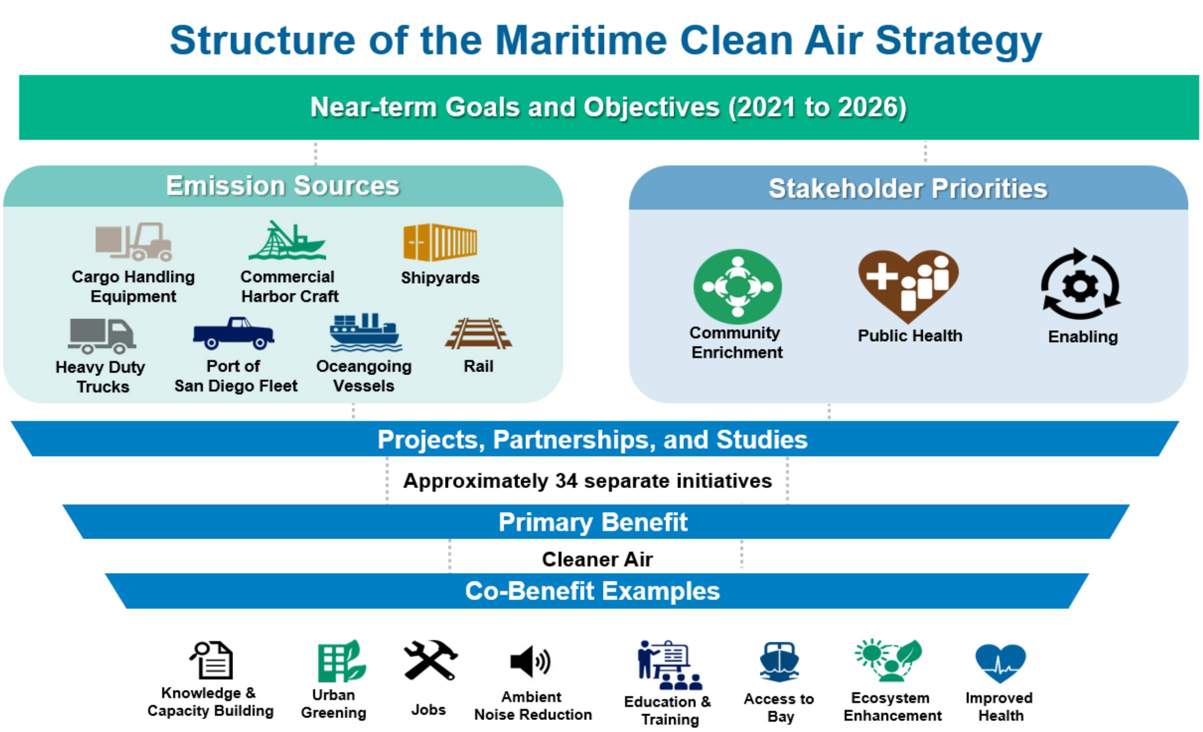


Figure S-2. Structure of the Port's MCAS

The emission reduction co-benefits are further described below:

- **Knowledge & Capacity Building** – Additional research, information, and/or partnerships that inform emission reduction strategies and build our collective ability to reduce emissions and improve public health.
- **Urban Greening** – Physical improvements that improve the built environment by increasing vegetation and tree canopies.
- **Jobs** – New jobs and/or additional types of jobs related to operations or construction.
- **Ambient Noise Reduction** – Projects and strategies that reduce the ambient noise levels in the Portside Community.
- **Education & Training** – Initiatives that lead to new and/or improved educational and training opportunities for maritime-related work and/or lower-emitting fuels and ZE technologies.
- **Access to the Bay** – Programs that increase Portside Community residents' access to the Tidelands.
- **Ecosystem Enhancement** – Projects and strategies that improve the functioning of natural systems and/or habitats.
- **Improved Health** – Projects and strategies that are expected to help reduce asthma, cancer and other longer-term health impacts experienced by Portside Community residents.

The following pages summarize the seven maritime-related emission source chapters, as well as the Community Enrichment, Public Health, and Enabling chapters. Each chapter summary includes goals and objectives through June 30, 2026, and identifies which objectives go beyond State regulatory requirements by using the icons shown below, as well any co-benefits associated with the objective.

Aligns with State Requirements

Goes Beyond State Requirements

S.3.1 Assumptions and Advancements

Maritime tenants and businesses create important maritime workforce jobs for the region. The maritime terminal workforce includes longshore workers, terminal operations and administrative employees, trucking companies and independent truckers, rail employees, transportation service providers, and others. The MCAS initiatives, including deployment of clean technology, should not result in the displacement of the existing workforce or be a hindrance to workforce growth.

The MCAS assumes the following conditions and advancements will be in place in support of the successful deployment of zero emission technologies at the Port of San Diego and to meet the MCAS' long-term goals:

- **Capability**: The state of technology meets the load, daily mileage, and hours of operations requirements, including cargo movements within the Port's marine cargo terminals, and ZEV Class 8 trucks will be in place for cargo transported to and from the Port's marine cargo terminals.
- **Infrastructure**: Zero emission infrastructure will be deployed and in place both within and outside of the San Diego region, with convenient charging locations and efficient charging capability.
- **Capital Expenditures**: Procurement costs of zero emission vehicles and equipment will continue to be offset by grants, subsidies, and other financing mechanisms to help achieve parity with traditionally powered vehicles and equipment. Additionally, it assumes technologies and markets will continue to mature.
- **Commercial Availability**: Commercial availability of vehicles and equipment will have increased, particularly with specialized equipment such as electric top handlers and auto carrier trucks.
- **Education and Training**: There will be an adequate number of trained service personnel to repair and maintain zero emission equipment and vehicles to ensure that there is no undue disruption of cargo and maritime operations.

While the MCAS focuses on advancing near-term objectives that will help accelerate the deployment of zero and near-zero emission technologies, the MCAS envisions these advancements being in place to support successful implementation of the MCAS goals and there will be contributions from other parties.

S.4 Goals and Objectives (2021 to 2026)

S.4.1 Public Health

The Portside Community has some of the poorest air quality in San Diego County. Polluted air can contribute to higher rates of asthma, cardiovascular disease, and a variety of other health related impacts. These health impacts are often exacerbated by socioeconomic factors, including poverty, educational attainment, unemployment, language barriers, and housing burdens—all of which are prevalent in the Portside Community.

Multiple sources contribute to the Portside Community's poor air quality, including freeway traffic, industrial/ manufacturing facilities, gas stations, and off-road mobile sources, such as oceangoing vessels and other diesel equipment.

The Port is committed to reducing diesel emissions at its two marine cargo terminals by advancing, (subject to future Board approval) plans, projects, and strategies, in collaboration with the goods movement industry and other stakeholders. It is important to translate how these emission reduction efforts would reduce health-related impacts affecting local community residents in the form of a health risk assessment, which is one of the near-term objectives listed below. Additionally, reducing exposure to poor air quality by measures, such as purchasing and installing air filtration devices for Portside Community residences, is yet another way the health impacts of poor air quality could be mitigated. Finally, as part of the Portside Community's Draft Phase II AB 617 CERP (July 2021), the San Diego Air Pollution Control District (SDAPCD) has committed to evaluating the feasibility of adopting a new rule to control emissions from indirect sources. As such, the Port will engage with SDAPCD as they evaluate and consider developing a new indirect source rule.

Health Goal 1: Protect and improve community health by reducing emissions and lessening Portside Community residents' exposure to poor air quality.

Health Objective 1: By October 2021, identify existing health risk levels generated from the Port's Tenth Avenue Marine Terminal and the National City Marine Terminal for Diesel Particulate Matter (DPM) and other Toxic Air Contaminant emissions.

a. Reduce DPM Emissions: The Health Risk Assessment (HRA) may be used to inform an emission reduction goal.
b. Reduce Health Risk: The HRA may be used to inform a cancer risk reduction goal.

Goes Beyond State Requirements

Knowledge & Capacity Building

***Note**: Completing the Health Risk Assessment for the Port's marine terminals will provide baseline health risk information through a refined locational analysis and will be an important reference, as the Port makes progress on the MCAS. This assessment is Port-centric and focuses on freight activity, as opposed to the regional focus of the cumulative or community health risk analysis addressed in Health Objective 2.*

Health Objective 2: Assist the San Diego Air Pollution Control District and the California Air Resources Board with preparing a cumulative or community health risk analysis for the AB 617 Portside Community by providing them with the Port's Health Risk Assessment (October 2021) and other operational related information.

Goes Beyond State Requirements

Knowledge & Capacity Building

***Note**: The California Air Resources Board has begun preparing a cumulative or community health risk analysis to further quantify health risk for the region, with an emphasis on the AB 617 Portside Community. The analysis is being prepared in coordination with the San Diego Air Pollution Control District and with input from the Port. It is anticipated that this analysis will be similar to the modeling performed for the South Coast and Bay Area regions and will take into consideration multiple sources of emissions in the region, including regional transportation systems and mobile sources.*

Health Objective 3: Work collaboratively with the San Diego Air Pollution Control District (SDAPCD) on the SDAPCD's Portside Air Quality Improvement and Relief (also known as PAIR) program, including pursuing a~~n~~ Memorandum of Agreement with the SDAPCD to contribute Port Maritime Industrial Impact Fund for the SDAPCD's purchase and installation of new portable air filtration devices at participating Portside Community residences.

Goes Beyond State Requirements | Improved Health | Education and Training

Health Objective 4: Collaborate with the San Diego Air Pollution Control District (SDAPCD) as they evaluate and consider developing a new rule to control emissions from indirect sources, in accordance with the timelines and dates established by the SDAPCD.

Goes Beyond State Requirements | Improved Health | Education and Training

***Note**: On May 7, 2021, the SCAQMD adopted Rule 2305, which is an indirect source rule (ISR) that regulates warehouse facilities to reduce air pollutant emissions from the goods movement industry. New requirements under this rule include zero emission or near-zero emissions trucks and onsite zero emission charging or fueling infrastructure. The adoption of this ISR rule is expected to substantially reduce DPM emissions from warehouse operations and, in turn, protect the vulnerable disadvantaged communities near them. SCAQMD's Rule 2305 may be a useful rule to explore as the SDAPCD evaluates developing an ISR for the San Diego region.*

S.4.2 Community Enrichment

Many state and federal agencies, such as the U.S. Environmental Protection Agency (EPA) and the California Coastal Commission, define “environmental justice” as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.” Generally, environmental justice issues are viewed through the lens of disadvantaged communities and relate to how environmental impacts, such as pollution- or climate-related stressors, may disproportionately affect these communities. Portside Community residents have been marginalized and suffer a disproportionate burden of environmental afflictions, namely air pollution.

The Port is committed to work on implementing measures designed to reduce the cumulative environmental health burdens on Portside Community receptors attributable to adjacent industrial, maritime, and transportation uses and operations and ensure fair treatment of people of all races, cultures, and incomes in developing, adopting, implementing, and enforcing environmental laws, regulations, and policies. The following Community Enrichment Goal and Objectives can help the Port to address some of the historic environmental injustices the Portside Community has experienced through: meaningful and frequent engagement and greater opportunities to participate in the Port’s planning and public involvement processes, support for additional recreational and outdoor educational opportunities, and enhanced collaboration to reduce pollution and improve the physical condition of the community.

Community Goal 1: Enrich the AB 617 Portside Community through Education, Engagement, and Urban Greening.

Community Objective 1: Rely on established processes for stakeholders and the public to provide input in the selection, deployment, and on-going monitoring of emission reduction projects.

Education and Training

Knowledge & Capacity Building

Community Objective 2: Port staff will provide the Board of Port Commissioners, Barrio Logan Community Planning Group, the National City Council, and the AB 617 Portside Community Steering Committee with periodic updates on the status of its emission reduction projects and initiatives and associated emission reduction levels.

Knowledge & Capacity Building

***Note**: Updates on emission reduction progress may accompany implementation of significant electrification projects or may be used to report progress as a part of a future maritime emissions inventories. The Port, at its discretion, may prepare maritime emissions inventories to track interim progress towards improving air quality. The first such maritime emissions inventory is scheduled to be completed in Q4 of calendar year of 2022, assuming there are sufficient resources to complete the inventory and adequate time to allow staff and technical experts to verify and validate results in an understandable way.*

Community Objective 3: Port staff will convene a group of stakeholders to explore increasing tree canopy in the Portside Community and continue to work with groups like Urban Corps of San Diego County to advance this objective.

Urban Greening

Improved Health

Ecosystem Enhancement

Community Objective 4: Support the expansion of the Port's existing outdoor educational programs to increase participation of youth that live in the AB 617 Portside Community.

Education and Training

Ecosystem Enhancement

Community Objective 5: Work with Portside Community residents and stakeholders to complete a comprehensive update in 2025 to the MCAS, including goals and objectives for 2026 to 2030 that are **S**pecific, **M**easurable, **A**ttainable, **R**elevant, **T**imebound, **I**nclusive, and **E**quitable that reflects updated technology, regulations, and market conditions.

Education and Training

Jobs

S.4.3 Cargo Handling Equipment

Cargo handling equipment is used to support terminal activities and move cargo on and off ocean-going vessels, harbor craft, rail, and trucks. Cargo handling equipment is necessary for coastal dependent maritime trade operations and water-based commerce. Based on the 2019 MCAS Emissions Inventory, if the 20 highest emitting cargo handling equipment pieces, all of which happen to be located at TAMT, were replaced with electric alternatives, the emission reduction objectives identified below could be attained. It should be noted that not all 20 pieces of equipment are the oldest or dirtiest; rather, some of this equipment is simply used at a high, continuous frequency, and the emissions associated with this activity would be eliminated if replaced with electric alternatives.

Cargo Handling Equipment Goal 1: Attain substantial reductions for cargo handling equipment related emissions by facilitating upgrades to zero emission/near zero emission equipment alternatives.

Cargo Handling Equipment Objective 1: Reduce emissions from cargo handling equipment by approximately 90% for nitrogen oxides (NO_X), 80% for diesel particulate matter (DPM), and 50% for carbon dioxide equivalent (CO_2e) below 2019 levels by January 1, 2025.

Goes Beyond State Requirements

Improved Health

Jobs

Ambient Noise Reduction

Note: *These emission reduction targets can be attained by replacing 20 of the highest emitting pieces of cargo handling equipment operating on the marine terminals, including the Port's Gottwald mobile harbor crane. The Gottwald mobile harbor crane is nearly 20 years old and is diesel-powered by a 1,030 horsepower Tier 1 engine. The remaining pieces of equipment targeted for replacement are not necessarily old, but they have high utilization rates and would yield substantial air quality benefits if they were replaced with electric alternatives.*

S.4.4 Commercial Harbor Craft

Commercial Harbor Craft (Harbor Craft) include all commercial marine vessels that are not considered ocean-going vessels. This source includes a variety of vessel and boat types that serve many functions within and near San Diego Bay including crew and supply boats, charter fishing vessels, commercial fishing vessels, ferry and excursion vessels, pilot vessels, towboats, tugboats, barges, and work boats. Although harbor craft emissions account for a little more than half of the total DPM emissions in the Port's MCAS Emissions Inventory (2019), it is important to note that a substantial portion (46%) of these emissions occur outside of San Diego Bay.

Commercial marine diesel engines are regulated by the EPA and CARB. CARB is currently updating its Harbor Craft Rule, which proposes that all new excursion vessels will need to be hybrid electric by 2025 and all in-use and new short-run ferries will need to be ZE by 2026. According to the proposed harbor craft rule, facilities that receive more than 50 visits per year will be required to install and maintain shore power by 2024.

During the next 5 years, the Port will research, propose, and implement, subject to CEQA review and Board approval, initiatives to assist vessel owners and facility owners/operators with the installation of electrical infrastructure and the transition to ZE/NZE emission technologies, in accordance with CARB's proposed regulation. The Port is also committed to facilitating implementation of the first all-electric tugboat in the nation.

Harbor Craft Goal 1: Reduce emissions from Harbor Craft by advancing emerging zero emission and advanced technologies.

Harbor Craft Objective 1: Facilitate implementation of the first all-electric tugboat in the United States by June 30, 2026.

Goes Beyond State Requirements

Jobs

Ecosystem Enhancement

Education and Training

Ambient Noise Reduction

Harbor Craft Objective 2: Identify suitable projects to assist with advancing the State's goals for commercial harbor craft by supporting:

a. Existing fuel docks with the transition to renewable diesel by January 1, 2023;
b. Installation and maintenance of landside shore power for all facilities that receive more than 50 visits per year by 2024;
c. All new excursion vessels transition to zero emission capable hybrid technologies starting on January 1, 2025; and
d. Short run ferry-operators transition to zero emission technologies for all new and in use short-run (under 3 nautical miles) trips starting on January 1, 2026.

Aligns with State Requirements	Jobs	Ecosystem Enhancement	Education and Training

Note: *Harbor Craft Objective 2 is based on CARB's Draft Proposed Regulation Order – Proposed Amendments to the Regulation to Reduce Emissions from Diesel Engines on Commercial Harbor Craft Operated within California Waters and 24 nautical miles of California's baseline (April 1, 2021).*

S.4.5 Trucks

Heavy duty trucks are used to transport cargo to/from the Port's two marine cargo terminals. While on-road trucks that serve operations at the marine cargo terminals contribute about 2% of the Port's total DPM emissions, according to the Port's 2019 MCAS Inventory, accelerating the transition to ZE/NZE emission trucks is a high-priority for community residents and is a central component of the Port's MCAS. In September 2020, Executive Order N-79-20 established the State goal that 100% of drayage trucks in the State be ZE by 2035, and non-drayage trucks be ZE by 2045. CARB is developing the Advanced Clean Fleet Regulation that will address how the State plans to phase in ZE drayage trucks and other medium- and heavy-duty fleet vehicles. Importantly, CARB acknowledges that some trucks that transport cargo at ports are not classified as drayage trucks and will be subject to the 2045 ZE standard. Nevertheless, the MCAS seeks to accelerate the transition to ZE for all trucks that call on the marine terminals by 2030, and the following specific goals support that transition.

Truck Goal 1: Improve the air quality in the Portside Community by accelerating the implementation of zero emission/near zero emission trucks.

Note: *The Port expects to achieve these goals through battery electric vehicles and those with hydrogen fuel cells. While these objectives move forward in the near future, the Port is also supporting and/or facilitating projects that achieve near-zero emissions today – those are compressed natural gas (CNG), and renewable compressed natural gas (RNG).* ***CNG*** *is considered NZE because it produces 90% less NOx than diesel engines and 100% less diesel particulate matter (DPM). GHGs are reduced by 40% compared to diesel, but GHGs are not an immediate health issue.* ***RNG*** *is nearly a ZE fuel – 90% reduction in NOx, 100% reduction in DPM, and significant reduction in GHGs.*

Truck Objective 1A: 20% of the Port's annual truck trips will be performed by zero emission trucks by June 30, 2026.

Goes Beyond State Requirements

Improved Health

Ambient Noise Reduction

Note: *CARB estimates that implementation of the Advanced Clean Truck Regulation and the proposed Advanced Clean Fleet Regulation will result in at least 8% of the State's drayage truck population being converted to zero emission by 2025. These estimates consider adoption of zero emission drayage trucks given market conditions, the regulatory environment, and Senate Bill (SB) 1 legislation. The MCAS seeks to exceed this statewide estimate so that 20% of drayage truck trips to/from the Port's marine cargo terminals can be done with ZE trucks by electrifying short-haul routes in collaboration with stakeholder and agency partners.*

Truck Objective 1B: By the end of 2022, Port staff will develop and present a short-haul, on-road, Zero Emission Truck Program for the Board's consideration that includes at least one collaborating trucking company and that targets having the necessary charging infrastructure in place by 2024, in order to displace approximately 65,000 diesel vehicle miles traveled.

Goes Beyond State Requirements

Improved Health

Ambient Noise Reduction

Note: *As of the date of publication, the maximum range for electric vehicle (EV) heavy duty trucks is approximately 120 miles; hence, Objective 1B focuses on what is technically feasible today. As technology advances, Port staff will consider all options available for implementation toward achievement of Truck Goal 1, Truck Objective 1A and Truck Objective 1B. Permitting requirements and environmental review pursuant to CEQA will be needed prior to installing Medium-Duty (MD)/Heavy-Duty (HD) Zero-Emission Vehicle (ZEV) charging infrastructure.*

Truck Objective 1C: Coordinate with the California Air Resources Board as they continue to develop the Advanced Clean Fleet Regulation regarding the transition to zero emission trucks to better understand associated State forecasts and forthcoming rulemaking.

Align with State Requirements

Knowledge & Capacity Building

Note: *Given the state of technology for these truck types and fleet characteristics, CARB is proposing a separate long-term goal for the conversion of non-drayage trucks to zero emission technology by 2045. The Port expects to achieve these goals through battery electric vehicles and those with hydrogen fuel cells. However, if ZE vehicles are determined to be infeasible based on CARB's regulations, the Port is also supporting and/or facilitating projects that achieve near-zero emissions today – those are compressed natural gas (CNG), and renewable compressed natural gas (RNG).*

Truck Objective 1D: In collaboration with the California Air Resources Board, the Port will utilize a truck registry or other system to summarize annual truck trips to the Port's marine cargo terminals and measure progress to achieve Port goals.

Goes Beyond State Requirements

Knowledge & Capacity Building

***Note:** The District recognizes the importance of 1) establishing a baseline of individual heavy-duty trucks which visit the marine cargo terminals and 2) measuring progress towards achieving the goals and objectives of the MCAS and seeks to acquire additional truck trip information by end of 2022, or sooner if possible. Furthermore, CARB's proposed regulatory language for the Advanced Clean Fleet Regulation will likely require marine terminal operators and ports to report heavy-duty truck visits on at least an annual basis beginning in November 2023. As such, the District will establish a truck registry or appropriate database in collaboration with CARB for those heavy-duty trucks visiting the marine cargo terminals by June 30, 2023.*

Truck Objective 1E: Provide status report to the Board of Port Commissioners with recommendations on zero emission truck technologies, as well as an evaluation of potential impacts to small fleets and/or independent truck drivers, as part of a biennial emissions reporting to better understand the transition zero emission truck technology.

Goes Beyond State Requirements

Knowledge & Capacity Building

Truck Goal 2: Facilitate the deployment of infrastructure to support the transition to zero emission truck trips to the Port's marine cargo terminals.

Truck Objective 2A: Within the fourth quarter of calendar year 2022, present a concept plan to the Board for its consideration that identifies four potential public-facing medium-duty/heavy-duty charging locations within the San Diego Region to support deployment of zero emission trucks, which may include locations in close proximity to or on the Tenth Avenue Marine Terminal and/or the National City Marine Terminal.

Goes Beyond State Requirements

Education and Training

Jobs

Improved Health

Note: *Planning for this item will start no later than January 1, 2022.*

Truck Objective 2B: Collaborate and coordinate with community residents, stakeholders, and agencies to ensure that the medium-duty/heavy-duty zero emission truck charging facilities identified in Objective 2A are aligned with and connect to the region's larger zero emission vehicle charging infrastructure system.

Goes Beyond State Requirements

Knowledge & Capacity Building

Note*: Several planning efforts for MD/HD ZEV charging infrastructure for the San Diego Region are currently underway, which include, but are not limited to, the Port's Short-haul ZEV Truck Program (Truck Objective 1B) and San Diego Association of Governments' (SANDAG's) MD/HD ZEV Charging and Infrastructure Blueprint Planning Grant, which was initiated in early 2021. San Diego Gas and Electric Company (SDG&E) is expecting to develop 300 sites through 2025 throughout San Diego.*

Truck Goal 3: Support the designated truck route to avoid truck impacts on the local community

Truck Objective 3A: Work with partners to continue advancement of the connected and flexible freight and transit haul route concept to provide more efficient freeway access and encourage truck drivers to avoid residential neighborhoods by leveraging technology to support dedicated lanes and signal prioritization.

Goes Beyond State Requirements | Ecosystem Enhancement | Jobs | Ambient Noise Reduction | Improved Health

S.4.6 Port of San Diego Fleet

The Port's fleet of vehicles, equipment, and vessels are necessary for managing the Port Tidelands and provide an opportunity to advance electrification. Port vehicles are used by the General Services Department to perform maintenance, by Harbor Police and Community Service Officers to ensure public safety, and by other Port departments to conduct field work and administrative duties. Most vehicles operated by the Port are medium-duty vehicles such as sport utility vehicles (SUVs) and utility trucks (approximately 65% of the fleet). To lead by example, the Port proposes, subject to future budget approvals, to update its relevant purchasing and/or procurement policies to support investments in ZE/NZE emission technologies and identify equipment and fleet within its inventory that may be phased out and replaced with electric and/or alternative fuel technologies. The Port will continue to partner with SDG&E to install charging infrastructure on Port Tidelands and seeks to procure at least two battery electric medium- to heavy-duty vehicles.

Fleet Goal 1: Update Port purchasing and/or procurement policies to acquire zero emission vehicles and best available alternative fuels or technologies.

Fleet Objective 1A: Update the Port's vehicle purchasing and/or procurement policy in Fiscal Year 2022 to identify a hierarchy of procurement considerations that prioritize zero emission vehicles, followed by the utilization of best available alternative fuels, to ensure Port fleet upgrades and replacements obtain the lowest emitting option available.

Goes Beyond State Requirements

Knowledge & Capacity Building

Education and Training

Fleet Objective 1B: Create a zero emission vehicle transition plan in Fiscal Year 2022 for the Port's fleet of vehicles and equipment that identifies a long-term acquisition schedule for when current vehicles and equipment will be phased out and when new electric vehicles and equipment are anticipated to be procured.

Goes Beyond State Requirements

Knowledge & Capacity Building

Education and Training

Fleet Goal 2: Procure zero emission vehicles and necessary electric vehicle charging equipment and infrastructure beginning in Fiscal Year 2022.

Fleet Objective 2A: Procure at least two battery electric medium- to heavy-duty vehicles in Fiscal Year 2022.

Goes Beyond State Requirements

Ambient Noise Reduction

Education and Training

Improved Health

Fleet Objective 2B: Identify power needs and electric vehicle charging options at the General Services facility and apply to SDG&E's Power Your Drive for Fleets Program in calendar year 2021.

Goes Beyond State Requirements

Jobs

Education and Training

S.4.7 Shipyards

Several private shipyard facilities, that are also Port tenants, are located along the working waterfront within the AB 617 Portside Community. While CARB regulates most of the off-road mobile equipment used at these facilities, SDAPCD issues stationary permits for these facilities and regulates many of the emissions that result from ship-repair related work. For example, SDAPCD regulates abrasive blasting (Rule 71) and marine coating (Rule 67.18). It also regulates particulate matter and various other stationary diesel engine emissions (Rule 52), as well as oxides of nitrogen, organic compounds, and carbon monoxide (Rule 69.4.1).

In addition, SDAPCD implements the Toxic Air Contaminant Public Health Risks – Public Notification and Risk Reduction (Rule 1210), which requires facilities whose public health risk assessment shows potential risks above specified levels (100 per million)[4] to implement a risk reduction plan to reduce those risks below the significance level within 5 years. In May 2019, Supervisor Nathan Fletcher directed the SDAPCD Officer to lower the 100 per million threshold to improve public health. In the Portside Community AB 617 CERP Phase II (July 2021), Goal 8 states: “By 2026 reduce the cancer risk below 10/million for each permitted stationary source, including portable equipment, in the Portside Communities.” In pursuit of this goal, the SDAPCD has committed to implementing a regulatory process to amend Rule 1210 and to propose Rule 1210 amendments to the San Diego Air Pollution Control Board by October 2021. Modifications to Rule 1210 may have implications to shipyards because they are stationary, permitted facilities regulated by SDAPCD.

The Port continues to collaborate with SDAPCD and CARB staff on developing an updated health risk assessment for the Port’s two marine cargo terminals, as well as a health risk assessment for the larger Portside Community. As such, it well positioned to collaborate with SDAPCD as they evaluate and consider any updates to Rule 1210. The Port will also continue to coordinate with the shipyards to support the emission reduction efforts that are included in the Portside Community’s AB 617 CERP.

Shipyard Goal 1: Collaborate with the San Diego Air Pollution Control District as they review and propose modifications to applicable rules, regulations, and/or programs.

Shipyard Objective 1: Collaborate with the San Diego Air Pollution Control District as they evaluate and consider potentially lowering the health risk in Rule 1210, including the threshold for stationary sources that reduce their estimated cancer risk.

Goes Beyond State Requirements

Knowledge & Capacity Building

Improved Health

[4] The 100 per million threshold means that out of one million people, 100 people have an increased risk of cancer.

Shipyard Objective 2: Continue to work with the shipyard facilities to identify and implement emission reduction projects and, subject to further Board approval, require such implementation, and support the shipyard-related actions that are identified in the Portside Community's AB 617 Community Emissions Reduction Program.

Goes Beyond State Requirements

Ambient Noise Reduction

Education and Training

The Port's three major shipyard tenants have indicated they will be pursuing the following emission reduction strategies as part of the Portside Community's AB 617 Draft Community Emission Reduction Plan (July 2021), which are provided below for reference only, as the CERP has not received final approval by CARB at this time.

AB 617 Draft CERP Action G4 – Reduce DPM and NO_X Emissions from Portable Air Compressors and Other Diesel Sources at Shipyards.

The shipyards have indicated they will begin requiring onsite portable air compressors to be powered by either electric or diesel Tier 4 engines, in addition to continuing ongoing actions to reduce emissions from on- and off-road diesel equipment, no later than May 1, 2021.

AB 617 Draft CERP Action G5 – Promote Best Practices for Reducing Diesel, VOC, and other Emissions from Ship Repair Activities.

The shipyards have indicated they will conduct trainings and events focused on best practices for ship repair contractors to reduce emissions.

AB 617 Draft CERP Action G6 – Reduce Emissions from Shipyard Employee Transportation.

The shipyards have indicated they will promote alternative transportation and increase their employee's participation in alternative participation.

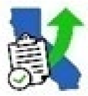
S.4.8 Ocean Going Vessels

Ocean-going vessels are used to transport goods and people to and from domestic and international seaports. Ocean-going vessels visit the Port's two marine cargo terminals and the two cruise ship terminals. The TAMT handles vessels that primarily carry refrigerated containers, break-bulk, and dry bulk cargos. The NCMT primarily handles vessels with "Roll-on/Roll-off" (RoRo) cargo, which are mostly motor vehicles. The Cruise Ship Terminal[5] (CST) handle passenger (cruise) vessels.

Ocean-going vessels contribute more than a third of the Port's total DPM emissions, according to the Port's Emissions Inventory (2019); however, 62% of these emissions occur outside of San Diego Bay. Ocean-going vessel emissions can be reduced by a combination of reduced vessel speeds, investing in cleaner fuels and engine types, upgrading on-board equipment, and expanding shore power capabilities. Shore power infrastructure enables vessels to turn off their auxiliary engines and plug into the electrical grid while the vessel is at berth. For non-shore power equipped vessels, alternative pathways such as Emission Capture Control Systems (or Bonnet), may also help reduce pollution by capturing and treating emissions from a vessel's exhaust while it is at berth. Currently, there is only one company authorized by CARB with Executive Order AB 15-01 to install a Bonnet system on vessel emissions while at berth. While Bonnet technology is capable of reducing criteria pollutant emissions from a vessel's exhaust, greenhouse gas emissions are not captured. Although this technology is still developing, Bonnets may be another tool to help reduce emissions while vessels are at berth. It is also anticipated that other innovative concepts to reduce emissions at berth will be advanced in the coming years.

Ocean-going Vessels In-Transit Goal 1: Reduce annual ocean-going vessel in-transit emissions.

Ocean-going Vessels In-Transit Objective 1A: Pursue implementing an expanded Vessel Speed Reduction Program that achieves upwards of 90% participation, subject to further Board of Port Commissioners' approval.



Goes Beyond State Requirements

Education and Training

Ecosystem Enhancement

Improved Health

[5] Cruise Ship Terminal comprises two terminals for cruise ships: Broadway Pier and B Street.

Ocean-going Vessels At-Berth Goal 2: Reduce ocean-going vessels' at-berth emissions by expanding existing and/or developing new shore power systems and/or equivalent technologies at the Port's marine terminals.

Ocean-going Vessels At-Berth Objective 2A: For cruise ships, add one additional plug to the existing shore power system by 2023.

Aligns with State Requirements | Jobs | Improved Health

Note*: The Cruise Ship Terminals comprises two adjacent terminals for cruise ships: B Street and Broadway Pier.*

Ocean-going Vessels At-Berth Objective 2B: At the National City Marine Terminal, add a new shore power system with at least two plugs and/or an alternative technology that reduces ocean-going vessel emissions at berth by 2025.

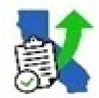
Aligns with State Requirements | Jobs | Improved Health

S.4.9 Rail

Rail locomotives carry freight cargo between the Port's two marine cargo terminals and regional destinations and/or to farther locations in the western United States. Freight rail service is provided exclusively by Burlington Northern Santa Fe (BNSF) Railway, which has direct access to the TAMT and the NCMT. However, the Port has no to little jurisdiction over rail operations. Nevertheless, rail upgrades, including rail reconfiguration at TAMT, would allow for BNSF line-haul locomotives to bypass the existing railyard, thereby eliminating a stop, and it would allow operations to shift from the Tier 0 switcher at the railyard to a line haul locomotive, which is much cleaner. These upgrades have already begun with the completion of the rail lubricator and air compressor improvements as part of the TIGER Project. In addition, encouraging—or requiring where the Port can—tenants to use cleaner switchers can also help reduce emissions associated with rail operations.

Rail Goal 1: Upgrade rail capabilities at the Tenth Avenue Marine Terminal to allow for more efficient and cleaner operations.

Rail Objective 1: Outline options to further develop rail upgrades, including rail reconfiguration within the Tenth Avenue Marine Terminal by June 30, 2026.



Goes Beyond State Requirements

Jobs

Education and Training

Rail Goal 2: Promote the use of a Single Engine Tier 4 Switcher if applicable to operations at the Tenth Avenue Marine Terminal and National City Marine Terminal.

Rail Objective 2: Encourage tenants that rely on rail operations that move cargo to use cleaner switchers.

Goes Beyond State Requirements

Knowledge & Capacity Building

S.4.10 Enabling

The Port has several options (or tools) to help advance emission reduction projects within and around the Tidelands, and to achieve the goals and objectives of the MCAS. Establishing voluntary programs, supporting regulatory efforts of other agencies, partnering on grant applications, providing incentives, and purchasing zero emission technology for its own fleet and equipment, as well as (subject to CEQA approval, reservation of discretion, and future Board approval) implementing projects are well established practices. Options that involve negotiating ZEV terms in leases, establishing new ZEV user fees, and/or imposing other mandatory ZEV requirements on tenants, workers, businesses, and others are more complicated because they may involve federal, State, and/or local requirements and responsibilities. In these cases, there may be disagreement among stakeholders regarding the Port's authority. From a technological and infrastructure perspective, considering emerging technologies and locational limitations for infrastructure, and maximizing emissions reductions are relevant to identifying and prioritizing potential projects intended to meet MCAS goals and objectives. While the Port may ultimately decide to rely on several options and tools to attain the goals identified for 2030, the following near-term enabling goals focus on establishing partnerships and completing the necessary due diligence and research to increase the likelihood of success.

Enabling Goal 1: Establish partnerships with stakeholders, tenants, and agencies to help increase the likelihood of implementation and project success.

Enabling Objective 1A: Pursue a potential Memorandum of Understanding with the San Diego Air Pollution Control District to administer California Air Resources Board Funding to help fund zero emission/ near zero emission trucks and/or cargo handling equipment.

Ambient Noise Reduction

Education and Training

Improved Health

Enabling Objective 1B: Work with the California Department of Transportation and other west coast ports to implement domestic shipping services to reduce emissions by facilitating the movement of goods by waterborne routes that are currently served by trucks or rail.

Jobs

Education and Training

Enabling Goal 2: Conduct the necessary research and analysis to inform additional options that could be used to help attain emission reductions and other MCAS-related goals.

Enabling Objective 2A: Create a clearinghouse process to track progress towards achieving MCAS and relevant AB 617 CERP goals and objectives, including technology and emission improvements associated with development, within 30-days of final approval of both documents.

Knowledge & Capacity Building

Note: *Once the formal clearing house process is established, Port staff will work expeditiously to put the information on-line so that the public can more easily monitor progress towards achieving the MCAS and AB 617 CERP related milestones and objectives. Given the broad range of emission reduction efforts and community engagement commitments, status updates and progress reports will vary as initiatives are further developed and funding and other resources are secured. For example, there may be monthly status updates for a period of time on the installation of shore power at the B Street Cruise Ship terminal (Oceangoing Vessels at Berth Objective 2A); whereas, preparing a comprehensive review of ZE truck technologies and providing recommendations to the Board is best handled at a 2-year interval (Truck Objective 1E). However, a high-level status update on all of the goals and objectives identified in the MCAS will be provided to the Board once a year.*

Enabling Objective 2B: Establish an Emissions Reduction Incentive Program.

Knowledge & Capacity Building

Education and Training

Enabling Objective 2C: Prepare a market study/feasibility analysis for the Board of Port Commissioners that explores a range of potential fees that can support zero emission/near zero emission reduction projects, as well as identify any implications the fee may have on the Port's revenue and maritime business opportunities.

Knowledge & Capacity Building

***Note**: At the July 13, 2021 Board of Port Commissioners meeting, as part of Item 8 - Presentation from staff on Financial Aspects and Funding Concepts Related to Electrification Initiatives on Port Tidelands and Direction to staff, the Board directed staff to return in September 2021 with more information about the market study/feasibility analysis and potential fees.*

Enabling Objective 2D: Explore potential credentials for installation and maintenance of emerging zero emission technologies and report recommendations to the Board of Port Commissioners by end of calendar year 2021.

Knowledge & Capacity Building

Enabling Objective 2E: Promote adoption of zero emission technologies by Port tenants, truckers, and other users of equipment.

Knowledge & Capacity Building

Education and Training

The Maritime Clean Air Strategy (MCAS) is a transformational policy document that provides pathways to a healthy, sustainable, and thriving future. Through a human health–centered vision, the MCAS holistically and inclusively advances public health with precedent-setting maritime-related goals and objectives for cleaner air and a suite of co-benefits that establish the San Diego Unified Port District (Port or Port of San Diego) as a leader.

Vision Statement

Health Equity for All.

Long-term Goal

100% zero emission Trucks and Cargo Handling Equipment by 2030.

Discussion

MCAS Vision Statement

The vision statement contains the aspirations that the Port would like to achieve.

On July 13, 2021, the Board of Port Commissioners (Board) identified a vision for the MCAS: Health Equity for All. The vision provides a higher-resolution lens for crisper and broader sight through which to view the primary and co-benefits of the MCAS. This vision is concise, transformational, and inclusive and acknowledges that the development and operation of a multiple-purpose use port like the Port of San Diego is to benefit all the people of California.[1] It focuses on public health for people who work, play, visit, or live near San Diego Bay, with an added emphasis on thriving maritime operations. The MCAS is part of a paradigm shift occurring across the United States, which recognizes that disadvantaged communities, defined within California Senate Bill (SB) 535 and by the California Environmental Protection Agency (CalEPA) as those communities in census tracts scoring in the top 25% in the CalEnviroScreen 3.0 data modeling tool, are disproportionally affected by incompatible land uses and industrialization. CalEnviroScreen weighs environmental factors, such as the level of pollutants, with social factors such as education, income, and ethnicity to produce a final score. The data from CalEnviroScreen show that disadvantaged communities are predominantly populated by people of color and have historically suffered more than their fair share of the environmental burden attributed to

[1] San Diego Unified Port District Act.

industrialization. More specifically, people of color face higher levels of pollution exposure from traffic and other sources.[2, 3, 4, 5]

This trend must be reversed and the MCAS outlines goals, objectives, and tools to be pursued to support action and advancement of environmental justice through the vision by addressing entrenched community disparities. "Health Equity for All" envisions a thriving Portside Community that enjoys a cleaner and more vibrant environment, with the Port as an active and inclusive partner in advancing environmental initiatives. This will require a sustained effort to position the region as a leader in setting and achieving ambitious clean air standards in support of healthy communities, a sustainable environment, and a thriving seaport.

MCAS's Long-term Goal

As a companion to the vision statement, the Board also identified a long-term goal to advance zero emission (ZE) truck and cargo handling equipment. Inclusion of a long-term goal is intended to identify a future state that the Port ideally desires to achieve with its partners in the upcoming decade. In addition to the primary benefit of clean air, the cumulative effect of transitioning to ZE trucks and cargo handling equipment will produce other community co-benefits such as new jobs, ambient noise reduction, and improved health. The State has also prioritized reducing emissions from these two sources.

In 2015, Governor Brown issued Executive Order (EO) B-32-15, which directed State agencies to establish targets to improve freight efficiency, transition to ZE technologies, and increase the competitiveness of California's freight transport system. In 2019, Governor Newsom signed EO N-19-19, which directed the State Transportation Agency to align the State's climate goals with transportation spending on planning, programming, and mitigation to achieve the objectives of the State's Climate Change Scoping Plan, where feasible. Finally, in September 2020, EO N-79-20 established that the State's goal is for 100% of the State's drayage truck fleet and off-road equipment to be ZE by 2035, and for 100% of medium- and heavy-duty vehicles to be ZE by 2045. These executive orders set the State's long-term vision for a sustainable freight transport system.

In support of California's direction and the MCAS vision, the long-term goal of 100% ZE trucks and cargo handling equipment serving Port operations at the marine terminals by 2030 has the potential to mitigate significant air quality impacts on the Portside Community attributed to the Port and exceeds the ZE goals

[2] "PM 2.5 polluters disproportionately and systematically affect people of color in the United States" (April 28, 2021) https://advances.sciencemag.org/content/7/18/eabf4491. Date accessed: July 21, 2021.

[3] "Deadly air pollutant 'disproportionately and systematically' harms Americans of color, study finds" (April 28, 2021) https://www.washingtonpost.com/climate-environment/2021/04/28/environmental-justice-pollution/. Date accessed: July 21, 2021.

[4] "Resolution of the Board of Supervisors of the County of San Diego Declaring Racism a Public Health Crisis" (January 12, 2021) https://www.sandiegocounty.gov/content/dam/sdc/lwhrc/011921/Jan%2019%202020%20Agenda%20Supporting%20Materials%20-%20Racism%20as%20a%20Public%20Health%20Crisis.pdf.

[5] "Pollution and Prejudice: Redlining and Environmental Injustice in California" (April 19, 2021), CalEPA: https://storymaps.arcgis.com/stories/f167b251809c43778a2f9f040f43d2f5.

established by the State of California by 5 years, and in some cases even longer. In alignment with its vision and long-term goal for trucks and cargo handling equipment, the MCAS also establishes additional complimentary long-term goals for 2030 for the other emission sources, as identified below:

Goal for Trucks: In advance of the State's goals identified in EO No. N-79-20, attain 100% ZE truck trips by 2030 for all trucks that call to the Port's two marine cargo terminals.

Goal for Cargo Handling Equipment: In advance of the State's goals identified in EO No. N-79-20, transition diesel cargo handling equipment to 100% ZE by 2030.

Goal for Harbor Craft: Tugboat related Diesel Particulate Matter (DPM) emissions identified in the Port's Emissions Inventory (2019) will be reduced by half by 2030 by transitioning to ZE/near-zero emission (NZE) technologies and/or other lower-emitting engines or alternative fuels.

Goal for Port Fleet: Transition Port-owned fleet of vehicles and equipment to ZE/NZE emission technologies in manner that meets operational needs and reduces emissions, as outlined below:

Transition light-, medium-, and heavy-duty vehicles beginning in 2022 to ZE.

Transition emergency vehicles to alternative fuels including hybrid, electric, and/or low-carbon fuels.

Convert equipment, such as forklifts and lawn maintenance equipment, to ZE.

Seek opportunities to advance lower emitting solutions for marine vessels.

Goal for Ocean-going Vessels: Equip marine terminals with shore power and/or an alternative technology to reduce ocean-going vessel emissions for ships that call to the Port.

MCAS's Near-term Goals and Objectives (2021 to 2026)

In support of its vision and long-term, the MCAS identifies ways of reducing emissions in the near-term for the seven maritime-related emission sources: cargo handling equipment, commercial harbor craft, shipyards, heavy-duty trucks, Port fleet, ocean-going vessels, and rail. As a result of public input and Board direction throughout development of the MCAS, three additional stakeholder priorities are also included in the MCAS: community enrichment, public health, and enabling actions, which also include near-term goals and objectives. For each of these ten areas, the MCAS includes specific, near-term goals and objectives to be accomplished between 2021 and June 30, 2026. While goals are broad statements that guide action, objectives are statements of a desired end. To the extent possible, the near-term goals and objectives have been written to be Specific, Measurable, Achievable, Relevant, Time-bound, Inclusive, and Equitable (or SMARTIE). Collectively, the near-term MCAS goals and objectives will lead to approximately 34 near-term projects, partnerships, and studies. If the 2030 goals represent where the Port desires to be in the future, these near-term goals and objectives identify where the work is going to start.

Environmental Justice and the Port of San Diego

The Port serves as an environmental steward of public Tidelands in and around San Diego Bay (Tidelands) and, as such, is committed to improving the quality of Tidelands and its surrounding environment. The objectives and strategies in the MCAS recognize the importance of improving the environmental health of disadvantaged communities and those that have been disproportionately and inequitably burdened by air quality impacts or other forms of environmental pollution.

In addition to promoting health equity for all, the Port is also committed to protecting waterfront jobs and ensuring that people from disadvantaged communities are afforded equitable opportunity to access Port Tidelands, participate in Port planning and public involvement processes, and enjoy a healthy environment. The Port will continue to promote these values through enhanced collaboration locally and regionally, as well as deepen relationships with indigenous communities, so that all communities near Tidelands and adjacent areas are cleaner and thriving places to work, live, and play.

Community Profile

Portside Community

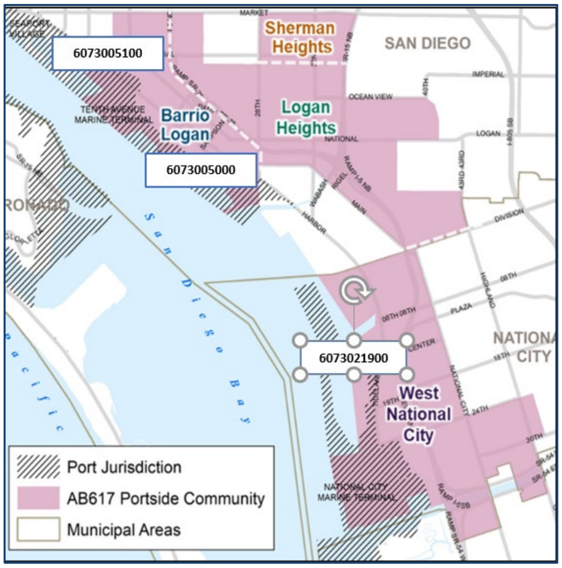
Overview

The Portside Community includes the neighborhoods of Barrio Logan, Logan Heights, and Sherman Heights in the City of San Diego, and West National City within National City. Port activities are a historical contributor of emissions to the Portside Community. However, as noted by the California Air Resources Board (CARB), the Portside Community "includes a variety of air pollution sources including the Port of San Diego, [but also] highly industrialized areas, and high truck traffic, including Interstate 5 and 15. The community also has large stationary sources like aircraft parts and auxiliary equipment manufacturing, and a power generation plant. The community also has a number of stationary sources including metal recyclers, welding shops, and auto body repair and paint shops that are located very close to homes."[6]

[6] California Air Resources Board website. https://ww2.arb.ca.gov/our-work/programs/community-air-protection-program/communities/portside-environmental-justice. Date accessed: July 30, 2021.

In 2018, as part of Assembly Bill (AB) 617, CARB selected the Portside Community for additional air quality monitoring by acknowledging that "communities near ports, railyards, warehouses, and freeways, for example, experience a higher concentration of air pollution than other areas due to emissions from mobile sources such as cars, trucks, locomotives and ships" (CARB, "Introduction to Community Air Quality" webpage). In 2019, the Portside Community was nominated by the San Diego Air Pollution Control District (SDAPCD) to participate in the AB 617 Community Air Protection Program for the development and implementation of a community emissions reduction program (CERP) that would be informed by the results of the additional air quality monitoring. It was nominated because it has several census tracts with some of the highest CalEnviroScreen 3.0 (CES 3.0) ratings in California and therefore is defined as an environmental justice community.

Figure I-1: Portside Community



The Portside Community includes 12 census tracts: four in the 98th percentile for CES 3.0, and eight in the 85th percentile for CES 3.0. This environmentally burdened and vulnerable community has over 50,000 residents. For this document, the MCAS highlights three census tracts (two in the Barrio Logan neighborhood of San Diego and one in the western portion of National City, as identified within the numbered boxes above in Figure I-1), all west of Interstates 5 and 15 adjacent to Port Tidelands. It should be noted that the complementary CERP includes more detail on additional census tracts.

Portside Community: Barrio Logan and West National City Neighborhood Description

The following is an abridged except from the Portside Environmental Justice Neighborhoods CERP:

> The Portside Community has a mix of residential and industrial land uses and is bisected by major transportation corridors including more than 13 miles of freeways that support regional and local transportation needs, including Interstate Highways 5 and 15, and part of the San Diego Coronado bridge.
>
> National City is the poorest city in San Diego County. It is a community of color with significant challenges including language barriers, insufficient access to reliable transportation and healthy food, and high exposure to pollutants. Notably, 22% of residents live below the federal poverty line and 35% of the population has less than a high school education. Most residents are people of color (88%) with Latinos constituting the greater share of the population (63%) and Asian-American/Pacific Islanders following with 20%.[7] The community is also quite young with approximately 26% of residents under the age of 18.

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[7] Demographic and Socioeconomic Profile 2010, Zip 91950. San Diego Association of Governments.

Barrio Logan is a mixed-use neighborhood south of downtown San Diego. Its bayfront is highly industrialized. In the period between the 1920s and 1950s, Mexican American, African American and Asian residents as well as Mexican immigrants moved into Logan Heights/Barrio Logan because of its proximity to the bay front, railroad jobs, and the availability of affordable housing.[8] The community was heavily residential and continued to be so as multi-family units were developed throughout the neighborhood to house the continuous influx of immigrant labor.

The neighborhood of Barrio Logan achieved its current identity because of its separation from Logan Heights due to the construction of Interstate 5 in 1963 and the San Diego-Coronado Bay Bridge in 1969, as well as the rezoning of the area from strictly residential to mixed use. Although it is considered a cultural gem of the county as San Diego's original Mexican-American neighborhood and a landmark site of the 1960s Chicano rights movement, the community still faces significant challenges: 78% of residents are characterized as low-income, 32% of the population is linguistically isolated, and 42% of the population has less than a high school education.[9]

Barrio Logan's rate of asthma-related hospital visits is higher than 92.9 percent of census tracts throughout the state, with about 81 visits per 10,000 people. Cancer is also a major health hazard for residents. Barrio Logan's cancer risk is in the 80th- 90th percentile nationally.

CalEnviroScreen 3.0 (CES 3.0)[10]

The California Office of Environmental Health Hazard Assessment (OEHHA), which is a part of CalEPA, serves as the scientific foundation for CalEPA's environmental regulations and provides valuable information to consumers, policy makers, and manufactures on the safety of chemicals in our environment. OEHHA is also the agency responsible for developing and updating the CalEnviroScreen tool. CalEnviroScreen is a science-based mapping tool that helps identify California communities that are most affected by many sources of pollution, and that are often especially vulnerable to pollution's effects. CES 3.0 is the current approved version and assesses several indicators; very high specific indicators drive overall community percentiles up. CES 3.0 percentiles of the Portside Community reflect the fact that emissions from a variety of historic and industrial and commercial uses, including those at the Port, those occurring within and adjacent to the Portside Community, and national defense operations, have disproportionately burdened the Portside Community. The focus of the MCAS is to set realistic and achievable goals to reduce indicators tied to maritime emissions within the Port's control, such as DPM (which is cumulatively linked to asthma, a source and

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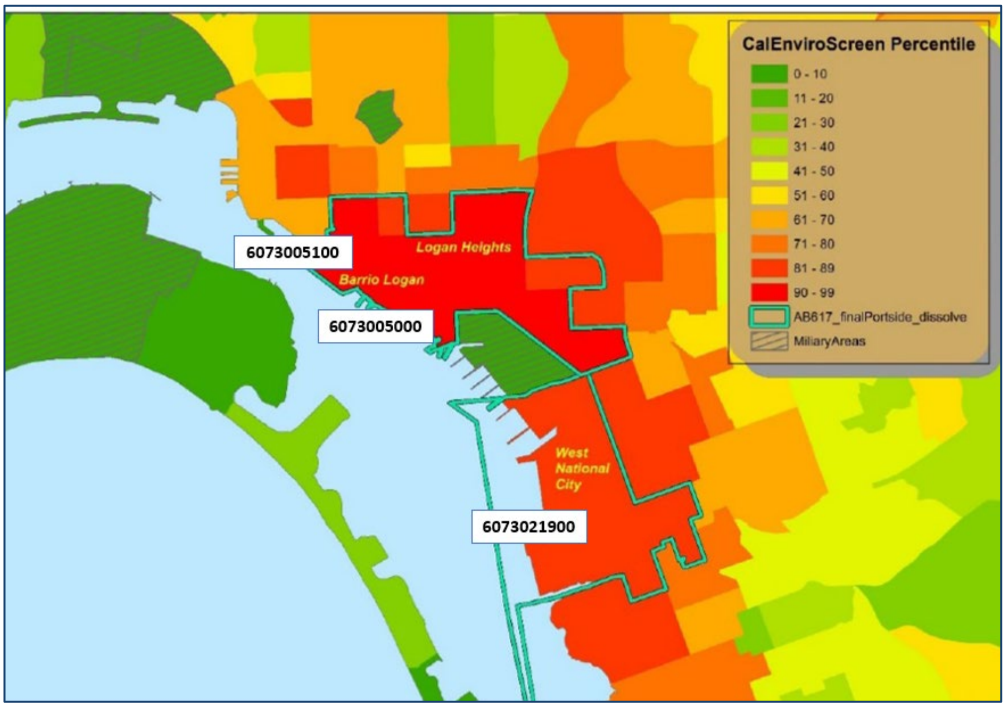
[8] Smith, Brian F. and Associates and the City of San Diego City Planning and Community Investment/Planning Divisions. "Barrio Logan Historical Resources Survey." February 1, 2011.

[9] "EJSCREEN Report (Version 2016) Block group: 060730050001." EJSCREEN Tool. U.S. Environmental Protection Agency.

[10] The State of California is currently working on an update to CalEnviroScreen, CES 4.0; however, it is still in draft form and is anticipated to be adopted in 2021.

consequence of poor air quality), in order to decrease the impact those specific indicators have on overall community health and percentiles. Reducing cumulative impact from DPM should support healthier communities, resulting in less disparity in and around San Diego Bay. See Figure I-2 for reference. The Portside Community includes 12 census tracts; however, for purposes of providing CES 3.0 background data, the MCAS focuses on the two Barrio Logan Census tracts (6073005000 and 6073005100) and the West National City Census tract (6073021900).

Figure I-2: MCAS Focused CalEnviroScreen 3.0 Census Tracts



DPM, which is a known carcinogen and the greatest toxic air pollutant risk in San Diego County, is one of the challenges faced by the community. All three census tracts have DPM exposure risk of greater than the 95th percentile. Additionally, the Barrio Logan neighborhood ranks high on the asthma indicator; coupled with significant pollution exposure, residents are more vulnerable to effects of asthma.

Table I-1: CES 3.0 Data for Barrio Logan and West National City Neighborhoods[11]

Neighborhood & Census Tract	CES 3.0 Overall Percentile	Diesel Particulate Matter (DPM) Percentile	Asthma Percentile
Barrio Logan (North)	95.79%	99.65%	81.00%

[11] The data included in this table are abridged from *the Portside Environmental Justice Neighborhoods Community Emissions Reduction Plan (CERP),* pages 14–18.

Neighborhood & Census Tract	CES 3.0 Overall Percentile	Diesel Particulate Matter (DPM) Percentile	Asthma Percentile
6073005100			
Barrio Logan (South) 6073005000	99.42%	99.65%	97.23%
West National City 6073021900	87.55%	95.49%	13.76%

The path to greater health equity for these Portside Communities will be chartered by progress in reducing exposure and occurrence of these indicators and, in turn, lowering their respective overall percentiles. The MCAS vision aims at accelerating actions already underway to reverse the historical trends that led to such a disparity amongst the overall percentiles of various neighborhoods and census tracts. The Port intends to serve as a catalyst for change and a regional hub for the transition of a reliance on traditional fossil fuel energy sources to a cleaner electric future.

It is of note that DPM and asthma indicators only tell a part of the story: there are significant socioeconomic indicators that show how the Barrio Logan and West National City Communities are limited in overcoming the pollution exposure and environmental effects. For the CES 3.0 Poverty indicator, residents in Barrio Logan are in the 91st percentile and residents in West National City are in the 84th percentile. The high poverty rate prevents residents from purchasing goods and services that would minimize any exposure. For the CES 3.0 Housing Burden indicator, residents in Barrio Logan are in the 92nd percentile and residents in West National City are in the 81st percentile. With significant poverty levels and having much of their limited income going toward housing, their ability to protect themselves from pollution exposure is greatly limited and highlights the need for the call to action led by the MCAS and the CERP. As of the publication date of the MCAS, the CES 4.0 (an update to CES 3.0) was still under development, but a draft was available for review in February 2021.

CES 3.0 Data in Practice

In 2021, CalEPA prepared a story map to help its staff, as well as the public, explore the connection between land use and environmental justice to better understand how environmental conditions are informed by legacy land use practices can help better focus and refine policy development to ensure equitable access to clean air, water, and land.[12] The story map includes data from CES 3.0 and digitized 1930s-era neighborhood assessment forms with California Home Owners Loan Corporation (HOLC) designations (today, often referred to as a form of redlining). The "Take-Aways" from the story map find that neighborhoods with less favorable HOLC risk ratings are generally associated with worse environmental conditions and greater population vulnerability to the effects of pollution today, and that people of color are over-represented in these neighborhoods. In addition, the story map demonstrates that assessing environmental conditions against the

[12] "Pollution and Prejudice: Redlining and Environmental Injustice in California" (April 19, 2021) CalEPA: https://storymaps.arcgis.com/stories/f167b251809c43778a2f9f040f43d2f5.

backdrop of data on income, class, and race and ethnicity can help us all better understand our shared history and, in partnership, construct shared solutions.

Port of San Diego as a Trustee

The San Diego Unified Port Act was established by the California legislature as outlined below to benefit to the people of California and provides critical guidance on the Port's mission. Port Act Section 2, State Policy states:

"It is hereby declared to be the policy of the State of California to develop the harbors and ports of this State for multiple purpose use for the benefit of the people. A necessity exists within San Diego County for such development. Because of the several separate cities and unincorporated populated areas in the area hereinafter described, only a specially created district can operate effectively in developing the harbors and port facilities. Because of the unique problems presented by this area, and the facts and circumstances relative to the development of harbor and port facilities, the adoption of a special act and the creation of a special district is required."

Additionally, environmental stewardship and the development, protection, and promotion of harbor-related operations are the core objectives of the Port as State trustee of the Tidelands. Port operations involve the transport of goods and services throughout the San Diego region and beyond. Overall direct and indirect economic impacts from the maritime industry operating in and around the Tidelands generate approximately \$4.3 billion and support nearly 25,000 jobs in the San Diego County region.[13] Many of these operations and activities utilize ocean-going vessels, railroads, heavy-duty trucks and vehicles, and equipment primarily powered by diesel engines, all of which produce air pollutant emissions. Advancing maritime operations and environmental stewardship are central to the Port's mission and are also prioritized by the California Coastal Act:

California Coastal Act Section 30708
Location, Design and Construction of Port-related Developments

All port-related developments shall be located, designed, and constructed so as to: (a) Minimize substantial adverse environmental impacts. (b) Minimize potential traffic conflicts between vessels. (c) Give highest priority to the use of existing land space within harbors for port purposes, including, but not limited to, navigational facilities, shipping industries, and necessary support and access facilities. (d) Provide for other beneficial uses consistent with the public trust, including, but not limited to, recreation and wildlife habitat uses, to the extent feasible. (e) Encourage rail service to port areas and multicompany use of facilities.

[13] Economic Impacts of the San Diego Unified Port District in 2017. Economic & Planning Systems, Inc., February 28, 2019.

The Port's MCAS is a guidance document that will assist the Port with identifying, prioritizing, and implementing emission reduction initiatives in a holistic and comprehensive manner. Based on Port-specific assets, inventories, and operations, as well as current and anticipated future harbor uses, the MCAS identifies emission reduction strategies that aim for health equity for all through striving for 100% ZE trucks and cargo handling equipment by 2030. The MCAS includes near-term goals and objectives through June 30, 2026 (1 to 5 years), as well as longer-term goals through 2030 (5 to 9 years), with a commitment to updating the strategy in 2025 to reflect new information and technology. Additionally, the MCAS provides background information on seven maritime-related operational sources and three stakeholder priorities including community enrichment, public health, and enabling actions. More generally, the MCAS seeks to provide recommendations and pathways in accordance with the following guiding principles, which are comprehensive statements that incorporate the Port's mission and values and serve as a foundation for the Port's MCAS:

Health Equity for All

Promote environmental stewardship and maritime activities, in accordance with the California Coastal Act, the Public Trust Doctrine, the Port Act, the Port's Strategic Port designation, and other applicable laws and regulations.

Advance emission reduction efforts that are ambitious and that provide direct benefits to the Portside Community residents and workers through ongoing engagement with a diverse group of community stakeholders, including the AB 617 Portside Community Steering Committee and subcommittees.

Address equity and environmental justice through transparency, broad community engagement efforts, and by providing meaningful opportunities for residents to participate in the decision-making.

Community engagement efforts shall continuously recognize and acknowledge that the nearby Portside Community has a high cumulative pollution exposure burden and that it includes several census tracts that have been designated as disadvantaged communities by the State.

Support and endeavor to exceed California's 2035 Zero- and Near-Zero Emission Heavy- and Medium-Duty Vehicle goals and emission reduction targets and align with the California Sustainable Freight Action Plan and related sustainability initiatives.

It should be noted that while these broad principles are likely to remain unchanged, emission reduction regulations and technologies are rapidly evolving, which could affect the costs, feasibility, and prioritization of several emission reduction strategies. As such, the MCAS will be updated in 2025 with supplemental technology reviews that consider regulatory changes at the federal, State, and local levels; new and/or expanded technologies; and cost estimates, market availability, and funding opportunities.

Background

The MCAS was developed pursuant to direction provided by the Board of Port Commissioners, California AB 617, as well as an extensive and robust public engagement process. Background is provided below along with a discussion explaining the difference between various Port long-range planning documents and a summary of stakeholder engagement efforts to date.

Assembly Bill 617 – Community Air Protection Program

CARB established the Community Air Protection Program (or AB 617 Program) in 2018, which tasks local air pollution control districts to work with communities to develop community focused emission reduction programs. In September 2018, CARB selected the Portside Community.

Based on the AB 617 Program and the State's ongoing efforts to reduce emissions, improve air quality, and combat climate change, the Board adopted Board Resolution #2019-084 in June 2019 authorizing staff to update the Port's 2007 Clean Air Program. The resolution also directed staff to develop Port-related plans and projects that reduce emissions and improve air quality. Acknowledging the complexity of emission reduction efforts, particularly on Port Tidelands, the Board also directed staff to do additional research to help inform the establishment of potential emission reduction targets. The Board emphasized its desire for the Port to lead in emission reduction efforts and encouraged staff to develop emission reduction targets and/or goals that were Specific, Measurable, Achievable, Relevant and Timebound (S.M.A.R.T).[14] Finally, the Board directed staff to work closely with community residents, Port tenants, public agencies, and other pertinent stakeholders, including the AB 617 Portside Community Steering Committee, while preparing the MCAS.

Port of San Diego Long-Range Planning Documents

The Port has several long-range planning documents that apply to varying aspects of the agency's operations and serve different functions with some overlap, where applicable. In addition to the MCAS, these plans include the Climate Action Plan, Port Master Plan, and Sea Level Rise Vulnerability Assessment and Coastal Resiliency Report. For more information, please refer to Table I-2, below.

Table I-2: Port of San Diego's Long-Range Plans Comparison

Plan Name	Purpose	State Legislation, Laws & Guidance	Relevant State Agencies
Maritime Clean Air Strategy (MCAS)	Guidance and strategic policy document to reduce **localized air pollutants and toxic air contaminants** associated with Port and maritime-related activities in alignment with the AB 617 Community Air Protection Program (2018) and the State's Sustainable Freight Strategy (July 2016).	• AB 617 (Community Air Protection Program) • EO N-79-20 (Climate Crisis) • CARB Regulations	• CARB

[14] As the result of subsequent public engagement efforts, this acronym was expanded to SMARTIE, to underscore that goals and objectives should also be inclusive by adding an "I" and equitable by adding an "E."

Plan Name	Purpose	State Legislation, Laws & Guidance	Relevant State Agencies
Climate Action Plan	Roadmap Document to reduce **greenhouse gas (GHG) emissions** in alignment with State goal for 2030, and potential downward trajectories for 2050.	• Senate Bill (SB) 97 (GHG analysis in the California Environmental Quality Act, 2007 & 2018) • EO S-03-05 – State GHG Emissions to 1990 levels by 2020 & 80% below 1990 levels by 2050 • AB 32 (2006, Nunez) – CARB to implement regulations to meet 2020 targets • SB 32 (2016, Pavley) – Codified 2030 emission reduction goal of 40% below 1990 levels by 2030.	• Office of Planning & Research • California Natural Resources Agency
Port Master Plan	Guiding land use document for all development within the Port's water and land jurisdiction. The Port Master Plan and any subsequent amendments must be certified by the California Coastal Commission.	• The California Coastal Act • The San Diego Unified Port District Act	• California Coastal Commission • California State Lands Commission
AB 691 Sea Level Rise Vulnerability Assessment and Coastal Resiliency Report	Vulnerability assessment required to be prepared by certain trustees of state public lands to address projected sea level rise within trustee jurisdiction	AB 691 (Proactive Planning for Sea-Level Rise Impacts)	• California Coastal Commission • Ocean Protection Council • State Lands Commission

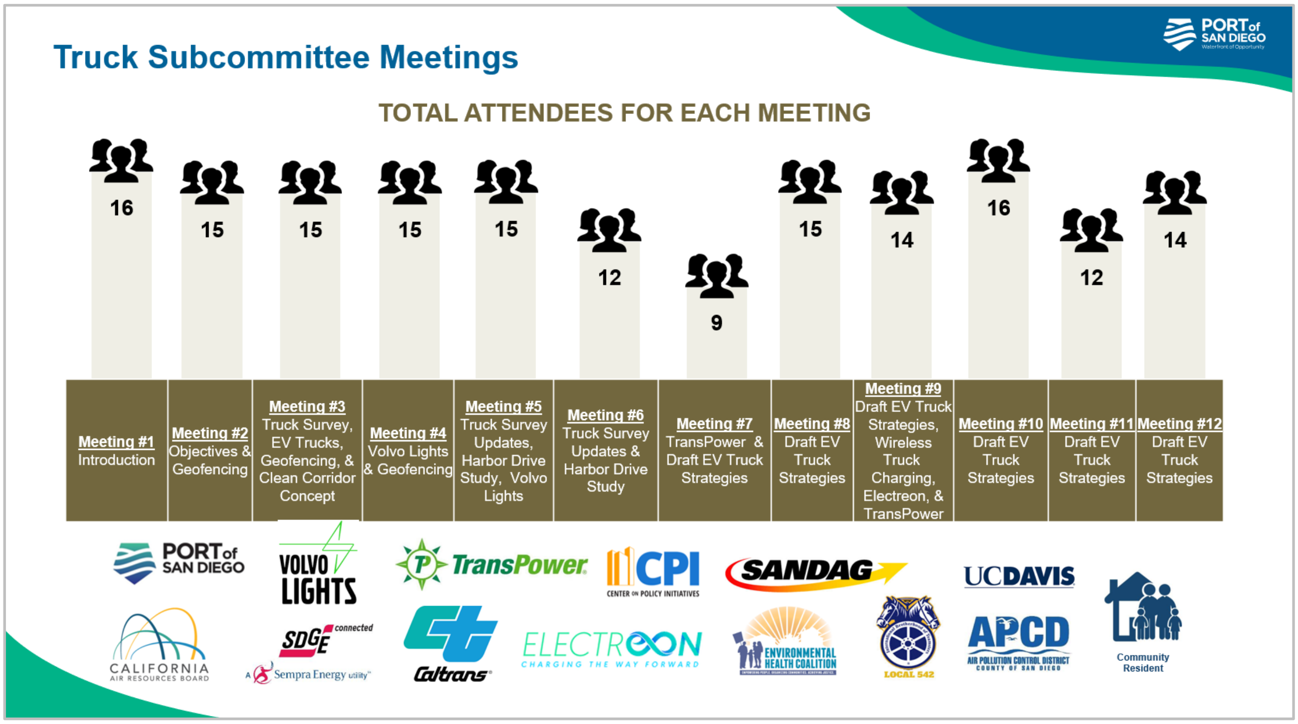
Stakeholder Engagement

Extensive stakeholder involvement has been the cornerstone of the MCAS. Initially, the AB 617 Portside Community Steering Committee served as the primary vehicle for stakeholder engagement. However, the subsequent establishment of several AB 617 subcommittees enabled staff to work more closely on emission reductions efforts with community residents, tenants, and several public agencies including staff from CARB, the San Diego Association of Governments (SANDAG), SDAPCD, the California Department of Transportation (Caltrans), San Diego Gas and Electric (SDG&E), City of San Diego, City of National City, and the U.S. Navy. The subcommittee structure proved to be ideal because it allowed for a sustained, transparent, and meaningful exchange of ideas.

The following AB 617 Subcommittees helped review, identify, develop, and refine much of the information included in the MCAS:

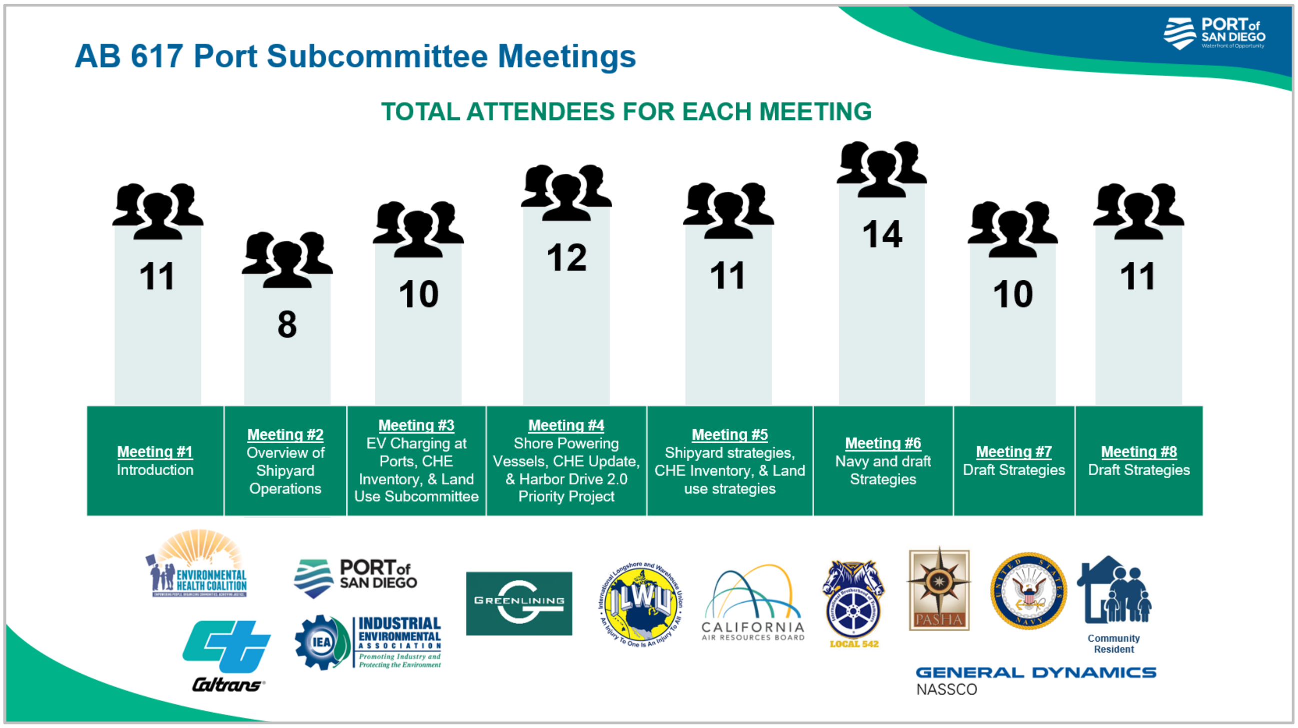
AB 617 Truck Subcommittee: This subcommittee met 12 times between May and July 2020 to discuss the technological and institutional obstacles to greater electrification of truck fleets, particularly trucks serving the Port's cargo terminals. Membership included representatives from SANDAG, Caltrans, SDG&E, Teamsters Local Union No. 542, and SDAPCD staff. Other participants from CARB, Volvo Lights, TransPower, Electreon, and University of California, Davis participated in certain meetings to cover specific topics.

Figure I-3: AB 617 Truck Subcommittee Meeting Summary



AB 617 Port Subcommittee: This subcommittee met eight times in June and July 2020 to produce a set of recommendations that addressed emissions along the working waterfront. Representatives from NASSCO, Pasha Automotive Services, the U.S. Navy, and the Teamsters Local Union No. 542 served on the Port subcommittee. Other meeting attendees included representatives from CARB, Caltrans, the International Longshore and Warehouse Union Local 29, the Industrial Environmental Association, and the Greenlining Institute.

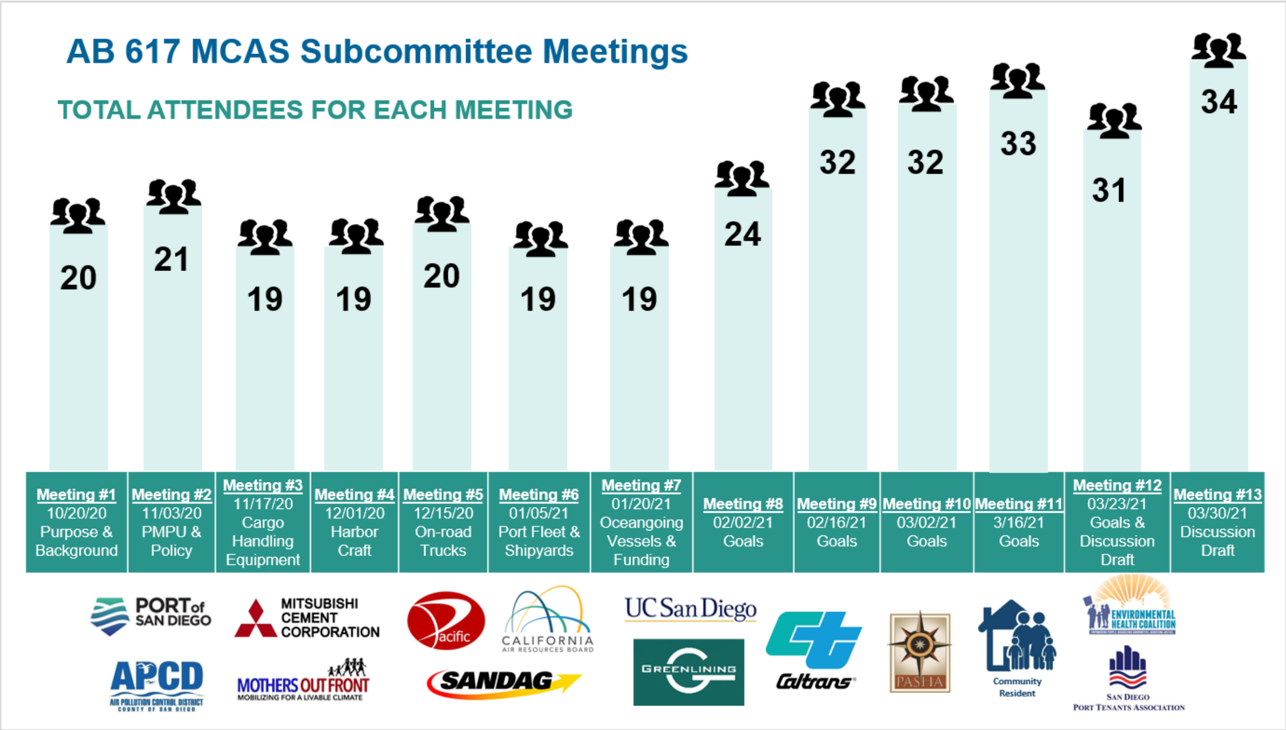
Figure I-4: AB 617 Port Subcommittee Meeting Summary



AB 617 MCAS Subcommittee**:** Building off the work of the Truck and Port Subcommittee, the MCAS Subcommittee met 13 times between October 2020 and March 2021. This subcommittee worked with Port staff to help prepare the MCAS by reviewing emissions data and other background information and with identifying potential emission reduction goals, objectives, and strategies. Attendance ranged between 19 and 31 people and included several Port tenants. Formal subcommittee membership included 16 people representing agencies and groups as follows:

- Mothers Out Front
- Greenling Institute
- Environmental Health Coalition
- Portside Community Residents
- SDAPCD
- Caltrans
- CARB
- National City Marine Terminal Operator
- Pacific Tugboat
- University of California, San Diego PhD student
- Port staff

Figure I-5: AB 617 MCAS Subcommittee Meeting Summary



In the spirit of continuing robust stakeholder engagement through the entire MCAS process including after adoption and through the implementation phase, Port staff shall continue its sustained effort to actively inform and engage the Portside Community with periodic status updates presented to the Barrio Logan Community Planning Group and National City's City Council.

II.1 Background and Context

Addressing air quality and public health is an essential government function at every level. At the federal level, the U.S. Environmental Protection Agency (EPA) is responsible for implementing the Clean Air Act (CAA), which established the National Ambient Air Quality Standards (NAAQS) to protect the public's health from harmful criteria air pollutants. If the air quality in a geographic area meets or is cleaner than the NAAQS, it is called an attainment area (designated "attainment/unclassifiable"); areas that don't meet NAAQS are called nonattainment areas. In some cases, the EPA is not able to determine an area's status after evaluating the available information and those areas are designated "unclassifiable." EPA has also established regulations for hazardous air pollutants (HAPs) from large industrial facilities, area sources, and mobile sources. Individuals exposed to these HAPs may have an increased chance of getting cancer or experience serious health effects.

In California, the California Air Resources Board (CARB) is responsible for implementing the California Clean Air Act (CCAA); and like the EPA, established the California Ambient Air Quality Standards (CAAQS). The CAAQS were established to help protect the public's health from criteria pollutants. CAAQS are generally more stringent than the NAAQS and incorporate additional standards for sulfate, hydrogen sulfide, vinyl chloride, and visibility-reducing particles. Furthermore, CARB relies on the California Office of Environmental Health Hazard Assessment (OEHHA) to conduct research and health literature review to develop recommendations for the CAAQS.

In addition, California has adopted regulations, such as the Air Toxics Hot Spots Information and Assessment Act (AB 2588, Connely 1987), to help protect the public from toxic air contaminants (TACs). Under AB 2588, CARB is required to develop a program to make emission data collected under the "Hot Spots" program available to the public. According to CARB, TACs may cause or contribute to an increase in mortality or an increase in serious illness or may pose a present or potential hazard to human health. OEHHA is also responsible for conducting research and health literature review to develop recommendations for TACs.

California also relies on the Diesel Risk Reduction Plan[1] and the Sustainable Freight Action Plan[2] to help reduce criteria pollutant and TAC emissions from off-road sources, stationary sources, mobile sources, and the freight transport system.

The Diesel Risk Reduction Plan was adopted by CARB in 2000 with the goal of reducing diesel particulate matter (DPM) emissions within the state of California. According to the Diesel Risk Reduction Plan, DPM emissions would be reduced with the adoption of new regulatory standards for on-road, off-road, and stationary diesel-fueled engines and vehicles. The Diesel Risk Reduction Plan recommended the

[1] California Air Resources Board. *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*. 2000. Available: https://ww2.arb.ca.gov/sites/default/files/classic/diesel/documents/rrpfinal.pdf. Accessed: July 2021.
[2] California Air Resources Board. *California Sustainable Freight Action Plan*. July 2016. Available: https://ww2.arb.ca.gov/sites/default/files/2019-10/CSFAP_FINAL_07272016.pdf. Accessed: July 2021.

implementation of state-of-the-art catalyzed diesel particulate filters (DPFs) and very low-sulfur diesel fuel. Since the release of the Diesel Risk Reduction Plan in 2000, DPM emissions within the state of California have lowered by approximately 50 percent.[3]

The California Sustainable Freight Action Plan underscores the need to modernize California's freight transport system in a manner that improves safety and reduces air pollution as essential to improving public health and meeting our environmental imperatives. It acknowledges that "technologies, such as zero emission and near-zero emission vehicles, intelligent transportation systems, and automated connected vehicles can help alleviate the impacts on the environment and public health, as well as increase system wide efficiencies." The incorporation of zero emission and near-zero emission vehicles would help reduce criteria air pollutant and DPM emissions; which would help improve air quality and public health.

At the local level, the San Diego Air Pollution Control District (SDAPCD) is responsible for implementing rules and regulations to help reduce criteria pollutants and TACs from stationary sources and portable equipment. Specifically, SDPACD has adopted Rule 1210: Toxic Air Contaminant Public Health Risks – Public Notification and Risk Reductions, which requires facilities whose public health risk assessment shows potential risks above specified levels (100 per million) to implement a risk reduction plan to reduce those risks below the significance level within five years. It also requires that that the owner or operator of a stationary source, with a public HRA that has a cancer or hazard risk that indicates potential public health risks, shall provide written public notice to sensitive receptors of such risks.

In May 2019, Supervisor Nathan Fletcher directed the SDAPCD Officer to lower the 100 per million threshold (thereby making it more restrictive) as a way to improve public health. In July 2021, Phase II of the Portside Community AB 617 CERP was approved by the San Diego County Air Pollution Control Board, which states under Goal 8: By 2026 reduce the cancer risk below 10/million for each permitted stationary source, including portable equipment, in the Portside Environmental Justice Community. In pursuit of this goal, the SDAPCD has committed to implementing a regulatory process to amend Rule 1210 and to propose Rule 1210 amendments to the San Diego Air Pollution Control Board by October 2021. The Port's commitment to work with SDAPCD on any modifications to Rule 1210 is identified in the Shipyards chapter because shipyards are stationary, permitted facilities regulated by SDAPCD, which are likely to be affected by amendments to Rule 1210.

To help reduce potential criteria pollutant and TAC emissions and improve public health, the Port is committed to doing its part by prioritizing investments in zero emission and near- zero technologies.

[3] California Air Resources Board. *Overview: Diesel Exhaust & Health*. Available: https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health. Accessed: July 2021.

II.1.1 Important Air Pollutants that Affect the Health of People

The San Diego Unified Port District (Port) Maritime Clean Air Strategy (MCAS) aims to reduce criteria pollutant and TAC emissions. Specifically, the MCAS targets the reduction of two pollutants (nitrogen oxides or NO_x and DPM emissions) that are known to have adverse health-related impacts.

The two most prevalent nitrogen oxides are NO_2 and nitric oxide (NO), and the combination is often referred to as NO_X. NO_2 is formed by the combination of NO and oxygen through internal combustion. It is a pungent gas that, along with $PM_{2.5}$, contributes to the reddish-brown haze characteristic of smoggy air in California. NO_x is an integral participant in ozone formation, which the San Diego County is in nonattainment for the NAAQS and CAAQS.

DPM differs from other TACs in that it is not a single substance, but rather a complex mixture of hundreds of substances. DPM is emitted from both mobile and stationary sources. Diesel exhaust is composed of two phases, gas and particle, and both phases contribute to the health risk. The gas phase is composed of many of the urban TACs, such as acetaldehyde, acrolein, benzene, 1,3-butadiene, formaldehyde, and polycyclic aromatic hydrocarbons. These are typically called Mobile Source Air Toxic's (MSATs). The particle phase is also composed of many different types of particles by size or composition, typically falling within the fine particulate ($PM_{2.5}$) category.

II.1.2 Common Health Problems Associated with Air Pollution

Communities around California's ports and marine terminals bear a disproportionate health burden due to their close proximity to emissions from vessels (at berth, at anchor, during maneuvering, and while in transit) and other emission sources including trucks, locomotives, and terminal equipment serving the port.

The Portside Community has some of the worst air quality in San Diego County, as indicated by DPM levels incorporated in the CalEnviroScreen 3.0 tool that is further discussed below. Polluted air with higher concentration of NO_X, $PM_{2.5}$, and DPM can contribute to higher rates of asthma, cardiovascular disease, and a variety of other health related impacts.

A large body of health science literature indicates that exposure to NO_x, or specifically NO_2, can induce adverse health effects. The strongest health evidence, and the health basis for the CAAQS for NO_2, are results from controlled human exposure studies that show that NO_2 exposure can intensify responses to allergens in allergic asthmatics. In addition, several epidemiological studies have demonstrated associations between NO_2 exposure and premature death, cardiopulmonary effects, decreased lung function growth in children, respiratory symptoms, emergency room visits for asthma, and intensified allergic responses[4]. NO_2 emissions can also reduce visibility and react with water, oxygen, and other chemicals to contribute to acid rain.[5]

Exposure to DPM comes from on-road, off-road, and stationary engine exhaust that is either directly emitted from the engines or aged through lingering in the atmosphere. DPM causes health effects from both short-term or acute exposures, and long-term chronic exposures.

DPM has a significant impact on California's population. It is estimated that about 70 percent of total known cancer risk related to TAC's in California is attributable to DPM. Based on 2012 estimates of statewide exposure, DPM is estimated to increase statewide cancer risk by 520 cancers per million residents exposed over a lifetime. Furthermore, non-cancer health effects associated with exposure to DPM is estimated to cause approximately 730 cardiopulmonary death's, 160 hospitalizations (cardiovascular and respiratory), and 370 emergency room visits annually within California.[6]

II.2 Tools and Resources to Help Measure Public Health

II.2.1 CalEnviroScreen 3.0

OEHHA maintains the California Communities Environmental Health Screening Tool (CalEnviroScreen or CES 3.0), which provides a relative ranking of communities based on a selected group of environmental, health, demographic, and socioeconomic indicators. The resultant score is the relative pollution burden and vulnerabilities in one census tract compared to others but is not a measure of health risk. Rather, each tract's score is ranked relative to all areas in the state. Those areas with a high score and percentile have relatively high pollution burdens and population sensitivities; those areas with low score and percentile values have relatively lower pollution burdens with less sensitive populations.

The currently adopted version of CalEnviroScreen is CES 3.0, which was mostly recently updated in June 2018. CalEnviroScreen4.0 was released for public review in February 2021 and is currently undergoing edits to address public and stakeholder comments. CalEnviroScreen4.0 is expected to be adopted sometime in 2021.

Pollution Burden scores for each census tract are derived from the average percentiles of the seven Exposures indicators - ozone and $PM_{2.5}$ concentrations, DPM emissions, drinking water contaminants, pesticide use, toxic releases from facilities, and traffic density - and the five Environmental Effects indicators - cleanup sites, impaired water bodies, groundwater threats, hazardous waste facilities and generators, and solid waste sites and facilities.

[4] California Air Resources Board. *Nitrogen Dioxide & Health*. Available: https://ww2.arb.ca.gov/resources/nitrogen-dioxide-and-health. Accessed: July 2021.
[5] California Air Pollution Control Officers Association. *Health Effects*. Available: http://www.capcoa.org/health-effects/. Accessed: July 2021.
[6] Refer to footnote number 3.

The AB 617 Portside Community includes several census tracts with high (poor) ratings as part of the CalEnviroScreen, including four census tracts that are in the 98th percentile in the state and another eight that are in the 85th percentile. Over 50,000 residents live in this area and are subject to pollution exposure (SDAPCD 2018). The Portside Community, along with other areas selected for monitoring throughout the state, will see additional new actions through potential regulations, focused incentive investments, enforceable agreements, and engagement with local land use authorities to reduce emissions and exposure to air pollution

II.2.2 Health Risk Assessments

Health Risk assessments (HRAs) are performed by air districts and local agencies to determine the potential human health impact at a sensitive receptor due to the air toxics emissions from a specific source. HRAs use air dispersion models to estimate concentrations of air pollutants in the air. These concentrations are then applied to standard health values or cancer potency factors established by the OEHHA to estimate health risks. For cancer health effects, the risk is expressed as the number of chances in a population of a million people who might be expected to get cancer, if they were to breathe the estimated concentration of pollution over a 30-year or 70-year lifetime. The number may be stated as “10 in a million” or “10 chances per million”.

While HRAs are an insightful tool for analyzing potential public health risks stemming from air pollution, they do have their limitations. Some of these limitations include incomplete emission inventories when data is unavailable, unknown source location; especially for highly variable sources such as boats or vehicles, and exposure durations at a single modeling grid point. To mitigate these limitations, close coordination between CARB, SDAPCD, and the Port is required.

As noted, CARB has formally identified over 200 substances and groups of substances as TACs. In most studies, DPM is the most significant TAC, accounting for 70% TAC-related cancer risk statewide, and 85% of TAC-related cancer risk in the West Oakland CERP.[7]

Exposure to DPM is a main contributor to many port communities with high (poor) ratings in CalEnviroScreen. Various port-wide HRAs have been implemented at the statewide, regional, and local level. to estimate health effects for rulemaking, environmental documentation, or to track progress of emission reduction plans. In 2018, CARB conducted HRAs to evaluate the health impacts of emissions, as well as public health benefits from control measures, from ocean-going vessels operating at berth at the Port of Los Angeles (POLA), Port of Long Beach (POLB), and the Richmond Complex. According to these studies, once fully implemented, implementation of the control measure would reduce air pollution from ocean-going vessels at berth by

[7] Bay Area Air Quality Management District (BAAQMD*). Owning Our Air: The West Oakland Community Action Plan (Final) – Volume 2: Appendices*. Available: https://www.baaqmd.gov/community-health/community-health-protection-program/west-oakland-community-action-plan. Accessed: July 2021.

approximately 90 percent and would result in a 55 percent reduction in potential cancer risk for communities near the POLA, POLB, and Richmond Complex.[8]

In 2019, CARB and BAAQMD worked to spatially map the contribution of emissions from major emissions sources to pollutant concentrations within the West Oakland community that may potentially impact current and future, as part of the West Oakland CERP.[9]

These HRAs informed these agencies to better identify and prioritize future emission reduction strategies that reduce emissions that result in increased health risk in the community.

II.3 Portside Community Health Risk Assessment

Following substantial stakeholder engagement regarding the link between emissions and public health, at the May 11, 2021 Board meeting, the Board directed Port staff to evaluate the health effects associated with Port operations based on its 2019 Air Emissions Inventory.

The HRA will help the Port identify health risk reduction goals in line with the Port's prioritization of community health. The HRA will be based on cargo movements at both cargo terminals (TAMT and NCMT) and will focus on diesel-related risk. The HRA will identify baseline health risk and evaluate the effect of attaining the objectives identified in the MCAS. The HRA will be completed in October 2021 and presented to the Board prior to the end of the calendar year.

[8] California Air Resources Board. *Preliminary Health Analyses for Public Review in Advance of the Initial Statement of Reasons (ISOR) for the Control Measure for Ocean-Going Vessels At Berth and At Anchor*. Available: https://ww2.arb.ca.gov/sites/default/files/classic//ports/shorepower/meetings/11052018/prelimhealthanalyses.pdf. Release Date: November 5, 2018. Accessed: July 2021.

[9] Refer to footnote number 7.

II.4 Goals and Objectives

Health Goal 1: Protect and improve community health by reducing emissions and lessening Portside Community residents' exposure to poor air quality.

Health Objective 1: By October 2021, identify existing health risk levels generated from the Port's Tenth Avenue Marine Terminal and the National City Marine Terminal for Diesel Particulate Matter (DPM) and other Toxic Air Contaminant emissions.

a. Reduce DPM Emissions: The HRA may be used to inform an emission reduction goal

b. Reduce Health Risk: The HRA may be used to inform a cancer risk reduction goal

Note: *Completing* the *Health Risk Assessment for the Port's marine terminals will provide baseline health risk information through a refined locational analysis and will be an important reference, as the Port makes progress on the MCAS.* This *assessment* is *Port-centric* and focuses on freight activity*, as opposed to the regional focus of the cumulative or community health risk analysis addressed in Health Objective 2.*

Discussion

The Port will conduct a HRA to analyze the health risk levels at nearby sensitive receptors - based on its cargo operations at TAMT and NCMT. More specifically, the HRA will look at the DPM and TAC emission sources at these facilities to establish an updated baseline utilizing the Port's 2019 Maritime Air Emissions Inventory. The results of the HRA may be used to inform terminal-specific emission reduction goals, as well as other health goals such as reducing cancer risk.

Health Objective 2: Assist the San Diego Air Pollution Control District and the California Air Resources Board with preparing a cumulative or community health risk analysis for the AB 617 Portside Community by providing them with the Port's Health Risk Assessment (October 2021) and other operational related information.

Note: *The California Air Resources Board has begun preparing a cumulative or community health risk analysis to further quantify health risk for the region, with an emphasis on the AB 617 Portside Community. The analysis is being prepared in coordination with the San Diego Air Pollution Control District and with input from the Port. It is anticipated that this* *analysis will be similar to the modeling performed for the South Coast and Bay Area regions and will take into consideration multiple sources of emissions in the region, including regional transportation systems and mobile sources.*

Discussion

In addition to providing SDAPCD and CARB with an HRA analysis at the TAMT and NCMT, the Port will coordinate with SDAPCD and CARB to prepare a cumulative cancer risk analysis for the larger Portside Community. Close coordination between the agencies is very important to ensure the best analysis and data are included.

Health Objective 3: Work collaboratively with the San Diego Air Pollution Control District (SDAPCD) on the SDAPCD's Portside Air Quality Improvement and Relief (also known as PAIR) program, including pursuing a Memorandum of Agreement with the SDAPCD to contribute Port Maritime Industrial Impact Fund for the SDAPCD's purchase and installation of new portable air filtration devices at participating Portside Community residences.

Discussion

The Port will pursue entering a Memorandum of Agreement (MOA) with SDAPCD to contribute $103,000 from the Port's Maritime Industrial Impact Fund (MIIF) to purchase and install new portable air filtration devices are participating Portside Community Residences. These air filtration devices will help reduce indoor DPM emissions and thus help reduce public health impacts caused by Port operations.

Health Objective 4: Collaborate with the San Diego Air Pollution Control District (SDAPCD) as they evaluate and consider developing a new rule to control emissions from indirect sources, in accordance with the timelines and dates established by the

***Note**: On May 7, 2021, the SCAQMD adopted Rule 2305, which is an indirect source rule (ISR) that regulates warehouse facilities to reduce air pollutant emissions from the goods movement industry. New requirements under this rule include zero emission or near-zero emissions trucks and onsite zero emission charging or fueling infrastructure. The adoption of this ISR rule is expected to substantially reduce DPM emissions from warehouse operations and, in turn, protect the vulnerable disadvantaged communities near them. SCAQMD's Rule 2305 may be a useful rule to explore as the SDAPCD evaluates developing an ISR for the San Diego region.*

Discussion

As part of the Portside Community's Draft Phase II AB 617 CERP (June 2021), SDAPCD has committed to evaluating the feasibility of adopting a new rule to control emissions from indirect sources. The Port is committed to engaging with SDAPCD as they evaluate and consider developing a new Indirect Source Rule (ISR).

III.1 Background and Context

As noted earlier, the Portside Community was selected for the AB 617 Program because it is identified as having a high cumulative air pollution exposure burden, a significant number of sensitive receptors, and includes census tracts that have been designated as disadvantaged communities.

Like many communities throughout the U.S., adverse environmental conditions that affect the Portside Community were compounded by a series of policies and land use decisions that were made at all levels of government over time. CalEPA (April 2021) acknowledges that *"although explicitly race-based zoning ordinances were deemed unconstitutional in 1917, local officials across the U.S. used economic zoning ordinances for decades after to prohibit anything except anything except single family residential development within predominantly white areas. Meanwhile, communities of color were frequently zoned to allow multifamily, commercial, and industrial use, even where those uses did not already exist."* The report notes that the intersection of these local policies and other programs, such as California Homeowners' Loan Corporation (HOLC) and Federal Housing Administration (FHA) polices, served to reinforce trends toward segregated housing as well as disproportionate pollution burdens. These historic trends help explain neighborhood-level conditions that are seen in the Portside Community today. Currently, an estimated 88% of residents are people of color in both National City[1] and Barrio Logan[2], and live in neighborhoods that have a mix of industrial and commercial uses interspersed with residential uses.

Over the years, the Port has advanced several initiatives to help address some of the off-site environmental impacts associated with maritime-related industrial activity along the working waterfront. Some of these initiatives are summarized below, including initiatives that are still being developed:

- **Transition Zone Policy (2008):** The Board of Port Commissioners established Board Policy No. 725 in June 2009 to establish general guidelines to encourage the creation of transition zones between industrial and residential neighborhoods.
- **Barrio Logan Shipyard Parking Study (2015):** The Port prepared this study to quantify on-street parking impacts in Barrio Logan to supplement previous planning efforts by identifying short- and mid-term, non-capital-intensive parking recommendations.
- **National City Balanced Plan (2017 to present):** The Port has been working closely with the City of National City, as well as business and community stakeholders, to rebalance land use for the National City Marina District based on public priorities. This effort proposes the following:
  - Expansion of Pepper Park by 2.5 acres;

[1] https://datasurfer.sandag.org/download/sandag_census_2010_zip_91950.pdf

[2] https://datasurfer.sandag.org/download/sandag_estimate_2010_cpa_barrio-logan.pdf

- Realignment of Marina Way, which will serve as the buffer area between commercial recreation and maritime uses;
- East-west and north-south public access corridors, with pedestrian, bicycle and visual access; and
- Better configured/more contiguous commercial recreation and maritime uses.

- **Harbor Drive Multimodal Corridor Study (2019):** In 2019, the Port initiated a collaborative, multi-agency effort to identify a series of complementary multi-modal improvements between TAMT and NCMT to improve mobility, including freight, passenger vehicles, truck traffic, transit opportunities, and pedestrian and bicycle connectivity.

  A key concept that came out of this effort is Harbor Drive 2.0 – A Greener, Safer, Healthier Harbor Drive, which includes a "haul road" and intelligent transportation systems to separate trucks from regular traffic. Through smart planning, this concept seeks to direct trucks away from residential areas by redesigning the industrial section of Harbor Drive using intelligent transportation systems, while adding protected bike lanes, beautification, and other elements. On October 9, 2020, the Board of Port Commissioners approved a framework Memorandum of Understanding with Caltrans and SANDAG to move this concept forward.

- **Barrio Logan Nighttime Noise Study (2020):** The Port commissioned the Barrio Logan Nighttime Noise Study to identify nighttime noise sources and options for reducing the noise. Ongoing collaboration between the Port, the City of San Diego, the Working Waterfront, local industry, and community residents is necessary to advance some of the Study's suggested measures to decrease nighttime noise. Nighttime noise is a neighborhood issue that affects quality of life, including mental and physical health.

- **Relief to Residents Following the USS Bonhomme Richard Navy Vessel Fire (2020):** Following the USS Bonhomme Richard Navy Fire that started on Friday, July 12, 2020, the Board of Port Commissioners took emergency action to authorize the expenditure of $200,000 to provide relief to residents who were impacted by the fire. In conjunction with the City of National City, Phase 1 of the effort involved allocating funding from the Port's Maritime Industrial Impact Fund (MIIF) to secure a total of 800 hotel rooms over two nights at participating District hotels to temporarily relocate impacted residents. Phase 2 of the effort is expected to involve partnering with the SDAPCD to allocate the remaining MIIF balance towards the purchase and installation of residential air filters, as part of SDAPCD's forthcoming Portside Air Quality Improvement and Relief (PAIR) Program.

Although these efforts illustrate the Port's commitment towards addressing some of the off-site environmental burdens experienced by residents, more needs to be done. The MCAS identifies following goal and five near-term objectives to ensure that the concerns and priorities of Portside Community residents remain front and center.

III.2 Goals and Objectives

Community Goal 1: Enrich the AB 617 Portside Community through Education, Engagement, and Urban Greening.

Community Objective 1: Rely on established processes for stakeholders and the public to provide input in the selection, deployment, and on-going monitoring of emission reduction projects.

Discussion

By providing residents with opportunities to participate in decision-making, in conjunction with broad community engagement efforts, the MCAS seeks to promote transparency, advance environmental justice, and attain greater health equity outcomes in the future.

Community Objective 2: Port staff will provide the Board of Port Commissioners, Barrio Logan Community Planning Group, the National City Council, and the AB 617 Portside Community Steering Committee with periodic updates on the status of its emission reduction projects and initiatives and associated emission reduction levels.

Note*: Updates on emission reduction progress may accompany implementation of significant electrification projects or may be used to report progress as a part of a future maritime emissions inventories. The Port, at its discretion, may prepare maritime emissions inventories to track interim progress towards improving air quality. The first such maritime emissions inventory is anticipated to be completed in Q4 of calendar year of 2022, assuming there are sufficient resources to complete the inventory and adequate time to allow staff and technical experts to verify and validate results in an understandable way.*

Discussion

Public engagement during development of the MCAS reaffirmed the need for Port staff to keep residents apprised of the Port's emission reduction initiatives including the implementation of significant electrification projects or future maritime emissions inventories. As such, the MCAS commits Port staff to providing periodic updates to residents at multiple forums over the life of the strategy.

Community Objective 3: Port staff will convene a group of stakeholders to explore increasing tree canopy in the Portside Community and continue to work with groups like Urban Corps to advance this objective.

Discussion

Urban greening is identified one of several land use strategies in the AB 617 Portside Community CERP Phase II (July 2021). Beginning in April 2021, Port staff began working with Urban Corps to explore increasing tree canopies at Cesar Chavez Park. In addition, Port staff agreed to convene a group of stakeholders to increase tree canopy in the Portside Community.

Community Objective 4: Support the expansion of the Port's existing outdoor educational programs to increase participation of youth that live in the AB 617 Portside Community.

Discussion

During development of the MCAS, stakeholders encouraged the Port to promote more programs for youth and to invest in community events that promote environmental stewardship. In response, the MCAS seeks to expand its Environmental Education Program (EEP) to increase participation of youth that live in the AB 617 Portside Community. The Port's EEP was developed to educate students, teachers, and the general public about pollution prevention, environmental stewardship, healthy ecosystems, and natural resources connected with San Diego Bay. Organizations supported under the EEP have provided a diverse range of educational content through field activities, classroom exercises, laboratory experiments, informative field trips, and engaging online curriculum.

Community Objective 5: Work with Portside Community residents and stakeholders to complete a comprehensive update in 2025 to the MCAS including goals and objectives for 2026 to 2030 that are **S**pecific, **M**easurable, **A**ttainable, **R**elevant, **T**imebound, **I**nclusive and **E**quitable, that reflects updated technology, regulations, and market conditions.

Discussion

The MCAS articulates a vision of health equity for all, which includes an overarching goal of ZE trucks and cargo handling equipment by 2030. As the necessary first step, the MCAS identifies a series of near-term goals and objectives to be accomplished by June 30, 2026 for seven maritime-related emission sources, as well for community enrichment, public health, and other enabling actions. To incorporate advancements in technology and to reflect updated market conditions and regulatory changes, the Port will collaborate with stakeholders to update to the MCAS prior to June 30, 2026, to address the time-period between 2026 and 2030.

IV.1 Background and Context

At the June 18, 2019 Board meeting, the Board adopted a resolution authorizing Port staff to update the Port's 2007 Clean Air Program to align with State programs and to develop Port-related plans and identify projects that would reduce emissions and improve air quality. To help the Port identify, understand, and prioritize potential emission reduction opportunities, the Port's Maritime Clean Air Strategy (MCAS) focuses on the following seven emission sources:

- Cargo Handling Equipment (CHE)
- Commercial Harbor Craft (CHC)
- Heavy Duty Trucks
- Shipyards (Stationary Maritime Industrial Uses)
- Ocean Going Vessels (OGV)
- Freight Rail
- Port of San Diego Fleet

This effort builds on the Port's 2016 Maritime Air Emissions Inventory, and updates emission estimates for CHE, CHC, OGVs within and around San Diego Bay, and the Port's fleet, based on 2019 calendar year activity. It also includes two new sources, Port Fleet and Shipyards, which have not been addressed in previous maritime inventories. While the Port's fleet is not technically a maritime-specific use, the Port has direct control over its own fleet and this category presents a unique opportunity for the Port to demonstrate leadership in emission reduction efforts. Therefore, it was included as one of the seven emission sources. Similarly, the shipyards operating on Port tidelands have not been included in the Port's previous maritime air emissions inventories, because these operations fall under the purview of the San Diego Air Pollution Control District (SDAPCD) and issues air pollution control permits and regulates industrial stationary sources. However, with the formation of the Assembly Bill (AB) 617 Portside Community Steering Committee in 2018, the Port's three shipyard tenants have committed to several emission reduction strategies in the AB 617 Community Emission Reduction Plan (AB 617 CERP). As such, the MCAS addresses the Shipyards qualitatively by describing their operations and the strategies that the shipyards have committed to as part of the AB 617 Draft CERP, in addition to a goal and objectives similar to the other emission sources. The AB 617 CERP Shipyard Actions are included within its emission source chapter for reference.

As shown in Table IV-1, CHC and OGV's make up approximately 90% of total NOx and DPM emissions from or associated with the Port operations. It is worth providing context in terms of where emissions occur. Maritime emissions occur within terminal boundaries, within neighboring communities along truck and rail routes, within San Diego Bay, and outside of the terminals, neighboring communities, and San Diego Bay. As shown in Table IV-2, most emissions occur outside the terminals and outside of the San Diego Bay. As shown, 55% of

NOx and DPM occur out at sea or along regional trucking and rail routes, beyond San Diego Bay and away from the Portside Community's residents and workers. All CHE emissions occur at the marine terminals and in closer proximity to the Portside Community's residents and workers. CHC emissions occur in disperse locations throughout San Diego Bay and in the open ocean. Most OGV emissions occur in transit outside of the bay. While truck emissions represent a small percentage of total emissions and occur mostly outside the Portside Community boundaries, reducing truck-related emissions has been identified as a high-priority goal by the Board of Port Commissioners, residents, and the AB 617 Portside Community Steering Committee.

Table IV-1. MCAS Emissions Inventory Estimates Summary (tons)

Source	NOx		DPM		CO_2e	
Cargo Handling Equipment (CHE) [1]	8.4	1%[3]	0.1	1%	2,439	3%
Commercial Harbor Craft (CHC) [1]	283.6	38%	9.1	52%	25,495	36%
On-road Trucks [2]	36.2	5%	0.5	3%	13,894	20%
Oceangoing Vessels (OGV's) [1]	378.3	51%	6.7	38%	25,770	37%
Rail [2]	30.3	4%	1.2	7%	2,916	4%
Total	737	100%	17.6	100%	70,513	100%

[1] Updated based on 2019 activity

[2] Estimates based on Maritime Air Emissions Inventory 2016

[3] Percent of total maritime emissions based on 2016 Inventory data

Table IV-2. MCAS Emissions Inventory Portions by Location

Source	At or Near Terminal and Within Bay			Away from Terminal and Bay		
	NOx	DPM	CO_2e	NOx	DPM	CO_2e
Cargo Handling Equipment (CHE)	100%	100%	100%	0%	0%	0%
Commercial Harbor Craft (CHC)	57%	54%	52%	43%	46%	48%
On-road Trucks	9%	2%	7%	91%	98%	93%
Oceangoing Vessels (OGV's)	42%	38%	31%	58%	62%	69%
Rail	24%	25%	24%	76%	75%	76%
Total	46%	45%	36%	54%	55%	64%

While reviewing the emission source chapters, keep in mind that not all diesel vehicles and equipment are equal. As shown in Figures IV-1 and IV-2 below, Tier 4 diesel equipment and marine engines are substantially cleaner than predecessors Tiers 0 through 3. In cases where zero emission vehicles and equipment are not yet feasible, Tier 4 diesel engines are preferred to lower tiered engines in order to allow for the most emission reductions possible. For trucks, the simplest way to compare emission factors is by model year. Figure IV-3 summarizes NOx and PM2.5 emission factors (per mile) for various model years. As shown, newer trucks emit substantially lower NOx and PM on a per mile basis.

The subsequent sections in this chapter provide background on each of these emission sources, including a brief history of previous emission reduction efforts, as well as existing and forthcoming regulations and requirements. Source specific emission reduction technology and/or other emission reduction strategies are presented, followed by high-level cost estimate. Finally, each section concludes with recommended emission reduction goals and objectives specific to each source.

Figure IV-1. NOx Emissions by Maritime Operating Source by Tier of Diesel Engine in grams per horsepower hour (hp-hr)

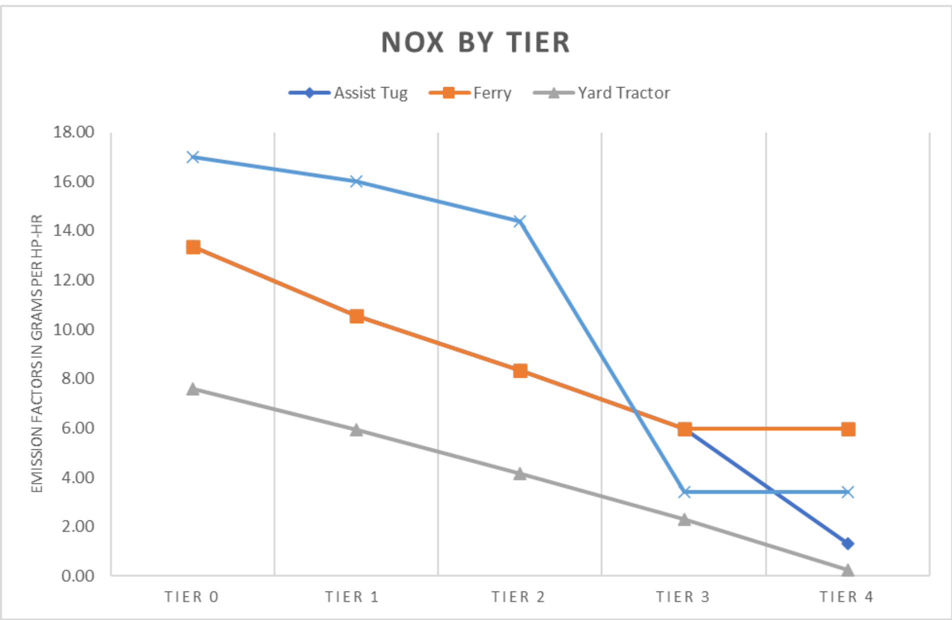


Figure IV-2. PM2.5 Emissions by Maritime Operating Source by Tier of Diesel Engine in grams per horsepower hour (hp-hr)

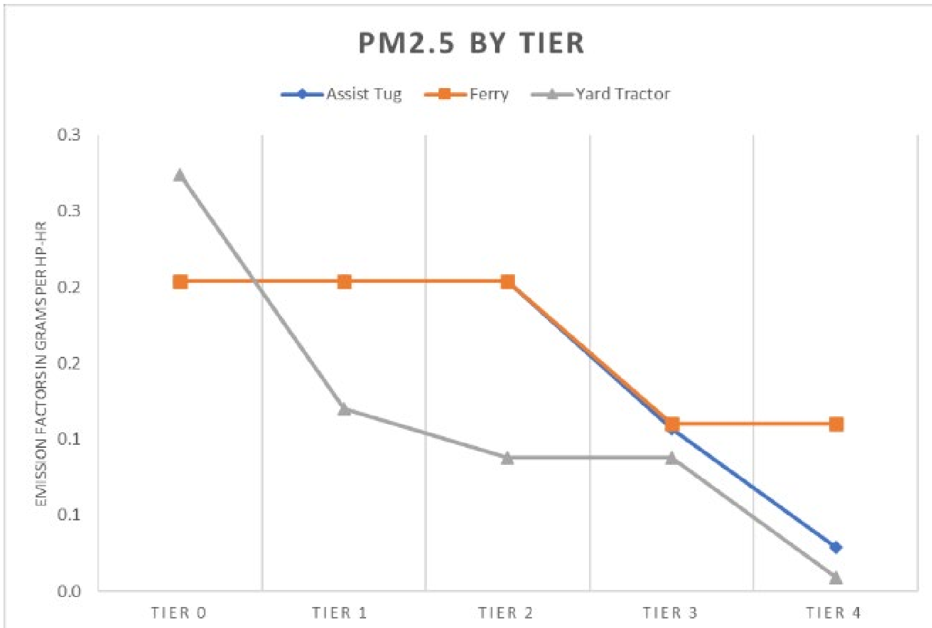
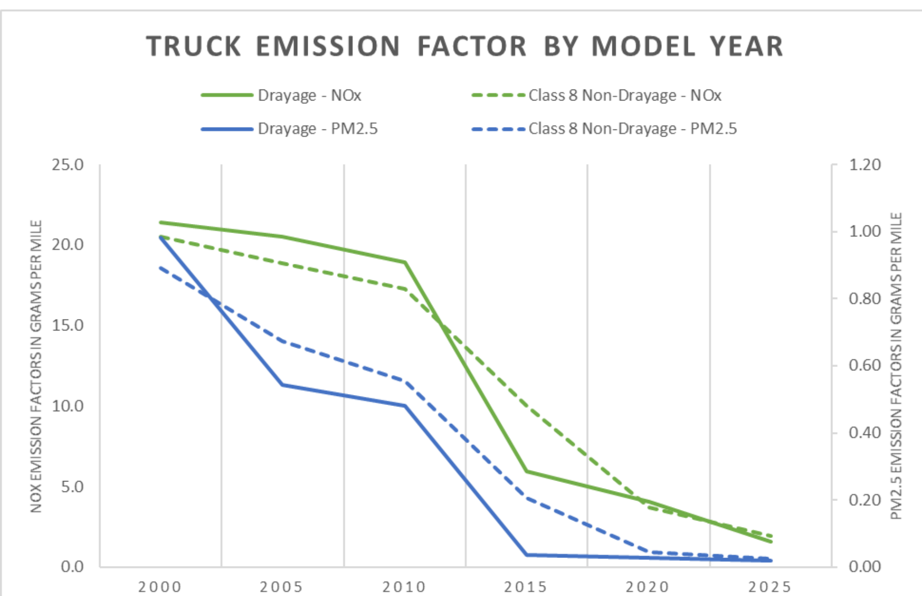


Figure IV-3. NOx and PM2.5 Emissions for Trucks by Model Year in grams per mile traveled



IV.1.1 Background and Context

This chapter provides the necessary background to identify near-term goals and objectives to support the MCAS vision of health equity for all and long-term goal of the transition of diesel cargo handling equipment (CHE) to 100% ZE by 2030, in advance of the State's goals identified in Executive Order No. N-79-20.[1]

CHE is used to support terminal activities and move cargo on and off ocean-going vessels (OGVs), harbor craft, rail, and trucks. CHE is necessary for coastal dependent maritime trade operations and water-based commerce. A wide range of CHE types operate within the Port's jurisdiction due to the diversity of cargo handled at each maritime terminal, which ranges from large containers to dry bulk; CHE is also needed to support cruise ship activity. Equipment operates at each of the Port's four terminals: National City Marine Terminal (NCMT), Tenth Avenue Marine Terminal (TAMT), and the two Cruise Ship Terminals (CSTs).

IV.1.1.1 Source Description

Types of CHE at the terminals include container handling equipment (e.g., reach stackers), yard tractors (also known as UTRs, yard trucks, or hostlers), forklifts, construction equipment (e.g., rubber-tired loaders), and general industrial equipment. The majority of CHE is electric or diesel-powered, although some smaller pieces are powered by gasoline or propane. CHE is only used at the Port's marine terminals and not on public roadways. Below is a description of the most common equipment types.

Yard Tractors

Yard tractors are designed to move cargo containers and are the most common type of CHE used at ports. These tractors are used at container ports, intermodal rail yards, distribution centers, and other intermodal facilities. Other CHE is used to load containers onto yard tractors, which are then used to move the containers around the facility for stacking and storing.

Yard tractors are similar to heavy-duty on-road truck tractors, but the majority are equipped with off-road engines. Per CARB's CHE Regulation, all yard tractors at California ports are required to be powered by engines that meet US EPA model year 2007 or newer on-road, or Tier 4 off-road engine emission standards. Yard tractors have a horsepower (hp) range of approximately 150 – 250 hp. There are 30 yard tractors in the Port's 2019 CHE inventory; 22 at TAMT and 8 at NCMT, all of which are owned and operated by Port tenants.

Forklifts and Heavy Lifts

Forklifts are industrial equipment that lift and transport materials using one or more steel forks, which are inserted under the load. Forklifts are designed to move and/or lift empty cargo containers, stacked or

[1] This goal applies to cargo handling equipment that serves primary operations and excludes equipment reserved for emergencies, exemptions, and Executive Orders issued by the state to converse power.

palletized cargo, and/or move or rotate truck chassis. They are found at container and bulk cargo facilities and vary by size and cargo handling abilities. Forklifts can be powered by electric motors or internal combustion engines, including compression ignition (diesel) and spark ignition (propane). Forklifts are broken out into classifications by applications, fuel options, and features: the higher the class, the greater the lifting capacity. Classes 1, 2, and 3 forklifts are typically electric, powered primarily by lead-acid batteries, while classes 4 and 5 use internal combustion engines, usually fueled by propane, but can also be natural gas, gasoline, and diesel. Class 6 can be either electric for internal combustion and are used for a variety of indoor and outdoor applications. Class 7 forklifts are for rough terrain and are typically diesel. Because they are designed for higher lift capacity, forklifts powered by diesel engines are the majority of forklifts used in typical port cargo handling operations.

Cargo handling forklifts used at ports typically range between 45 and 280 horsepower. Forklifts can be separated by horsepower into light-, medium-, and heavy-lift size categories for planning and emission purposes. Light-lift forklifts are less than 75 hp and typically lift up to 9,000 pounds; medium lifts range between 75 and 120 hp and lift between 9,000 and 20,000 pounds; and heavy lifts are greater than 120 hp and lift greater than 20,000 pounds. A summary of forklift categories by size is shown in Table IV.1-5 below.

Stackers

Stackers, or “Reach Stackers” are CHE that have telescopic booms that move upward and outward to reach over two or more stacks of containers. The stacker boom locks onto the top of containers and can transport them short distances. Reach stackers have a horsepower range of approximately 250 – 400 hp. There are four reach stackers in the Port’s 2019 CHE inventory, all owned and operated by Port customers at TAMT.

Handlers

Handlers are designed to stack containers for temporary storage or load them on and off yard tractors, and include top handlers and side handlers. Top handlers are a common type of CHE and are truck-like vehicles that have an overhead boom to lock onto the top of containers. Top handlers have a horsepower range of approximately 250 – 400 hp and can lift loaded containers weighing as much as 45,000 pounds. There are two top handlers in the Port’s 2019 CHE inventory, both owned and operated by Port customers at TAMT.

Side handlers are similar to top handlers, except that their boom arm extends the width and locks onto the sides of containers, and they are usually used to lift empty containers. Side handlers generally have a horsepower range of approximately 120 – 400 hp. There are no side handlers in the Port’s 2019 CHE inventory.

Cranes

Cranes used for general port operations include rubber-tired gantry cranes (RTGs), rail-mounted gantry cranes (RMGs), ship-to-shore cranes, and mobile harbor cranes.

Gantry cranes are designed to load and unload containers from yard tractors and stacks at a very fast pace. Both types of cranes operate a lifting mechanism that is mounted on a cross-beam supported on vertical legs running on either rubber tires (RTGs) or rails (RMGs). RTG and RMG cranes have a horsepower range of approximately 200 – 1,000 hp. While the propulsion of the crane is very slow (about three miles an hour), the lifting mechanism is very quick.

Ship-to-shore cranes are designed to load and unload containers directly from vessels at port. They are generally fixed and move containers from ships to yard tractors. Safe working loads from 44 to 132 tons (40 to 120 metric tons) are available in single, twin, and tandem lift configuration.

Mobile harbor cranes are designed to lift all types of cargo from containers to bulk commodities, general cargo and even heavy lifts such as utility scale transformers. They can move on rubber tires to provide lifting where needed. Generally, mobile harbor cranes can lift up to 330 tons (300 MT) with a single crane or up to 440 tons (400 MT) with a dual crane. Competitor ports to our north are capable of lifts in excess of 575 tons.

There is one mobile harbor crane within the Port's 2019 CHE Inventory at TAMT. Because the Port has no plans to add gantry or ship-to-shore cranes to the CHE Inventory in the foreseeable future, the analysis below will focus solely on emission reduction potential associated with the mobile harbor crane.

Other Equipment

The CHE used at the Port also includes construction equipment such as rubber-tired loaders, lifts, and trailers, as well as other general industrial equipment such as carts, sweepers, and lighting. Most of these pieces powered by gasoline and are relatively insignificant sources of emissions, in large part, because they are not housed and/or used at the terminals regularly or with any level of frequency. Furthermore, any significant amount of construction activity at the marine terminals would be subject to subsequent environmental review and would be looked at on a project-by-project basis. As such, construction equipment is not the focus of the MCAS and will not be discussed further. There are also six solar powered signal boards within the inventory: four at CST and two at TAMT.

Existing Fleet Summary – 2019 Port CHE Inventory

In Spring 2020, Port staff conducted a Maritime Cargo Handling Equipment Inventory (Inventory) to update the prior iteration from 2016, identify the higher-emitting equipment that is in use, and to determine the feasibility of cleaner upgrades to reduce emissions. The scope of the Inventory includes all CHE utilized by the Port and participating tenants at the marine terminals (Cruise Ship Terminals or CST, TAMT, and NCMT) in 2019. This is the fourth Maritime Cargo Handling Equipment Inventory conducted by the Port. Past inventories were conducted in 2006, 2012 and 2016. Emissions were calculated based upon CARB's CHE methodology.[2] CHE inventory emissions are summarized in Appendix A. Inventory data and emissions inform the analysis below.

[2] CARB, *Cargo Handling Equipment Emissions Inventory Methodology*, 2011. Available at https://ww3.arb.ca.gov/regact/2011/cargo11/cargoappb.pdf

The breakdown of CHE by fuel type by terminal is provided in Table IV.1-1 and further shown in Figure IV.1-1 for the Port as a whole and for TAMT. As shown, of the 184 total CHE pieces, the largest portion (84 pieces) is comprised of electric- or solar- powered (approximately 45%). Diesel comprises the next largest share, making up approximately 35% of the equipment inventory. However, as shown in Figure IV.1-1, diesel pieces comprise most of the equipment at TAMT, and the majority of diesel pieces Port-wide operate at TAMT. While the NCMT has the most pieces of CHE of all the marine terminals, most of these pieces are non-emitting or smaller gasoline or propane pieces. Most equipment at the CST are small electric pieces.

Table IV.1-1. Summary of Cargo Handling Pieces by Fuel Type*

Terminal	Diesel	Gasoline	Propane	Electric	Solar	Total
TAMT	53	2	3	7	2	67
NCMT	11	23	6	48	0	88
CST	1	0	1	23	4	29
Total	65	25	10	78	6	184

*Please note that the Port owns one diesel mobile harbor crane that operates at the TAMT. All other pieces of equipment identified in the Port's CHE Emission Inventory are owned and operated by Port tenants.

Figure IV.1-1. Cargo Handling Equipment Portions by Terminal

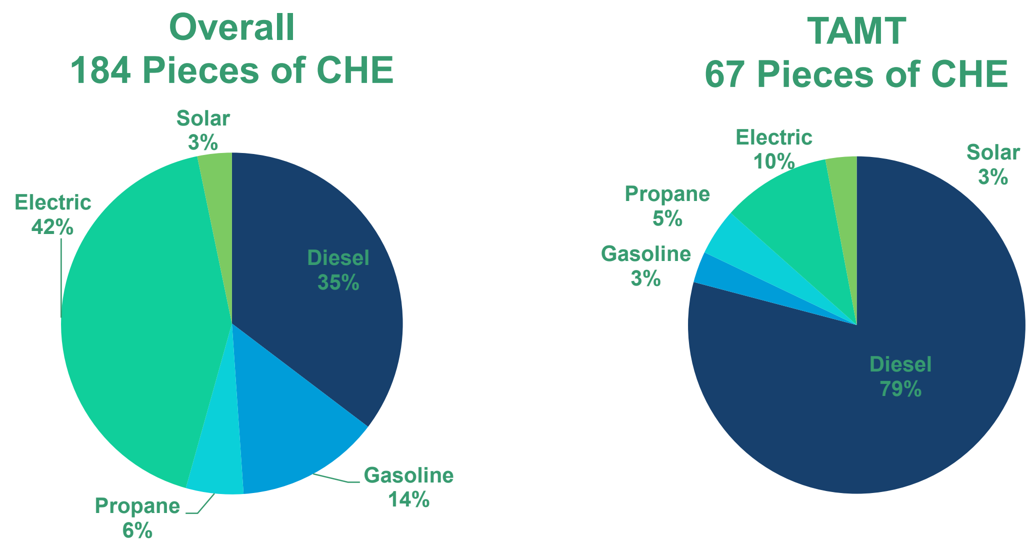


Table IV.1-2 summarizes the portion of emissions by pollutant type by terminal, which shows most CHE emissions occur at TAMT. Table IV.1-3 summarizes the portion of emissions by fuel type, which shows diesel equipment being responsible for all the DPM emissions and for most of the NOx and GHG emissions. Therefore, while there are more non-diesel pieces of equipment than diesel at the Port, most emissions are emitted from diesel equipment, primarily at TAMT.

Table IV.1-2. Portion of Total Cargo Handling Equipment Emissions by Terminal

Terminal	NOx	DPM	CO_2e
TAMT	81%	72%	73%
NCMT	18%	23%	21%
CST	1%	5%	6%

Table IV.1-3. Portion of Total Cargo Handling Equipment Emissions by Fuel

Terminal	NOx	DPM	CO_2e
Diesel	90%	100%	83%
Gasoline	8%	-	5%
Propane	2%	-	2%
Electric	-	-	10%
Solar	-	-	-

IV.1.1.2 History of Previous Efforts

The Port has encouraged and supported its tenants' efforts to electrify the marine terminals, including assisting to secure and manage external funding sources. Port tenants have been the recipients of various grant awards to demonstrate pre-commercial zero emission CHE. Most notably, the San Diego Port Tenants Association, on behalf of five Port Tenants (Dole Fresh Fruit Company, Pasha Automotive Services, Marine Group Boat Works, Terminal Lift, and Continental), was awarded $5.9 million in funding from the California Energy Commission (CEC) to demonstrate pre-commercial zero emission medium and heavy-duty equipment. The grant included *ten battery-electric yard tractors, drayage trucks, and forklifts* on tidelands adjacent to the Portside Community.[3] The purpose of the demonstration was to advance the commercialization of zero emission CHE and to allow users to better understand how zero emission technology operates. The success of these zero emission CHE demonstration projects has continued to progress electrification at the Port's marine terminals. Electric CHE located at the marine terminals include: three (3) yard tractors; one (1) reach stacker; 21 electric forklifts; and at NCMT, several pieces of electric automobile processing equipment (vehicle

[3] California Energy Commission. 2020. *San Diego Port Sustainability Freight Demonstration Project.* Available: https://www.energy.ca.gov/showcase/driving-cleaner-transportation/san-diego-port-sustainability-freight-demonstration-project. Accessed December 2020.

lifts, tire processing, car washing, compressors). In addition, four message boards were converted from diesel to solar for use at the CST. Finally, since the 2019 Inventory, Dole has acquired one additional electric forklift.

IV.1.1.3 Legislative and Regulatory Framework

Emissions from cargo handling equipment are managed by regulations and emission limits implemented at the federal, state, and local levels. The EPA has established a series of increasingly strict emission standards for new off-road diesel engines. Tier 1 standards were phased in on newly manufactured equipment from 1996 through 2000 (year of manufacture), depending on the engine horsepower category. Tier 2 standards were phased in on newly manufactured equipment from 2001 through 2006. Tier 3 standards were phased in on newly manufactured equipment from 2006 through 2008. Tier 4 standards, which require advanced emission control technology to attain them, were phased in between 2008 and 2015.

In December 2005, CARB approved the Regulation for Mobile Cargo-Handling Equipment at Ports and Intermodal Rail Yards (13 CCR 2479) designed to use best available control technology (BACT) to reduce DPM and NOx emissions from mobile cargo handling equipment at ports and intermodal rail yards. Since January 1, 2007, the regulation has imposed emission performance standards on terminal equipment that vary by type.

Additionally, CARB has promulgated more stringent emissions standards for hydrocarbons and NOx combined emissions and test procedures for gasoline-powered forklifts and other industrial equipment. The engine emission standards and test procedures were implemented in two phases. The first phase was implemented for engines built between January 2007 and December 2009. The second, more stringent, phase was implemented for engines built starting in January 2010. The regulation was amended in 2010, establishing fleet average emissions requirements for existing engines and those amendments took effect on October 14, 2012. All in-use non-yard truck equipment had to be fully compliant with the regulation by December 31, 2013, and yard truck equipment must be fully compliant with the CHE Regulation by December 31, 2017. All in-use non-yard truck engines must have a Verified Diesel Emission Control Strategy (VDECS) installed. VDECS are emissions control strategies that reduce PM and/or NOx. Diesel particulate filters (DPFs), which reduce PM emissions, are the most common type of VDECS. All newly purchased yard truck and non-yard truck equipment brought onto a port or intermodal rail yard must have either a Tier 4 Final off-road engine or a model year (MY) 2010 or newer on-road engine.

In March 2018, CARB staff presented to its Board a proposed plan to develop regulations to minimize emissions and community health impacts from CHE.[4] The regulatory concepts proposed by CARB staff focus on zero emission CHE. The regulatory amendments would enact an implementation schedule for new equipment and facility infrastructure requirements, with effective dates beginning in 2026. In this potential action, all mobile equipment at ports and rail yards, including but not limited to diesel, gasoline, natural gas,

[4] CARB. 2018. Available: https://ww2.arb.ca.gov/resources/documents/cargo-handling-equipment-regulation-transition-zero-emissions. Accessed March 2021.

and propane-fueled equipment, would be subject to new requirements. CARB staff would also consider opportunities to prioritize the earliest implementation in or adjacent to the communities most impacted by air pollution. The amendment is anticipated to be considered by CARB in 2022 or 2023.[5]

Finally, it is important to recognize the federal Occupational Safety and Health Act of 1970 (OSHA), which assures the safe and healthful working conditions for men and women by authorizing enforcement of standards under the Act and by assisting and encouraging the states in their efforts to meet this objective. Many OSHA standards include explicit safety and health training requirements to ensure that workers have the required skills and knowledge to safely do their work. OSHA identifies several operational and training standards for marine terminals in general, as well as operational and training requirements for CHE more specifically.

IV.1.2 Technology and Strategies

While there are several options to electrify CHE operated at the Port, it is important to note that several ZE/NZE CHE alternatives are not yet commercially available for purchase; many ZE/NZE pieces of CHE are still being built to specifications provided by the customer on a case-by-case basis and are not yet mass produced. However, it is expected that ZE/NZE CHE pieces will be commercially available for purchase soon. Electrification options are described below.

IV.1.2.1 Forklifts

A summary of existing forklifts by fuel, by terminal operation, and by size is shown in Table IV.1-4. Note that the forklift sizes are broken down by lift for all fuel types and for diesel forklifts only.

The size of existing forklifts for all terminals is further broken down in Table IV.1-5. As shown, most forklifts at the Port are heavy-lift forklifts (37 out of 59) and diesel fueled (27 out of 59).

Electric forklifts (Classes 1, 2, and 3) built today are often used in similar applications as the fuel-powered counterparts and can do the work of most Class 4, and many Class 5 forklifts. Specifications for available electric forklifts are provided in Table IV.1-6 and include energy potential (volts [V]), lift capacity in pounds (lbs), and designed use. As shown, electric forklifts are commercially available for up to 40,000-lb lift capacity. For lift capacities above 40,000 lbs, diesel forklifts are still required. As of the date of publication, replacing existing heavy-lift forklifts with Tier 4 diesel engine forklifts would result in significant NOx and DPM emission reductions (but negligible GHG reductions), however in order to achieve the goal of 100% zero emission CHE by 2030, the technology for electric forklifts must advance to include heavy-lift models.

[5] CARB's Website (linked in endnote 3, above) identifies 2022 as the estimated timeframe for Board consideration on CHE regulations. However, in December 2020, CARB released an updated graphic entitled "Suite of CARB Regulations", that shows that the 1st Board hearing date for Port and Railyard Cargo Handling Equipment will be in year 2023.

Table IV.1-4. Summary of Forklifts by Fuel, Terminal, and Size at the Port*

Terminal	All Pieces				By Lift All Fuels (Diesel Only)		
	Gasoline	Propane	Electric	Diesel	Light	Medium	Heavy
TAMT	1	3	1	22	7 (5)	3 (1)	17 (16)
NCMT	0	6	4	4	3 (0)	6 (0)	5 (4)
CST	0	1	16	1	2 (0)	1 (1)	15 (0)
Total	1	10	21	27	12 (5)	10 (2)	37 (20)

* All of the forklifts are owned and operated by Port tenants.

Table IV.1-5. Summary of Forklifts by Size at the Port

Lift Category	Horsepower Range	Lift Capacity (lbs)	All Pieces			Diesel Only		
			Total	Model Year	Average Hours	Total	Model Year	Average Hours
Light	<75	up to 9,000	12	2012	324	5	2012	307
Medium	75-120	9,000 to 20,000	10	2012	334	2	2011	490
Heavy	>120	Greater than 20,000	37	2008	368	20	2008	226
Total	-		59	-	-	27	-	-

Table IV.1-6. Specifications for Available Electric Forklifts

Class	Voltage	Lift Capacity (lbs)	Use
Class 1	36 V, 48 V, or 80 V	Typical: 3,000 – 12,000	Indoor or outdoor, ideal for loading and unloading tractor-trailers, or handling pallets.
Class 2	24 V, 36 V, or 48 V	Typical: 3,000 – 5,500	Indoor narrow aisle, designed for compact vertical spaces
Class 3	12 V, and 24 V	3,500 – 8,000	Electric hand ("walkie") or rider models
Source: Electric Power Research Institute. 2015. *Electric Forklifts. April*			

Batteries for electric forklifts are sized to accommodate the typical hours of daily use. There are two battery charging methods available, including conventional charge and rapid/opportunity charge. Conventional charging is the most common for electric forklifts and operates on a regular cycle where the forklift is in use for 8 hours, is charging for 8 hours, and cooling for 8 hours. Because even the most demanding operations only typically require forklift use about 50% of the time, most pieces are able to be used for two 8-hour shifts on a single battery and charge. With rapid/opportunity charging, the battery charges for about 1-2 hours during the day, and only requires an 8-hour equalization charge once a week. This charging method is ideal for forklifts needed for 2 or more shifts.

Select manufacturers of electric forklifts (brand/supplier) are listed below.

- CAT/ Mitsubishi Caterpillar Forklift
- Clark/ Clark Material Handling International
- Crown/ Crown Equipment Corp.
- Doosan/ Doosan Industrial Vehicle
- HC Hangcha/ Hangcha Group Co.
- Heli/ Heli Americas
- Hyster/ Hyster-Yale Materials Handling
- Hyundai/ Hyundai Heavy Industries
- Jungheinrich/ Mitsubishi Caterpillar Forklift
- Kalmar/ Cargotec USA
- Komatsu/ Komatsu Ltd.
- Linde/ KION Group
- Mitsubishi/ Mitsubishi Caterpillar Forklift
- Raymond/ Toyota Industries Corp.
- Toyota/ Toyota Industries Corp.
- UniCarriers, Nissan/ UniCarriers Americas Corp.
- Yale/ Hyster-Yale Materials Handling

Figure IV.1-2 shows electric forklift models of various lift sizes offered by Toyota, Yale, and Hyster. Electric forklifts have been demonstrated at both the San Pedro Bay ports (SPBPs) as well as the Port of San Diego. Electric forklifts are currently in use at all four Port terminals, operated by the Port, Pasha, and NOAA. These forklifts include Jungheinrich, Caterpillar, DOOSAN, and Toyota models with horsepower ratings ranging from 28 – 149 hp.

Figure IV.1-2. Electric Forklifts

Toyota THDE400-24	Yale ERP155-190VNL	Hyster J155-190XNL
		
Light Lift	*Medium Lift*	*Heavy Lift*

IV.1.2.2 Mobile Harbor Crane

Mobile harbor cranes come in a variety of lift capacities (from 100 to 308-ton lifts). Currently, they have three potential power configurations. The first configuration, used predominantly by the maritime industry, has both the crane's movement and the crane's lift powered by a diesel engine. The second configuration is called a hybrid-electric crane, where movement is powered by a diesel engine and the lift is powered by electricity from a plug. The third configuration is new commercial entry into the market of a fully electric mobile harbor crane with movement powered by a battery and the lift would be powered by electricity over a plug, therefore emitting zero tailpipe emissions.

The Port currently owns one Kone Gottwald mobile harbor crane, that is used for various lifting operations at TAMT. The Kone Gottwald mobile harbor crane is nearly 20 years old and is diesel-powered by a 1,030 horsepower Tier 1 engine. It has a maximum lifting capacity of 100 metric tons (with a much lower capacity when extended over a ship). At this time, it is operated for approximately 245 hours annually (See Appendix A, Cargo Handling Equipment Inventory). Based on CARB regulations, this piece of equipment must be phased out by January 1, 2029, or potentially sooner based on the proposed amendment to CARB's current Mobile Cargo Handling Equipment Regulation mentioned above. Additionally, based on the crane's age, the Port anticipates substantially increased maintenance costs prior to its retirement. In June 2021, the Kone experienced a hydraulic lift failure, forcing the District to pay $50,000 to bring in a temporary replacement since the Port is contractually required to provide a mobile harbor crane to Dole Fresh Fruit.

The Port requires a truly multi-purpose mobile harbor crane to support operations. Options for mobile harbor cranes to replace the Kone Gottwald are presented below. It should be noted that Federal government funding normally is not awarded to purchase mobile harbor cranes because that type of CHE is produced in Germany, and Federal grant funds typically have a “Buy America” preference provision that makes projects to purchase these foreign-built cranes highly unlikely to receive Federal grant funds.

Diesel-powered Cranes (Diesel Lift, Diesel Positioning)

Traditional diesel-powered cranes, such as the Port’s current Kone Gottwald mobile harbor crane, utilize a diesel engine over a hydraulic distribution gearbox to move and complete lifts. Since the Port is not considering the purchase of a traditional diesel-powered mobile harbor crane to replace the Kone, options for diesel-powered mobile harbor cranes are not presented below.

Electric Hybrid Cranes (Electric Lift, Diesel Positioning)

Until recently, the cleanest mobile harbor cranes on the market were electric hybrid cranes. They use Tier 4 diesel engines to drive and position the crane around the terminal, and they use electricity (carried over a wire from a plug) to power lifting activities. While the hybrid electric crane models are equipped with two power supply methods, the two work separately, not concurrently. These electric hybrid cranes are much cleaner than the traditional diesel-powered cranes, since most of the power used by the crane is for lifting cargo.

Hybrid electric cranes are currently in use in Europe and the U.S., including nine demonstrations at the SPBPs. Additionally, operators at the Port of Hueneme purchased the hybrid model of the Liebherr LHM 420 for their operations in 2019. The crane and accompanying infrastructure cost approximately $7 million, and plug into Port Hueneme’s electrical infrastructure, which was upgraded as part of their Zero and Near Zero-Emission Freight Facilities (ZANZEFF) grant funded by California Cap and Trade dollars.[6]

Electric (Zero Emission) Cranes (Electric Lift, Electric Positioning)

Fully electric mobile harbor cranes became commercially available in 2021. These cranes have the same lifting capacity as the electric hybrid cranes and operations would be similar. Unlike the other options, these cranes would have zero tailpipe emissions and are the staff’s recommendations for replacing the Kone Gottwald.

[6] *Port Welcomes First Zero-Emission Crane.* July 9, 2019. *Available:* https://www.portofhueneme.org/zero-emission-crane/ Accessed January 2021.

Figure IV.1-3. Mobile Harbor Cranes

Liebherr LHM 800 (ZE)

Konecranes G HMK 8710 Mobile Harbor Crane (ZE)

Potential Replacements for the Kone Gottwald Mobile Harbor Crane

In exploring potential replacements, the Port has determined that there are opportunities to secure additional heavy-lift cargoes by increasing crane lift capacity to 300 metric tons, while also pursuing zero emission electric mobile harbor crane technologies. Examples of all-electric crane models include:

Liebherr LHM 800 (single crane with lift capacity of 180-300 metric tons depending on positioning of the cargo aboard the vessel)

Konecranes Model 8 G HMK 8710 (tandem/dual crane operation of up to 300 metric tons depending on positioning of the cargo aboard the vessel)

A breakdown of crane characteristics can be seen in Table IV.1-7. The cranes would need to be plugged in and fully powered by electricity instead of diesel; thus, the Port would need to install three additional plugs at the terminal in order to allow for movement around the terminal since each crane must be plugged into a power source in order to operate. This configuration is similar to those being installed at the Port of Hueneme.

Table IV.1-7. Specifications for Example Replacement Cranes

Specifications	Liebherr LHM 800	2 Kone Crane Model 8 G HMK 8710
Cost: Fully Electric (ZE) Crane	$8.9 million	$14.03 million
Effective Lift Capacity when extended over Vessel (Spec Capacity) (MT)	170 (308)	264 (400)
Weight (MT)	795	600
Crane Reach (m)	64	56

IV.1.2.3 Yard Tractors

A summary of existing yard tractors by terminal and by fuel is shown in Table IV.1-8. As shown, most yard tractors are diesel that operate at TAMT. As of the 2019 Inventory, there are three electric yard tractors – two at TAMT and one at NCMT – and 20 diesel yard tractors – 20 at TAMT and 7 at NCMT.

Table IV.1-8. Summary of Yard Tractors at the Port

Terminal	Electric	Diesel
TAMT	2	20
NCMT	1	7
CST	0	0
Total	3	27

Along with the electric yard tractors in use at the Port, electric yard tractors are also currently being demonstrated at the Ports of Long Beach and Oakland. In the spring of 2019, the Ports of Long Beach and Oakland acquired 38 electric yard tractors as part of CARB’s ZANZEFF program. The tractors are all-electric drivetrain systems with Meritor axles and brakes, and TransPower electric powertrain, capable of hauling

130,000 pounds of cargo. The 38 tractors feature automated charging technologies, which further reduce operating costs.[7,8]

Charging methods for electric yard tractors are the same as those for electric forklifts, and include conventional charging, and rapid/opportunity charging. Conventional charging is the most common for 1-shift operation, as it follows a regular cycle where the tractor is running for eight hours, is charging for eight hours, and cooling for eight hours. With rapid/opportunity charging, the battery charges for about 1-2 hours during the day, and only requires an 8-hour equalization charge once a week. This charging method is ideal for yard tractors needed for two or more shifts. At this time, there is no universal charger for electric yard tractors made by different manufacturers.

Electric yard tractors are available to customize and order from several manufacturers, including BYD 8Y, Kalmar Ottawa T2, and Orange EV T-Series. Yard tractor options are shown in Figure IV.1-4. All three have been certified under CARB's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP). Specifications for these electric yard tractor options are provided in Table IV.1-9, and include tractor range, battery size, gross vehicle weight rating (GVWR), top speed, estimated endurance in hours, and estimated price (MSRP low-high estimates).

At the Port, there are three electric yard tractors in use, one at NCMT (Pasha) and two at TAMT (Dole). All the electric tractors currently operating at the Port are BYD 8Y model, with 241 HP.

Figure IV.1-4. Example Electric Yard Tractor Options

BYD Battery-Electric Yard Tractor | *Kalmar Ottawa Battery-Electric Yard Tractor* | *Orange EV Battery-Electric Yard Tractor*

Source: San Pedro Bay Ports, Draft 2018 Feasibility Assessment for Cargo-Handling Equipment

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[7] *Meritor to electrify Port of Long Beach tractors.* April 25, 2019. Available: https://www.freightwaves.com/news/greentrucking/meritor-to-electrify-port-tractors Accessed January 2021.

[8] *Meritor readies improved e-axle, wins contract with California ports.* April 25, 2019. *Available:* https://www.fleetowner.com/running-green/article/21703750/meritor-readies-improved-eaxle-wins-contract-with-california-ports Accessed January 2021.

Table IV.1-9. Electric Yard Tractor Specifications

Specification	Manufacturer/ Model		
	BYD/ 8Y	Kalmar Ottawa/ T2E	Orange EV/ T-Series
Battery Size (kWh)	217	220	80-160
GVWR (lbs)	>26,000	>26,000	40,900
Top Speed (mph)	32	45	25
Estimated Endurance on single charge (hours)	12-16	12-16	9-12
MSRP ($ low-high)	-	-	$199,000 - $285,000
Source: ICF, San Pedro Bay Ports, Draft 2018 Feasibility Assessment for Cargo-Handling Equipment.			

IV.1.2.4 Top Handlers & Reach Stackers

As of 2019, there are two top handlers and five reach stackers operating across the Port. One of the reach stackers is electric-powered, while the remaining four pieces are diesel. As shown in Table IV.1-10 below, diesel reach stackers operate for an average 328 hours annually, while top handlers operate an average 853 hours annually.

While electric options for top handlers and reach stackers are not commercially available, several crane manufacturers are working to develop such models in the near future ~~by 2021~~.

In October of 2019, the Port of Los Angeles announced that it will begin a one-year demonstration of two battery-electric top handlers, which cost $1.8 million each. The battery-electric top handlers were designed and built in the U.S. by Taylor Machine Works, Inc., which is currently the largest supplier of top handlers at the Port of Los Angeles. The battery-operated top handlers have a one-megawatt battery and can operate for up to 18 hours on a single charge. For optimum performance, the top handlers are outfitted with data loggers that track hours of operation, charging frequency, energy usage, and various additional performance indicators.[9,10] As of August of 2020, the top handlers were integrated into normal daily operations at the

[9] The Port of Los Angeles. 2019. *Port of Los Angeles Unveils World's First Zero-Emissions Top Handlers*. October. Available: https://www.portoflosangeles.org/references/news_100219_top_handler.

[10] *Ports of Long Beach, L.A. unveil new zero-emission vehicles*. October 2, 2019. Available: https://www.presstelegram.com/2019/10/02/ports-of-long-beach-l-a-unveil-new-zero-emission-vehicles/. Accessed January 2021.

Everport Container Terminal.[11] Electric top handlers are also under demonstration at Ports of Oakland and Long Beach.

At the Port of San Diego, there is one electric reach stacker operating at the TAMT by TerminalLift. The stacker is a retrofitted Fantuzzi Siemens with 354 hp. TerminalLift is in the process of converting additional reach stackers and a top handler to electric motors.

IV.1.3 Emission Reductions and Cost

IV.1.3.1 Emission Reductions

Conversion of forklifts (light-, medium-, and heavy-lift), the crane, yard tractors, top handlers, and reach stackers from diesel to electric would result in emissions reductions. Given the limited options for heavy-lift forklifts, the analysis below also considers replacing equipment with a new Tier 4 piece to serve as a transition and to further reduce emission below current equipment. Emission reductions are based on replacing diesel pieces only and do not consider replacing in-use electric pieces.

Emission reductions are based on the average specs for each equipment type. This allows for a more useful ballparking of emissions, given the fact that the specific piece equipment of equipment to replace is not always known. Diesel equipment averages by type, based on the 2019 Inventory, are shown in Table IV.1-10.

Table IV.1-10. 2019 Diesel Equipment Averages at the Port

Type	Lift	Quantity	Engine MY	HP	Annual Hours
Forklifts	Light	5	2012	64	307
	Medium	2	2011	105	490
	Heavy	20	2008	191	226
Yard Tractors	-	27	2011	201	578
Reach Stacker	-	4	2011	344	328
Top Handler	-	2	2002	327	853
Harbor Crane	-	1	2002	1,030	245

[11] *Eco-friendly technology now fully operational at the Port of LA.* August 7, 2020. Available: https://www.porttechnology.org/news/eco-friendly-technology-now-fully-operational-at-the-port-of-la/. Accessed January 2021.

A summary of emissions per piece of CHE is presented in Table IV.1-11. Emissions are presented as annual average tons. It was assumed that the replacement pieces would operate the same number of average hours per year and would be the same size as its diesel counterparts. Emissions are based on the averages shown in Table IV.1-10.

As shown in Table IV.1-11, replacing diesel CHE equipment with electric alternatives would result in the elimination of all NOx and DPM emissions, while emissions of CO_2e would decrease substantially due to the fact that the electrical grid results in lower emissions per unit of activity than diesel. Note that grid emissions are based on SDG&E's emission rate as of 2018. Because SDG&E's procurement of carbon-free renewable energy sources will increase over time, so too will the GHG benefit of electric replacement equipment, leading to increases in the GHG reduction estimates presented here.

Table IV.1-11. Summary of Annual Average Emissions per Piece (Tons per Year)

Equipment Type	Option	Tier	Emissions Per Year			Emission Reductions Per Year		
			NOx	DPM	CO_2e	NOx	DPM	CO_2e
Light-Lift Forklifts (<75 hp)	Existing Diesel	3	0.02	0.001	4	-	-	-
	Electric	-	-	-	1	0.02	0.001	3
Medium-Lift Forklifts (75-120 hp)	Existing Diesel	2	0.05	0.004	10	-	-	-
	Electric	-	-	-	3	0.05	0.004	7
Heavy-Lift Forklifts (>120 hp)	Existing Diesel	3	0.04	0.002	8	-	-	-
	Tier 4	4	0.004	0.0001	8	0.03	0.002	0
	Electric	-	-	-	3	0.04	0.002	6
Yard Tractors	Existing Diesel	4i[1]	0.13	0.007	29	-	-	-
	Electric	-	-	-	9	0.13	0.007	20
Reach Stackers	Existing Diesel	4i[1]	0.19	0.009	42	-	-	-
	Electric	-	-	-	13	0.19	0.015	29
Top Handlers	Existing Diesel	2	1.10	0.040	104	-	-	-
	Electric	-	-	-	33	1.10	0.040	71
Cranes	Existing Diesel	1	0.53	0.015	69	-	-	-
	Hybrid	-	-	-	22	0.53	0.015	47
	Electric	-	-	-	22	0.53	0.015	47

[1] Tier 4 standards for the 75-750 hp rated power engines, the standards were phased-in over a few years. The initial standards, which affect PM emissions only, are sometimes referred to as Tier 4 interim, or Tier 4i. The final standards, which include NOx and hydrocarbon standards as well as PM, are sometimes referred to as Tier 4 Final, or Tier 4f.

The range in reductions per pieces depends on various factors, including but not limited to the amount each piece is used in a given year.

IV.1.3.2 Cost

A summary of technology capital cost and cost per emissions saved for CHE is presented in Table IV.1-12. The lower the cost per emission saved indicates a higher cost effectiveness. Cost effectiveness is a useful metric because it allows us to compare investments reducing CHE emissions, with investments in other maritime-related emission sources, such as shore power and ZE/NZE on-road trucks. Technology costs were obtained from various sources including Port staff, tenants, and online research.

As shown, cost-effectiveness per pound of emissions saved tends to be highest for light- and medium-lift forklifts, the yard tractors, and the top handlers. In effect, the cost effectiveness is highest for the cheaper pieces. An underlying assumption here is that the activity is assumed to be the same as existing conditions. If replacement pieces would be used more frequently, cost effectiveness is likely to increase. Note that the technology cost here does not include any cost associated with electrical charging infrastructure at the terminals. Based on early demonstration project for ZE/NZE CHE Equipment, charging infrastructure can be up to $750,000 per outlet, which could substantially increase the cost per pound of emissions saved, shown below.

Table IV.1-12. Summary of Cost and Emission Savings per Cost

Equipment Type	Option	Technology Cost	Cost per Pound of Emissions Saved Annually*		
			NOx	DPM	CO_2e
Light-Lift Forklifts (<75 hp)	Electric	$25,000[a]	$645	$11,638	$5
Medium-Lift Forklifts (75-120 hp)	Electric	$50,000[a]	$480	$5,835	$4
Heavy-Lift Forklifts (>120 hp)	Tier 4	$150,000[b]	$2,308	$44,176	no reduction
	Electric	$250,000[c]	$3,452	$68,986	$22
Yard Tractors	Electric	$250,000[d]	$957	$17,781	$6
Reach Stackers	Electric	$1,850,000[e]	$4,954	$17,781	$6
Top Handlers	Electric	$1,850,000[e]	$839	$98,274	$32

Equipment Type	Option	Technology Cost	Cost per Pound of Emissions Saved Annually*		
			NOx	DPM	CO_2e
Cranes	Kone Hybrid (2)	$14,030,000[f]	$13,235	$465,215	$149
	Kone Electric (2)	$13,810,000[f]	$13,027	$457,920	$146
	Liebherr 600 Hybrid	$7,040,000[g]	$6,641	$233,436	$75
	Liebherr 600 Electric	$6,600,000[h]	$6,226	$218,847	$70
	Liebherr 800 Hybrid	$9,300,000[g]	$8,773	$308,375	$99
	Liebherr 800 Electric	$8,900,000[h]	$8,396	$295,111	$94

[*] Formula = Cost / (emissions saved per year * equipment life (in years)

[a] Toyota. 2021. *Forklift Pricing 1010: What You Should Know*. Available: https://www.toyotaforklift.com/resource-library/material-handling-solutions/finance/forklift-pricing-101-what-you-should-know. Accessed January 2021.

[b] CostOwl. *Average Forklift Prices.* Available: https://www.costowl.com/b2b/forklift-cost.html. Accessed January 2021.

[c] CostOwl. *Average Forklift Prices.* Available: https://www.costowl.com/b2b/forklift-cost.html. Accessed January 2021.

[d] Price provided by the Port.

[e] Retrofit estimate from discussion with existing terminal operator.

[f] Price of **Two** Kone Crane Model 8 G HMK 8710.

[g] Price represents high estimate for Liebherr LHM 600 and 800 hybrid cranes.

[h] Price represents high estimate for Liebherr LHM 600 and 800 full-electric cranes.

IV.1.4 Commercial Availability

As discussed above, electric forklifts, hybrid-electric cranes,[12] and electric yard trucks are currently commercially available or available for specific order, depending on the technology. While electric-powered top handlers and reach stackers are not currently available for purchase, demonstrations are currently underway for these pieces on Port tidelands and at other nearby Ports. Port staff is optimistic that more electric models will become commercially available in the next few years in order to meet the Port's 2030 goal of zero emission CHE.

IV.1.5 Overall Feasibility

Initially prioritizing the highest emitting diesel pieces of CHE for replacement with electric models will achieve significant reductions in the next five years that will aid in achieving the 2030 goal of zero emission cargo handling equipment. Based on the 2019 Inventory, Table IV.1-13 identifies the highest emitting CHE, which are all operated at TAMT, however they represent the highest emitters for all marine terminals.

[12] Electric hybrid

If these 20 pieces of diesel CHE were upgraded to electric or lower emitting alternatives, NOx could be reduced by approximately 89% (6.79 tons), DPM by approximately 80% (0.097 tons) and CO_2e by 49% (885 tons) annually.

Table IV.1-13. Highest Emitting CHE

			Emissions Rank		
Type	**Name**	**#**	**NOx**	**DPM**	**CO_2e**
Crane	Gottwald HMK300 Mobile Harbor Crane	1	3	1	3
Reach Stacker	TAYLOR RS9968 OSM11-C	1	4	3	4
Yard Tractor	CAPACITY TJ5000	15	1	2	1
Loader	CAT 928 G	1	6	6	18
Top Handler	TAYLOR TEC-9501	1	5	4	6
Top Handler	Taylor TEC950L Cummins C260	1	2	5	2

At the July 2020 Board Meeting, staff presented a preliminary draft of these findings[13] and received support from the Board to target and prioritize upgrading or replacing the higher emitting CHE with zero emission alternatives. The Board directed staff to work with tenants to upgrade or replace high emitting CHE.

Practically, however, there continues to be several obstacles associated with acquiring ZE and NZE CHE alternatives. The cost of ZE/NZE CHE still tends to be more expensive than its diesel counterpart. Although there are multiple programs and grant opportunities for ZE/NZE CHE, there are often restrictions that limit this funding source from reaching the Port of San Diego and/or its tenants. For example, some programs require an existing piece of diesel equipment to be destroyed in exchange for grant funding, which deters equipment owners from pursuing lower-emitting alternatives, particularly if the diesel piece is only a few years old and/or still within its useful life. For a case in point, staff worked with a tenant looking into replacing yard tractors that were a few years old with Tier 4 diesel engines. However, the grant program did not allow them to move the equipment out of state, but rather, required that the existing equipment be destroyed. Additionally, the award was minimal because the equipment was not considered as dirty as other older pieces of equipment that applied for the grant. This reduced the cost effectiveness of the replacement and proved to be suboptimal for the environment. Additionally, the owner needs to be confident that the lower-emitting

[13] At the July 2020 Board Meeting, staff initially identified 28 higher emitting CHE to upgrade to zero emission models. However, as staff began working with Port tenants and terminal operators, staff discovered that the Preliminary Inventory overestimated activity at TAMT. The Preliminary Inventory relied on CARB's EMFAC default hours for several pieces of equipment which was significantly greater than actual hours of use. For example, EMFAC lists 1,409 annual hours of operation per forklift annually as a default whereas when staff received updated information based on actual hours used, staff discovered that the forklifts operate for an average of 196 hours annually. As a result, this yielded a substantially lower amount of emissions, as well as a different set of CHE targeted for upgrades. The updated information was shared with the AB 617 MCAS Subcommittee on November 17, 2020 and it was incorporated into staff's status update on the MCAS to the Board of Port Commissioners on February 11, 2021.

alternative will meet their operational needs, including the ability of the CHE's battery life to last the length of a labor shift to avoid idle workers. Additionally, not all models are commercially available as of October 2021.

Recent grant programs have not provided adequate funding for zero and near-zero CHE. Based on four pieces of high-emitting CHE at TAMT, which was estimated to cost a total of $6.1 million, a recent analysis demonstrated that the maximum award potential would only be $736,000, or about 12%. Conversations with SDAPCD staff have indicated that the reason that these maximum award amounts are so low is because the diesel emissions, which are based on MY Engine, Engine Tier and annual hours of operation, are not that high at TAMT when compared to other pieces of equipment in San Diego County and the State of California. That said, SDAPCD staff have recognized the limitations of existing grant opportunities and have committed to try to increase the flexibility of various programs. More specifically, the Portside Community's AB 617 Community Emission Reduction Program (CERP) includes Action B1: Create Additional Flexibility for Mobile Source Incentives, which states:

Work with the [AB 617] Community Steering Committee and the public to identify and prioritize opportunities that could benefit from incentive funding. Work with CARB to increase flexibility to provide funding for other projects in the Portside Community through the Community Air Protection Incentives Guideline process. Potential flexibilities include:

- *Modified cost-effectiveness limits for zero-emission Moyer-type projects*
- *Eligibility for new purchase without scrappage requirements*
- *Eligibility for supporting infrastructure*
- *Provide mechanism for funding pilot projects to demonstrate new technologies*
- *Eligibility for projects to reduce exposure including air filtration, tree and vegetation plantings*
- *Eligibility for projects that reduce emission from passenger car use, including incentives for zero and near-zero emission vehicles, transit passes, bicycle and pedestrian projects, and others*
- *Consideration of proximity of emissions to sensitive receptors, such as schools*

Despite these obstacles, various electrical pieces are already in use at the Port, and various tenants have secured funding and/or have expressed an interest in future electrification efforts. Electric forklifts are readily available under a certain size. Electric yard tractors are in use at both cargo terminals, with more anticipated. The Port should track the demonstrations for the electric reach stackers and top handlers, particularly since one reach stacker and two top handlers are identified in Table IV.1-13 as some of the highest emitters in operation at the Port, however these pieces of equipment aren't yet commercially available. The Port has expressed interest in replacing the mobile harbor crane, another high emitter identified in Table IV.1-13, to not only service existing needs with a zero emissions equipment, but to expand service by increasing lift capacity. Some operational changes may be required.

In addition to and in support of the 2030 goal, the TAMT Final EIR requires a specific number of CHE to be replaced with electric alternatives by 2020, 2025, and 2030. The Port has been working with tenants to meet these targets and will continue to do so. Based on the 2019 Inventory, the Port will be able to focus on the highest emitting equipment in use, so that limited funds can be used to attain the maximum amount of emission reductions. Although, these commitments are clearly identified in the TAMT Final EIR, correlating references and commitments are included here too.

IV.1.6 Goals and Objectives

Cargo Handling Equipment Goal 1: Attain substantial reductions for cargo handling equipment related emissions by facilitating upgrades to zero emission/near zero emission equipment alternatives.

Cargo Handling Equipment Objective 1: Reduce emissions from cargo handling equipment by approximately 90% for nitrogen oxides (NO_X), 80% for diesel particulate matter (DPM), and 50% for carbon dioxide equivalent (CO_2e) below 2019 levels by January 1, 2025.

Discussion

The baseline for CHE emission reductions was established by the 2019 CHE Inventory. The near-term goal to be completed by 2026 is to reduce emissions from cargo handling equipment by approximately 90% for NOx, 80% for DPM and 50% for CO_2e by replacing the 20 highest emitting pieces of equipment identified in the 2019 Inventory with electric models; the Port hopes all of these electric CHE models will become commercially available in the near future. These pieces are not necessarily the oldest, but several of them are responsible for a lot of activity at the cargo terminals and could greatly benefit from electrification. Upgrading those identified pieces of CHE will pave the way for 100% zero emission equipment by 2030.

IV.2 Harbor Craft

IV.2.1 Background and Context

This chapter provides the background to support the MCAS vision of health equity for all through reduced DPM emissions with the following Long-term Goal for Harbor Craft: Tugboat related Diesel Particulate Matter (DPM) emissions identified in the Port's Emissions Inventory (2019) will be reduced by half by 2030 by transitioning to ZE/near-zero emission (NZE) technologies and/or other lower-emitting engines or alternative fuels.

Commercial harbor craft include all commercial marine vessels that are not considered ocean-going vessels (OGVs). Unlike OGV, harbor craft typically operate within 200 nautical miles (nm) from shore, however some vessels operate beyond that. Depending on the vessel certification, they can operate in the harbor, on near coastal routes, or on ocean routes.

Non-commercial harbor craft, including recreational boats, are used solely for personal enjoyment on San Diego Bay. These include a variety of gasoline- and diesel-powered vessels that spend most of the~~ir~~ operating hours within the Bay. Recreational boating includes personal watercraft (jet skis), sailboats, jet boats, and yachts. Smaller watercraft are usually gasoline powered and larger yachts are usually diesel powered. The Port tracks emissions from recreational boats; however, because CARB has excluded recreational boats from current and future harbor craft rules, they are not addressed in this chapter. The MCAS is focused on reducing emissions from commercial harbor craft, not harbor craft used for recreation.

Harbor craft include a variety of vessel and boat types that serve many functions within and near San Diego Bay, including crew and supply boats, charter fishing vessels, commercial fishing vessels, ferry and excursion vessels, pilot vessels, towboats or push boats, tugboats, barges, and work boats.

Harbor Craft represent a substantial portion of bay-wide emissions. Based on the 2019 Inventory Update, harbor craft accounted for 45% of NOx, 60% of DPM and 40% of CO_2e of maritime-related emissions. However, these emissions occur during transit throughout the Bay and within 24 nm of Point Loma. As such most of the~~ir~~ emissions occur while on the water and not while at berth adjacent to the community. Nevertheless, they are a significant source of harbor-related maritime emissions.

Source Description

Harbor craft engage in a wide variety of activities in San Diego Bay: assist in moving OGVs through the harbor and in and out of berth; move cargo and people into and out of the harbor area; provide fuel to OGVs; provide police, fire, pilot, and other services to harbor users; transport crew and supplies to offshore facilities; provide recreation opportunities; and transport crew and passengers to offshore fishing destinations. Most harbor craft are U.S. Environmental Protection Agency (EPA) Category 1 or 2 vessels, vessels with diesel engines less than 30 liters per cylinder. Table IV.2-1 lists harbor craft vessel types and the~~ir~~ typical function within the Bay.

Table IV.2-1. Commercial Harbor Craft Vessel Types

Vessel	Description
Assist tugboats	Help OGVs maneuver in the harbor during arrival and departure and shifts from berth, and can also provide escort for OGVs
Towboats/push boats/ocean-going tugboats	Self-propelled vessels that tow or push barges within and outside of the port
Ferries and excursion vessels	Ferries transport people and property; Excursion boats provide harbor cruises and whale watching
Crew boats	Carry personnel and supplies to and from off-shore and in-harbor locations
Work boats	Include utility, inspection, survey, spill/response, research, mining, training, and construction
Government vessels	Belong to U.S. Coast Guard; U.S. Navy; Fish and Game; and fire, police, and harbor departments[1]
Commercial and Sport Fishing Vessels	Carry crew and/or passengers to fishing areas both within and outside 24 nautical miles of the Port

Tugboats, Towboats, Push Boats, and Assist Tugs

Tugboats, towboats, push boats, assist tugs, and ocean-going tugs are typically regulated under one category. Assist tugs, tow boats, and push boats perform a variety of general work functions within the harbor, including assisting OGVs maneuvering into and out of berth and pushing and pulling barges. Assist tugs ensure safe navigation for large cargo vessel movements upon arrival to and departure from marine terminals. Assist tugs have unique power levels, rudders, and other equipment designed and designated specifically to support the variety in size and maneuverability of the cargo vessels. Ocean-going tugs active within San Diego Bay primarily include tugs that pull fuel barges to and from the Ports of Los Angeles and Long Beach, and lumber barges to and from the Pacific Northwest. There were eight assist tugs, two tow or push boats, and five ocean-going tugs operated by Port tenants in San Diego Bay in 2016.

Commercial and Sport Fishing

Commercial fishing includes vessels harbored at commercial fishing areas located at Shelter Island and Tuna Harbor, along the Embarcadero. The commercial fishing fleet varies in size mainly due to the specialization in geographic range and space requirements necessary for the type of catch. Sport fishing, or charter fishing, vessels are fishing boats that are commercially chartered by passengers. These vessels are operated by sport fishing operations located out of Shelter Island including Fisherman's Landing, H&M Landing, and Point Loma Sport Fishing. Similar to commercial fishing, the sport fishing fleet varies in size depending on the location and

[1] Note that US military operations are excluded here. Generally, states cannot require emission reductions from federal vessels. Additionally, Port fleet vessels are not included in this source and are discussed in the Port Fleet section.

range of the vessels. Generally, sport fishing vessels have greater engine power than commercial fishing vessels due to the demands of moving passengers and equipment.

Ferry and Excursion

Ferry and excursion vessels are used to move passengers for public transportation, sightseeing, whale watching, dinner cruises, and other similar recreational opportunities within and near San Diego Bay. Ferry and excursion services operate from the Embarcadero area along the northeastern shore of the Bay within the vicinity of Broadway and B Street. Two companies primarily provide ferry and excursion services: San Diego Harbor Excursion (a.k.a. Flagship) and Hornblower Cruises and Events. Passenger ferries and excursion vessels rarely travel beyond 24 nm from the Port.

Other Commercial Harbor Craft

Other harbor craft include boats that perform a variety of functions within the Bay. In this analysis, these were broadly treated as crew, supply, pilot, work, and other vessels. Crew and supply boats are smaller boats that are used for carrying personnel and supplies. Work boats perform inspections, survey, and assist with construction. As OGVs approach the Bay, a pilot boat carries a Bay pilot that then boards OGVs in the vicinity of the Whistle Buoy[2] to ensure safe navigation to the berthing location within San Diego Bay. A fuel barge (auxiliary engines only) is considered in this category and the boat pushing the barge (carrying fuel or something else) is considered an ocean-going tug.

Existing Fleet Summary – 2019 Port Commercial Harbor Craft Inventory

In Spring 2020, Port staff conducted a Maritime Commercial Harbor Craft Inventory (Inventory) to update the prior iteration from 2016, identify the higher-emitting equipment that is in use, and to determine the feasibility of cleaner upgrades to reduce emissions. The scope of the Inventory includes all commercial harbor craft that are based in the Port jurisdiction or that visited one of the three marine terminals (CST, TAMT, and NCMT) in 2019. This is the fourth commercial harbor craft Inventory conducted by the Port, past inventories were conducted in 2006, 2012 and 2016. Emissions inventories were calculated based upon CARB's methodology.

Commercial harbor craft is broken into two major groups: harbor craft associated with commercial and sport fishing, and all other types of harbor craft. The commercial harbor craft inventory for the fishing fleet relies on the 2016 inventory because it was based on several months of research and extensive outreach to the fisherman and marinas.

The inventory for all other harbor craft was updated based on 2019 activity. All harbor craft in operation are diesel-fueled. The commercial harbor craft inventory includes several one-off ship visits for activities such as

[2] The Whistle Buoy marks the approach to San Diego Bay from the open ocean (32 deg 37.3 min N, 117 deg 14.7 min W). It is designed to make noise to alert mariners in reduced visibility, using an airflow chamber and the motion from wind and wave action to create a whistling sound.

repairs. In 2019, a few work boat and research boats that are not based in San Diego visited and made up a large share of emissions. While these emissions are accounted for, the recommended strategies and options at the end of the chapter focus on emission sources that are consistently in the Bay, such as assist tugboats, excursions, and ferries. Inventory data and emissions are summarized in Table IV.2-2 and inform the analysis below. Commercial harbor craft inventory emissions are provided in greater detail in Appendix A.

Table IV.2-2. Portion of Commercial Harbor Craft Pieces and Emissions by Type

Type	Pieces	NOx	DPM	CO_2e
Crew Supply	10%	13%	9%	17%
Dredge	2%	1%	1%	1%
Escort/Ship Assist Tug	6%	4%	3%	6%
Excursion	26%	20%	18%	23%
Ferry	2%	4%	4%	4%
Bunker Barge	1%	0%	0%	0%
Pilot Boat	2%	2%	1%	2%
Push Tow Tug	28%	18%	17%	17%
Research Boat	11%	23%	23%	14%
Work Boat	13%	16%	16%	16%
Total	100%	100%	100%	100%

IV.2.1.2 History of Previous Efforts

With the exception of CARB establishing minimum engine compliance standards for various harbor craft in 2007 and 2011, there have been relatively few strategies to reduce harbor craft-related emissions. However, given that ferries and tugs owned by Port tenants account for the vast majority of harbor craft emissions, Port tenants, have been advancing zero and near zero emission technologies including applying for grants to electrify a ferry vessel and obtaining a grant award for electric tug vessels.

Electric Ferry

In 2017, the Port applied to the *CARB Off-Road Advanced Technology Demonstration Project* grant program in part to fund the purchase of a 74-ft lithium-ion battery electric ferry to provide hourly passenger service between the Broadway Pier, San Diego Convention Center, and the City of Coronado. The proposal, which also included funds for seven high-capacity forklifts and a boat hoist, totaled $13.9M, with $9.7M from CARB, and a Port match of $4.2M.[3] The project was expected to reduce emissions by 658 MTCO2e, 0.7 tons NOx,

[3] Port of San Diego. 2020. *AB 617 MCAS Subcommittee Meeting #4*. December 2021.

and 0.02 tons of DPM annually.[4] While this particular grant application was not successful in 2017, the Port may consider pursuing a similar electric ferry application with a ferry operator in the future, given that the Portside Community was officially designated by CARB for the AB 617 Community Air Protection in 2018.

Electric Tug

In 2019, Crowley Marine Services was awarded a total of $18M from the 2019SDAPCD, CARB Clean Air for All Grant Campaign and the U.S. Maritime Administration for the design, build, and demonstration of an all-electric tugboat.[5] This will be the first all-electric tug to be built and home-ported in the United States. The "E-Tug" will replace one that uses 30,000 gallons of diesel per year. At the time of this report (2021), the "eWolf's" build contract had been awarded and it is anticipated to be in operation by 2023. Of special note is that Crowley is also installing a microgrid with this project. It will include a canopy solar system that will provide shade and power to large battery cabinets. The tug will never use grid power during peak hours, significantly lowering costs.

IV.2.1.3 Legislative and Regulatory Framework

Commercial Harbor Craft

At the federal level, the EPA has adopted emission standards for new Category 1 (0 to 7 liters per cylinder) and Category 2 (between 7 and 30 liters per cylinder, which includes most harbor craft) diesel engines rated over 50 horsepower (hp) (or 37 kilowatts) used for propulsion in most harbor craft. The new Tier 3 engine standards were phased-in beginning in 2009 and the more stringent Tier 4 engine standards for commercial marine diesel engines greater than 800 hp were phased in beginning in 2014. The regulation also includes requirements for remanufacturing commercial marine diesel engines greater than 800 hp. Additionally, the EPA has set sulfur limitations for non-road diesel fuel, including locomotives and marine vessels (though not for the marine residual fuel used by very large engines on OGVs). Under this rule, diesel fuel used by locomotives and harbor craft was limited to 500 parts per million (ppm) sulfur content starting June 1, 2007, and further limited to 15 ppm sulfur content (ultra-low-sulfur diesel) starting January 1, 2010, for non-road fuel and June 2012 for marine and locomotive fuels.

At the state level, CARB adopted a regulation that reduces DPM and NOx emissions from new and in-use commercial harbor craft operating in Regulated California Waters (i.e., 24 nm off the California shoreline). CARB adopted this regulation on November 17, 2007, and it became effective on January 1, 2009. CARB's definition for commercial harbor craft includes tugboats, towboats, ferries, excursion vessels, workboats,

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[4] CARB. 2017. *Low Carbon Transportation Investments: Fiscal Year 2016-2017 Off-Road Advanced Technology Demonstration Project Solicitation*. October 12. Available: https://ww2.arb.ca.gov/sites/default/files/classic//msprog/aqip/solicitations/fy1617offroaddemoapplications.pdf. Accessed February 2021.

[5] SDAPCD. 2019. *Clean Air For All 2019 Funded Applications- AB 617 Projects*. Available: https://www.sdapcd.org/content/dam/sdc/apcd/PDF/Grants/2019%20Apps%20AB617%20Funded%20List.pdf. Accessed February 2021.

crew boats, and fishing vessels that do not otherwise meet the definition of OGVs or recreational vessels. All in-use, newly purchased, or replacement engines must meet the EPA's current emission standards up to Tier 3 according to the compliance schedule set by CARB. In addition, propulsion engines on all new ferries acquired after January 1, 2009, with a capacity of more than 75 passengers are required to apply best available control technologies (BACT) to engines to meet EPA Tier 2 or Tier 3 marine engine standards at the time of vessel acquisition. CARB amended the commercial harbor craft regulation in 2010 to include crew and supply vessels, barges, and dredge vessels to clarify requirements and address issues that arose during implementation of the initial regulation. CARB set sulfur limitations for diesel fuel sold in California for use in on- and off-road motor vehicles (13 CCR 2281–2285; 17 CCR 93114). Harbor craft and intrastate locomotives were originally excluded from the rule but were later included by a 2004 rule amendment. Under this rule, diesel fuel used in motor vehicles except harbor craft and intrastate locomotives has been limited to 500 ppm sulfur since 1993. The sulfur limit was reduced to 15 ppm on September 1, 2006. A federal diesel rule similarly limited sulfur content nationwide to 15 ppm by October 15, 2006.

CARB is in the process of updating the commercial harbor craft rule to include additional vessel categories and require Tier 3 or Tier 4 engines with a diesel particulate filter for all vessels below 600 kW (such as excursion boats and ferries), and Tier 4 engines with a diesel particulate filter for all vessels above 600 kW (such as tugs, work boats and many research vessels). If the proposed update to the rule goes into effect, by 2025, all new excursion vessels will need to be hybrid electric, and by 2026, all in-use and new short run (< 3 nm) ferries will need to be ZE. Commercial fishing boats, historic boats and Coast Guard/Military boats are excluded from the rule. The US EPA has already certified 40 unique Tier 4 marine engine families, ranging from 600 to 7,485 horsepower; the agency has delayed Tier 4 engine certification requirements for high power density engines until 2022 or 2024. CARB staff does not expect the delay will impact the proposed compliance schedules. Also, under the proposed update, facilities that receive more than 50 visits per year would be required to install and maintain dock power by 2024. The amendment to the commercial harbor craft rule is anticipated to be adopted by CARB November 2021.

IV.2.2 Research and Analysis

IV.2.2.1 Description of Emission Reduction Technology Options

Electric Tugs

All-electric technology is typically a valuable option when vessels have predictable duties, with specific routes and speeds, and with scheduled downtimes, which are necessary for charging the vessel battery. While tugboats typically have more inconsistent duties than ferries and passenger ships, electric tug technology is emerging as an option for reducing emissions at ports around the world.[6]

The world's first all-electric tug, the ZEETUG, went into service at the Port of Tuzla in Istanbul in 2020. The ZEETUG, short for "Zero Emission Electric Tug Boat", was designed and built by Navtek Naval Technologies at the request of GISAS Shipbuilding. The boat has a 35-ton bollard pull[7] and a service speed of 10 knots, drawing power from two Corvus Energy 1,450-kW lithium-ion battery packs. While the time to charge can vary based on the charger, a full charge for the ZEETUG can be accomplished in as little as one hour. The tug is also equipped with the Smart Tug Energy Management System (STEMS), which is designed to optimize power consumption by tracking tug and motor speed, and battery temperature and state of charge, and providing feedback to the user. Additionally, remote monitoring of Navtek's client fleet means that any issues pertaining to battery life, charging, or performance, can be resolved quickly. The ZEETUG is projected to save approximately 210 $MTCO_2$, and 9 MT of NOx on an annual basis. Two additional ZEETUGs are planned for delivery to GISAS Shipbuilding, with construction currently underway.[8] Based on conversations with Navtek, tugboats can be customized up to 80-ton bollard pull, can utilize quick charging, and batteries can be exchanged at the end of the~~ir~~ useful life. Navtek's estimate for a 55-ton bollard pull tug (equivalent to the current Crowley tugs) is $8.5 million euros ($10.1 million USD).

There have been similar requests recently for all-electric tugboats in New Zealand and Japan. The Port of Auckland signed a contract with Damen Shipyards in 2019 to purchase a fully electric port tug, which is expected for delivery in 2021.[9] The Damen RSD-E Tug 2513 is expected to have the same power as the port's strongest diesel tug, with an approximately 77-ton bollard pull and a maximum service speed of 12 knots.[10] The Damen electric tug will also be equipped with two 1,000 kW generator sets, which will allow the tug to operate at 44-ton bollard pull if there is a failure of the electrical system or the vessel needs to operate beyond the battery capacity. Under normal conditions, the tug will be operational for about 3-4 hours of work on a full charge. A full charge will take at least two hours with a 1.5MW charger.[11] The charging system is not

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[6] Pessa, A.J. 2020. *The Zero-Emissions Tug*. January 24. The Maritime Executive: https://www.maritime-executive.com/magazine/the-zero-emissions-tug. Accessed September 2020.

[7] Bollard Pull is a measure of the pulling power of a vessel, comparable to the horsepower rating of conventional vehicle engines.

[8] Navtek Naval Technologies. 2020. *World's First All-Electric Tugboat Delivered, Three More on the Way*. August 4. The Maritime Executive: https://www.maritime-executive.com/features/world-s-first-all-electric-tugboat-delivered-three-more-on-the-way-1. Accessed September 2020.

[9] Pessa, A.J. 2020. *The Zero-Emissions Tug*. January 24. The Maritime Executive: https://www.maritime-executive.com/magazine/the-zero-emissions-tug. Accessed September 2020.

[10] Damen. 2020. *RSD Tug 2513 Electric*. Available: https://products.damen.com/en/ranges/rsd-tug/rsd-tug-2513-electric. Accessed September 2020.

[11] The Maritime Executive. 2019. Ports of Auckland Buys World-First Electric Tug. August 5. Available: https://www.maritime-executive.com/article/ports-of-auckland-buys-world-first-electric-tug. Accessed September 2020.

complex, featuring four on-board cables that connect directly to the station.[12] The Damen RSD-E Tug 2513 is shown in Figure IV.2-1.

The Tokyo-based company e5 Lab is currently working on a battery-and-hydrogen-powered tugboat that is expected for delivery in 2022. The tug will have 50-ton bollard pull and a service speed of 14 knots.[13] While the e5 Lab electric tub will be mostly operated via battery, hydrogen fuel cells and auxiliary generator will provide supplementary power.[14]

The vessels described above operate completely on electric-power, with bollard pull ratings ranging from 35- to 77-tons. For context, the Crowley tugs have a bollard pull of around 50 tons.[15]

While the examples above show promise, the industry is in its infancy and there are still several barriers that must be overcome before all-electric tugboats will be available for widespread commercial deployment. CARB will be collaborating with a broad range of stakeholders over the next year to make sure that the forthcoming regulatory requirements consider economic, technical, and logistical barriers to widespread deployment. The Port and its tenants are well-positioned to help promote and advance these new technologies, as discussed later.

Figure IV.2-1. All Electric Tug in Auckland, New Zealand

[12] Labrut, Michele. 2019. *Damen signs contract with Ports of Auckland for first fully-electric tug*.

[13] Tokyo Kisen. 2019. *"e5 Tug"—Electric Tug Powered by Battery and Hydrogen Fuel Cell*. October 29. Available: https://e5ship.com/pdf/2019-10-29.pdf. Accessed September 2020.

[14] Pessa, A.J. 2020. *The Zero-Emissions Tug*. January 24. The Maritime Executive: https://www.maritime-executive.com/magazine/the-zero-emissions-tug. Accessed September 2020.

[15] Crowley Fleet. Available: https://www.crowley.com/shipping/sae/fleet/#san-diego. Accessed: March 2021.

Hybrid-Electric Tug

The *Carolyn Dorothy* was the world's first hybrid tug, built in 2008 by the Foss Maritime Shipyard in Rainier, Oregon. The tug was built to retain the power and maneuverability of previous models, equipped with two Tier II Cummins QSK50 diesel engines, two Siemens Motor generators, and two Cummins QSM11 diesel generators.[16] The tug also contains 126 gel cell, lead acid batteries, which are recharged using shore power. The *Carolyn Dorothy* has a bollard pull of 60 tons and can reach speeds of up to 8 knots. In 2012 Foss Maritime added the *Campbell Foss* to the fleet of hybrid tugs, which was converted from a conventionally powered tug. When compared to conventional tugs, the hybrid-electric tugs reduce emissions of particulate matter by 73 percent, NOx by 51 percent, and CO_2 by 27 percent. In addition to emission reductions, hybrid tug technology has been found to reduce fuel consumption by 20-30 percent and main engine maintenance costs by 50 percent.[17] The *Carolyn Dorothy* is pictured in Figure IV.2-2.

Baydelta Maritime introduced the *Delta Teresa*, the first hybrid tugboat since the *Carolyn Dorothy,* in 2019. The tug was built by Nicholas Brothers Boat Builders, and unlike the hybrid tugs before it, the *Delta Teresa* has no battery power storage on board, due to operators' concerns related to heat, weight, and space.[18] Instead, the *Delta Teresa* is powered with two Tier III Caterpillar C3516 C diesel engines (2 x 2,675 hp), and two Rolls-Royce 424 kW electric motors. The tug is also equipped with three CAT C9.3 300 kW generators, and one C7.1 150 kW harbor generator to provide electrical service.[19] The tug has a 90-ton bollard pull, and can reach approximately 12.5 knots, or 9 knots in electric mode.[20] Since the *Delta Teresa*, several companies have introduced similar battery-less hybrid tugs into their fleets, including Great Lakes Towing Co. of Cleveland, and Harbor Docking & Towing of Lake Charles, Louisiana. In addition to reduced fuel consumption and less wear on the main engines, the towing companies cite ability to achieve the same bollard pull ratings with smaller engines as an appeal. Given these advantages, cost remains a drawback, with the price of hybrid

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[16] Tugboat Information. 2020. *Carolyn Dorothy.* Available: http://www.tugboatinformation.com/tug.cfm?id=1274. Accessed September 2020.

[17] Foss Maritime. 2020. *The Green Assist^{TM} Hybrid Tug.* Available: https://www.foss.com/foss-innovation/the-hybrid-tug/. Accessed September 2020.

[18] Conley, Casey. 2019. *Industry closely watching hybrid tug performance*. July 1. Professional Mariner: http://www.professionalmariner.com/American-Tugboat-Review-2019/Industry-closely-watching-hybrid-tug-performance/. Accessed September 2020.

[19] Tugboat Information. 2020. *Delta Teresa.* Available: http://www.tugboatinformation.com/tug.cfm?id=10215. Accessed September 2020.

[20] Professional Mariner. 2019. *Delta Teresa Specifications.* July 1. Available: http://www.professionalmariner.com/American-Tugboat-Review-2019/Delta-Teresa-specifications/. Accessed September 2020.

tugs typically exceeding that of conventionally powered vessels by approximately $1-$2 million.[21] The Delta Teresa cost more than $10 million.[22]

In December 2020, two hybrid tugs, *Pennsylvania* and *Wisconsin*, began operation on the Great Lakes for the Great Lakes Towing Company. The 64-ft harbor tugs were built by the Great Lakes Shipyard and are powered by two 1,000-hp MTU 8V4000 Tier III diesel engines, generating over 30-tons of bollard pull. The tugs utilize electric power for idling and low speeds, and only use the main engines for higher speeds.[23]

The vessels described above operate on hybrid-electric-power, with horsepower ratings ranging from 5,080 to 5,350. The most powerful tugs currently operating at the Port are in the 4,400 to 4,800 hp range.

Electric Ferries

As mentioned previously, vessels that have predictable routes are ideal for all-electric technologies, as this allows for ease of planning range and charging schedules. For this reason, ferries are obvious candidates for electrification. Sample electric ferries are shown in Figure IV.2-3.

Figure IV.2-2. Hybrid-Electric Tug

[21] Conley, Casey. 2019. *Industry closely watching hybrid tug performance.* July 1. Professional Mariner: http://www.professionalmariner.com/American-Tugboat-Review-2019/Industry-closely-watching-hybrid-tug-performance/. Accessed September 2020.
[22] Baydelta's Hybrid Tug: Batteries Not Included. https://www.pacmar.com/story/2019/07/01/features/baydeltas-hybrid-tug-batteries-not-included/710.html. Accessed: October 2020.
[23] Blenkey, Nick. 2020. *Great Lakes Towing christens two latest hybrid tugs.* December 17. Available: https://www.marinelog.com/coastal/tugs-barges/video-great-lakes-towing-christens-two-latest-hybrid-tugs/. Accessed February 2021.

Figure IV.2-3. Electric Car/Passenger Ferries

MV *Ampere* | MF *Tycho Brahe* | E-ferry *Ellen*

The *Ampere* was the world's first all-electric ferry, introduced in Norway in 2015. The ferry has a 120-car/ 360-passenger capacity and makes 34 trips per day between Lavik and Oppedal. With on-board battery capacity of 1 MWh, *Ampere* can reach a maximum speed of 14 knots and completes its 3.5-mile route in approximately 20 minutes. There is an additional 10 minutes of loading and unloading at each stop, during which time the lithium-ion batteries are recharged.[24] Operators have found that compared to its fuel-powered counterparts, the all-electric ferry has cut GHG emissions by 95 percent, and costs by 80 percent.[25]

In 2017, two ferries operated by ForSea were converted from conventional diesel operations to all-electric battery power. The *Tycho Brahe* and *Aurora* were originally built in 1991 and operate between Helsingør, Denmark, and Helsingborg, Sweden, transporting at least 7.4 million passengers and 1.9 million vehicles per year. While the two ferries are still equipped with the~~ir~~ original diesel engines, they were updated in 2017 to include 640 lithium batteries, with a total charge power of 11 MW and battery capacity of 4.16 MWh. Both ferries have a cruising speed of 14.5 knots. The ferries can run on exclusively battery power or diesel power, or in a hybrid set-up with a combination of both. ForSea reports that the ferries have saved approximately 65 percent of CO_2 emissions.[26]

The world's current most powerful electric ferry is the *Ellen E-Ferry* that operates the 22-nm crossing between the Danish Islands of Ærø and Fynshav. The *Ellen*, designed by Jens Kristensen Consulting Naval Architects and built by the Søby Værft shipyard, began operation in Denmark in June 2019. The 60-m long, 13-m wide ferry can carry up to 198 passengers and 31 cars at one time. The ferry is equipped with 840 lithium-ion batteries, which provide a total battery capacity of 4.3MW, and are recharged within 25 minutes using a mechanical

[24] ShipTechnology. 2020. *Ampere Electric Powered Ferry*. Available: https://www.ship-technology.com/projects/norled-zerocat-electric-powered-ferry/. Accessed September 2020.
[25] Lambert, Fred. 2018. *All-electric ferry cuts emission by 95% and costs by 80%, brings in 53 additional orders*. February 3. electrek: https://electrek.co/2018/02/03/all-electric-ferry-cuts-emission-cost/. Accessed September 2020.
[26] DEIF. 2020. *Ferries of the future save 65% carbon dioxide.* Available: https://www.deif.us/marine-and-offshore/cases/tycho-brahe. Accessed September 2020.

arm plug in.[27] With maximum speeds of 13-15.5 knots, the *Ellen* has cut travel time by 21 percent compared to a fuel-powered vessel traveling the same route.[28] It is estimated that the ferry will save 2,000 tons of CO_2 annually.[29]

The U.S. first all-electric ferry was introduced in Alabama in early 2019. The *Gee's Bend Ferry* operates in the Alabama River between Gee's Bend and Camden with a capacity of 15-vehicles/132-passengers. The ferry was gutted and retrofitted with four 150-hp electric motors and Spear Power Systems batteries after issues with the conventional diesel engines made ferry schedules consistently unreliable.[30] There are chargers on both sides of the river, and a full charge takes approximately 25 minutes.[31] The new all-electric ferry has a service speed of eight knots and cost $1.8 million.

Hybrid-Electric Ferries

The *Enhydra* hybrid-electric ferry was introduced to the San Francisco Red and White Fleet in September 2018. The 128-foot long vessel has a 600-passenger capacity and is intended to help the fleet reach the~~ir~~ goal of zero emissions by 2025. The ferry is equipped with a 410-hp Cummins QSL9 diesel engine and twin Corvus Energy 80-kW lithium-ion battery banks. The battery-electric hybrid propulsion system allows the ferry to run over two hours at seven knots in all-electric mode. Depending on weather conditions, this means that typical cruises can run half the time in all-electric, and slower-speed cruises can operate in electric mode for the~~ir~~ entire trip.[32] The hybrid-electric ferry provides 20-30 percent fuel savings, and reduces GHG emissions by 30-80 percent, as it is paired with Tier 3 magnet generators that run exclusively on biofuel.[33] The *Enhydra* hybrid-electric ferry is pictured in Figure IV.2-4. For context, the Coronado commuter ferries travel at an average speed of 5.5 knots and take about 15-minutes to travel between downtown and Coronado.

[27] Murray, Adrienne. 2020. *Plug-in and sail: Meet the electric ferry pioneers*. January 14. BBC: https://www.bbc.com/news/business-50233206. Accessed September 2020.
[28] Tunnicliffe, Andrew. 2019. *Ellen E-ferry: the world's glimpse of the future of ferries*. September 3. ShipTechnology.
[29] Danfoss. 2019. *World's most powerful fully-electric ferry got her name and is getting ready for Danish waters*. June 3. Available: https://www.danfoss.com/en/about-danfoss/news/cf/world-s-most-powerful-fully-electric-ferry-got-her-name-and-is-getting-ready-for-danish-waters/#:~:text=Ellen%20is%20the%20world's%20most,operation%20anywhere%20in%20the%20world. Accessed September 2020.
[30] Gauvin, Brian. 2020. *Alabama River ferry reborn with electricpropulsion.* January 30. Professional Mariner: http://www.professionalmariner.com/February-2020/Alabama-River-ferry-reborn-with-electric-propulsion/. Accessed September 2020.
[31] DuPont, Dale K. 2020. *First all-electric ferry in U.S. reaches milestone.* WorkBoat: https://www.workboat.com/news/passenger-vessels/first-all-electric-ferry-in-u-s-reaches-milestone/. Accessed September 2020.
[32] Conley, Casey. 2020. *2019 Ship of the Year: Enhydra*. Professional Mariner: http://www.professionalmariner.com/American-Ship-Review-2019/2019-Ship-of-the-Year-Enhydra/. Accessed September 2020.
[33] Red and White Fleet. 2020. *Enhydra*. Available: https://redandwhite.com/enhydra/. Accessed September 2020.

Washington State Ferries also has plans to electrify the~~ir~~ ferry system within the next couple years. As the world's second-largest ferry system, they currently consume approximately 20 million gallons of diesel per year. By 2021, the state's three largest polluting vessels will be upgraded to hybrid-electric propulsion with Siemens battery systems, an upgrade that is anticipated to cut GHG emissions by 48,000 $MTCO_2$ per year.[34] The state is also working with the Seattle shipyard, Vigor, to build Olympic-class hybrid ferries with 144-car/1,500-passenger capacity each. Construction on these new vessels is set to begin this year and be completed by 2022.[35] The ferry agency's long-range plans include a goal that 22 of the 26 vessels in the fleet are hybrid-electric by 2040.[36]

Figure IV.2-4. Hybrid-Electric Ferry in San Francisco, CA

IV.2.2.2 Emission Reductions and Costs

Emission Reductions

A summary of emissions for existing tugs and ferries, as well as the emission-reducing replacement options is presented in Table IV.2-3. Each technology is compared to the average existing diesel vessel at the Port and assumes that the replacement piece would operate the same number of hours per year and would be the same size as the current fleet.

[34] Deign, Jason. 2019. *World's Second-Largest Ferry Operator Switching From Diesel to Batteries.* November 29. Green Tech Media: https://www.greentechmedia.com/articles/read/worlds-second-largest-ferry-operator-switching-from-diesel-to-batteries. Accessed September 2020.
[35] Stiffler, Lisa. 2019. *How Washington state plans to create the world's largest hybrid-powered, auto-carrying ferries*. Geek Wire: https://www.geekwire.com/2019/washington-state-plans-create-worlds-largest-hybrid-powered-auto-carrying-ferries/. Accessed September 2020.
[36] Giordano, Lizz. 2019. *Washington State Ferries plans for an electric-hybrid fleet*. November 4. HeraldNet: https://www.heraldnet.com/news/washington-state-ferries-aiming-for-a-fleet-energy-sea-change/. Accessed September 2020.

Emission factors for the replacement vessels were based on best available information from models currently in operation. Conventional hybrid vessels tend to utilize battery power while idling and at low speeds and employ the main engines for higher speeds.[37] Emissions for the hybrid vessels are based on an assumed 35% reduction in fuel consumption from a Tier 3 engine.[38] For the emissions from the fully electric vessels, there are no tailpipe emissions, and the only emission are from the SDG&E's grid. The GHG benefits over time would increase over the estimates presented here as SDG&E increases its procurement of carbon-free renewable energy sources.

Table IV.2-3 also provides the emission reductions with replacement of the existing diesel vessels. As shown, emissions of all pollutants would decrease with electric and hybrid replacements.

Table IV.2-3. Summary of Annual Average Emissions per Vessel (tons per year)

Vessel	Option	Tons of Emissions Per Year			Emission Reductions Per Year		
		NOx	DPM	CO2e a	NOx	DPM	CO2e a
Assist Tug	Existing Diesel	1.44	0.05	135	-	-	-
	Electric	-	-	49	1.44	0.05	86
	Hybrid Electric	0.49	0.03	88	0.95	0.02	42
Ferry	Existing Diesel	4.41	0.16	339	-	-	-
	Electric	-	-	136	4.41	0.16	203
	Hybrid Electric	1.22	0.06	220	3.19	0.10	119

[a] CO_2e emissions in metric tonnes.

Costs

A summary of technology capital cost and cost per emissions saved is presented in Table IV.2-4. Technology costs were obtained from various sources including online research and personal communication with industry specialists, manufacturers, and operators. As shown in Table IV.2-4, the cost per emissions saved is better (higher) for the fully electric tug and ferry relative to the hybrid counterparts. Note that the technology cost here does not include any cost associated with electrical infrastructure at the terminal.

Cost for the electric Crowley is based on the application submitted for its grant award. Cost for the hybrid tug is based on the *Delta Teresa* tug operating in San Francisco Bay. Cost for the electric ferry is based on *Gee's Bend* operating in Alabama. Cost for the hybrid ferry based on the *Happiness* ferry based out of Taiwan. As

[37] Blenkey, Nick. 2020. *Great Lakes Towing christens two latest hybrid tugs*. December 17. Available: https://www.marinelog.com/coastal/tugs-barges/video-great-lakes-towing-christens-two-latest-hybrid-tugs/. Accessed February 2021.

[38] Squatriglia, Chuck. 2008. *G.E. Developing a Diesel Hybrid…Tugboat?*. May 21. Available: https://www.wired.com/2008/05/ge-developing-a/. Accessed February 2021.

shown in Table IV.2-3, the cost per ton is better for both the electric tug and ferry relative to the hybrid counterparts.

Table IV.2-4. Summary of Total Cost and Cost per Emissions Saved

Vessel	Option	Technology Cost	Cost per Pound of Emissions Saved		
			NOx	DPM	CO2e
Assist Tug	Existing Diesel	-	-	-	-
	Electric	$10,000,000 – $15,000,000 [a]	$3,500 – $5,200	$105,000 – $157,000	$55 – $88
	Hybrid Electric	$10,000,000 [b]	$5,300	$228,000	$106
Ferry	Existing Diesel	-	-	-	-
	Electric	$1,800,000 [c]	$200	$5,500	$4
	Hybrid Electric	$2,000,000 [d]	$315	$9,700	$8

[a] Cost for the electric tug based on $10 million estimate for ZEETUG and $15 million cost proposal from Crowley.
[b] Cost for the hybrid tug is based on the *Delta Teresa* tug operating in San Francisco Bay.
[c] Cost for the electric ferry is based on *Gee's Bend* operating in Alabama.
[d] Cost for the hybrid ferry based on the *Happiness* ferry based out of Taiwan.

IV.2.2.3 Commercial Availability

As discussed above, some options for electric and hybrid tugs and ferries are mostly still in the prototype stage. Various demonstrations are currently underway worldwide, including one tug replacement at the Port. Commercial harbor craft are built to order therefore they are available today to be ordered and built over the next many months. However, the cost today is significantly greater for electric than for traditional diesel powered.

IV.2.3 Goals and Objectives

Harbor Craft Goal 1: Reduce emissions from Harbor Craft by advancing emerging zero emission and advanced technologies.

Harbor Craft Objective 1: Facilitate implementation of the first all-electric tugboat in the United States by June 30, 2026.

Discussion

Technology for zero emission tugs is still mostly in the proto-type stage. However, the Port and its tenants will explore opportunities to advance this technology as opportunities present themselves.

Harbor Craft Objective 2: Identify suitable projects to assist with advancing the State's goals for commercial harbor craft by supporting:

a. Existing fuel docks with the transition to renewable diesel by January 1, 2023;
b. Installation and maintenance of landside shore power for all facilities that receive more than 50 visits per year by 2024;
c. All new excursion vessels transition to zero emission capable hybrid technologies starting on January 1, 2025; and
d. Short run ferry-operators transition to zero emission technologies for all new and in use short-run (under 3 nautical miles) trips starting on January 1, 2026.

Discussion

Choosing to electrify the highest emitters, namely the most active assist tugboat and the most active ferry, would result in substantial emissions savings. A tugboat tenant has already secured a substantial portion of the funding for an electric tug, although charging infrastructure will be needed. For the ferry, given the short runs of the commuter ferries and opportunity for charging during the longer headways during the non-peak time periods, the fully electric version would be useful and unlikely to require substantial operational changes.

IV.3.1 Background and Context

This chapter provides the necessary background to identify near-term strategies that may be implemented to support the MCAS vision of *Health Equity for All* and attain the Long-Term Goal of 100% ZE truck trips to the Port's marine cargo terminals by 2030.

According to California's emission inventory model, almost a million heavy-duty vehicles operate on its roads each year. CARB estimates that heavy-duty vehicles contribute 31% of all statewide NOx emissions and approximately 26% of total statewide DPM emissions. In 2015, Governor Brown issued Executive Order B-32-15, which directed State agencies to establish targets to improve freight efficiency, transition to zero emission technologies, and increase the competitiveness of California's freight transport system. This direction resulted in the California Sustainable Freight Action Plan (2016), which acknowledged that the plan's targets are not mandates, but rather aspirational measures of progress toward sustainability for the State to meet and try to exceed. It also noted that:

> *The [Sustainable Freight] Action Plan is the beginning of a process and signals the State government's interest in collaborating with stakeholders on defining the actions necessary to make the vision for sustainable freight transport system a reality.*

In 2019, Governor Newsom signed Executive Order N-19-19, which among other things, directed the State Transportation Agency to *align the state's climate goals with transportation spending on planning, programming and mitigation to achieve the objectives of the State's Climate Change Scoping Plan, where feasible* and noted that CARB shall:

> a. *Develop new criteria for clean vehicle incentive programs to encourage manufacturers to produce clean, affordable cars,*
>
> b. *Propose new strategies to increase demand in the primary and secondary markets for zero emissions vehicles, and*
>
> c. *Consider strengthening existing or adopting new regulations to achieve the necessary greenhouse gas reductions from within the transportation sector.*

Finally, in September 2020, Executive Order N-79-20 established that it shall be the goal of the State that 100% of medium- and heavy-duty vehicles be zero emission by 2045, and 100% zero emission for drayage trucks by 2035. These executive orders set the State's long-term vision for sustainable freight transport system, which includes zero emission trucks. They also establish the foundation for regulatory changes that CARB is tasked with executing. Current and forthcoming regulatory requirements pertaining to on-road trucks are discussed in this chapter.

Improving air quality in portside communities by reducing on-road truck emissions remains a high-priority of the District. The AB 617 Portside Community Draft CERP acknowledges that truck movements associated with nearby industrial and business uses expose Portside Community residents and sensitive receptors to diesel emissions. In the summer of 2020, the AB 617 Steering Committee created the AB 617 Truck Subcommittee, which explored technological and institutional challenges to the electrification of heavy-duty trucks. The AB 617 Truck Subcommittee's activities resulted in several early emission reduction strategies for on-road trucks in the AB 617 Draft CERP. In Fall 2020, the AB 617 MCAS Subcommittee built on this earlier work to further develop and refine strategies that the Port could help advance to accelerate the deployment of zero and near-zero emission (ZE/NZE) trucks, in alignment with and/or in advance of Statewide goals.

This chapter focuses on heavy-duty trucks that transport freight from the Port's marine cargo terminals at TAMT and NCMT, including trucks that move containers, bulk, break-bulk, and Roll-on/Roll-off cargo. It provides an overview of the Port's participation in clean- and ZE/NZE- truck programs, as well as the results from the Port's Truck Survey that was conducted in Spring 2020. It provides a high-level overview of CARB's current and forthcoming requirements pertaining to drayage trucks, which is followed by a discussion of ZE/NZE truck technology and potential applications, with an emphasis on battery electric vehicle (BEV) technology. In conjunction with extensive stakeholder involvement discussed earlier, these data points were used to inform the recommendations included at the end of the chapter, which seek to further accelerate the deployment of ZE/NZE trucks within and around Port tidelands.

The term *drayage truck* is defined by CARB as Class 7 and 8 trucks (trucks with a gross vehicle weight rating of greater than 26,000 pounds) that are used for transporting cargo, such as containerized bulk, or break-bulk goods, that operates (a) on or transgresses through port of intermodal rail yard property for the purpose of loading, unloading or transporting cargo, including transporting empty containers and chassis or (2) off port or intermodal rail yard property transporting cargo or empty containers or chassis that originated from or is destined to a port or intermodal rail yard property.[1] This chapter also addresses other types of trucks that transport cargo to and from TAMT and NCMT and that may be subject to other regulations, such as CARB's Truck and Bus Regulation.

IV.3.1.1 Source Description

The truck source includes drayage trucks that are used to transport port-related cargo between NCMT and TAMT as well as local and regional destinations. To properly account for all emissions associated with truck travel, activity for truck trips is split geographically between the following activities:

On-Port Moves: These include truck movement and idling within the terminal boundary as trucks move into position to pick up or drop off cargo.

[1] 13 CCR § 2027(c)(15).

Local-Port Moves: These include truck trips to and from the Ports marine cargo terminals and locations within San Diego County.

Regional-Port Moves: These include truck trips to and from the Port's marine cargo terminals which originate or end outside of San Diego County.

At TAMT, trucks mainly consist of refrigerated container trucks, dry bulk and unibody trucks to move dry bulk (e.g., cement, bauxite, and fertilizers), and multi-purpose general cargo (e.g., wind turbine parts), as well as other miscellaneous deliveries. At NCMT, trucks mainly consist of car carriers, along with some flatbeds and trailers to move general project cargo, and material (parts) deliveries for automobile services. At NCMT, automobile imports arrive by vessel and are off-loaded and driven a short distance to parking areas near the terminal prior to loading onto trucks or rail.

IV.3.1.2 History of Previous Efforts

Truck Retrofit and Replacement Program (2008)

In 2008, the Board of Port Commissioners authorized an MOU with SDAPCD to implement, on behalf of CARB, the Port's Truck Retrofit and Replacement Program in an amount not to exceed $1,150,000. Under the terms of the MOU, SDAPCD entered into an agreement with CARB to obtain Goods Movement Emissions Reduction Program (GMERP, or Proposition 1B) funding, and then allocated money (though a cost-sharing agreement) to selected truck owners to either retrofit their trucks with Diesel Particulate Filters (DPF) or replace their trucks, with newer, less polluting models. Under the GMERP, CARB programmed $2.9 million to fund approximately 35 truck retrofits that served the Port of San Diego.

Clean Truck Program (2010)

The Clean Truck Program was adopted by the Port in 2010 as part of the Clean Air Program (precursor to MCAS) to address emissions from on-road, heavy-duty diesel trucks serving the marine cargo terminals. The Clean Truck Program amended the Port's tariff to require trucks entering the Port's marine cargo terminals to reflect CARB's Drayage Truck Regulation ("Drayage Regulation"), which requires ports to report trucks which do not meet emissions standards, but still allows those trucks to do business on the terminals. However, commencing on January 1, 2011, the Port went beyond CARB compliance by prohibiting trucks that did not meet the Drayage Regulation from entering the Port's marine cargo terminals.

San Diego Port Tenant's Association – $5.9 Million All Electric MD/HD Vehicle Grant (2016)

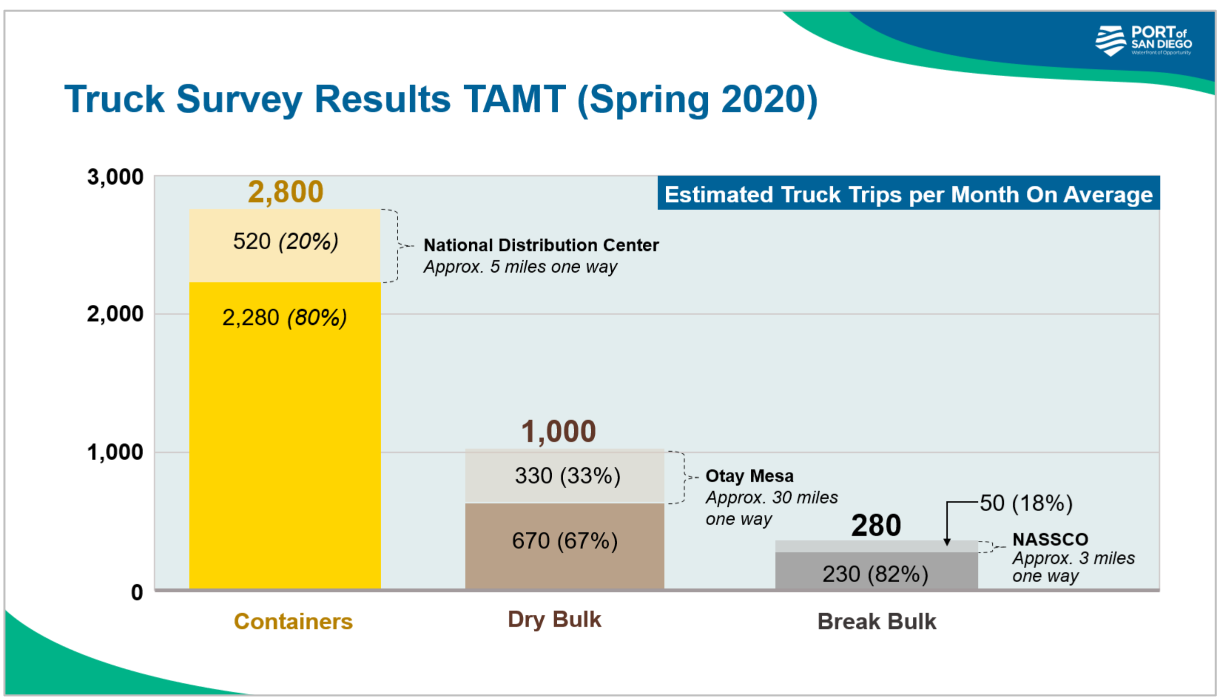
In July 2016, the San Diego Port Tenant's Association (SDPTA) was awarded a $5.9 million grant from the California Energy Commission (CEC) to demonstrate ten freight vehicles (including several pieces of heavy-duty equipment and four drayage trucks), that were outfitted with zero-emission technologies[2]. This award

[2] The grant award was matched with $2.3 million in cash and contributions from the SDPTA and its industrial tenant partners, bringing the project total to $8.2 million.

involved the demonstration of four battery electric, on-road Class 8 drayage trucks, as well as to demonstrate Intelligent Transportation Systems (ITS) technologies for freight signal prioritization along Harbor Drive. Information and lessons learned from the SDPTA's ZE Medium- and Heavy-Duty Demonstration Project was shared with the AB 617 MCAS Subcommittee, to help inform and guide the ZE/NZE truck goals and objectives that are identified at the end of this chapter.

IV.3.1.3 Port of San Diego Truck Survey

Figure IV.3-1: Truck Survey Results at TAMT



Refrigerated Containers (TAMT)

Refrigerated containers are one of the three major cargo types that are processed at the TAMT, which results in approximately 700 containers per week. Containers are transported to destinations throughout the western United States. While a majority of the containers are transported great distances outside of San Diego County, about 520 monthly containers are moved by truck from TAMT to the National Distribution Center (NDC) in National City, approximately five miles south. Once at NDC, produce is transferred from the 40-foot refrigerated containers to 53-foot long-haul trailers before being transported off Tidelands. The truck survey determined that currently, one company is responsible for the five-mile route to NDC, and it uses both company-owned and contracted vehicles. This route is a potential candidate to test electric truck and charging technologies given that it is relatively short and regular.[3]

Dry Bulk (TAMT)

The primary bulk products passing through TAMT are bauxite, sugar, and fertilizer. Unlike the refrigerated container cargo that has a vessel call every week, none of the bulk carriers arrive on a predictable schedule. The fertilizer has the shortest trip of two to three miles depending on the route; however, the trucking company handling this commodity also does many long hauls in the region. The bauxite goes to Victorville, California (roughly 164 miles one way) and Tucson, Arizona (roughly 408 miles one way). Sugar is hauled to a processing facility in Otay Mesa, approximately 30 miles away. Staff have learned that these operations require each truck to drive four or five trips per shift and to change drivers so that two shifts can be performed in one day. This sugar route may be another good candidate for testing electrification.

Break Bulk (TAMT)

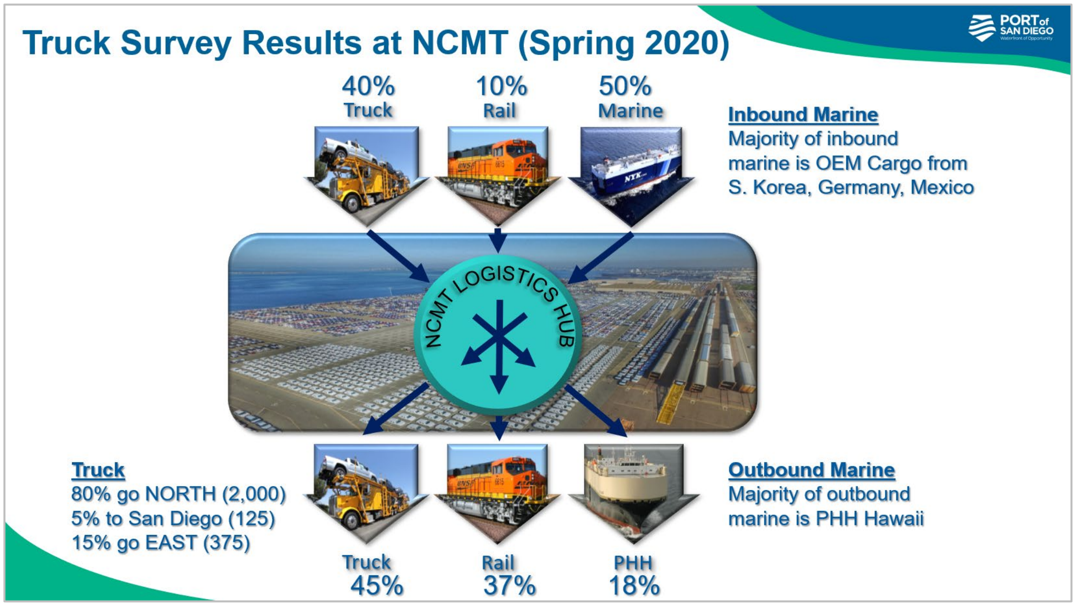
Cargo that arrives at TAMT includes steel for shipbuilding, wind turbine blades and tower pieces, military ordnance, and electrical gear. The locations where trucks haul break bulk include the Working Waterfront, which is three miles away; Riverside, approximately 100 miles away; Tehachapi, approximately 235 miles away; and Palm Springs, approximately 140 miles away. There is a current terminal service provider that is located at TAMT with equipment that can move these heavy, break bulk items. The short-haul route along the Working Waterfront may be another potential candidate for electrification.

Roll-on / Roll-off Cargo (NCMT)

The Port's truck survey results for NCMT are summarized in Figure IV.3-2 below, and is followed by a discussion of how Roll-on / Roll-off cargo is transported and moved at this facility.

[3] San Diego Unified Port District. July 14, 2020. Presentation and Direction to Staff on Clean Air and Emission Reduction Advancements.

Figure IV.3-2: Truck Survey Results at NCMT



Approximately 400,000 vehicles pass through NCMT per year. The site is a confluence of ships, trains, and trucks that import vehicles from both foreign and domestic locations. Generally, about 37% of cargo leaves NCMT by train, 18% leave by ship to Hawaii, and 45% leave by truck. Of those that leave by truck, roughly 5% are delivered within San Diego County, 80% go north toward Los Angeles and beyond (120 miles or more), and 15% go east toward Arizona and Nevada (350 miles or more). A high potential candidate for electrification is a route that transports vehicles from NCMT to an offsite storage facility in Otay Mesa, roughly 15 miles away. Currently, the NCMT terminal operator, has three electric class-8 trucks that can haul eight cars at a time on this route. The terminal operator does not currently need another truck for this route, but there may be an opportunity to electrify with trucking companies that visit NCMT.[4]

IV.3.1.4 Legislative and Regulatory Framework

Emissions from heavy-duty trucks are managed by regulations or emission limits implemented at the federal, state, and local levels[5]. In December 2000, the EPA adopted the Heavy-Duty Highway Rule, which reduces emissions from on-road, heavy-duty diesel trucks by establishing a series of increasingly strict emission standards for new engines. Manufacturers were required to produce new diesel vehicles that meet PM and

[4] San Diego Unified Port District. July 14, 2020. Presentation and Direction to Staff on Clean Air and Emission Reduction Advancements.

[5] At the local level, a Memorandum of Understanding (MOU) was signed with CARB in 2014 designating which mobile source inspections the San Diego Air Pollution Control District will enforce, and an updated MOU was signed in 2017 to allow the San Diego Air Pollution Control District to settle certain types of violations.

NOx emission standards beginning with model year 2007, with the phase-in period being between 2007 and 2010. The phase-in was based on a percentage-of-sales basis: 50% from 2007 to 2009 and 100% in 2010.

CARB adopted the Drayage Truck Regulation in December 2007 to modernize the Class 8 (Gross Vehicle Weight Rating: more than 33,000 pounds [lbs.]) drayage trucks in use at California's ports. Emergency vehicles and yard trucks (cargo handling equipment) are exempted from this regulation. The regulatory objective was to be achieved in two phases.

> By December 31, 2009, pre-1994 model year engines were to be retired or replaced with 1994 and newer model year engines. In addition, all drayage trucks with 1994 to 2003 model year engines were required to achieve an 85% particulate matter emission reduction using a CARB-approved, Level 3, verified diesel emission control strategy.
>
> By December 31, 2013, all trucks operating at California ports were to comply with the 2007 and newer on-road heavy-duty engine standards.

In December 2010, CARB amended the regulation to include Class 7 drayage trucks with a GVWR between 26,000 and 33,001 pounds. CARB further expanded the definition of drayage trucks to include dray-offs, those non-compliant trucks that may not directly come to the ports to pick up or drop off cargo but that engage in moving cargo destined to or originating from port facilities, and to/from near-port facilities or railyards.

A companion regulation to the Drayage Truck Regulation is CARB's Truck and Bus Regulation. This regulation requires existing heavy-duty trucks to be replaced with those that use the latest NOx and particulate matter Best Available Control Technology (BACT) or be retrofitted to meet required levels. Trucks with a GVWR less than 26,000 pounds, which includes most construction trucks, are required to replace engines with ones that are year 2010 or newer, or equivalent, by January 2023. Trucks with a GVWR greater than 26,000 pounds, which includes most drayage trucks, must meet particulate matter BACT and upgrade to a 2010 or newer model year emissions equivalent engine pursuant to the compliance schedule set forth by the rule. By January 1, 2023, all Class 8 drayage trucks are required to have 2010 model year engines or newer and/or meet the equivalent NOx and particulate matter BACT standards (i.e., EPA 2010 and newer standards).

Various trucks are exempt from the Drayage Truck Regulation. This list includes dedicated use vehicles, such as those with unibody construction – car carriers, refuse trucks, cement mixers, fuel delivery vehicles, mobile cranes, dump trucks, and tractor-trailers equipped with a power take-off unit to provide auxiliary power to hydraulic motors or blowers – as well as emergency equipment and military tactical support trucks. While these trucks are not regulated under the Drayage Truck Regulation, they are subject to the Truck and Bus Regulation.

In addition, CARB adopted an Airborne Toxic Control Measure in 2005 to limit diesel-fueled commercial motor vehicle idling. This regulation states that diesel vehicles with a GVWR greater than 10,000 pounds may not idle the vehicle's diesel-powered primary or auxiliary power system for more than 5 minutes at any location (13 CCR 1956.8 and 2485). This regulation applies to all trucks that visit the Port.

Advanced Clean Trucks Regulation

In 2020, CARB adopted the Advanced Clean Trucks (ACT) rule, which is the first zero-emission commercial requirement in the U.S. The ACT was approved on June 25, 2020 and has two main components, a manufacturers ZEV sales requirement and a one-time reporting requirement for large entities and fleets. To satisfy the reporting requirement, large employers will need to report information about their shipments and shuttle services, and owners of fleets with fifty or more trucks will have to report on their fleet operations. The sales requirement will require manufacturers to sell an increasing annual percentage of zero-emission trucks beginning in 2024 through 2035, such that by the end of the regulation 75 percent of Class 4 – 8 straight truck sales and 40 percent of truck tractor sales will be zero-emission (Table IV.3-1).[6] Sales requirements in the first three years of the rule are relatively conservative in order to provide manufactures sufficient time to establish supply chains and manufacturing capacity. Beginning in 2027, annual sales percentage targets ramp up. The Natural Resources Defense Council estimates that by 2035 approximately 63% of all cumulative truck sales (all truck classes from 2024 through 2035) in California could be zero-emission as a result of the ACT, approximately 319,000 trucks.[7]

Table IV.3-1. ACT Truck Sales Requirements

Model Year	Required ZE Class 2b-3 Truck Sales %	Required ZE Class 4 – 8 Straight Truck Sales %	Required ZE Class 7 – 8 Tractor Sales %
2024	5%	9%	5%
2025	7%	11%	7%
2026	10%	13%	10%
2027	15%	20%	15%
2028	20%	30%	20%
2029	25%	40%	25%
2030	30%	50%	30%
2031	35%	55%	35%
2032	40%	60%	40%
2033	45%	65%	40%
2034	50%	70%	40%
2035	55%	75%	40%

[6] CARB. n.d. *Advanced Clean Trucks Fact Sheet*. Available online at: https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-trucks-fact-sheet. Accessed January 2021.

[7] Portillo, Patricio. 2020. *California Makes History with Clean Trucks Rule [Expert Blog]*. NRDC. Available online at: https://www.nrdc.org/experts/patricio-portillo/california-makes-history-clean-trucks-rule. Accessed January 2021.

Advanced Clean Fleets Rule (Proposed)

CARB is currently working on the [Advanced Clean Fleets rule.](https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets)[8] This regulation is expected to establish requirements for fleet adoption of zero-emission trucks and buses in certain market segments, and it is meant to complement the Advanced Clean Truck Rule. Early indications suggest that CARB hopes to make progress on developing the proposed regulation and consider it for approval in 2022. CARB's current target is consistent with the Governor's Executive Order N-79-20 to achieve 100% zero emission drayage trucks by 2035 at California ports. CARB has indicated that the truck exemptions included in the current Drayage Truck Regulation may apply to the proposed Advanced Clean Fleets Regulation. These trucks include uni-body trucks such as auto-carrier vehicles, which transport freight to and from ports. These vehicle types may not have to meet 100% ZEV requirements by 2035 but rather a later deadline in the 2040's. It is important to note that CARB has not yet adopted the Advanced Clean Fleet Regulation and the regulatory concepts proposed by CARB staff may evolve. Regardless, the Port may choose different goals than CARB for reaching 100% ZEV in the future.

IV.3.2 State of Technology

Throughout the past decade, there has been large focus on developing the technology, supply chains, and marketing strategies to accelerate adoption of light- and medium-duty electric vehicles as the battery electric vehicle market matured. As a result, heavy-duty electric vehicles have been slower to evolve and implement. Recently, however, focus has shifted to electrifying heavy-duty vehicles with a particular emphasis on drayage trucks in the near-term. Drayage may be an attractive near-term application because current electric heavy-duty vehicles are well positioned to handle short-range, regular-duty cycles. Transit buses, school buses, urban delivery vehicles, and yard tractors have all seen success partially due to their regular duty cycles; drayage trucks are also well positioned for future success as the technology for heavy-duty trucks advances.

As noted earlier, transitioning the commercial vehicle market to zero- and near-zero emission technologies is occurring at different stages. CALSTART's Beachhead Strategy[9] projects that ZE/NZE drayage trucks will occur as part of Wave 4 applications and estimates full commercialization in 2023 based on data in the Zero Emission Technology Inventory (ZETI).[10] Commercial availability is defined as when vehicle manufacturers are positioned – through established manufacturing facilities, supply-chain agreements, and logistics – to begin production due to orders placed.

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[8] CARB. n.d. *Advanced Clean Fleets*. Available online at: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets. Accessed December 2020.

[9] CALSTART: 2020. *The Beachhead Model: Catalyzing Mass-Market Opportunities for Zero-Emission Commercial Vehicles*. Available online at https://globaldrivetozero.org/public/The_Beachhead_Model.docx.

[10] *Drive to Zero's Zero-emission Technology Inventory (ZETI) Tool Version 5.5*. Available online at https://globaldrivetozero.org/tools/zero-emission-technology-inventory/. Accessed December 2020.

IV.3.2.1 Charging and Infrastructure

Charging infrastructure for heavy-duty electric trucks (ZE HD), which are of the weight-class required to serve as drayage trucks for operations at the Port, requires a higher power output than light-duty and medium-duty electric trucks in order to charge larger batteries in a constrained amount of time. The appropriate power level of a charger depends on vehicle resting time, vehicle operations, and the size of the vehicle's battery. Additionally, charging time for every EV will be impacted by the maximum power acceptance rate (in KW) for the given EV; the lesser of this versus the charger power level (also in KW) will be the limiting factor that determines charging time.

Critical for enabling heavy-duty charging was the international standard for three-phase charging, which is common at commercial and industrial locations in the U.S. and Canada. The standard, SAE J3068, was instituted in 2018 and was designed specifically for medium-duty and heavy-duty vehicle charging. SAE J3068 was designed to enable the use of three-phase 480 volts (V) (up to 133 kW at 160 amperes), as well as 600 V alternating current (AC) (up to 166 kW at 160A). Additionally, SAE J3105 applies to overhead charging and SAE J2954/2 to HD wireless charging. However, to date overhead and wireless have only been used for electric buses, not for electric tractor-trailer trucks.

While plug-in EV charging is expected to serve a sizeable truck population, drayage trucks often idle in queues while loading and unloading, which could make strategically placed opportunity charging using technology such as wireless chargers an option for fleets and Ports to consider in the future.

Beyond technological specifications, the ownership model of certain charging options is important for stakeholders to consider. Charging infrastructure for many trucks is expected to be located at a fleet depot as fleets are expected to charge at the end of their workday. This will be true for fleets that operate predictable routes and have depots that allow their trucks to sit and charge overnight. However, many fleets in California are small and may not have such a facility. Innovative options for delivering electricity to these fleets will need to be developed in the years to come, which will likely include public, shared, and/or limited-access charging sites.

Importantly, entities that deploy charging infrastructure at their facilities (e.g., fleet depots and warehouses) may require facility and grid upgrades to accommodate new power demand, depending on how extensive their deployment plans are. Although the cost of these upgrades can be significant, the State of California and its investor-owned utility companies have implemented 'make-ready' programs to help entities deploy this infrastructure at low or zero cost. These utility make-ready programs typically cover the cost infrastructure between the grid interconnection and up to the electric vehicle supply equipment (EVSE, or 'charger'), taking the burden off fleets and other entities that are installing charging infrastructure.

The Port is evaluating how to support the electrification of vehicles, including by potentially providing locations for the infrastructure necessary for these technologies. The Port is considering strategies to accelerate the advancement of battery electric technology for on-road drayage trucks and cargo handling equipment. For example, chargers have been installed at the NCMT to power one truck as well as electric cars and yard tractors. However, there are several technologies and fuels that produce lower emitting trucks, which the Port will continue to track, including natural gas, renewable natural gas, renewable diesel, hydrogen and others. A more detailed discussion of these technologies are included in Appendix A – ZE/NZE Truck Technology Assessment.

IV.3.2.2. Heavy-Duty Truck Market

There are a handful of ZE HD truck models currently available, and many more expected to come in the short- and mid-term. Several traditional truck and engine manufacturers have each developed zero-emission trucks and there are numerous OEMs entering the market.

The commercial availability of ZE heavy-duty trucks lags slightly behind other vehicle types which were targeted in earlier markets. Battery electric and fuel cell drayage trucks are currently participating in pilot projects in California and beyond. As these pilot projects continue, vehicle and charger manufacturers are expected to improve their technology as the vehicles approach full commercial availability. California's regulatory environment is also evolving: CARB's Advanced Clean Trucks (ACT) regulation was instituted in 2020, and this will put pressure on manufacturers to achieve increasing ZE heavy-duty sales targets over time. CARB is also working on a medium- and heavy-duty ZE/NZE fleet regulation to complement the ACT regulation as it seeks to achieve the State's ZE goals for all truck types by 2045. Given the State's goals for accelerating the adoption of ZE heavy-duty trucks, the state of the market is advancing with an increasing list of technology options that are available. Tenants, terminal operators and trucking companies that call to the Port of San Diego will continue to see a rapidly maturing market for on-road ZE heavy-duty trucks.

IV.3.2.3 Emission Reduction Estimates

Renewable diesel, renewable natural gas, and battery electric are three options that are presently available to reduce truck emissions. For fleets operating diesel trucks, using renewable natural gas or battery electric technology means truck replacement or repowering. For renewable diesel, however, existing diesel vehicles can be utilized because renewable diesel is a "drop-in" fuel such that no modifications or vehicle replacements are necessary. Biofuels such as biodiesel may be blended with renewable diesel.

Although hydrogen is another viable fuel for Class 8 heavy-duty trucks, at this time hydrogen fueling station development is still in its early stages, with approximately 44 stations currently in operation in California.[11] So far these stations are designed for light-duty vehicles, but much can be learned from these developments in

[11] AFDC. n.d. *Hydrogen Fueling Station Locations.* Available online at: https://afdc.energy.gov/fuels/hydrogen_locations.html#/find/nearest?fuel=HY&hy_nonretail=true&location=california&page=5. Accessed January 2021.

preparation for building out hydrogen infrastructure for heavy-duty applications. For more information about hydrogen and fuel cell trucks, please see Appendix ~~A~~ B – ZE/NZE Truck Technology Assessment.

Based on the results on of the Port of San Diego's Truck Survey (Spring 2020) and the current state of EV HD technology, staff identified some existing, fixed short haul routes that may be good candidates for ZE Trucks. Table IV.3-2 below compares the emission estimates of different fuels and technologies assuming a regular, fixed route of 120 miles day or less, that would target traveling about 20,000 vehicle miles annually. As shown below, diesel trucks produce the highest amounts of emissions for NOx, DPM and CO2e. If renewable diesel fuel was used instead of traditional diesel, the NOx and DPM emissions would be the same, but CO_2e emissions would be reduced from 45 metric tons to 14 metric tons. If trucks were retrofitted to use renewable natural gas, NOx emissions would be reduced from 107 pounds to 11 pounds annually, CO_2e emissions would be 21 MT (or slightly less than half of the 45 metric tons produced by a diesel truck), DPM emissions would be eliminated, however some PM emissions would still be emitted from brake and tire wear. Finally, ZE Trucks would eliminate all NOx and all DPM emissions, and would produce approximately 12 metric tons of CO_2e, (or about a quarter of a diesel truck). Clearly, there are alternative fuels and technologies that can reduce emissions compared to traditional diesel trucks. Selecting the appropriate fuel or technology may depend on a variety of factors including State regulations, Port goals, commercial availability of new technologies, and the capability of a technology to meet operational demands. As noted in the letter dated August 3, 2021 from the South Coast Air Quality Management District, alternative fuels like renewable natural gas serve as important interim fuels where zero emission technologies cannot be deployed. Given the emission reduction benefits of ZEV Trucks, the remaining discussion focuses on battery electric trucks.

Table IV.3-2. Estimated Emissions Associated with Diesel Replacements

	Pounds of Emissions Assuming 20,000 Vehicle Miles Annually		
	NOx	DPM	CO_2e MT*
Diesel	107	0.4	45
Renewable Diesel	107	0.4	14
Renewable Natural Gas	11	-**	21
ZEV	-	-**	12

Note: *CO2e is measured in metric tons because this is the international standard used to measure greenhouse gases. ** Some PM emissions would still be emitted.

IV.3.2.4 Estimated Costs

Currently, the capital costs of electric trucks and charging infrastructure are higher than their diesel counterparts. While a traditional diesel truck is approximately $110,000, electric trucks are approximately $350,000, although that cost is expected to come down to $275,000 in 2023 (See Table IV.3-3). Costs associated with charging stations will vary widely based on site specific characteristics, but a $40,000 estimate for a 150 KW charger and $48,000 for installation, which is used in the AFLEET model to estimate an operations and maintenance cost of $4,000 per station for overall maintenance and networking costs.[12]

Table IV.3-3. Capital Cost of Diesel Truck Compared to Electric Truck

Input Category	Diesel	Electric	Source
Vehicle Cost	$110,000	$350,000 – 2020 $275,000 – 2023	CalETC report, conversations with OEMs

However, the total cost of ownership (TCO) is another metric that is used when trying to understand the total cost to purchase, operate, and maintain the vehicle over its lifetime. TCO is case specific and depends on a number of assumptions and variables, including the purchase price of the vehicle, fueling and maintenance costs, and incentive amounts that may be available fuel, infrastructure, insurance, taxes, and more (e.g., depreciation cost and resell value for fleets that wish to include these parameters). While TCO is case specific and depends on the variables and assumptions identified above, generally there is potential for electric trucks to have lower lifetime TCO than diesel or natural gas trucks if the conditions are right. The payback period, or breakeven point when the clean fuel vehicle becomes less expensive than the conventionally fueled vehicle, will vary as well. Currently, the California's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program (HVIP) incentives improve the TCO of Class 8 drayage trucks. However, going forward there is uncertainty to what degree incentive programs will be available.[13]

CARB provided a TCO comparison between diesel, battery-electric, and hydrogen at three different time periods: 2018, 2024, and 2030.[14] The TCO shows that battery electric technology appears to achieve parity with diesel for regional haul truck activity (180 miles a day and 54,000 miles a year over 12 years) by 2024 and becomes even more cost effective by 2030. This is primarily due to the net purchase price of a ZE Truck is projected to decrease and the fuel economy for ZEV trucks is projected to increase. Please note that the TCO analysis shown in Table IV.3-4 does not include HVIP incentives, which can further reduce the net purchase price of an electric truck by $150,000-$165,000. Also, note that the size and weight of the battery in the EV Truck may decrease truck payload capacity for heavier cargo types (such as bulk), thereby increasing the number of trips that would be needed to move the same about of cargo. The TCO analysis below does not account for any increased in trips.

[12] Zero Emission Truck Feasibility Study for Mitsubishi Cement Corporation, Port of San Diego, (November 2020), prepared by ICF and CALSTART

[13] ICF. 2019. *Comparison of Medium- and Heavy-Duty Technologies in California*. December.

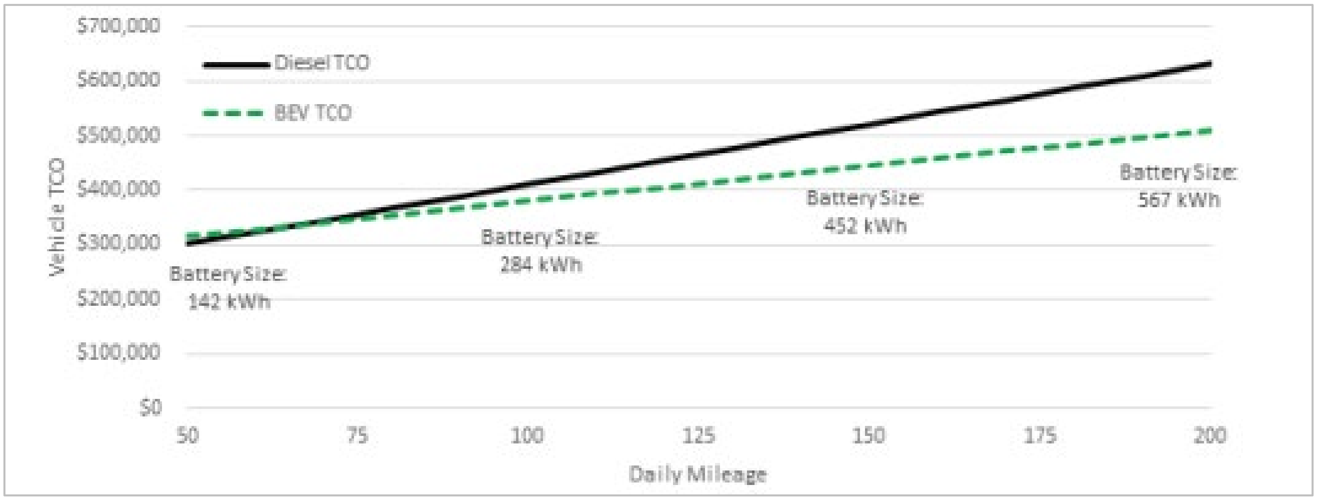
[14] CARB. Advanced Clean Trucks: Total Cost of Ownership Discussion Document. Available: https://ww2.arb.ca.gov/sites/default/files/2020-06/190225tco_ADA.pdf.

Table IV.3-4. CARB TCO Results Assuming 180 miles in Daily Activity Over 12 years (54,000 miles Annually)

Metric	2018 Regional Haul		2024 Regional Haul		2030 Regional Haul	
	Diesel	Electric	Diesel	Electric	Diesel	Electric
Net Purchase Price	$134,000	$474,930	$144,101	$232,155	$146,442	$195,960
Fuel Cost	$296,381	$152,074	$300,308	$145,975	$312,805	$144,375
LCFS Revenue	$0	-$167,778	$0	-$127,348	$0	-$117,637
Other Costs	$141,076	$247,040	$142,768	$165,060	$143,162	$154,685
Total without Infrastructure	$571,456	$706,266	$587,178	$415,841	$602,408	$377,383

Figure IV.3-3 below graphically shows the TCO for battery electric vs. diesel trucks relative to the daily distance traveled. CARB notes that the TCO comparison has a stronger relationship with the duty cycle of a vehicle. ZEV's do better from a TCO perspective, the more they are driven; however, longer daily duty cycles require larger batteries, as noted in Figure IV.3-3.

Figure IV.3-3. CARB TCO Results Versus Mileage 2024



IV.3.3 Goals and Objectives

Truck Goal 1: Improve the air quality in the Portside Community by accelerating the implementation of zero/near-zero emission trucks.

Note: *The Port expects to achieve these goals through battery electric vehicles and those with hydrogen fuel cells. While these objectives move forward in the near future, the Port is also supporting and/or facilitating projects that achieve near-zero emissions today – those are compressed natural gas (CNG), and renewable compressed natural gas (RNG).* ***CNG*** *is considered NZE because it produces 90% less NOx than diesel engines and 100% less diesel particulate matter (DPM). GHGs are reduced by 40% compared to diesel, but GHGs are not an immediate health issue.* ***RNG*** *is nearly a ZE fuel – 90% reduction in NOx, 100% reduction in DPM, and significant reduction in GHGs.*

Truck Objective 1A: 20% of the Port's annual truck trips will be performed by zero emission trucks by June 30, 2026.

Discussion

In order to accelerate implementation of zero emission trucks servicing the Port's marine cargo terminals, Truck Objective 1A aims to achieve 20% zero emission truck trips to TAMT and NCMT by June 30, 2026. The goal was established based on pairing the existing truck routes with the current state of zero emission truck technology; evaluating schedules for ZEV adoption given CARB regulations; determining infrastructure deployment; as well as development of incentives for fleets to procure vehicles. For example, CARB estimates that implementation of the Advanced Clean Truck Regulation and the proposed Advanced Clean Fleet Regulation will result in at least 8% of the State's drayage truck population converted to zero emission by 2025[15]. These estimates consider adoption of zero emission drayage trucks given market conditions, the regulatory environment, and SB-1 legislation. The MCAS seeks to exceed this statewide estimate by targeting 20% of truck trips to/from the Port's marine cargo terminals to be done with zero emission trucks through electrifying short-haul routes in collaboration with stakeholder and agency partners. It should be noted that while preliminary conversations with CARB staff have indicated that several trucks (such as unibody trucks and tractor-trailers equipped with a power take-off units) are likely to be exempt from the forthcoming ACF Regulation, the MCAS seeks to transition 20% of ***all*** of truck trips at both marine terminals to be performed by zero emission trucks by June 30, 2026.

There are several conditions that must be met to successfully deploy zero emission technologies. The MCAS' near-term goals and objectives assumes the following:

- The state of technology can meet the daily mileage requirements or hours of operations for freight movement, which is transported to and from the Port’s marine cargo terminals;

- Infrastructure such as charging stations or hydrogen fueling stations will be deployed, both within and outside of the San Diego region, to support zero emission goods movement;

- Initial procurement costs of zero emission vehicles and equipment will be offset by grants, subsidies, and other financing mechanisms and will continue to decrease as the technologies and markets mature; and

- Commercial availability of vehicles will continue to grow and increase, particularly with specialized vehicles such as car carrier trucks.

Through the Truck Survey conducted in 2020, the Port identified a variety of fixed, short haul truck routes with daily mileages of approximately 120 miles or less which represent ideal candidates for early adoption of zero emission trucks. Each one of these routes will require deployment of infrastructure to support ZEV operation and working closely with trucking companies to procure vehicles. The primary focus for implementation of Truck Objective 1A will be on those truck routes which emanate and end within the County

Although truck trips to the Port’s marine cargo terminals vary on an annual basis, the number of truck trips identified in calendar year 2019 serve as a proxy for understanding future goals. In 2019, there were 37,886 truck trips at TAMT and 48,260 at NCMT for a total of 86,146 truck trips. A goal of 20% ZEV truck trips would result in 17,229 truck trips.

The Port will continue to monitor truck activity at the marine cargo terminals, determine conversion of existing truck routes to zero emission, and report progress to the public and to the Board of Port Commissioners.

Although the Port expects to achieve these goals through battery electric vehicles and/or those with hydrogen fuel cells, the Port recognizes that alternative fuels provide decreased emissions today. As displayed in Table IV.3-2, renewable natural gas trucks using a low NOx engine decrease emissions substantially. As a result, the Port supports use of alternate fuels like renewable natural gas in cases where the operational needs of a fleet cannot be met by the current state of ZEV technology.

Truck Objective 1B: By the end of 2022, Port staff will develop and present a short-haul, on-road, Zero Emission Truck Program for the Board’s consideration that includes at least one collaborating trucking company and that targets having the necessary charging infrastructure in place by 2024, in order to displace approximately 65,000 diesel vehicle miles traveled.

Discussion

The Port of San Diego's Truck Survey identified three potential fixed routes that occur with some regularity and which occur within the 120-mile EV heavy-duty truck distance ranges that can be achieved with today's technology. Of these, the five-mile (short-haul) route from the Tenth Avenue Marine cargo terminal to the National Distribution Center (NDC)in National City may be the most promising for electrification because (1) approximately 130 truck trips occur weekly; (2) there appears to be adequate land at the NDC for EV HD charging infrastructure; and (3) all of the emission reductions would occur along Harbor Drive and would directly benefit the Portside Community.

Conversion of this route to zero emission truck trips would result in a reduction of roughly 65,000 diesel vehicle miles along Harbor Drive. Preliminary estimates suggest that this short-haul, on-road ZE Truck Program could reduce NOx emissions by 1,486 lbs, DPM emissions by 5.3 lbs, and CO_2e emissions by 167 metric tons annually.

It is important to note that securing agreements with willing partners (i.e., tenants and truckers), developing the program (i.e., identifying the # of trucks, types of trucks, and/or modifying current business practices), completing the planning, environmental review, and permits to site and install the charging infrastructure, and ordering and purchasing electric trucks to conduct the operations, requires an investment of time and money. Once partnerships are secured and planning funds for a ZE Truck Program is identified, staff estimates that the planning, design, environmental review, and permitting could be completed in an 18- to 24-month timeframe.

To ensure ongoing transparency and accountability to the Board of Port Commissioners and other community stakeholders, Port staff will provide annual updates on the ZEV Truck Program to the Board, AB 617 Steering Committee, Barrio Logan Community Planning Group (BLCPG), and to the National City, City Council. The annual updates may involve tracking the progress of finalizing agreements, securing entitlements, and receiving environmental approvals in relation to the 18- to 24-month timeframe. Once the ZEV Truck Program is operational, Port staff will report the number of ZE HD truck trips that occurred along the corridor annually, as well as the estimated reductions in DPM and NOx emissions.

Truck Objective 1C: Coordinate with California Air Resources Board as they continue to develop the Advanced Clean Fleet Regulation regarding the transition to zero emission trucks to better understand associated State forecasts and forthcoming rulemaking.

Note: *Given the state of technology for these truck types and fleet characteristics, CARB is proposing a separate long-term goal for the conversion of non-drayage trucks to zero emission technology by 2045. The Port expects to achieve these goals through battery electric vehicles and those with hydrogen fuel cells. However, if ZE vehicles are determined to be infeasible based on CARB's regulations, the Port is also supporting and/or facilitating projects that achieve near-zero emissions today – those are compressed natural gas (CNG), and renewable compressed natural gas (RNG).*

Discussion

Port staff will remain actively engaged with CARB as they continue to progress the proposed Advanced Clean Fleet Regulation. CARB has held a series of workshops to convey regulatory concepts for the regulation and to seek feedback from the public. Initially set to be considered by CARB for adoption in late 2021, the regulation will likely be considered for adoption in 2022. Port staff will provide reports to the Board of Port Commissioners and stakeholders as new regulatory concepts are discussed and draft regulatory language is provided.

Truck Objective 1D: In collaboration with California Air Resources Board, the Port will utilize a truck registry or other system to summarize annual truck trips to the Port's marine cargo terminals and measure progress to achieve Port goals.

Discussion

The Port recognizes the importance of establishing a baseline of individual heavy-duty trucks which visit the marine cargo terminals and to measure progress towards achieving the goals and objectives of the MCAS and seeks to acquire additional truck trip information by end of 2022, or sooner if possible. Furthermore, CARB's proposed regulatory language for the Advanced Clean Fleet Regulation will likely require marine terminal operators and ports to report heavy-duty truck visits on at least an annual basis beginning in November 2023. As such, the Port will establish a truck registry or appropriate database in collaboration with CARB for those heavy-duty trucks visiting the marine cargo terminals by June 30, 2023.

Truck Objective 1E: Provide status report to the Board of Port Commissioners with recommendations on zero emission truck technology, as well as an evaluation of potential impacts to small fleets and/or independent truck drivers, as part of a biennial emissions reporting to better understand the transition zero emission truck technology.

Discussion

Recognizing that ZE truck technology is evolving, Port staff will continue to survey conditions and report to the Board of Port Commissioners biennially. These reports will offer the current state of technology, commercial availability and market trends, infrastructure deployments, funding, and fleet adoption. In cases where ZE Truck technology is not commercially available or cannot meet the operational demands of fleets, alternative fuels may serve as interim solutions to improve air quality and/or reduce GHG emissions. Based on these future analyses in collaboration with stakeholders, Port staff may provide the Board of Port Commissioners with new recommendations to be included in the MCAS.

Truck Goal 2: Facilitate the deployment of infrastructure to support the transition to Zero Emission truck trips to the Port's marine cargo terminals.

Truck Objective 2A: Within fourth quarter of calendar year 2022, present a concept plan to the Board for its consideration that identifies four potential public-facing medium-duty/heavy-duty charging locations within the San Diego Region to support deployment of zero emission trucks, which may include locations in close proximity to or on the Tenth Avenue Marine Terminal and/or the National City Marine Terminal.

Discussion

To support Truck Objective 1A to attain 20% ZE truck trips to TAMT and NCMT in 2026, it is important for the Port to identify locations for charging infrastructure. This infrastructure may be located throughout the San Diego Region along freight corridors and/or in close proximity to the Port's marine cargo terminals where truck drivers can charge their vehicles. As such, the Port will provide a concept plan that identifies at least four public-facing charging locations. Critical to the concept plan will be the location, partners, funding, design, environmental review, permitting, construction, and ongoing maintenance of the equipment and infrastructure. The concept plan will be brought to the Board for direction no later than Q4 of 2022.

Truck Objective 2B: Collaborate and coordinate with community residents, stakeholders, and agencies to ensure that the medium-duty/heavy-duty zero emission truck charging facilities identified in Objective 2A are aligned with and connect to the region's larger zero emission vehicle charging infrastructure system.

Discussion

Several planning efforts for MD/HD ZEV charging infrastructure for the San Diego Region are currently underway. The Port is actively working with tenants, trucking companies, and SDG&E to identify charging opportunities to support the Short-Haul ZEV Truck Program (Truck Objective 1B). Recently, the Port contributed to and supported grant applications by SANDAG and private firms in association with National City to develop Electric Vehicle Charging Blueprints. Both of these applications were funded by the California

Energy Commission resulting in approximately $400,000 to the region to support planning for EV charging infrastructure. The Port will continue to collaborate with its members cities, SANDAG, MTS, APCD, CalTrans, SDG&E and community stakeholders to ensure that charging infrastructure to support freight movement in the region is aligned.

Truck Goal 3: Support the designated truck route to avoid truck impacts to the local community.

Truck Objective 3A: Work with partners to continue advancement of the connected and flexible freight and transit haul route concept to provide more efficient freeway access and encourage truck drivers to avoid residential neighborhoods by leveraging technology to support dedicated lanes and signal prioritization.

Discussion

In December 2019, staff completed the Harbor Drive Multimodal Corridor Study, which included a concept plan entitled Harbor Drive 2.0 – A Greener, Safer, and Healthier Harbor Drive. Harbor Drive 2.0 would create a flexible freight and transit haul road between TAMT, NCMT and the regional freeways by providing a dedicated lane(s) with freight signal prioritization technology. These improvements would result in lower truck emissions by reducing the stop and go movements of trucks along Harbor Drive. By providing a safer and more efficient route to the highways, this improvement would also incentivize truckers use the designated truck route and avoid traveling through residential areas. Harbor Drive 2.0 is identified as an emission reduction strategy in the AB 617 Draft CERP (November 2020), and was identified as high-priority project by the AB 617 Truck Subcommittee, AB 617 Land Use Subcommittee, and the AB 617 MCAS Subcommittee.

Because the majority of Harbor Drive is located outside the Port's jurisdiction, on December 10, 2019 the Board of Port Commissioners directed staff to continue to collaborate with pertinent stakeholder agencies and to work with them to seek federal, state and/or local funding that could be used to further advance the Harbor Drive 2.0 concept. On October 6, 2020, the Port entered into a Memorandum of Understanding (MOU) with the San Diego Association of Governments (SANDAG) and the California Department of Transportation (Caltrans) to further advance the Harbor Drive 2.0 project and other projects along the corridor, including project identification, environmental review and funding opportunities. While SANDAG is likely to be the lead agency for this project, Port staff will remain actively engaged in the ongoing development and refinement of Harbor Drive 2.0.

IV.4.1 Background and Context

Although not primarily involved in maritime-related operations, the Port's fleet of vehicles, equipment, and vessels are necessary for managing Port Tidelands. To demonstrate leadership, the Port's Long-Term Goal is to transition its fleet of light-, medium-, and heavy-duty vehicles and equipment to zero emissions by 2030. The Port's fleet is comprised of many different types of vehicles that run on different fuels. This chapter will summarize the Port's existing fleet, fuels used, and describe opportunities to advance zero emission and lower emitting options in the future. Although there is some cross over between Port Fleet and other Sources, such as harbor craft and cargo handling equipment in particular, all Port Fleet inventory is addressed exclusively within this source chapter.

IV.4.1.1 Source Description

The Port's fleet is comprised of vehicles, equipment, and vessels. The following overview is reflective of the Port's fleet in calendar year 2019.

Vehicles

The Port's vehicle fleet includes 190 vehicles of various types. Port vehicles are used by the General Services Department to perform maintenance, Harbor Police and Community Service Officers to ensure public safety, and other Port departments to conduct administrative duties. Table IV.4-1 identifies the Port's fleet of vehicles organized by the type of vehicle associated with weight (gross vehicle weight). As shown, most vehicles operated by the Port consist of medium duty vehicles such as SUV's and utility trucks.

Figure IV.4-1 showcases the types of fuels used by the Port's fleet. Figure IV.4-2 summarizes fuel consumption. Consistent with the number of vehicles, the majority of fuel used by the fleet is gasoline. As the Port's sole electric vehicle consumes electricity, it is not summarized in Figure IV.4-2. Diesel consumed by the fleet is renewable diesel, which is a biogenic fuel.

Table IV.4-1. Port Vehicle Fleet (2019)

Vehicle Type (GVWR)	Description	Number of Vehicles
Light Duty (<6,000 lbs)	Passenger vehicles, patrol vehicles, and light trucks	53
Medium Duty (6,001-26,000 lbs)	SUV's, vans, and utility trucks	127
Heavy Duty (>26,000)	Refuse and Dump trucks	10
Total		190

Figure IV.4-1. Fuel Type of Port Vehicles

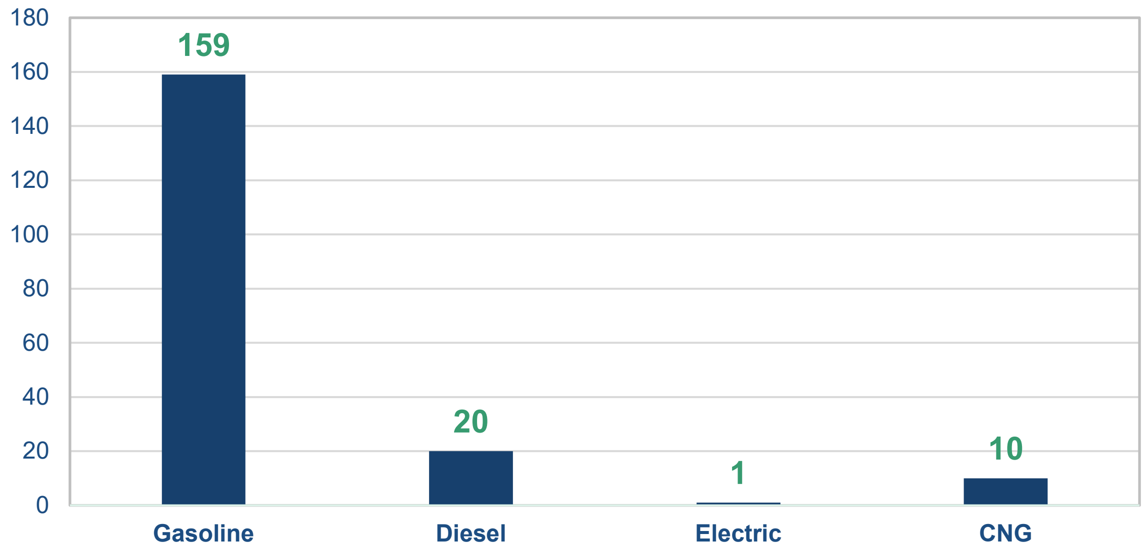
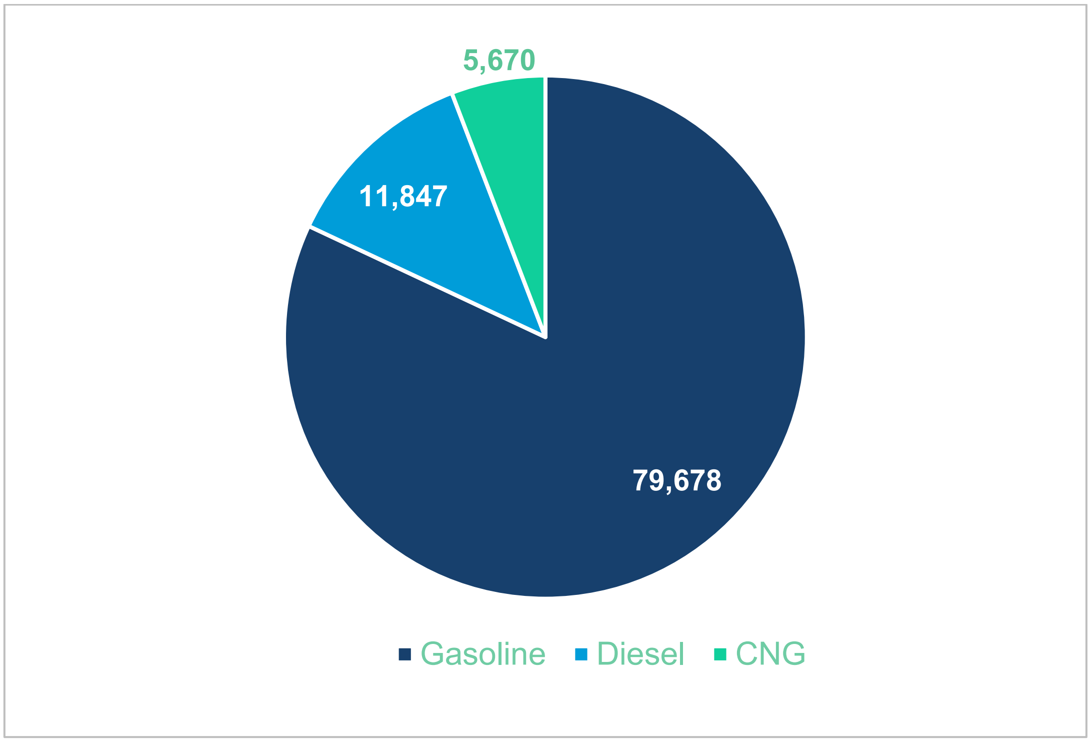


Figure IV.4-2. Fuel by Port Vehicles (Gallons)



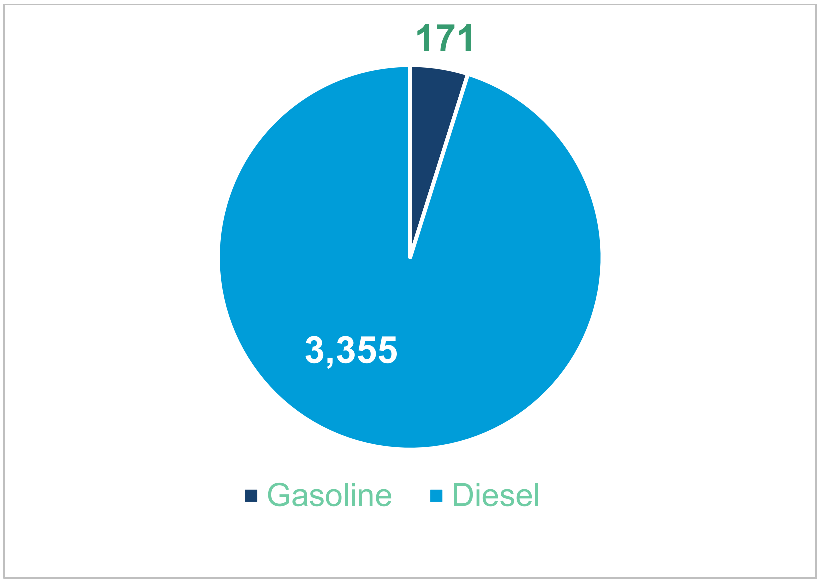
Equipment

The Port's inventory of equipment is diverse. Most of the equipment at the Port is operated by General Services and Maritime Staff for maintenance purposes and backup power. A small amount of the equipment may be used for cargo operations at the Port's marine terminals. Table IV.4-2 summarizes the type of equipment and fuel used by the Port. Figure IV.4-3 summarizes fuel use by the Port's equipment. Most equipment uses diesel fuel, followed by gasoline, and propane (limited propane was used in 2019). The Port does not track fuel consumption per each piece of equipment. Electricity use by equipment is not shown in Figure IV.4-3.

Table IV.4-2. Port Equipment Inventory and Fuel Type

Equipment	Gasoline	Diesel	Propane	Electric	Total Equipment
General (generators, concrete mixers, power washers, etc.)	5	9	0	0	14
Forklifts	0	2	2	4	8
Lawn Mowers	0	13	0	0	13
All-Terrain Vehicles	1	2	0	4	7
Lifting Equipment	0	3	0	0	3
Construction Equipment	0	2	0	0	2
Sweepers and Vacuums	0	2	0	0	2
Total Fuel Types	6	33	2	8	49

Figure IV.4-3. Fuel Use by Port Equipment (Gallons)



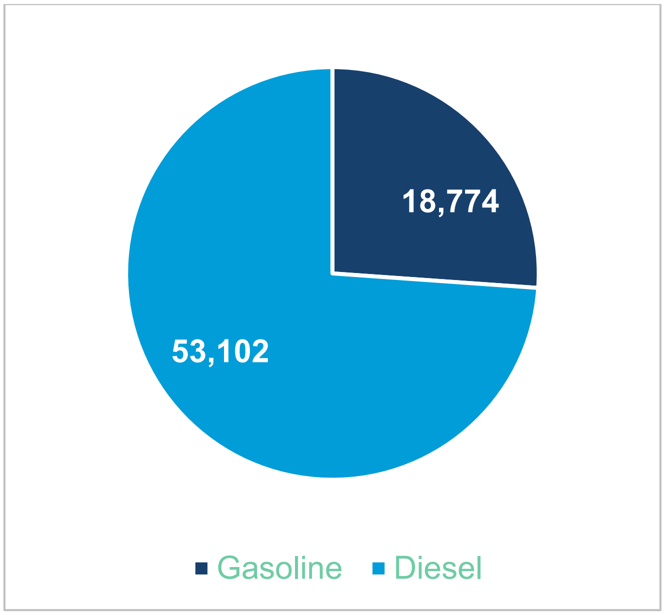
Vessels

The Port operates a variety of marine vessels that are used on San Diego Bay by different departments to perform maintenance, conduct monitoring, and respond to emergencies. Table IV.4-3 identifies the different types of vessels operated by the Port organized by fuel type. Figure IV.4-4 displays the amount of fuel consumed by the Port's fleet of vessels. As shown, the majority of fuel used is by diesel powered vessels.

Table IV.4-3. Port Vessel Fleet and Fuel Type

Vessel Type	Department(s)	Gasoline	Diesel	Total Vessel Type
Fireboat & Patrol Vessels	Harbor Police	5	5	10
Work Vessels	General Services	1	3	4
Environmental	Environmental Conservation and Environmental Protection	1		1
Total Fuel Type		7	8	15

Figure IV.4-4. Fuel Use by Vessels (Gallons)



IV.4.1.2 History of Previous Efforts

With the adoption of the Green Port Program in 2008, the Port began introducing alternative fuels to reduce emissions from its fleet. Today, approximately 24% of the vehicle fleet includes alternative fuels or cleaner technology such as a hybrid vehicle. Since the Port's first inventory of GHG emissions from the vehicle fleet, emissions have decreased roughly 19% reflecting a reduction in fuel consumptions and use of low carbon fuels. Below are examples of alternative fuels and cleaner technologies incorporated into the fleet:

15 hybrid vehicles including SUVs and police vehicles;

10 CNG vehicles across a variety of vehicles types from light-duty passenger vehicles to heavy-duty trucks;

Diesel particulate filters for heavy-duty vehicles, where necessary;

One electric light-duty passenger vehicle; and

Use of renewable diesel beginning in 2018.[1]

While alternative fuels are used in the Port's inventory of equipment including electric and propane forklifts, their use is a small percent of the total. None of the Port's fleet of vessels uses alternative fuels; however, all diesel vessel engines are equipped with Tier 3 engines.

IV.4.2 Technology and Strategies

The Port's fleet of vehicles and most types of equipment are well-situated to shift to electric-powered units. However, when shifting to electric power, it's not just the units that need to be replaced, but each unit also needs to be supported by the appropriate electric vehicle service equipment, also known as charging station infrastructure. Even though electric vehicles and equipment have higher procurement costs compared to traditionally fueled vehicles and equipment, lower total costs of ownership may occur due to incentive programs and the lower cost of electricity and maintenance.

IV.4.2.1 Description of Emission Reduction Technology Options

Vehicles

Zero emission vehicles, including battery-electric, are being developed and already include commercially available options for medium to heavy-duty applications starting at a GVWR 6,000 lbs and greater. This includes battery-electric pickups, SUVs, vans, and platforms for heavier duty vehicles such as refuse and dump trucks. Specialized body configurations for typical municipal work trucks may take longer to come to market but are expected in the next decade. Battery-electric vehicles are a good fit for the Port as average daily mileage of the vehicles is low and the vehicles are domiciled at a central location during off-peak hours for overnight charging.

[1] Renewable diesel is a low carbon fuel produced from waste materials and can be used in existing diesel infrastructure. While criteria pollutant emissions associated with the combustion of renewable diesel are not reduced, the release of GHG emissions is not a net increase.

Emergency Vehicles

Emergency vehicles, such as pursuit-rated police vehicles, also have zero emission and electric hybrid options. Primarily, the shift for emergency vehicles has focused on electric hybrids to ensure confidence in quick fueling and higher mileage. Hybrids help to increase fuel efficiency and decrease idling emissions. As battery-electric technology advances with longer range capability and quick charging, electric vehicles may present a lower cost of ownership compared to hybrids due to a lower cost of electricity and maintenance per mile.

Equipment

The technology to support zero emission equipment used by the Port is at different states of readiness. Electric lawn mowers, forklifts, and all-terrain vehicles are available. Battery electric options for generators are also available to support portable power needs. Specialized scrubbers, vacuums, and sweepers are still largely powered by traditional fuels. Lower carbon fuels such as propane and renewable diesel can be used as bridge fuels until electric options become more readily available.

Vessels

Few options exist for zero emission marine vessel craft at this time. Battery-electric as well as hydrogen fuel cells may be promising solutions to transition vessels to zero emissions; however, research and development for these technologies is needed. In the meantime, best available control technologies to reduce emissions and low carbon fuels can be used.

Infrastructure

Due to the importance of charging infrastructure to support the transition to battery-electric vehicles, California has many programs to incentivize the installation of charging infrastructure. Most importantly, is Senate Bill 350 which requires the State’s three investor-owned utilities to invest in transportation electrification. As a result, San Diego Gas & Electric has developed programs to install electric vehicle service equipment and infrastructure at workplaces, public parks and beaches, and for fleets operating medium- and heavy-duty vehicles. Collectively, SDG&E’s programs are known as Power Your Drive and represent a critical opportunity to advance the infrastructure to support charging.

IV.4.3 Goals and Objectives

Fleet Goal 1: Update Port purchasing and/or procurement policies to acquire zero emission vehicles and best available alternative fuels or technologies.

Fleet Objective 1A: Update the Port's vehicle purchasing and/or procurement policy in Fiscal Year 2022 to identify a hierarchy of procurement considerations that prioritize zero emission vehicles, followed by the utilization of best available alternative fuels, to ensure Port fleet upgrades and replacements obtain the lowest emitting option available.

Fleet Objective 1B: Create a zero emission vehicle transition plan in Fiscal Year 2022 for the Port's fleet of vehicles and equipment that identifies a long-term acquisition schedule for when current vehicles and equipment will be phased out and when new electric vehicles and equipment are anticipated to be procured.

Discussion

To be a leader in the transition to near-zero and zero emission technologies, the Port can create a foundation set up for success in this venture. The solid foundation includes updating the Port's procurement policy to support these types of investments, identifying equipment and vehicles within the Port's fleet that may be phased out and replaced with electric and alternative fuel technologies such as ultralow carbon fuel blends and traditional biodiesel blends, and finally, continuing to create the charging infrastructure to support this transition.

Fleet Goal 2: Procure zero emission vehicles and necessary electric vehicle service equipment for charging beginning in Fiscal Year 2022.

Fleet Objective 2A: Procure at least two battery electric medium- to heavy-duty vehicles in Fiscal Year 2022.

Fleet Objective 2B: Identify power needs and electric vehicle charging options at the General Services facility and apply to SDG&E's Power Your Drive for Fleets Program in calendar year 2021.

Discussion

Many electric vehicle options are available in the light-duty sector to meet the Port's administrative transportation duties. Advances in electric medium- to heavy-duty vehicles have already taken place and can begin to meet the Port's operational needs in certain instances. In order to demonstrate the Port's commitment to transitioning the electrification, the agency will target procuring at least two electric vehicles and equipment beginning in FY2022.

Long-Term Goals

The Port's long-term goal to transition Port-owned fleet vehicles and equipment to ZE/NZE emission technologies in manner that meets operational needs and reduces emissions, is outlined below:

Transition light-, medium-, and heavy-duty vehicles beginning in 2022 to ZE.

Transition emergency vehicles to alternative fuels including hybrid, electric, and/or low carbon fuels.

Convert equipment, such as forklifts and lawn maintenance equipment, to ZE.

Seek opportunities to advance lower emitting solutions for marine vessels.

The long-term recommended goals identify objectives for the next 15 years. As electric and alternative fuel technology continues to advance, the Port will continue to upgrade its vehicles and equipment. For details on the Long-Term goals, please refer to Table IV.4-4.

Table IV.4-4. Recommended Goals for Port Fleet

Fleet Category	Type	Goal	Cost per Piece[1]	Total Cost
Vehicles	Light-Duty (<=6,000 lbs)	100% EV by 2030	$46,550	$1,900,000
	Medium-Duty (6,000 to 26,000 lbs)	100% ZEV by 2030	$127,000	$11,300,000
	Heavy-Duty (>26,000 lbs)	100 % ZEV by 2030	$480,000	$4,800,000
	Emergency and/or Pursuit-Rated Vehicles	100% Alt. Fuels (including hybrid, electric, and/or low carbon fuel) by 2035	$40,770	$2,000,000
Equipment	Lifts, gardening equipment, etc.	100% zero emissions by 2030	$18,000	$1,600,000
Vessels	Patrol, General Services, and Departmental Vessels	Best available low emitting technology by 2035	$400,000 - 1,700,000	$6,750,000 - $25,000,000
Total				**$28 – $47 million**

Note: Vehicle prices were derived from ICF Fleet Transition Tool's EV Model Library. Equipment cost based on internet research. Price for vessels based on repowered hybrid and battery electric options.

To achieve these long-term goals, it is anticipated that the rough order of magnitude costs is approximately $28M to $47M. These costs can be phased over the next 15 years. The costs reflect assumptions in 2021 and may change over time.

IV.4.4 Conclusion

As new zero emission vehicle and equipment requirements advance and these technologies continue to enter the marketplace, the Port can begin its preparation for zero emission operations. Because infrastructure is important to make the shift to these new types of technologies, the Port can take advantage of current programs to incentivize the installation of infrastructure to save future expenses. In addition, the Port can continue to track research and development for reducing emissions from marine vessels and seek opportunities to deploy zero emission vessels where appropriate. Meanwhile, low carbon fuels can be utilized to decrease the GHG emissions from these vessel types.

IV.5.1 Background and Context

For over a century, the construction and repair of ocean-going vessels have occurred in and around San Diego Bay. In 1915, the first shipyard was the San Diego Marine Construction Company that developed a wharf and facilities for repairing and constructing marine vessels at the foot of Sampson Street. The three shipyards and their suppliers that are in operation today build, repair, and maintain private, commercial, and U.S. Navy vessels. These vessels may be homeported at the Port of San Diego or bound for international ports.[1] These shipyards undertake the following activities: "…maintenance, conversion, overhaul and ship repair that include specialized crafts such as welding, vessel painting, pipefitting, shipfitting, electrical work, abrasive blasting, carpentry and rigging…"[2]. Today the majority of the shipyard work serves the U.S. Navy and associated defense contractors, but the commercial work is significant as well.

The following three shipyards[3] are located along the Working Waterfront, which includes the area west of Harbor Drive between the Tenth Avenue Marine Terminal and the National City Marine Terminal:[4]

BAE Systems San Diego Ship Repair

Continental Maritime of San Diego (F/K/A Huntington Ingalls Industries San Diego Shipyard)

General Dynamics NASSCO

Shipyards Today

The working waterfront is a powerful economic generator for the region. For instance, a Port 2017 economic impact review[5] concluded that the direct economic impact for its industrial maritime sector, which includes shipbuilding, is $2.7 billion. Approximately 46 percent of that total output benefits the San Diego economy. Further, the total number of direct industrial maritime jobs equals approximately 13,300. In 2015, the shipyards alone employed approximately 7,090 workers[6], which is roughly 53 percent of industrial and maritime employment within Port tidelands. The industrial and maritime salaries and benefits per job are

[1] https://www.portofsandiego.org/maritime/shipyards

[2] http://sandiegoshiprepair.com/

[3] In addition to the Port's three shipyards, Marine Group Boat Works (MGBW) is a full-service boat construction facility that specializes in refits, repairs, and new construction of boats up to 220 feet long. MGBW has one 5-acre facility in National City and one 15-acre facility Chula Vista. Although MGBW is not a shipyard, they are in contact with Port staff on various emission reduction opportunities.

[4] While it is not within Port's jurisdiction, U.S. Navy Base San Diego is also located within this area and is oftentimes considered part of the region's working waterfront.

[5] *Economic Impacts of the San Diego Unified Port District in 2017 (*published in February 2019*)* (administration/port-of-san-diego-economic-impact-report-2017)

[6] *Barrio Logan Shipyard Parking Study*, San Diego Unified Port District, December 2015

approximately $62,205[7]. In addition to the private shipyards, the United States Navy also helps drive economic benefits to the region, particularly with its shipbuilding facilities: in 2019, with the installation of 60 ships in San Diego Bay, the Navy generated a total direct economic impact of $6.8 billion and their shipyards provided approximately 7,600 jobs[8]. Furthermore, a recent report concluded that out of 800 occupations in the Standard Occupational Classification (SOC) system, only 25 occupations were found to be both "recession-resilient" and "pandemic-resilient." Of those 25 occupations, shipbuilding and repair is one of 12 jobs that were classified as a "middle-skill job" that could be trained by a community college program[9]. Thus, the working waterfront remains integral component of our regional economy that is better equipped to keep people employed during challenging economic times.

The working waterfront is an important part of the country's national defense. The United States Maritime Administration has designated the Port as one of 17 commercial strategic ports in the United States[10]. To accommodate rapid military mobilization, these ports provide the infrastructure and resources needed to accomplish such a deployment[11]. Part of the resources offered within Port jurisdiction are the shipbuilding facilities, including wet and dry docks. Further, supporting industries to shipbuilding are located within the Barrio Logan community, east of the BNSF Railroad tracks off Port tidelands.

IV.5.1.2 Source Description

Shipyards and their associated maritime industrial uses are highly regulated by federal, state, and local government agencies due to the nature of their operations. The most common activities that emit air pollutants at the shipyards include welding, vessel painting, abrasive blasting, and carpentry. Additionally, some internal combustion engines are used in load handling and lifting activities that support movement of materials and supplies used in shipbuilding and repair. Welding creates fumes that are oxidized by the reaction between the welding arc and oxygen in the air[12]. Fumes and gases represent the main pollutant sources from welding operations. Fumes create particulate matter such as $PM_{2.5}$ and the gases generated are carbon monoxide, ozone, and nitrous gases[13]. Vessel painting results in the emission of volatile organic compounds (VOC)[14]and other toxic air pollutants. Internal combustion engines used in equipment and vehicles to move parts and materials in shipbuilding and repair emit criteria pollutants and greenhouse gasses (GHG) as part of the processes. Abrasive blasting [15] and carpentry primarily produce particulate matter.

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[7] (See Footnote 2, above)

[8]*San Diego Military Economic Impact Study* (2019), San Diego Military Advisory Council

[9] https://myworkforceconnection.org/wp-content/uploads/2020/08/Resilient-Jobs_2020-08-27v2.pdf

[10] blankrome.com/publications/strategic-seaports

[11] globalsecurity.org/military/agency

[12] intechopen.com/books/current-air-quality-issues

[13] intechopen.com/books/current-air-quality-issues

[14] https://www.tecamgroup.com/paint-voc-levels/

[15] sdapcd.org/content/sdc/apcd

According the U.S. Environmental Protection Agency (EPA), shipyards in the United States produce air emissions such as CAPs, GHGs, and other chemical substances found within the EPA's Toxics Release Inventory (TRI). As noted above, the primary air emissions generated by shipyards originate from vessel painting, welding, and abrasive blasting[16]. The shipyards within Port tidelands emit similar chemicals and hazardous substances as described by the EPA for shipyards nationally. For those activities that produce greenhouse gases, the pollutant generated is carbon dioxide. Shipyard activities that involve combustion of fuel results in direct emissions of GHG (carbon dioxide), while consumption of electricity results in indirect GHG emissions.

The EPA's TRI tracks several hazardous chemicals that are present in the shipbuilding industrial sector, including manganese, N-Butyl Alcohol, nickel, ethyl benzene, and copper. These TRI listed chemicals are generated from activities such as welding, abrasive blasting, and painting.

IV.5.1.3 Brief Overview of Legislative and Regulatory Framework

Shipyards are subject to a number of Federal, State, and local regulations designed to reduce emissions. In California, the Clean Air Act compliance is a shared responsibility between the EPA, the California Air Resource Board (CARB), and the local air pollution control agency. Under this framework, the San Diego Air Pollution Control District (SDAPCD) is the local agency with authority for issuing air pollution control permits to stationary sources. SDAPCD also regularly inspects shipyards and other facilities holding air pollution control permits to verify compliance with permit conditions, emission limits, and applicable prohibitory rules. In addition to SDAPCD, CARB is responsible for developing statewide programs to reduce the air pollution from mobile sources, including on-road sources such as passenger cars, trucks, busses, and off-road sources such as construction equipment, vessels, forklifts, and load handling equipment; some of these programs are implemented by SDAPCD at the local level.

Since each shipyard may have different activities and equipment, and because they rely on variety of contractors and subcontractors to perform certain work, there is variation in the type of permits and regulations that may apply to each facility. While not exhaustive, Table IV.5-1 summarizes the major regulatory areas applicable to shipyard air emissions.

Table IV.5-1: Sample of Existing Regulatory Measures Governing Shipyard Emissions

Regulation	Description	Originating Agency
Stationary Sources		
Rule 10 - Permit Required	Regulation requiring air pollution control permits for stationary emission units operated in San Diego County	SDAPCD
Rule 52 - Particulate Matter	Regulates emissions of particulate matter (PM)	

[16] https://archive.epa.gov/sectors/web/pdf/shipbuilding_bw.pdf

Regulation	Description	Originating Agency
Rule 67.17 – Storage of Volatile Organics	Regulates volatile organic material storage and handling practices to minimize emissions	
Rule 67.18 - Marine Coating	Regulates volatile organic emissions from marine painting products and activities	
Rule 69.4.1 – Stationary Reciprocating Internal Combustion Engines	Regulates emissions of oxides of nitrogen, organic compounds, carbon monoxide, and other pollutants from stationary diesel engines	
Rule 71 – Abrasive Blasting	Regulated emissions from abrasive blasting	
Rule 1200 – Toxic Air Contaminants	Regulates toxic air contaminant emissions from new or modified emissions units	
17 CCR 93115 - Airborne Toxic Control Measure from Stationary Compression Ignition Engines	Regulation to reduce diesel particulate and criteria pollutant from stationary diesel engines	CARB
Mobile and Portable Sources		
13 CCR 2025 – Truck and Bus Rule	Regulation to reduce diesel PM and oxides of nitrogen from in-use, diesel fueled, on-road vehicles such as trucks and busses	CARB
13 CCR 2449 – In-Use Off-road Diesel Rule	Regulation to reduce diesel PM and oxides of nitrogen emission from in-use, diesel fueled, off-road vehicles such as forklifts, load handlers, and other construction equipment	
13 CCR 2775 – Large Spark Ignition Rule	Regulation to reduce hydrocarbon and oxides of nitrogen emissions from spark-ignited vehicles such as propane forklifts and sweepers	
17 CCR 93118.5 – Airborne Toxic Control Measure for Commercial Harborcraft	Regulation to reduce diesel PM, oxides of sulfur, and oxides of nitrogen from diesel propulsion and auxiliary engines on harbor craft operating in regulated waters of California	
17 CCR 93116 - Airborne Toxic Control Measure for Portable Diesel Engines	Regulation to reduce diesel PM from portable diesel engines	

IV.5.1.4 History of Previous Efforts

The Port’s shipyards have provided the following background on their operations, which identifies several steps they have taken over the past 10 to 15 years to reduce emissions that result from shipbuilding. Measures related to painting, welding, and abrasive blasting activities have helped lower emissions. For example, shipyards use shrouding or temporary enclosures and portable filters to reduce emissions from vessel repair and maintenance activities whenever safe and feasible. Although most ship repair activities occur outdoors, some shipyards have fixed shops or stationary production areas that have been fitted with capture and control devices, such as filtration systems for welding and blasting. However, because many operations can only be conducted on-board or outside vessels, functional or technological barriers or safety concerns may limit the ability to fully capture and control emissions under all circumstances. Because of these constraints, other emission reduction methods may be used to reduce emissions. These techniques include the use of inert gas shielding or lower-emitting welding products or processes, use of hydro-blasting processes, the use of low-VOC paints or solvents, and other work practices designed to reduce emissions when feasible.

General Dynamics NASSCO[17]

NASSCO is a major ship builder for the US Navy and has been designing and building ships in the Portside Community since 1960. In 2000, General Dynamics NASSCO became the first commercial shipyard in the United States to be certified to the ISO 14001 Standard[18]. This framework emphasizes continual improvement in environmental performance, which has led to the following steps that help reduce emissions.

Reduced Diesel Emissions

Since 2004, NASSCO estimates diesel emissions from stationary sources and portable equipment have been reduced by approximately 75% as the result of changes to equipment, infrastructure, and operations. These changes included improving yard air and electrical infrastructure and retiring all owned portable diesel generators, fire pumps, and compressors, as well as installing after-treatment systems (SCR and/or DPF) on nine diesel gantry cranes. Significant investments have also been made to reduce emissions from mobile sources. Since 2009, General Dynamics NASSCO has been on an accelerated program to retire or replace mobile diesel equipment, achieving compliance with CARBs off-road diesel fleet standards six years ahead of the regulatory deadline.

Reduced Welding Emissions

Emissions from welding have been reduced through installation of filtration systems on selected fixed welding locations as well as through implementation of process or material changes that reduce emissions. In 2018, General Dynamics NASSCO commissioned a laser-hybrid thin panel plate line into its new vessel construction process. This line uses 30% less weld filler material and is equipped with integrated filtration capability.

[17] General Dynamics NASSCO – Presentation to Port Maritime Stakeholder Forum: “Update on Shipyard Environmental Programs,” August 2020

[18] The International Organization for Standardization (ISO) 14001 is the international standard that specifies requirements for an effective environmental management system (EMS). It provides a framework that an organization can follow, rather than establishing environmental performance requirements. ISO 14001 is a voluntary standard that organizations can certify to.

Reduced Painting and Blasting Emissions

In 2009, General Dynamics NASSCO added a 66,000 square foot blast and paint facility equipped with capture and control systems that destroy 96% of VOCs from painting and remove more than 99.9% of particulate matter from blasting. Together with the control systems in the automated primer lines used for new vessel construction, it is estimated that these systems destroy 150 tons per year of VOCs. In addition, temporary enclosures are erected to control blasting and painting activities occurring on-board vessels and all paints meet strict federal and local limits on VOCs.

Reduced Greenhouse Gas Emissions

Over the past ten years, several initiatives have helped reduce direct and indirect GHG emissions. These changes included LED lighting upgrades, installation of controlled lighting systems, retirement of gas-fired boilers, and improvement to compressed air control systems. As a result of joining a Strategic Energy Management program in 2018, General Dynamics NASSCO's energy team was able to identify and implement an additional twenty-six new projects that further reduced GHG emissions. Collectively, General Dynamic NASSCO estimates that these efforts have reduced the GHG emissions by more than 3,300 tons/year, which is equivalent to taking 720 cars off the road.

Reduced Emissions from Employee Transportation

General Dynamics NASSCO also sponsors ongoing programs to reduce emissions from employee transportation. To incentivize the use of transportation alternatives, fuel costs are paid for employees utilizing vanpools and trolley passes are offered at a 20% discount, which can be bought through payroll deduction. Secured bike parking areas and more than 100 bike lockers are available for employees who bike to work. More than 150 electric carts and over 200 bicycles have been provided for transportation in-plant and between shipyards.

BAE Systems San Diego Ship Repair (BAE)[19]

BAE is another major shipyard and provides ship repair services for more than 50 US Navy vessels homeported in San Diego, in addition to the various commercial ships that make port calls in San Diego. At BAE, efforts to reduce potential pollutants associated with its operations include changes to equipment, processes, and industrial products, as well as monitoring of these efforts for continual improvement. The focus of these efforts is the reduction and control of emissions from industrial processes and sources such as diesel engines, welding and preservation operations as follows:

Reduced Diesel Emissions

Electric equipment, like cranes on both the Pride of California (POCA) dry dock and Pier 4 were installed in 2017, and both propane and electric forklifts are replacing diesel-operated models. During ship movements,

[19] https://www.baesystems.com/en-us/product/san-diego-ship-repair - BAE Systems: *San Diego Ship Repair 2018 Annual Sustainability Booklet*

the lowest emission generators are utilized whenever possible. All diesel-powered equipment used on-site has a CARB permit, ensuring equipment is approved for operation in California, and subcontractors are required to use the highest Tier certified engines available to operate mobile and portable equipment. The floating barge Heavy Lift Crane and Pier 3 gantry crane were voluntarily upgraded to the cleaner Tier 4 engines in 2013, and the Pride of San Diego drydock is targeted for electrification over the next five years. Further, BAE has operated electric trucks and working with Meritor manufacturer, has leased another electric semi-tractor used for transporting equipment between the Yard and nearby warehouses. A current sustainability goal is to add additional electric forklifts to the current fleet by the end of 2021. Over the past several years, the off-road diesel fleet maintained onsite (currently reduced to six vehicles) is being downsized as units are sold or scrapped.

Reduced Welding Emissions

Throughout the yard, controls are in place to reduce emissions associated with industrial activities. Gas shielding and HEPA filtration are used to reduce welding emissions, and as much welding as possible is conducted in a controlled setting in production shops, as opposed to on the vessel. Prohibitions are also in place to prevent the use of certain types of stainless-steel welding and weld rods containing high concentrations of chromium.

Reduced Painting and Blasting Emissions

For marine coating and painting applications, products are reviewed before use for VOC content to ensure compliance with APCD rules and of the lowest VOC available for the work. Many solvents have been replaced with non-VOC or exempt VOC products, and solvent-based part washers have been removed from service or replaced with water-based cleaners. On ships or piers, shrouding is installed to protect air and water quality during spray painting and abrasive blasting operations. Inspections of these spaces occur prior to beginning work, whenever industrial activity in the space changes, and prior to deconstruction of the containment by BAE Environmental staff.

Reduced Greenhouse Gas Emissions

Reductions in GHG emissions are achieved through capital and noncapital energy reduction projects such as the acquisition and installation of the all-electric POCA dry dock, replacing incandescent and fluorescent lighting with LED lights, improvements to HVAC systems, automatic lighting in office spaces, and energy-efficient air compressors and fire pumps.

Reduced Emissions from Employee Transportation

BAE Systems employees utilize Global Electric Motorcars (GEM; “golf carts”) to transit between the yard and Naval Base San Diego and bicycles for transit through the yard, thereby reducing noise and air emissions associated with diesel-power vehicles. Employees are encouraged to participate in SANDAG’s iCommute program through vanpool offerings and use of MTS buses and trolleys. For those who drive a personal vehicle, BAE provides a free shuttle bus between the yard and the Hilton San Diego Bayfront Hotel downtown parking structure; shuttle buses are also available between the US-MX boarder and the Yard, further reducing the number of vehicles in the local area.

Continental Maritime San Diego (F/K/A Huntington Ingalls Industries San Diego Shipyard)

Continental Maritime San Diego is also in the ship repair business. In 2008, its facility became ISO 14001 certified. Since receiving the certification, the company has utilized the ISO 14001 as a basis to show its commitment to operate in a more environmentally responsible manner, which includes taking the following actions identified below:

Reduced Diesel Emissions

Since 2012, the company estimates that diesel fuel usage has been reduced from about 30,000 gallons a year to approximately 3,000 gallons per year, for 50 horse-power engines and above. This has been achieved by replacing the upper-level engines in two cranes with EPA Certified Tier 4 engines, as well as replacing a crane with one that is Tier 4 compliant in the Off-Road Diesel Fleet. In 2018 the company retrofitted a crane with a PM filter to reduce particulate emissions. By the end of 2020, a diesel forklift was replaced with an electric forklift, the On-Road Diesel Fleet was reduced from five vehicles to four, a sweeper was upgraded to a newer propane model, and a current diesel bus was replaced with a Tier 4 model.

Reduced Welding Emissions

Emissions from welding have been reduced through installation of filters on selected ventilation systems, where feasible, as well as through implementation of material changes that reduce emissions.

Surface Coatings Emissions Reduction

All paints, solvents, and adhesives used are reviewed for VOC content, and whenever feasible, a non-VOC containing product will be used. All products must adhere to local and federal VOC regulations. Painting and blasting conducted inside of the facility is done within a paint and blast booth equipped with a capture and control system to remove particulate matter, and all blasting operations performed on-board vessels is conducted inside temporary enclosures that are constructed on the vessels. In addition, a plural component sprayer was purchased, substantially reducing the amount of paint and solvents used in painting processes.

Reduction of Greenhouse Gas Emissions

Changes have been made in recent years both in the facility and onboard the ships to reduce GHG emissions. Controlled lighting systems have been installed inside of the facility, and in 2020 temporary lighting for the ships was transitioned to more efficient LED lighting. Electric golf carts and bicycles are used for transportation around the facility.

Reduced Emissions from Employee Transportation

Continental Maritime San Diego promotes a carpool incentive program, in which all employees who carpool may enter a raffle daily for the opportunity to win a $100 monthly drawing. The company also utilizes SANDAG's ICommute program to offer employees discounts on Compass Cards.

IV.5.2 Technology

IV.5.2.1 Emission Reduction Technology Options

Future emission reduction opportunities within shipbuilding and the shipyards include those that reduce air pollutants and greenhouse gas emissions from transportation, such as the use of electric vehicles, reducing reliance on diesel engines, and increasing employee use of carpools, shuttles, and public transport. Further, ongoing compliance with CARB's on and off-road vehicle standards and airborne toxic control measures will result in decreasing emissions from diesel equipment and vehicles through replacement with clean (Tier 4) or zero emission technology.

The Shipyards and marine industrial uses are highly regulated by SDAPCD and CARB and the Port has limited authority to require adoption of emission reduction technologies; even so, Port staff will continue to stay engaged and support tenants utilization of emerging technologies and comply with SDAPCD's Community Emission Reduction Program (CERP) relevant actions in order to achieve emission reductions from this source.

IV.5.3 Emission Reduction Strategies

IV.5.3.1 Portside Environmental Justice CERP

In response to Assembly Bill 617, CARB established the Community Air Protection Program. The program's mission is to reduce pollution exposure in communities based on environmental, health and socioeconomic information. This first-of-its-kind statewide effort requires community air monitoring, community emission reduction plans, and incentive funding to deploy the cleanest technologies in the most impacted areas. The San Diego Portside Communities' CERP includes several strategies intended to reduce both air pollution emissions and community exposure to air pollution. The strategies, or actions, account for existing and forthcoming regulations, the operational requirements of the shipyard's facilities and equipment needs, as well as extensive public engagement with local residents and stakeholder agencies through the AB 617 Portside Community Steering Committee.

In the Portside Community AB 617 CERP Phase II (July 2021), Goal 8 states: By 2026 reduce the cancer risk below 10/million for each permitted stationary source, including portable equipment, in the Portside Environmental Justice Community. In pursuit of this goal, the SDAPCD has committed to implementing a regulatory process to amend Rule 1210 and to propose Rule 1210 amendments to the San Diego Air Pollution Control Board by October 2021. Modifications to Rule 1210 may have implications to shipyards because they are stationary, permitted facilities regulated by SDAPCD.

The Port continues to collaborate with SDAPCD and CARB staff on developing an updated health risk assessment for the Port's two marine cargo terminals, as well as a health risk assessment for the larger Portside Community. As such, it well positioned to collaborate with SDAPCD on any updates to Rule 1210. The Port will also continue to coordinate with the shipyards to support the emission reduction efforts that are included in the Portside Community's AB 617 CERP.

Shipyard Goal 1: Collaborate with the San Diego Air Pollution Control District as they review and propose modifications to applicable rules, regulations, and/or programs.

Shipyard Objective 1: Collaborate with the San Diego Air Pollution Control District as they evaluate and consider potentially lowering the health risk in Rule 1210, including the threshold for stationary sources that reduce their estimated cancer risk.

Shipyard Objective 2: Continue to work with the shipyard facilities to identify and implement emission reduction projects and, subject to further Board approval, require such implementation, and support the shipyard-related actions that are identified in the Portside Community's AB 617 Community Emission Reduction Program.

The Port's shipyards have collectively identified the following action items within the CERP to further reduce emissions, and are provided below for reference:

AB 617 Draft CERP Action G4 – Reduce DPM and NOx Emissions from Portable Air Compressors and Other Diesel Sources at Shipyards.

The shipyards have committed to requiring on site portable air compressors to be powered by either electric or diesel Tier 4 engines, in addition to continuing ongoing actions to reduce emissions from on and off-road diesel equipment, no later than May 1, 2021.

AB 617 Draft CERP Action G5 – Promote Best Practices for Reducing Diesel, VOC, and other Emissions from Ship Repair Activities.

The shipyards have committed to conduct trainings and events focused on best practices for ship repair contractors to reduce emissions.

AB 617 Draft CERP Action G6 – Reduce Emissions from Shipyard Employee Transportation.

The shipyards have committed to promoting and increasing participating in alternative transportation.

IV.5.4 Conclusion

The shipyards contribute important economic benefits to the Port and the region. This is due to the high dollar values of wages and the direct and indirect economic benefits to the region, as well as the recession-resilient characteristics of the industry. Activities integral to shipyards such as use of mobile equipment, painting, welding, and abrasive blasting generate some air emissions that have the potential to affect public health. In most cases, these activities are subject to a complex framework of Federal, State, and local air pollution control regulations that have already resulted in significant reductions in shipyard emissions. Future rulemaking activities from APCD, CARB, and EPA will continue to drive the conversion to zero and near-zero emission equipment and result in additional reductions to criteria and toxic pollutant emissions. Compliance with these standards and applicable permit conditions continues to be routinely verified though unannounced inspections by APCD and other regulatory agencies, as well as through required reporting and monitoring activities. The Port has worked, and continues to coordinate, with the shipyard tenants, as well as air pollution control agencies to identify additional projects and strategies that can further reduce shipyard air emissions and improve the air quality for the neighboring residents, the Tidelands, and the region.

IV.6.1 Background and Context

This chapter provides the necessary background to identify near-term strategies to support the MCAS vision of health equity for all and long-term goal for every marine terminal to be equipped with shore power and/or an alternative technology that reduces ocean-going vessel emissions for ships that calls at the Port.

Ocean-going vessels (OGVs) are used to transport goods and people to and from domestic and international ports. OGVs visit the two cargo terminals and the two cruise ship terminals. Tenth Avenue Marine Terminal (TAMT) handles vessels that primarily carry refrigerated containers, break-bulk, and dry bulk cargos. National City Marine Terminal (NCMT) primarily handles vessels with "Roll-on/Roll-off" (RoRo) cargo, mostly motor vehicles. Cruise Ship Terminals (CST) handle passenger (cruise) ships.

The Port has implemented two significant strategies to reduce OGV emissions: Vessel Speed Reduction (VSR) and shore power. The VSR program is a voluntary program that is also employed as required CEQA mitigation at TAMT and NCMT. Participants are currently asked to reduce their transit speed to 12 knots for cargo ships, and 15 knots for cruise ships within 20 nautical miles (nm) of Point Loma. The current target rate of participation is 80%. Additionally, each cargo terminal has mitigation that is triggered at specific throughput thresholds or by January 1, 2030, whichever comes first. Once these thresholds are met 90% compliance with 12 knot average speeds within 40 nm of Point Loma would be the standard for cargo ships and 15 knot average speeds would be the standard for cruise ships. The Port is currently drafting an update to the existing VSR program to reflect the larger zone, and increased goals for participation. Shore power is also used at the Port, with a connection available to passenger vessels at the B-Street and Broadway[1] terminals, and a connection at the container terminal at TAMT. This section will discuss these programs in greater detail and how the Port can expand upon these existing strategies to optimize OGV emission-reductions.

IV.6.1.1 Source Description

OGVs are defined as vessels that move cargo and people over the open ocean and have a Category 3 propulsion engine and two or more Category 2 auxiliary engines. Engine categories are defined by the U.S. Environmental Protection Agency (EPA) based upon displacement per cylinder as shown in Table IV.6-1. CARB defines OGVs as longer than 400 feet and/or weighing greater than 10,000 Gross Registered Tons. OGVs vary greatly in speed and engine sizes based on ship type. Vessel types have been broken out by the cargo they carry. Table IV.6-2 describes the OGV types that call at the Port, by terminal.

[1] Although the shore power connection is located at B Street, it is accessible at Broadway by moving the boom over to the other berth.

Table IV.6-1. EPA Marine Compression Ignition Engine Categories

Category	Specification	Use
1	Gross Engine Power ≥ 37 kW Displacement < 7 liters per cylinder	Small harbor craft and recreational propulsion
2	Displacement ≥ 7 and < 30 liters per cylinder	OGV auxiliary engines, harbor craft, and smaller OGV propulsion
3	Displacement ≥ 30 liters per cylinder	OGV propulsion

Table IV.6-2. Ship Types and Predominant Terminal*

Ship Type	Description	Terminal
Auto Carrier	Self-propelled dry-cargo vessel that carries automobiles	NCMT primarily, TAMT rarely
Bulk Carrier	Self-propelled dry-cargo ship that carries loose cargo	TAMT
Container Ship	Self-propelled dry-cargo vessel that carries containerized cargo	TAMT
General Cargo	Self-propelled cargo vessel that carries a variety of dry cargo	TAMT
Passenger Ship	Self-propelled cruise ship	CST
RoRo Vessels	Self-propelled vessels that carry wheeled cargo, such as automobiles, and other cargo, such as containers.	NCMT

*The Port does not own any OGVs.

Emission sources from OGVs include propulsion engines, auxiliary engines, and auxiliary boilers. Propulsion engines are used to propel the ship and are usually either medium-speed diesel (MSD) or slow-speed diesel (SSD). Passenger ships usually have electrically powered propulsion (ED) and all engine power is used to generate electricity. Most passenger ships are MSD-Electric Drive (MSD-ED), but some are Gas Turbine-Electric Drive (GT-ED). Auxiliary engines on non-passenger ships are used to power the ship's electrical needs and are usually Category 2 MSD engines. Auxiliary boilers are used to heat residual oil in the fuel tanks (used outside the 200-nautical-mile North American Emission Control Area [ECA] boundary). Auxiliary boilers also supply heat for engines as well as heat and hot water for crew or passenger needs.

IV.6.1.2 Existing Vessel Summary – 2019 Port OGV Inventory

In Spring 2020, Port staff conducted an OGV Inventory (Inventory) to update the prior iteration from 2016, identify more recent vessel call data, adjust for recent methodological changes recommended by CARB, and to determine the feasibility of upgrades to reduce emissions. The scope of the Inventory includes all OGV calls at the four marine terminals (CSTs, TAMT, and NCMT) in 2019. This is the fourth Maritime OGV Inventory conducted by the Port, past inventories were conducted in 2006, 2012 and 2016. Emissions were calculated based upon CARB's OGV methodology.[2]

OGV inventory emissions are summarized in Appendix A. Inventory data and emissions inform the analysis below.

Average engine power by ship type for the ships that called on the Port in 2019 are shown in Table IV.6-3. As shown, auto carriers are most ships that call on the Port, and passenger ships have the largest engines.

Vessel activity can be broken out into distinct activity modes. Vessel transit includes movements both outside and within the VSR Zone, entirely outside of the harbor. Maneuvering includes activity within the harbor, between the mouth of the Bay to the berthing areas. Hoteling occurs when vessels are stopped at berth. Anchorage occurs when vessels are stopped outside of a berth, typically outside of the Bay, as the vessel waits for berth capacity. Table IV.6-4 summarizes the portion of emissions by pollutant types by activity mode. As shown, most emissions are associated with vessel transit and hoteling. Thus, the focus of this chapter is on vessel transit and hoteling emissions. Emissions associated with maneuvering and anchorage comprise a portion of OGV emissions that are both small and difficult to reduce. Vessels already travel at slow speeds while maneuvering and anchorage occurs when the marine terminals have no berth capacity: both situations are unavoidable. Emissions from transit and hoteling, and the measures to reduce them, are discussed below.

Table IV.6-3. Average Engine Power by Ship Type (2019)

Ship Type	Engine Type	Calls	Average by Engine (kW) Propulsion	Auxiliary	Boiler
Auto Carrier	SSD	243	14,161	1,089	316
Bulk Carrier	SSD	8	8,425	262	131
Container Ship*	SSD	52	19,420	811	308
General Cargo	MSD	7	6,843	502	130
	SSD	16	9,260	640	172
Passenger Ship	GT-ED	2	70,977		1,694
	MSD-ED	89	68,792		1,693
	MSD	6	18,513		410
RoRo Vessels	SSD	1	14,123	1,087	315
Overall	-	424	24,388	2,565	600

*Container ships include refrigerated containerized cargo vessels that call on TAMT.

[2] CARB, 2019. *Update to Inventory for Ocean-Going Vessels At Berth: Methodology and Results*. Available at: https://ww3.arb.ca.gov/msei/offroad/pubs/2019_ogv_inventory_writeup_ver_oct_18_2019.pdf.

Table IV.6-4. Portion of Total OGV Emissions by Mode (2019)

Terminal	NOx	DPM	CO_2e
Transit	37%	33%	24%
Maneuvering	17%	17%	12%
Hoteling	41%	46%	57%
Anchorage	5%	6%	7%

IV.6.1.3 IV.6.1.3 History of Previous Efforts

In 2009, the Port established a voluntary VSR program that encouraged OGVs to lower their speeds within 20 nm from Point Loma and targeted an 80% compliance rate. The program was adopted by Board resolution and a strategy of both the Port's 2009 Clean Air Program and its 2013 Climate Action Plan (CAP). Subsequently, VSR Program has been required mitigation for some tenants through the CEQA process.

In 2010, the Port installed its first shore power plug at CSTs, which was the first passenger ship system in California, in operation four years prior to the regulation. In 2014, a shore power plug was also installed at TAMT to serve Dole's weekly refrigerated container service.

IV.6.1.4 Legislative and Regulatory Framework

Emissions from OGVs are managed by regulations and emission limits implemented at the international, federal, state, and local levels. The International Maritime Organization (IMO) International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI, which came into force in May 2005, set new international NO_X emission limits on marine engines over 130 kilowatts installed on new vessels retroactive to the year 2000. In October 2008, IMO adopted amendments to international requirements under MARPOL Annex VI, which introduced NO_X emission standards for new engines and more stringent fuel quality requirements. Annex VI was ratified by the United States in 2008. The waters off North American coasts, which include the Port of San Diego, are considered ECAs, and ships operating in ECAs are required to comply with more stringent fuel sulfur and engine NO_X limits. Applicable requirements at the Port of San Diego include the following:

- Caps on the sulfur content of fuel as a measure to control SO_X emissions and, indirectly, particulate matter emissions. For ECAs, the sulfur limits were capped at 1.0% starting in 2012 and 0.1% starting in 2015.[3] This inventory assumes full compliance with MARPOL Annex VI sulfur limits.

[3] The sulfur requirements in ECAs are 1.0% as of July 2010 and 0.1% starting in January 2015. North America was designated as an ECA in August 2012, and the sulfur requirements became applicable at the time of designation.

- NO_X engine emission rate limits for new engines. Tier I rate limits, effective in 2000, and Tier II rate limits, effective in 2011, are global limits and apply to all new vessel builds, whereas Tier III limits, effective in 2016, apply only in NO_X ECAs.

To reduce emissions from Category 3 engines (propulsion engines on OGVs), EPA established 2003 Tier 1 NO_X standards for marine diesel engines above 30 liters per cylinder, and large Category 3 marine propulsion engines on U.S. flagged OGVs (40 Code of Federal Regulations [CFR] Parts 9 and 94) (68 *Federal Register* [FR] 9745–9789). The standards went into effect for new engines built in 2004 and later. Tier 1 limits were achieved by engine-based controls, without the need for exhaust gas after-treatment. These standards are similar to IMO MARPOL Annex VI rules which went into effect in 2000.

In December 2009, EPA adopted Tier 2 and Tier 3 emissions standards for newly built Category 3 engines installed on U.S. flagged vessels, as well as marine fuel sulfur limits. The Tier 2 and 3 engine standards and fuel limits are equivalent to the amendments to MARPOL Annex VI. Tier 2 NO_X standards for newly built engines apply beginning in 2011 and require the use of engine-based controls, such as engine timing, engine cooling, and advanced electronic controls. Tier 3 standards apply beginning in 2016 in ECAs and would be met with the use of high-efficiency emission control technology, such as selective catalytic reduction. According to the EPA's Regulatory Announcement, Tier 2 standards are anticipated to result in a 20% NO_X reduction below the Tier 1 levels, while Tier 3 standards are expected to achieve NO_X reductions 80% below the Tier 1 levels. In addition to the Tier 2 and Tier 3 NO_X standards, the final regulation established standards for hydrocarbons and CO (particulate matter is reduced from fuel sulfur requirements).

In addition, existing ships that were built between 1990 and 2000, with marine diesel engines greater than 5,000 kilowatts and a per-cylinder displacement 90 liters or more, are subject to retrofit requirements of the Tier 1 NO_X standard if a remanufactured system (or approved method) has been certified. Of the vessels that called at the Port during 2019, only vessels equipped with specific B&W S-series engine vessels fit in this category and have certified retrofit kits. There were eleven B&W S-series vessels that made up 13 calls during 2019, and the assumption is that each of these had been retrofit by 2019.

At the state level, CARB approved the *Regulation for Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline* (13 California Code of Regulations [CCR] 2299.2) in 2008.[4] This regulation requires vessel propulsion engines, auxiliary engines, and auxiliary boilers operating in California waters since July 2009 to either use marine diesel oil with a maximum sulfur content of 0.5% or marine gas oil with a maximum sulfur content of 1.5%. By January 1, 2014, these source activities were required to meet a marine diesel or gas oil sulfur limit of 0.1%, which is now in effect. The analysis herein assumes all vessels comply with the 0.1% sulfur limit.

Additionally, CARB adopted a regulation to reduce emissions from diesel auxiliary engines on OGVs while at berth for container, passenger cruise, and refrigerated cargo vessels: *Airborne Toxic Control Measure for Auxiliary Diesel Engines Operated on Ocean-Going Vessels At-Berth in a California Port* (17 CCR 93118.3). The

[4] This regulation has a sunset clause if/when the US EPA adopts equal or greater requirements.

regulation requires that auxiliary diesel engines on container, reefer and cruise OGVs be shut down for specified percentages of a fleet's visits and also that the fleet's at-berth auxiliary engine power generation be reduced by the same percentages. Applicable vessels can either plug into the electrical grid (i.e., shore power, otherwise known as cold-ironing or alternative maritime power) or use an alternative emission control device. The law sets compliance percentages that phase in over time. By 2014, applicable vessel operators were required to shut down their auxiliary engines at berth for 50% of the fleet's vessel visits and also reduce their onboard auxiliary engine power generation by 50%. The specified percentages increased to 70% in 2017 and 80% in 2020. Applicable vessel operators can also choose an emissions reduction equivalency alternative; the regulation requires a 10% reduction in container, reefer, and cruise OGV hoteling emissions starting in 2010, increasing in stringency to an 80% reduction by 2020.

In August 2020, CARB announced updates to the at-berth regulations that aim to expand public health and environmental benefits by providing additional reductions of particulate matter (PM) and oxides of nitrogen (NOx). The updates include an "Innovative Concepts" (IC) option, where entities are permitted to use other emission-reducing strategies for up to five years as opposed to strategies directly at berth. The regulation also specifies the vessel emissions control strategy connection time of two hours, expands reporting deadlines, and provides greater flexibility with the use of remediation funds. The updates also include an updated implementation schedule to accelerate program benefits. Container, reefer, and cruise vessels are covered by the existing regulation through 2022. The updated implementation schedule expands the regulation to include RoRo vessels by 2025, tanker vessels at the Ports of Los Angeles and Long Beach by 2025, and tanker vessels at ports in Northern California by 2027.[5] Shore power capabilities at the Port currently exist at both Broadway Pier and B Street Pier and at berths 10-3/10-4 at TAMT.

While not specific to OGVs, California's Renewables Portfolio Standard helps to further reduce emissions over time for vessels that plug in to shore power. The Renewables Portfolio Standard originally obligated investor-owned utilities, energy service providers, and Community Choice Aggregations to procure an additional 1% of retail sales per year from eligible renewable sources until 20% was reached by 2010. SB100 called the California Renewable Energy Resources Act, obligates all California electricity providers to obtain at least 33% of their energy from renewable resources by 2020. SB 350 requires electricity providers to obtain at least 50% of their energy from renewable resources by 2030 while requiring a doubling of efficiency for existing buildings by 2030. Finally, SB 100 establishes a new RPS target of 50 percent by 2026, increases the RPS target in 2030 from 50 percent to 60 percent, and establishes a goal of 100 percent zero-carbon energy sources by 2045. As of 2018, San Diego Gas and Electric's renewable procurement was at 43%, with 45.2% procured under contract for 2020. OGVs that cold iron while at berth receive additional emissions benefit over time; as the grid becomes increasingly renewable, GHG emissions per unit of electricity consumed from vessels that cold iron will decrease over time.

[5] CARB. 2020. *Control Measure for Ocean-Going Vessels at Berth.* August 26. Available: https://ww2.arb.ca.gov/sites/default/files/2020-08/External%20At-Berth%20Fact%20Sheet%20August%202020%20ADA_0.pdf. Accessed January 2021. Additionally, it should be noted that tanker vessels do not call on Port of San Diego.

IV.6.2 Research and Analysis

IV.6.2.1 Description of Emission Reduction Technology Options

There are three primary options to reduce emissions from OGVs herein. The first is vessel speed reduction within a designated distance from Port. Generally, for every 10% reduction in OGV speed, emissions are reduced by 19%.[6] Second, shore power can significantly reduce emissions from ships at berth. Shore power refers to vessels plugging into the electrical grid instead of running auxiliary engines while at berth. Because renewable energy (solar, wind, hydro) powers a significant portion of California's electricity, the emissions from plugging in are significantly less than running diesel engines while at berth. Finally, capture and control systems can also reduce emissions while vessels are at berth. Capture and control systems attach to vessels' exhaust stacks to capture emissions and route them to an emissions control unit where they are filtered and treated. Each of these emission reduction options is discussed below in further detail.

Vessel Speed Reduction Program

As discussed above, and summarized in Table IV.6-4, in-transit OGV emissions are responsible for measurable criteria pollutant and GHG emissions. A strategy for lowering these in-transit emissions is requiring vessels to reduce speeds when in proximity to the Port. When vessel speeds are reduced, less power is required for propulsion, which results in lower emissions. The Port's existing voluntary vessel speed reduction (VSR) Program targets emissions associated with vessels in transit to and from the Port. At present, starting at 20 nautical miles (nm) from Point Loma, cruise ships are encouraged to reduce speeds to 15 knots and cargo vessels are encouraged to reduce speeds to 12 knots. Pursuant to a handful of CEQA mitigation measures, some tenants are required to adhere to the VSR program, identifying at least 80% compliance.

While the Port does not require all vessels to adhere to the VSR program, some operators are already choosing to voluntarily reduce speeds while traveling in and out of the Port. Table IV.6-5 summarizes achievement rates within 20 nm and 40 nm of Point Loma by year. Note that VSR participation is currently evaluated based on a 15-knot speed for cruise ships and a 12-knot speed for all other vessels.

[6] OGV speed optimization is also important, which is typically 10-30% below operating speed. If an OGV travels at a speed lower than within the optimization range, the OGV may increase emissions by loading injectors. Additionally, there would be an increase in transit time.

Table IV.6-5. VSR Participation Rates

Year	Participation at 20nm	Participation at 40nm
2017	79%	53%
2018	72%	52%
2019	73%	46%
2020	76%	53%

Increasing passenger ship involvement in the VSR program, and expanding the VSR zone are strategies that would result in further emissions reductions. Overall, higher compliance from all vessels, and increasing the distance to a 40-nm VSR zone would result in greater emissions reductions than those currently being realized under the existing 20-nm VSR Program.

Shore Power

As discussed above and summarized in Table IV.6-4, OGVs are a source of emissions while at-berth, as auxiliary engines often must remain running to support activities at Port. One strategy to reduce these at-berth emissions is plugging into the electrical grid, also known as "shore power".

The Port installed California's first shore power system for passenger ships at the B Street Cruise Terminal in 2010, four years ahead of CARB's At-berth regulation regulatory requirement. The B Street shore power system is pictured in Figure IV.6-1. The shore power upgrades for the CST were funded in part by a $2.4M CARB Carl Moyer Grant.[7]

In 2014, the Port installed shore power at TAMT to service refrigerated cargo vessels. The project cost approximately $4.25M and was funded by the Port's Capital Improvement Program.[8] In light of CARB's expanded shore power requirements, the Port is working with the NCMT Terminal Operator (Pasha) to plan a shore power system at the NCMT to accommodate auto carriers, and received Board approval in April 2021 to commence the process of installing a second plug at CSTs that is anticipated to be in operation by September 2022.

[7] US EPA. 2017. *Shore Power Technology Assessment at U.S. Ports.* March. Available: https://www.epa.gov/sites/production/files/2017-05/documents/420r17004-2017-update.pdf. Accessed January 2021.

[8] Safety 4 Sea. 2014. *Port of San Diego celebrates shore power installation.* February 26. Available: https://safety4sea.com/port-of-san-diego-celebrates-shore-power-installation-2/. Accessed January 2021.

Figure IV.6-1 Street Cruise Ship Terminal Shore Power System[9]

Capture and Control Systems

Emission control systems or "capture and control" systems are another strategy available to ports for reducing emissions from vessels at berth. Capture and control systems are exhaust gas scrubbing technologies combined with after-treatment technologies that allow for the capture of auxiliary engine emissions as they exit the vessel's stack (main engines are for propulsion and are off while at berth). An example capture-and-control system in use at the Port of Long Beach is pictured in Figure IV.6-2.

With these control systems, a vessel can continue to burn compliant marine gas oil (MGO)[10] or marine diesel oil (MDO)[11] in its auxiliary engines and boilers while berthed. The exhaust from the operating auxiliary engines and boilers is treated to remove criteria pollutants before it is released into the atmosphere. The exhaust cleanup system captures the vessel's exhaust directly from the exhaust stack, using long, flexible ducting to transfer the exhaust back to the barge-based system to be scrubbed/cleaned. However, there is a slight increase in GHG emissions as the barge system runs an auxiliary engine to power the emission control equipment.

[9] Cochran Marine. 2021. *B Street Cruise Ship Terminal Shore Power System.* Available: https://www.cochranmarine.com/yacht_charters/san-diego/. Accessed January 2021.

[10] Marine gas oil are marine fuels that consist exclusively of distillates.

[11] Marine diesel oil are marine fuels that are composed of various blends of distillates and heavy fuel oil.

Figure IV.6-2. Barge-Based Emissions Control System[12]

There are two commercialized barge-based capture-and-control systems currently in use at the Ports of Los Angeles and Long Beach, with other systems under development.[13] Of the two systems originally verified by CARB, one has been issued a "cease and desist" letter because they were not meeting the emission reductions claimed.[14]

IV.6.3 Emission Reductions and Costs

Three OGV emissions control options are available to the Port including: VSR Program expansion, shore power expansion, and introduction of capture and control systems. In addition, ocean carriers can potentially gain greater fuel efficiencies, save money and reduce emissions on their own by investing in new technologies and cleaner fuels for their vessels. The emissions reduction potential and related costs of the Port strategies are described below.

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[12] Business Wire. 2015. *AEG Receives California Air Resource Board Approval for its Advanced Maritime Emission Control System ("AMECS) Technology.* October 22. Available: https://www.businesswire.com/news/home/20151022005432/en/AEG-Receives-California-Air-Resource-Board-Approval-for-its-Advanced-Maritime-Emission-Control-System-%E2%80%9CAMECS%E2%80%9D-Technology. Accessed January 2021.

[13] San Pedro Ports. 2017. *San Pedro Bay Ports Clean Air Action Plan 2017.* November. Available: https://cleanairactionplan.org/documents/final-2017-clean-air-action-plan-update.pdf/. Accessed January 2021.

[14] https://ww2.arb.ca.gov/berth-regulation-executive-orders

IV.6.3.1 Expanding VSR

In the absence of formal speed reduction programs or mitigation measures, OGVs traveling in and out of Port are a significant source of criteria pollutant and GHG emissions. Table IV.6-6 summarizes the total annual emissions from vessels traveling at the service speed[15] within 40 nm of Point Loma, using 2019 call data. As shown, under unregulated conditions, in-transit OGVs could emit up to approximately 570 tons of NOx, 11 tons of DPM, and over 24,000 MT CO_2e annually.

Table IV.6-6. Total Annual Emission at Service Speed within 40 nm of Point Loma (tons per year) (2019)

Vessel Type	NOx	DPM	CO_2e *
Auto Carrier	206.0	3.7	7,349
Bulk Carrier	5.0	0.1	188
Container Ship	56.1	1.2	2,194
General Cargo	13.4	0.3	528
Passenger Ship	287.9	5.9	13,841
RoRo	1.0	0.0	31
Total Emissions	570	11	24,130

*CO_2e emissions in metric tonnes.

At present, the VSR program at the Port is voluntary, except for operators bound by specific CEQA mitigation. The program encourages 80% participation at VSR speeds within 20 nm of Point Loma. To achieve additional emission reductions from OGVs calling to the Port, the current VSR program will be expanded in the following ways:

- Expanding the *distance* of the VSR zone to 40 nm; and
- Increasing the compliance *rate* to 90%.

The emission reductions and other related benefits of these options are discussed below.

Expanding Distance of VSR Zone

VSR is one strategy that can lead to emission reductions from shipping. When combined with other strategies such as cleaner fuels, newer engine configurations and exhaust gas scrubbers, even greater efficiencies can be achieved. VSR is a voluntary local program in addition to low-sulfur fuel requirements within the North American Emission Control Area, the California Emission Control Area and Tier III engine requirements for new builds after 2016. Presently, VSR speeds are encouraged (or required for some vessels through CEQA mitigation) within 20 nm of Point Loma. Expanding the current program boundaries to 40 nm from Point Loma

[15] Service speed refers to the average speed a vessel maintains under normal load and weather conditions.

would mean vessels would be traveling at optimum speeds for a longer period thus increasing the emission reductions achieved through the VSR Program. Figure IV.6-3 shows the current 20-nm and proposed 40-nm VSR zones. The emission reduction potential of expanding the VSR Zone is presented together with increased compliance rates below.

Figure IV.6-3. Port of San Diego VSR Zones

Increasing the Compliance Rate

As noted, participation with VSR speed limits through the 20 nm VSR zone is currently encouraged, or required~~,~~ for some vessels through CEQA mitigation. In addition to an expanded VSR zone, the Port will facilitate greater emission reductions from OGVs traveling in and out of the harbor by increasing the participation rate from 80% to 90%. To understand the emission reduction benefit from a 10% increase in participation, comparative data are provided in Table IV.6-7.

Emissions in Table IV.6-7 are presented as total annual reductions achieved by reducing vessel speeds from the operating speed to the VSR speed limit. The data illustrate that the proposed program updates are projected to reduce NOx and CO_2e emissions significantly when compared to the current program parameters.

The costs related to updating the VSR Program are expected to be relatively minimal for the Port since the VSR Program does not require additional equipment or other capital expenditures. The costs associated with updating and implementing the VSR Program would be for annual access to Geographic Information System (GIS) software, administrative efforts in the implementation of the Program, outreach, and consulting costs. These costs are expected to be covered by the Port's annual budget allocations. However, extending the overall travel time of an OGV may have cost implications to the terminal operators in terms of operations, scheduling and/or labor agreements.

The updated program may also benefit operators in the form of fuel savings from reduced fuel consumption. The fuel savings related to the proposed program updates are presented in Table IV.6-8 as total weight, and total cost savings on the purchase of fuel. Fuel cost was obtained from Ship and Bunker Average Bunker Prices and represents cost of fuel in November 2020, which assumes $386 per MT.[16] As fuel prices fluctuate and change over time, so too would the total cost benefit to vessel operators. Operators at the Port would save approximately 2,800 MT of fuel and $1,100,000 in fuel costs annually with the updates to the VSR Program.

Table IV.6-7. Total Annual Emission Reductions under Current and Proposed VSR Program Scenarios (tons per year) (2019)

Vessel Type	NOx	DPM	CO_2e [a]
80% Compliance within the 20-nm VSR Zone			
Auto Carrier	46.5	0.8	1,541
Bulk Carrier	0.6	<0.0	22
Container Ship	12.6	0.3	458
General Cargo	2.0	<0.0	77
Passenger Ship	38.3	0.8	1,844
RoRo	0.2	<0.0	6
Total Reductions	100.2	1.9	3,948
90% Compliance within the 40-nm VSR Zone			
Auto Carrier	104.6	1.9	3,466
Bulk Carrier	1.4	<0.0	49
Container Ship	28.5	0.6	1,031
General Cargo	4.5	0.1	173
Passenger Ship	86.1	1.8	4.148
RoRo	0.5	<0.0	14

[16] Ship and Bunker. 2020. *Regional Average Bunker Prices*. Accessed November 17, 2020. Available: https://shipandbunker.com/prices/av/

Vessel Type	NOx	DPM	CO_2e [a]
Total Reductions	*225.5*	*4.3*	*8,882*

[a] CO_2e emissions in metric tonnes.

Table IV.6-8. Annual Fuel Savings under Current and Proposed VSR Program Scenarios (2019)

Vessel Type	Total Fuel Savings (MT)	Total Cost Savings($ USD)
80% Compliance within the 20-nm VSR Zone		
Auto Carrier	485	$187,059
Bulk Carrier	7	$2,647
Container Ship	144	$55,652
General Cargo	24	$9,331
Passenger Ship	580	$223,860
RoRo	2	$768
Total Savings	*1,242*	*$479,317*
90% Compliance within the 40-nm VSR Zone		
Auto Carrier	1,090	$420,883
Bulk Carrier	15	$5,955
Container Ship	324	$125,216
General Cargo	54	$20,996
Passenger Ship	1,305	$503,685
RoRo	4	$1,728
Total Savings	*2,794*	*$1,078,462*

IV.6.3.2 Shore Power

As discussed above and in Table IV.6-6, the Port currently has shore power systems at CST and TAMT, which allowed for 40% of hoteling hours at CST and almost 90% of hoteling hours at TAMT to be powered by the grid as opposed to diesel engines in 2019. Expanding shore power capabilities would expand availability to plug in at other berthing locations, allow for multiple vessels to shore power simultaneously, and would result in greater emissions reductions given that electricity in California is becoming increasingly reliant on renewable energy sources.

Table IV.6-9 summarizes the annual emission reduction potential of shore power at the Port. The emission estimates presented use 2019 call and hotel duration data and assume all vessels use shore power (i.e., 100% of vessel calls are accommodated by shore power minus two hours for each vessel for plugging in and unplugging for each call) versus actual shore power use while at-berth.

Table IV.6-9. Total Annual Emission Reductions with Shore Power (tons per year)

Vessel Type	Actual Shore Power (2019)			All Shore Power			Reduction		
	NOx	DPM	CO_2e [a]	NOx	DPM	CO_2e [a]	NOx	DPM	CO_2e [a]
Auto Carrier/RoRo	61.8	1.3	4,270	9.9	0.2	2,507	51.9	1.1	1,764
Bulk Carrier	2.8	0.1	257	0.3	0.0	165	2.4	0.1	92
Container Ship	3.1	0.0	1,551	3.1	0.0	1,551	0.0	0.0	0
General Cargo	12.3	0.3	866	0.9	0.0	465	11.4	0.3	401
Passenger Ship	78.8	1.5	6,526	25.4	0.4	4,872	53.5	1.1	1,654
Total Savings	*158.7*	*3.1*	*13,471*	*39.6*	*0.6*	*9,560*	*119.2*	*2.5*	*3,911*

[a] CO_2e emissions in metric tonnes.

As shown in Table IV.6-10, updating terminal infrastructure so that all vessels are accommodated with shore power while at berth could reduce emissions of NOx by 119 tons, DPM by 3 tons, and CO_2e by 2,570 MT annually, which translates to a 75% reduction in NOx, 80% reduction in DPM, and 29% in CO_2e annually from vessel hoteling. However, it is important to emphasize that in addition to installing the landside shore power system, the vessels also need to be retrofitted for shore power use. The General Cargo and Bulk Carriers that call to TAMT are largely spot calls and CARB does not have any pending or anticipated regulatory mandates that would require these vessel types to become shore power capable. One option for reducing hoteling emissions with these two vessel types, is a capture and control system, which is discussed in the following section.

New shore power outlets would cost approximately $10M whereas new plugs to existing systems would cost at least $5M per outlet to install at CST, TAMT, and NCMT, with additional costs for planning, design, and engineering. NCMT may require up to four outlets to accommodate overlapping vessel activity and berthing preferences, while TAMT would not require any additional outlets in the next ten years in order to comply with the CARB At-Berth Regulation. However, the Port is targeting to install an additional plug at TAMT by 2030. The CST would also require a second outlet, which would cost approximately $5M to install to comply with the At-Berth Regulation; as already noted, this additional outlet has already been approved by the Board and should be in operation by September 2022. The total capital cost is approximately $50M to install these outlets (four at NCMT, one at CST, and one at TAMT) in order to increase shore power compliance.

IV.6.3.3 Capture and Control Systems

A Capture and Control System or "bonnet" system is an alternative to shore power that works by placing a filtration system over a vessel's stack while at berth to capture and treat emissions from its auxiliary engines. As such, it carries the benefit of not requiring a vessel to be retrofitted. A capture and control system can be located on a moveable barge or as a shore-side unit (mobile or stationary). The control element of the system is very similar to control technology in place for many. The capture and control system requires power, either from a stand-alone generator or the electric grid. While this technology is still being demonstrated and piloted, there is one system that has been certified by CARB as meeting the emission reduction standards specified in CARB's At-Berth Regulation. The Port was awarded grant funding for installation of a capture-and-control system to be utilized at TAMT and NCMT. To accommodate the annual vessel load at NCMT, two capture-and-control systems would need to be installed (if no shore power). Table IV.6-10 summarizes the annual emission reduction potential of two capture-and-control systems at NCMT and one system at TAMT. The emission estimates presented use 2019 call and hotel duration data and assume all auto carriers and RoRos use the capture-and-control system while at berth versus actual 2019 at-berth activity.

Given that auto carriers and RoRos are similar vessels and all stop at NCMT, their emissions are combined here for ease of analysis. The capture-and-control system at TAMT is assumed to only affect bulk carrier and general cargo ships, as container ships use shore power. For purposes of analysis, it is assumed that capture and control systems will be powered by diesel generators. Use of another fuel (e.g., natural gas, renewable diesel) or electricity would result in emissions lower than assumed herein.

Table IV.6-10. Potential Annual Emission Reductions with Capture-and-Control Systems at NCMT and TAMT (tons per year)

Vessel Type	Actual 2019 Emissions			Two Bonnets at NCMT/ One Bonnet at TAMT			Reductions		
	NOx	DPM	CO_2e [a]	NOx	DPM	CO_2e [a]	NOx	DPM	CO_2e
Auto Carrier/RoRos	61.8	1.3	4,270	51.9	1.1	4,741	9.9	0.2	-471
Bulk Carrier	2.8	0.1	257	2.3	0.1	370	0.5	0.0	-113
Container Ship	3.1	<0.1	1,551	3.1	<0.1	1,551	-	-	-
General Cargo	12.3	0.3	866	10.1	0.2	1,043	2.2	0.0	-177
Passenger Ship	78.8	1.5	6,526	78.8	1.5	6,526	-	-	-
Totals [b]	*159*	*3*	*13,471*	*146*	*3*	*14,231*	*12*	*<0.2*	*-760*

[a] CO_2e emissions in metric tonnes.

[b] Totals may not add up due to rounding.

As shown, two bonnet systems installed at NCMT would reduce NOx emissions by approximately 10 tons and DPM emissions by approximately 0.2 tons per year. As mentioned previously, because the barge system utilizes an auxiliary engine to power the control equipment, GHG emissions with the bonnet system would increase. With two bonnet systems accommodating all vessels that call on NCMT, CO_2e emissions would increase by approximately 471 MT annually. Land-based systems are likely to be less expensive, and cost between \$2M and \$3.6M per installation. Barge-based systems would cost approximately up to \$7M, making this option \$14M in total.

A single system at TAMT would reduce NOx and DPM emissions but would increase CO_2e 113 MT from bulk carriers and 177 MT from general cargo ships, annually. Emission reductions from as single system at TAMT would result in fewer emission reductions than two systems at NCMT, but reductions would still be substantial.

An alternative at-berth emissions control configuration that would accommodate all vessels at NCMT would be the installation of one shore power system and one capture-and-control system. The emissions benefits of this alternate configuration are provided in Table IV.6-11. The emission estimates use 2019 call and hotel duration data and assume all auto carriers and RoRos use either the capture-and-control system or shore power while at berth versus actual 2019 at-berth activity.

Table IV.6-11. Potential Annual Emission Reductions with Capture-and-Control and Shore Power System at NCMT (tons per year)

Vessel Type	Actual 2019 Emissions			One Bonnet + One Shore Power at NCMT			Reductions		
	NOx	DPM	CO_2e [a]	NOx	DPM	CO_2e [a]	NOx	DPM	CO_2e
Auto Carrier/ RoRos	61.8	1.3	4,270	30.9	0.6	4,019	30.9	0.6	251

[a] CO_2e emissions in metric tonnes.
[b] Totals may not add up due to rounding.

As shown in Table IV.6-11, this alternative configuration would yield greater emissions reductions than the two-bonnet setup (Table IV.6-10), with emissions of NOx, DPM, and CO_2e decreasing by 31 tons, 1 ton, and 251 MT annually, as compared to 2019 OGV at-berth emissions. However, it would result in fewer reductions than installing two shore power systems at NCMT (Table IV.6-9), which estimates a 51.9 tons reduction in NOx, 1.1 ton reduction in DPM, and 1,764 ton reduction in CO2e. This configuration would cost approximately \$17M in total, with the shore power installation at \$10M, and bonnet system at \$7M. Cost per ton would therefore range from approximately \$17M per ton of DPM to approximately \$68,000 per MT CO_2e.

IV.6.4 Overall Feasibility

A summary of the cost and reduction potential of the available OGV emissions-reducing strategies is provided in Table IV.6-12. These strategies include that which addresses in-transit emissions (VSR Program), and those that address emissions at berth (shore power, capture-and-control). A discussion of the feasibility of these strategies is provided in the Recommendation section below.

Table IV.6-12. Summary of OGV Emissions-Reducing Strategies

Option	NOx	DPM	CO_2e[a]	Estimated Costs[b]
In-Transit Strategy				
Expand VSR Program	226	4	8,882	*minimal*
At-Berth Strategies				
Shore Power				
Shore power for all vessels	119	3	3,911	$50M
Shore Power at NCMT (4 plugs)	52	1	1,764	$40M
Additional Shore Power at CST	53	1	1,654	$5M
Additional Shore Power at TAMT	14	<1	493	$5M
Capture-and-Control Systems				
Two barge-based capture-and-control systems installed at NCMT and one at TAMT	12	<1	(760)	$14M
One barge-based capture-and-control and one shore power system installed at NCMT	31	1	251	$17M

[a] CO_2e emissions in metric tonnes.
[b] Approximate capital costs only. Does not include other costs, such as planning, design, and engineering and therefore these costs are based on predesign and are subject to change based on actual design.

IV.6.5 Goals and Objectives

Ocean-Going Vessels In-Transit Goal 1: Reduce annual ocean-going vessel in-transit emissions.

Ocean-Going Vessels In-Transit Objective 1A: Pursue implementing an expanded Vessel Speed Reduction Program that achieves upwards of 90% participation, subject to further Board of Port Commissioners' approval.

Discussion

An expanded VSR Program would encourage 90% of vessels instead of 80% to comply within a 40- nm zone instead of a 20-nm zone

As shown in Table IV.6-12, expansion of the current VSR program yields the greatest emissions reductions and would have negligible operational costs to the Port. It may result in a net cost benefit given the fuel savings that result from reducing vessel speed, but there may be increased costs operational and/or labor costs associated with extending the vessels travel time. In addition to the high emission reduction potential and negligible costs to the Port, the VSR Program may be one of the more feasible of the strategies considered. The VSR Program only requires a reduction of vessel speed, which is technically feasible as no additional equipment needs to be installed on the vessel or at the Port to achieve the reduced speeds. In addition, the Port already has an AIS receiver in operation to obtain real-time vessel data. No additional evaluations of technological feasibility are required. Note that because vessel transit emissions occur outside of the Bay, emission reductions may not result in community health benefits as significant as other more localized strategies sited closer to the community. However, VSR would contribute reductions in emissions associated with regional air quality violations (i.e., NOx and ozone) and would reduce GHG emissions to assist both the Port, regional, and state agencies in meeting GHG emission reduction goals.

As noted above, one issue that arises with implementation of the VSR Program is longer transit times that will result from requesting vessels to slowdown in the VSR Zone. Under current procedures for making dock-side labor assignments based on the time a ship arrives at the dock, this would impact vessels that require land-based labor. One option to address this issue is working with labor groups to provide gang assignments based on the estimated time when the ship would enter in the VSR Zone region, rather than when the vessel docks at the Port. This would ensure that participating vessels retain the same access to labor as those that choose not to participate. The implementation of the expanded VSR Program would require a limited amount of effort from Port staff. The expanded VSR Program is not expected to compromise safety in any way.

Ocean-Going Vessels At-Berth Goal 2: Reduce ocean-going vessels' at-berth emissions by expanding existing and/or developing new shore power systems and/or equivalent technologies at the Port's marine terminals.

Ocean-Going Vessels Objective 2A: For cruise ships, add one additional plug to the existing shore power system by 2023.

Ocean-Going Vessels Objective 2B: At the National City Marine Terminal, add a new shore power system with at least two plugs and/or an alternative technology that reduces ocean-going vessel emissions at berth by 2025.

Discussion

Shore power for all vessels hoteling at the Port would also provide significant emissions reductions but would be the costliest option of those considered. In addition to infrastructure upgrades at the Port, individual vessels would also require retrofitting to participate in shore power at berth. Per CARB, average vessel retrofit costs are approximately $1.6M for each cruise ship, $880K for each container vessel, and $3.2M for each RoRo/auto carrier. The cost range for RoRo/auto carriers is quite large, though, and has been cited as low as $900K, and as high as $4.8M.[17] While OGV Near Term Objective 2 identifies installing shore power at NCMT by 2025, the Port anticipates commencing testing by 2024 in order to train vessel crews and land-based labor how to operate the technology and incorporate it into their operations.

An alternative to shore power is the capture-and-control system, which is not as costly as shore power installation, and unlike shore power, capture-and-control systems do not require vessel retrofit. However, reduction benefits are not as high as those achieved with shore power, and at present, the capture-and-control strategy has poor feasibility given the status of CARB-approved technologies and operational expenses. As discussed previously, given that capture and control systems may operate with small generator-type engines that run on a fossil fuel (e.g., diesel), the system results in a slight increase in GHG emissions, as opposed to shore power and VSR Program expansion which decrease GHG emissions. Additionally, in November 2020, CARB officially issued a cease-and-desist letter to Advanced Environmental Group (AEG), which is the manufacturer of the barge-based capture-and-control systems. CARB removed their verification letter on AEG's system after finding it was not meeting the emission reductions it claimed. With this letter, all

[17] CARB. 2019. *Control Measure for Ocean-Going Vessels At Berth Cost Analysis Inputs and Assumptions for Standardized Regulatory Impact Assessment.* May 10. Available: https://ww2.arb.ca.gov/sites/default/files/2020-04/costassumptions_may19_ADA.pdf. Accessed February 2021.

operation of the AMECS as a control technology under the At-Berth Regulation was ordered to stop.[18] Given these issues, barge-based capture-and-control is not recommended as a long-term OGV emissions-reducing strategy for the Port, however it could be used as a bridge technology while the Port gathers enough funding to install shore power infrastructure and carriers retrofit their ships to plug in while at berth. In the alternative, if the Port moves forward with procuring a capture-and-control system, vessels would not be required to retrofit for shore power in the short-term.

[18] CARB. 2020. *CARB AEG Cease and Desist Letter*. November 5. Available: https://ww2.arb.ca.gov/sites/default/files/2020-12/AEG-AMECS%20Immediate%20Cease%20and%20Desist%20Letter.pdf. Accessed January 2021.

IV.7.1 Background and Context

IV.7.1.1 Source Description

Rail locomotives carry freight cargo between the Port's maritime cargo terminals and anywhere from regional destinations to farther locations in the western United States. Freight rail service at the Port is provided exclusively by Burlington Northern Santa Fe (BNSF) Railway which has direct access onto Tenth Avenue Marine Terminal (TAMT) and National City Marine Terminal (NCMT) along the north-south BNSF right-of-way. The railroad also has switch yards adjacent to the terminals where rail cars can be decoupled to be added to other trains, which is located adjacent to the Portside Community. Auto cargo from NCMT often travels to Dallas, Memphis, Kansas City, St. Louis, and Chicago. Dry bulk and breakbulk cargos from TAMT often travel to Arizona, Nevada, and the California desert.

At NCMT, rail tracks used for auto train cars are on the terminal grounds. About 10 percent (%) of the vehicles arrive at NCMT via rail (from the Midwest) and about one-third of the cars leave via rail. To accommodate this movement there is an 8-track switch yard on the terminal and many long stretches of track as well. Adjacent to the Port's NDC warehouse is another yard that serves Cal Portland cement and can also hold numerous cars. The tracks also serve Dixieline lumber yard at the east side of the terminal.

At TAMT, there are limited tracks on the terminal for loading and unloading; however, rail re-configuration and other upgrades are necessary to make the use of rail more efficient. Cargo that can be moved from TAMT by rail includes dry bulk and military ordnance. Adjacent to TAMT to the east is a large 20-track switch yard that is in constant use. It is not on Port property but sits between TAMT and Barrio Logan.

Brief Overview of Regulations

CARB recognizes three categories of locomotive by horsepower (hp) and type of operation:

Interstate line haul – (>4,000 hp);

Medium horsepower – (2,301 to 3,999 hp); and

Switch (yard) or switcher – (1,006 to 2,300 hp).

Emissions from locomotives are managed by regulations and emission limits implemented at the federal, state, and local levels.[1] At the federal level, the EPA has established a series of increasingly strict emission standards for new or remanufactured locomotive engines (63 FR 18997-19084). Tier 0 standards, effective as of 2000, applied to engines manufactured or remanufactured from 1973 to 2001. Tier 1 standards applied to engines manufactured/remanufactured from 2002 to 2004. Tier 2 standards applied to engines

[1] Freight rail is regulated at the federal level, commuter rail is regulated predominately at the local level; in San Diego County, commuter rail is overseen and regulated by the Metropolitan Transit System (MTS).

manufactured/remanufactured after 2004. In 2008, EPA strengthened the Tier 0 through 2 standards to apply to existing locomotives and introduced more stringent Tier 3 and 4 emission requirements (73 FR 88 25098-25352). Tier 3 standards, met by engine design methods, were phased in between 2011 and 2014. Tier 4 standards, which are expected to require exhaust gas after-treatment technologies, became effective starting in 2015.

At the state level, CARB has two agreements with Class 1 railroads that affect emissions from locomotives in Southern California. In 1998, CARB, Class I freight railroads operating in the South Coast Air Basin (BNSF and Union Pacific Railroad [UPRR]), and EPA signed the 1998 Memorandum of Understanding (MOU), agreeing to a locomotive fleet average emissions program. The 1998 MOU required that, by 2010, the Class I freight railroad fleet of locomotives in the South Coast Air Basin achieve average emissions equivalent to the NOX emission standard established by EPA for Tier 2 locomotives (5.5 grams per brake horsepower-hour). BNSF and UPRR must continue to comply with the Tier 2 locomotive fleet average from 2010 to 2030. This MOU also provides emission reductions at the Port of San Diego because all freight trains either arrive from or depart to the South Coast Air Basin. BNSF's NOX emission level is 5.1 grams per brake horsepower-hour as of its most recent reporting.

In 2005, the same parties signed another MOU agreeing to several program elements intended to reduce the emission impacts of railyard operations on local communities. The 2005 MOU includes a locomotive idling-reduction program, early introduction of lower-sulfur diesel fuel in interstate locomotives, and a visible emission reduction and repair program. The 2005 agreement also required a number of efforts to gather information and assess advanced technologies to further reduce locomotive and railyard emissions in the future, including the preparation of emission inventories and health risk assessments at the 17 major railyards in the state (including San Diego Railyard), community and air district involvement, evaluation and development of measures to further reduce impacts on local communities, and ongoing efforts to evaluate and assess advanced control technologies.

In April 2017, CARB petitioned the EPA to update its standards to take effect for remanufactured locomotives in 2023 and for newly built locomotives in 2025. The new emission standards would provide critical further NOx and PM emissions from locomotives as well as provide the first emission standards for rail GHGs. To date, there has been no regulatory action at the federal level,[2]

In March 2018, CARB staff provided an informational update on potential concepts for minimizing community health impacts from large freight facilities including seaports, rail yards, warehouses, and distribution centers. The concepts for rail included: (1) evaluation and potential development of a regulation to reduce idling emissions from all rail yard sources and emissions from other stationary locomotive operations; and (2)

[2] CARB. 2020. *Draft 2020 Mobile Source Strategy*. Available: https://ww2.arb.ca.gov/resources/documents/2020-mobile-source-strategy. November 24.

evaluation and potential development of regulation to reduce emissions from locomotives not preempted under the Clean Air Act. Neither concept has formally been brought to CARB for consideration.[3]

IV.7.1.3 History of Previous Efforts at the Port

In December 2016, the Board of Port Commissioners certified the TAMT Redevelopment Plan and Demolition and Initial Rail Component Environmental Impact Report (TAMT EIR). The project description includes "on-terminal rail upgrades that include a rail lubricator and compressed air system for air brake testing." One of the objectives for the proposed project is to establish "an expanded on-dock rail facility to broaden certain cargo customer access to rail in the long term." The existing Tier 0 locomotive switcher that moves cargo between the marine terminals and the BNSF yard was not assumed to be replaced over the life of the plan (through 2035). However, additional rail upgrades, including rail re-configuration, would allow for BNSF line-haul locomotives, which are much cleaner than the existing switcher, to bypass the yard and access the existing on-dock rail facility at the southeastern portion of the project site and the proposed expanded on-dock rail. Shifting work from the switcher to the line-haul locomotive and removing the stop at the yard would help to reduce emissions beyond what was contemplated in the EIR.

IV.7.2 Technology and Strategies

IV.7.2.1 Switcher

Tier 4 Single Engine Switcher

Switcher locomotives are often Tier 0 and pre-Tier 0 units that have been retired from a line-haul operation or diesel-electric switcher units. The vast majority (75%) of switchers statewide are Tier 0.[4] Railyard emissions can be reduced by replacing these high emission locomotives with Tier 4 switcher locomotives that rely on clean engines and exhaust after-treatment to meet the most stringent EPA standards.[5] Single engine Tier 4 switchers have been adopted in other ports across California. For instance, in 2018 the Sacramento Metropolitan Air Quality Management District and the Bay Area Air Quality Management District acquired grants totaling $15 million to facilitate repurposing 10 diesel-electric switchers into Tier-4 single engine switchers in conjunction with Union Pacific. Funding for this initiative was made possible through California's Proposition 1B: Goods Movement Emission Reduction Program, a partnership between CARB and local air

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[3] CARB. 2019. *California Air Resources Board Staff: Update on Concepts to Minimize the Community Health Impacts from Large Freight Facilities*. Available: https://ww2.arb.ca.gov/sites/default/files/2020-07/Revised%20Advance%20Materials%20-%2010-10-2019%20ADA%20Final.pdf.

[4] CARB. 2020. *2020 Locomotive Emissions Inventory*. Available: https://ww2.arb.ca.gov/sites/default/files/2020-09/CARBlocoinvwebinar2020.pdf. September 3.

[5] CARB. 2016. *Technology Assessment: Freight Locomotives*. Available: https://ww2.arb.ca.gov/resources/documents/technology-assessment-freight-locomotives. November.

districts. Reporting suggests that the Tier 4 switchers reduced PM and NOx emissions by more than 90%. Tier 4 single engine technology tends to be more reliable and easier to repair than genset models.[6]

Gen-Set Switcher

A gen-set switcher locomotive is powered by one or more nonroad (off-road) engines (typically three) of less than 1,006 horsepower (750 kilowatt), instead of one large diesel fuel-powered locomotive engine. EPA regulates nonroad engine emissions use a tier structure more stringent than locomotive engine standards. Gen-set switchers are presently built up to 2,100 horsepower utilizing three nonroad 700 horsepower engines. Nearly every action that a conventional (diesel only) switcher makes (including idling and low-load movements) requires for the main engine to be powered up resulting in large inefficiencies while going through daily operations. In comparison, a gen-set switcher can use as many or as few engines as the action requires, resulting in higher efficiencies. As a result, gen-set switchers can reduce diesel fuel consumption, as compared to older switch locomotives, by 20% to 40%. Recently, various ports have chosen gen-set switchers over hybrid-electric models due to the greater gen-set operational capabilities and flexibility. However, many ports have found that as the number of engines has increased so have the maintenance issues encountered by the switchers, therefore lowering the popularity.[7]

As noted in the paragraph above there is a Tier structure in which nonroad engines are classified according to the emission levels. As you go up in tier the cleaner the engine performs with Tier 4 being the highest level that can be obtained. EPA's 2005 ruling on nonroad engines introduced tier 4 nonroad engine standards that phased into effect between 2011 and 2015. Manufacturers met Tier 4 standards by introducing exhaust treatment controls such as DPF and SCR. While new nonroad engines must meet Tier 4 PM standards, the Tier 4 NOx requirements were implemented in phases from 2011 to 2014. By 2015, new-model gen-sets were mandated to be fully compliant with Tier 4 nonroad engine standards. Through this process, new gen-set switchers are Tier 4 and bring all the associated efficiencies.

Battery Electric Hybrid Switch Locomotive

A typical locomotive is referred to as diesel-electric: a diesel engine drives an electrical generator or alternator; the generator provides electricity to the traction motors, which in turn drive the locomotive wheels.

While battery-electric hybrid switchers use a design that incorporates small diesel-powered generators combined with large banks of recyclable, long-life batteries. This design allows for the hybrids to run at a higher efficiency.[8] The energy stored in the batteries (lead acid in original and most recent models) of the hybrids can be used to produce the equivalent of 1,000 to 2,000 tractive horsepower for switch locomotive

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[6] Union Pacific. 2018. *New California Locomotives Designed to Reduce Emissions*. Available: https://www.up.com/aboutup/community/inside_track/repowered-switchers-11-16-2018.htm.

[7] CARB. 2009. *Technical Options to Achieve Additional Emissions and Risk Reductions from California Locomotives and Railyards*. Available: https://www.ci.benicia.ca.us/vertical/sites/%7BF991A639-AAED-4E1A-9735-86EA195E2C8D%7D/uploads/CARB_2009.pdf

[8] *Development of a hybrid switcher locomotive the Railpower Green Goat*. Available: https://ieeexplore.ieee.org/document/1634954

operations, primarily within a railyard. Additionally, hybrid locomotives can cut NOx and diesel particulate matter (DPM) by 80-90%, while achieving fuel savings in the order of 50-80%, when compared to conventional yard locomotives in the 1,000-2,000-horsepower range.[9] However, several factors have caused some ports and yards to turn away from battery-electric hybrid switchers. For instance, battery-electric switchers are limited to light-duty applications due to the relatively quick drawdown of battery stored power under heavier workloads, and the time needed to recharge the lead-acid batteries. Additionally, a number of the battery-electric hybrid switchers caught fire when in operation due to the~~ir~~ batteries. Finally, this form of switcher is not currently being produced by any manufacturers and therefore should not be considered as a replacement option at this time.

Full Battery Electric

Full battery electric freight line haul locomotives operate in other parts of the world (e.g., Europe, China, and Russia) and can cost up to two times more than current U.S. diesel-electric freight locomotives. These locomotives are typically built for greater speeds, to reduce slowdowns for high-speed passenger trains that share the same rail electrification system (CARB 2016). No all-electric freight line haul locomotives are active in the US.

However, CARB notes that with the all-battery power system, there may be potential to utilize all electric technologies for switching operations. In 2018, the San Pedro Bay Ports partnered with VeRail Technologies, Inc. to build and demonstrate a zero-emission switcher locomotive. The project started as a low emission CNG switcher, but after receiving $3 million in grants, the project transitioned to the construction and demonstration of a full battery-electric model. This 2,100 horsepower six-axle switcher locomotive was being designed to operate throughout the on-terminal rail network that services the Ports of Los Angeles and Long Beach, and was anticipated to be capable of working a full 12-hour shift before needing to charge.[10] However, recent conversations with CARB revealed that the project was canceled on request of the Port, citing logistical issues. After the Port of Los Angeles requested cancellation of the project, CARB redirected the project funds (through legislation) to CARB's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP). CARB noted that it is possible for similar projects to move forward as there is continued interest in demonstrating a zero-emission switcher locomotive in California.

In July of 2020, Progress Rail, a Caterpillar company, announced they are in the process of developing a lithium-ion battery, zero-emission, zero-idle and low noise switcher with Brazilian mining company Vale. The switcher includes battery capacity of 1.9 megawatt hours and could reach up to 2.4 megawatt hours with additional options. The switcher has nominal power up to 3,000 horsepower (2,230 kilowatt), and a run time of up to 24 hours, depending upon charging and utilization. The new switcher will go into a pilot phase late

[9] *RailPower announces 'Green Goat Plus' development*. Available: https://www.ble-t.org/pr/news/headline.asp?id=7736

[10] CARB. N.d. *Zero-Emission Track-Miles Locomotive Project*. Available: https://ww3.arb.ca.gov/msprog/lct/pdfs/zelocomotive.pdf

2020, with full service anticipated for Vale thereafter. Progress Rail anticipates global availability of the new switcher locomotive in 2021.[11]

Hydrogen Fuel Switcher

Test Runs were completed in 2008 and 2009 by BNSF in Los Angeles. In 2009 an operational unit was then shown at another BNSF facility in 2009 and then sent to Colorado for further testing in 2010. Following this, no updates were posted. It does not appear that any additional research interest has been garnered by hydrogen switchers in the year following these initial test phases.[12,13]

100% Natural Gas Switcher

The railroad companies are also interested in natural gas as a locomotive fuel because of its potentially favorable economics as compared with diesel fuel. The benefit of natural gas is that DPM emissions are eliminated relative to diesel. However, from an operational standpoint, the most significant difference between natural gas (both liquified and compressed) and diesel is the energy density (the amount of energy produced per unit volume of fuel). According to the 2016 CARB freight study, compressed natural gas (CNG) has approximately 25% of the energy density of diesel fuel and liquified natural gas (LNG) has about approximately 60% of the energy density of diesel fuel. Because of this difference in energy density, more fuel is required to move the same ton-mile of cargo. Given the fact that its energy density is higher than that of CNG, LNG will likely be the form of natural gas used by interstate line haul locomotives.

CARB discusses a few 100% natural gas locomotive projects and applications. The Napa Valley Wine Train used Carl Moyer Program funding to retrofit a diesel locomotive. This has been running on 100% CNG since May 2003. Most of the CNG usage, particularly for freight applications, have favored dual-fuel applications, as discussed below. Currently, there is no commercially available natural gas freight interstate line haul locomotive.[14]

Dual engine (Natural Gas/Diesel)

A dual fuel engine is characterized as one that operates on a variably adjusted ratio of diesel and natural gas supplied to a compression ignition engine. The diesel fuel is mixed with the vaporized natural gas in the engine combustion chamber to provide full rated horsepower of the engine while allowing up to 80% natural gas substitution at various loads, thus gaining the dual benefits of reducing exhaust emissions and allowing the

[11] Progress Rail. 2020. *Progress Rail Signs Contract with PT KAI for GT Series Locomotives*. Available: https://www.progressrail.com/en/Company/newsandevents/corporatepressreleases/ProgressRailSignsContractwithPTKAIforGTSeriesLocomotives1.html

[12] BNSF Railway and Vehicle Projects Demonstrate Experimental Hydrogen-Fuel-Cell Switch Locomotive. Available: http://www.3plnews.com/rail-freight/bnsf-railway-and-vehicle-projects-demonstrate-experimental-hydrogen-fuel-cell-switch-locomotive.html

[13] Fuel cell-Hybrid Shunt Locomotive. Available: http://www.fuelcellpropulsion.org/projects.html

[14] CARB Technology Assessment: Freight Locomotives. https://ww2.arb.ca.gov/sites/default/files/2020-06/final_rail_tech_assessment_11282016%20-%20ADA%2020200117.pdf

use of a lower cost fuel. Typical usage ratios run 70%/30% natural gas to diesel, with the ratio of natural gas increasing with the throttle notch.

Converting a diesel locomotive to a dual-fuel model involves either installing a conversion kit on an existing locomotive engine or utilizing a commercially available dual fuel engine. In each case, the technologies work with either LNG or CNG.

In 2016, Indiana Harbor Beltway (IHB) released a request to convert up to 21 EMD SW1500 switcher locomotives to dual-fuel technologies. IHB's goal was to convert 70% of IHB's fleet to CNG as the primary fuel source by the end of 2020. The locomotives feature a 1,500-hp twin-engine configuration using two 750-hp engines. These engines support single-engine or multiple-engine locomotive configurations and different modular onboard CNG storage sizes. The first two engines were sent in 2017 and are currently in use.[15] Each CNG conversion was expected to cost approximately $1.7 million.

IV.7.3 Emission Reductions and Costs

A summary of emissions for each technology is presented in Table IV.7-1. A summary of technology capital cost and cost per emissions saved is presented in RL Table IV.7-2. Note that the analysis below does not include hydrogen or 100% natural gas switcher options because those are not viable at this time, as explained in the preceding section.

As shown, NOx, PM, and DPM emissions decrease with use of Tier 4 diesel. GHGs do not change because there are no fuel consumption benefits associated with Tier 4 relative to the existing switcher. For full battery electric, all emissions at the tailpipe are eliminated, and GHGs associated with upstream electricity consumption are significantly reduced related to the diesel option. The dual engine (CNG/diesel) reduces NOx, DPM, and GHGs, but PM10 and PM2.5 increase substantially since natural gas PM is not DPM by definition. Natural gas has a lower carbon content, but the calculations herein do not account for the potential decrease in fuel efficiency relative to diesel.

Table IV.7-1. Summary of Emissions for Each Technology Option

Equipment Type	Pounds Per Year			Emission Reductions Per Year		
	NOx	DPM	CO_2e	NOx	DPM	CO_2e
Pre-Tier 0 Diesel (Current Piece)	82.6	1.2	5,281	-	-	-
Tier 4 Diesel	9.9	0.1	5,281	72.7	1.2	-
Full Battery Electric	-	-	817	82.6	1.2	4,464
Dual Engine (CNG/Diesel)	7.8	0.04	4,602	74.8	1.2	679

[15] IHB Going CNG: https://www.cmap.illinois.gov/documents/10180/614534/05.01.17_IHB+going+CNG_RAILWAYAGE.pdf/bc4d87af-23e4-4ed4-91c7-925ec801fb3e

Table IV.7-2. Summary of Cost

Equipment Type	Technology Cost	Cost per Pounds of Emissions Saved		
		NOx	DPM	CO_2e
Pre-Tier 0 Diesel (Current Piece)		-	-	-
Tier 4 Diesel	$2 million	$27,500	$1,690,000	-
Full Battery Electric	$3.8 million	$46,000	$3,050,000	$851
Dual Engine (CNG/Diesel)	$1.7 million	$22,700	$1,400,000	$2,500

IV.7.3.1 Tier 4 Single Engine

Cost

As mentioned in the technology description above, the Sacramento Metropolitan Air Quality Management District and the Bay Area Air Quality Management District acquired grants totaling $15 million, which were used to aid in repurposing/repowering 10 diesel-electric switchers into tier-4 single-engine switchers in conjunction with the rail company Union Pacific. This was stated to have covered approximately 75% of costs. This is in line with a briefing put out by the Utah Department of Environmental Quality, which reported a $1.5 million unit cost plus an additional $400,000 - $500,000 in installation expenses. Thus, cost to repower a switcher to Tier 4 is approximately $2 million per switcher.

Emissions Reductions

Based on the EPA Port Strategy Assessment, Tier 4 results in a 95% reduction in PM emissions and 88% reduction in NOx relative to the current switcher. There is no change in GHGs with engine tiers. Emissions associated with a Tier 4 diesel switcher are summarized in Table IV.7-1, above. Cost per pound of emission saved is higher than both the other replacement options. Note that the emissions estimate for the Tier 4 switcher assumes the same activity is the current switcher.

IV.7.3.2 Full Battery Electric

Cost

The cost of the switchers under development by Progress Rail has yet to be released, but the proposed costs of the full battery electric switcher pilot locomotive that was slated to be constructed at the San Pedro Bay Ports was $3,833,150. Most (70%) of this funding was set to be financed by a CARB grant, with the remainder of the cost being split between the City of Los Angeles Harbor Department, Pacific Harbor Line Inc., SCAQMD, and VeRail Technologies.[16] In the 2016 technology assessment, CARB stated since an all-battery powered switch locomotive would reduce diesel fuel consumption to zero, at about 33,000 gallons annually and $3 per gallon, the annual diesel fuel cost savings could be up to $100,000. However, this project only reached the

[16] SCAQMD. 2018. *Develop and Demonstrate Zero Emissions Battery-Operated Switcher Locomotive*. Available: http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2018/2018-oct5-005.pdf?sfvrsn=2

initial phases of research before being called off by the port who cited logistical issues. Fuel savings at Port of San Diego would likely be not significant given the switcher activity is fairly limited at this point.

Emissions Reductions

The battery-electric switcher was slated to have zero tailpipe emissions. However, there are upstream (electrical grid) emissions associated with charging the battery from the grid. Emissions associated with upstream (grid-related GHG emissions) are summarized in Table IV.7-1. Cost per pound of emission saved ($851 per pound of GHG, zero for other pollutants) is much lower for the battery-electric switcher than other technologies given the fact that there are no tailpipe emissions. Note that the emissions estimate for the battery-electric switcher assumes the same activity is the current switcher.

IV.7.3.3 Dual Engine (Compressed Natural Gas/Diesel)

Cost

The exact cost of the dual engine systems was not provided by the Indiana Harbor Belt Railroad Co. when plans to convert 31 of the~~ir~~ 46 diesel-powered locomotives to CNG/diesel were discussed. However, it did state that it had obtained a $34.25 million grant from the Chicago Metropolitan Agency for Planning in late 2013 to cover 65% of the conversion's costs. This would mean that the full cost to convert the 31 switchers was approximately $52 million in total, resulting in an approximate cost of $1.7 million to convert one switcher to a dual engine unit.

Emissions Reductions

As noted above, Tier 4 diesel engines decrease NOx and PM 88% and 95%, respectively, relative to a pre-tier 0 engine. CNG combustion results in much higher PM than a Tier 4 diesel engine but note that none of this PM is in the form of DPM. CO_2 from CNG is assumed to be about 24% lower than diesel, while NOx is assumed to be the same. Emissions associated with a dual fuel switcher are summarized in Table IV.7-1. Cost per pound of emission saved is similar to Tier 4 diesel for NOx but actually in the negative for PM10 and PM2.5 because PM10 and PM2.5 emissions are much higher than the current switcher. However, none of this PM is in the form of DPM, and cost per DPM pound saved is better than the Tier 4 diesel. Note that the emissions estimate for the Tier 4 switcher assumes the same activity is the current switcher assuming 70% of fuel consumption is from CNG and 30% is from diesel.

IV.7.4 Overall Feasibility

Emissions associated with the existing pre-controlled switcher that operates between the BNSF yard and TAMT are low in comparison to other sources. However, the switcher does operate near residential uses. The simplest replacement would be a Tier 4 diesel upgrade. From a cost per ton perspective, the full battery electric option would provide the cheapest method to reduce GHG emissions from the Port's current switching operations but is likely to have the highest initial cost. Also note this cost does not yet consider the cost to install electrical infrastructure.

On the cost side, there are funding opportunities available through CARB, CEC, EPA, and other agencies. However, due to the complexity of replacements and the low usage of the switcher, Port staff would not recommend prioritizing the immediate replacement of switchers to reduce criteria pollutant, DPM, and GHG emissions due to the high associated costs and relatively low contribution to maritime related emissions. If the switcher is used more in the future, the emissions benefit and cost per emissions saved would increase along with activity.

IV.7.5 Goals and Objectives

Rail Goal 1: Upgrade rail capabilities at Tenth Avenue Marine Terminal to allow for more efficient and cleaner operations.

Rail Objective 1: Outline options to further develop rail upgrades, including rail reconfiguration within Tenth Avenue Marine Terminal by June 30, 2026.

Discussion

Additional rail upgrades, including rail re-configuration at TAMT EIR are necessary to allow for BNSF line-haul locomotives, which are much cleaner than the existing Tier 0 switcher, to bypass the yard and access the existing on-dock rail facility at the southeastern portion of the project site and the proposed expanded on-dock rail. Shifting work from the switcher to the line-haul locomotive and removing the stop at the yard would help to reduce emissions beyond what was contemplated in the EIR since the Tier 0 switcher could be bypassed.

Rail Goal 2: Promote the use of Single Engine Tier 4 Switcher if applicable to operations at Tenth Avenue Marine Terminal and National City Marine Terminal.

Rail Objective 2: Encourage tenants that rely on rail operations that move cargo to use cleaner switchers.

Discussion

Local switcher locomotives are often Tier 0 and pre-Tier 0 units. Port related rail emissions can be reduced by replacing these high emission locomotives with a Tier 4 single fuel switcher locomotives. Single engine Tier 4 switchers rely on clean engines and exhaust after-treatment to meet the most stringent EPA standards and have been adopted in other ports across California. Reporting suggests that the Tier 4 switchers reduced PM and NOx emissions by more than 90%. Tier 4 single engine technology tends to be more reliable and easier to repair than genset models. Upgrading switcher technology at NCMT and TAMT (prior to completion of rail upgrades) would reduce Port related rail emissions. The Port will continue to promote the cleanest available switcher technologies, as feasible.

V.1 Background and Context

The vision and goals of the Maritime Clean Air Strategy (MCAS) set in place, many pieces that need to come together for the successful completion of a future project. The following enabling tools provide detail on actions that will enable goals to be met:

V.1.1 Collaborating Partners

The overarching goal of the CERP and MCAS is to improve public health through emissions reduction by replacing fossil fuel energy with clean energy from the grid. Under that common vision, freight movement relies on a solid partnership between Port tenants, shippers, freight movers, truckers, utilities and other government agencies. A transparent business plan that explains the roles, responsibilities, timeframes, and costs – and how they are shared among the parties – is a useful tool for agencies, businesses, and stakeholders to advance a shared objective or a common project. This can be accomplished by memorializing a business plan and each party's commitment to it.

V.1.2 Engineering/Design

Without a design, a project remains just another good idea. On tidelands, a design can be done by the Port, a tenant, SDG&E, consultants, and/or some combination thereof. The time and resources needed to reach a "30 percent design" is an important milestone to qualify for technical review by the Port. With few exceptions, most projects will involve the Port Engineering department, and projects with "as-built plans" are required to include a certified plat map displaying any easements created by the project.

V.1.3 Entitlements

A "30 percent design" drawing is also generally required to start environmental review and the entitlement process. Pursuant to the California Environmental Quality Act (CEQA), environmental review is required of all projects to determine its impact on the environment. If the analysis determines the project may have a significant impact on the environment, the lead agency must identify mitigation to reduce these impacts to a level below significance, or to the maximum extent practicable[1]. This analysis is necessary prior to beginning construction and/or issuing any permits that allow the project to operate. Projects that involve approval from federal agencies, or that receive federal funding, must also comply with the National Environmental Protect Act (or NEPA). Environmental review and permitting, collectively, are typically referred to as the project's entitlements.

V.1.4 Technology

Technology continues to advance followed by market expansion and maturation, but it has not kept up with the demand for long-range, heavy-duty, class-8 trucks. The Port's accelerated goals to replace diesel drayage

[1] If a project's environmental impacts cannot be reduced to a level below significance, CEQA requires the lead agency to mitigate its impacts to the maximum extent practicable and to adopt a Statement of Overriding Considerations that state the specific reasons to support project, which may include economic, legal, social, technological, or other benefits (See CEQA Guidelines Section 15093 for more information).

trucks with zero-emission trucks by 2030 – well in advance of state targets – provide an ambitious path forward, but there are some uncertainties. Several technological advancements are necessary for the Port to reach this goal, such as increased energy density of batteries that allow longer range, mass development of fast heavy-duty charging stations allowing trucks to charge up in twenty minutes, and dual development of hydrogen fuel cell powered trucks with advancements in fueling infrastructure. Port staff will need to carefully follow the advancement of ZE technology for heavy-duty trucks and other maritime emissions sources, as well.

V.1.5 Procurement

In accordance with State law, the Port has an established procurement process for selecting between multiple vendors for a service or goods. The procurement process that the Port and other public agencies must follow may take several months to complete. In many circumstances, the State's own procurement process may be utilized, allowing the Port to buy directly from a list of qualified vendors, if the need may be met in that fashion.

V.1.6 Funding

Industrial infrastructure and equipment are expensive, and maritime applications of such technology almost always require customization, more frequent replacement, and are often in short supply. Faced with such high up-front costs, massive funding is typically required from multiple sources. From the tenants' and truckers' perspective, their operations must balance finances and risk. Companies may be reluctant to purchase equipment that is unproven or are at costs beyond what they can afford, even though there is a strong desire and willingness to invest in ZE technologies. Innovative sources of funding to help overcome tenants' initial reluctance may include the Port's own Low Carbon Fuel Standard funds; COVID relief stimulus funds; financial grants from the state and/or local air pollution control agency; grants from environmental non-government organizations and community groups; and fees collected by the Port.

V.1.7 Policies

To better enable the new ventures and meet upcoming challenges, the Port needs appropriate policies in place. Policies provide the ability for people to devote their time working together and provide the parameters to ensure that the best ideas are prioritized for attention and move forward. The policy direction included in the MCAS will assist the Port with identifying, prioritizing, and advancing emission reduction initiatives in a holistic and comprehensive manner. Policies pave the way to progress by establishing a legal way forward that the agency can follow.

V.1.8 Community Reporting

The Port depends on community involvement in its collaborative decision-making process, and as a public agency, continually provides updates to the public on the progress of projects as they are developed. As Port staff continues to regularly report emission reduction estimates as ZE reduction projects are implemented, public input will help Port staff identify potential locations for new "electric truck stops" and inform on tree-planting efforts. This symbiotic relationship is not only healthy, it is a vital.

V.1.9 Project Management

The tools identified above will be organized into a cohesive system with timelines, as goals and objectives identified in the MCAS are further refined into actionable projects or initiatives. Projects at the Port usually start with a narrative in the Preliminary Engineering Report which explains the background of the project. Gantt charts are oftentimes used to show the length and interdependence of different phases and if they are sequential or overlapping. A summary of the numerous aspects can be organized in Excel so that they can be sorted and queried. The finances also need to be tracked – both income (such as grants) and expenses.

V.1.10 Enabling Goals and Objectives

In conjunction with the tools listed above, there are several ways the Port can advance emission reduction projects within and around Tidelands. Establishing voluntary programs, supporting regulatory efforts of other agencies, partnering on grant applications, providing incentives, and purchasing zero emission technology for its own fleet and equipment, are well established practices. Options that involve negotiating ZEV terms in leases, establishing new ZEV user fees, and/or imposing other mandatory ZEV requirements on tenants, workers, businesses, and others are more complicated because they may involve federal, State, and/or local requirements and responsibilities. In these cases, there may be disagreement among stakeholders regarding the Port's authority. The following near-term enabling goals focus on establishing more formal partnerships as a means of reducing risk, as well as completing the necessary outreach, research, and analysis on potential new programs and/or fees to increase the likelihood of success.

Enabling Goal 1: Establish partnerships with stakeholders, tenants, and agencies to help increase the likelihood of implementation and project success.

Enabling Objective 1A: Pursue a potential Memorandum of Understanding with the San Diego Air Pollution Control District to administer California Air Resources Board Funding to help fund zero emission/ near zero emission trucks and/or cargo handling equipment.

Discussion

Many of the SDAPCD programs[2] that are used to fund equipment and prioritize equipment applications on basis of cost effectiveness calculations and/or utilization rates. These programs have yielded few awards to Port tenants because several pieces cargo handling equipment have either newer (Tier 4) engines, which rank lower relative to other equipment in the County, or the older pieces of cargo handling equipment are not used enough to make upgrades or replacement "cost effective", as established by the programs. At the May 18, 2021 AB 617 Steering Committee meeting, steering committee members ranked advancing a ZE

[2] Programs include the Carl Moyer, FARMER and the Community Air Protection Program

Truck Program and replacing Port equipment as their second and third priority for incentive funding, followed only by putting air filtration devices in schools and homes, which was their first priority. This objective seeks to pursue an MOU with SDAPCD to administer CARB funding to help fund ZE/NZE trucks and/or cargo handling equipment. Similar to the MOU executed in 2008[3], the Port could work with SDAPCD and CARB to set aside a pre-determined amount of money for ZE/NZE trucks and equipment that serve the Port of San Diego.

Enabling Objective 1B: Work with California Department of Transportation and other west coast ports to implement domestic shipping services to reduce emissions by facilitating the movement of goods by waterborne routes that are currently served by trucks or rail.

Discussion

Developing a domestic shipping service along the west coast to facilitate the movement of goods by waterborne routes is expected to reduce emissions associated with truck and rail activity.

Enabling Goal 2: Conduct the necessary research and analysis to inform additional options that could be used to help attain emission reductions and other MCAS-related goals.

Enabling Objective 2A: Create a clearinghouse process to track progress towards achieving MCAS and relevant AB 617 CERP goals and objectives, including technology and emission improvements associated with development, within 30-days of final approval of both documents.

Discussion

Several of the Port's emission reduction initiatives involve multiple entities, as well as the deployment of new technologies, and many will be implemented over the course several years. To ensure that these

[3] In 2008, the BPC authorized an MOU with SDAPCD to implement the Port's Truck Retrofit and Replacement Program in an amount not to exceed $1,150,000. Under the terms of the MOU, APCD entered into an agreement with CARB to obtain Goods Movement Emissions Reduction Program (GMERP, or Proposition 1B) funding, and then solicited truck owners to participate in the cost sharing agreement to either retrofit their trucks with Diesel Particulate Filters (DPF) or replace trucks, with newer, less polluting models. Under the GMERP, CARB programmed 2.9 million to fund emission reductions for trucks serving the Port of San Diego.

efforts remain on track, and to document other emission reduction improvements within and/or around tidelands, the MCAS seeks to develop a clearinghouse to track efforts.

Enabling Objective 2B: Establish an Emissions Reduction Incentive Program.

Discussion

To support the goals and help reach the objectives identified in the Port's MCAS, the Port will establish an incentive program that may include monetary and/or non-monetary incentives. Monetary incentives may include reduced fees. Non-monetary incentives could include public recognition awards, positive marketing, and/or promotional materials.

Enabling Objective 2C: Prepare a market study/feasibility analysis for the Board of Port Commissioners that explores a range of potential fees that can support zero emission/near zero emission reduction projects, as well as identify any implications the fee may have on the Port's revenue and maritime business opportunities.

Discussion

To better understand the implications of establishing new or increased fees at the Port of San Diego, and help determine what the rate should be, the Port should prepare a market study / feasibility analysis that explores the range of potential fees that could be levied to support zero and near-zero emission reduction projects. The study should determine the price elasticity for transportation of the cargoes through TAMT and NCMT to help forecast the impacts of any fees on current or future cargo volumes.

Enabling Objective 2D: Explore potential credentials for installation and maintenance of emerging zero emission technologies and report recommendations to the Board of Port Commissioners by end of calendar year 2021.

Discussion

The Port will evaluate industry standards for training and certification, to determine the appropriate level of training required for installing, operating and maintaining zero and near zero emission equipment. This may include certifications such as the Electric Vehicle Infrastructure Training Program (EVITP), the Energy Storage and Microgrid Training and Certification (ESAM-TAC) and the Certified Electric Vehicle Technician Training Program (CEVT).

Enabling Objective 2E: Promote adoption of zero emission technologies by Port tenants, truckers, and other users of equipment.

Discussion

The Port will continue to promote the adoption of ZE technologies by organizing special events and/or by reaching out to shipyards, ILWU, Teamsters, and other users of equipment.

A.1 Background and Context

As part of the Maritime Clean Air Strategy (MCAS), Port staff conducted a Maritime Air Emissions Inventory to update the prior iteration from 2016 for several emission sectors, identify the higher-emitting equipment that are in use, and to determine the feasibility of cleaner upgrades to reduce emissions.

The equipment and emissions inventory was developed for four sectors: Ocean Going Vessels (OGVs), Commercial Harbor Craft (CHC), Cargo Handling Equipment (CHE), and Heavy-Duty Trucks. Emissions from rail were not updated from 2016 because rail emissions are assumed to be relatively unchanged since 2016. Port Fleet and Shipyard emissions are discussed qualitatively in their respective chapters. The emissions inventory update includes OGV, CHC, CHE, and truck sources throughout the bay and at the three marine terminals: Cruise Ship Terminal (CST), Tenth Avenue Marine Terminal (TAMT), and National City Marine Terminal (NCMT).

The inventory covers the same pollutants covered in previous maritime inventories: reactive organic gases (ROGs), nitrogen oxides (NO_X), carbon monoxide (CO), particulate matter 10 microns or less in diameter (PM10), particulate matter 2.5 microns or less in diameter (PM2.5), diesel particulate matter (DPM), sulfur dioxide (SO_2), and carbon dioxide equivalent (CO_2e).

A.2 Emissions Summary

A summary of maritime emissions is provided in Table A-1. Note that estimates for some emission sectors increased relative to 2016 due to increased visitation of some large CHC research vessel and work boats that remained in the bay for a substantial amount of time, revised methodological guidance from the California Air Resources Board (CARB) for estimating emissions OGVs, a slight increase in vessel calls (from 420 to 424), and more complete data provided by the tenants (e.g., truck counts at the marine cargo terminals).

Emission estimation methods follow the same methods, formulas, and emission factors presented in the 2016 Maritime Air Emissions Inventory (2016 Inventory) except for some updates to address CARB's revised methods.[1] Changes since 2016 include revised CHC load factors for some ship types as well as OGV auxiliary engine and auxiliary boiler loads and low load adjustment factors. These changes are discussed at a high level below.

[1] *Port of San Diego 2016 Maritime Air Emissions Inventory*. Available: https://pantheonstorage.blob.core.windows.net/environment/2016-Maritime-Air-Emissions-Inventory.pdf

Table A-1. Summary of 2019 Maritime Air Emission Inventory (tons)

Type	ROG	CO	NOx	PM10	PM2.5	DPM	SO2	CO_2e (tons)	CO_2e (MT)
Ocean-Going Vessels	17.5	33.4	378.3	7.5	6.9	6.7	15.8	25,770	23,378
Harbor Craft	33.9	200.0	283.6	9.1	8.9	9.1	0.4	25,495	23,128
Cargo Handling Equipment	1.0	22.6	8.4	0.1	0.1	0.1	0.0	2,439	2,213
Freight Rail	1.9	7.5	30.3	1.2	1.2	1.2	0.5	2,916	2,646
Heavy Duty Trucks	1.0	3.6	36.4	1.5	0.8	0.5	0.1	13,958	12,663
Total Emissions	***55.4***	***267.2***	***737***	***19.5***	***17.9***	***17.6***	***16.8***	***70,578***	***64,028***

A.3 Ocean Going Vessels

The OGV emissions inventory was updated based on 2019 conditions. Data sources used for this analysis include vessel call data from the Port, Automatic Identification System (AIS) data, and Lloyd's data. The scope of the Inventory includes all OGV calls at the three marine terminals (CST, TAMT, and NCMT) in 2019. This is the fourth OGV Inventory conducted by the Port, past inventories were conducted in 2006, 2012 and 2016. Emissions were calculated based upon CARB's OGV methodology.

Average propulsion and auxiliary power by ship type is shown in Table A-2. OGV emission estimates by ship type are shown in Table A-3. Emissions by activity mode are shown in Table A-4. Figure A-1 portrays the relative contribution of each pollutant by geographic area: outside of bay, maneuvering in-harbor, and hoteling at-berth. Note that emissions outside of the bay includes transit, VSR, and anchorage emissions.

Table A-2. Average Propulsion and Auxiliary Power by Ship Type 2019

Ship Type	Engine Type	Calls	Average Power (kW)		
			Propulsion	Auxiliary	Boiler
Auto Carrier	SSD	243	14,161	1,089	316
Bulk Carrier	SSD	8	8,425	262	131
Container Ship	SSD	52	19,420	811	308
General Cargo	MSD	7	6,843	502	130
	SSD	16	9,260	640	172
Passenger Ship	GT-ED	2	70,977		1,694
	MSD-ED	89	68,792		1,693

Ship Type	Engine Type	Calls	Average Power (kW)		
			Propulsion	Auxiliary	Boiler
	MSD	6	18,513		410
RoRo	SSD	1	14,123	1,087	315
Total	-	424	24,388	2,565	600

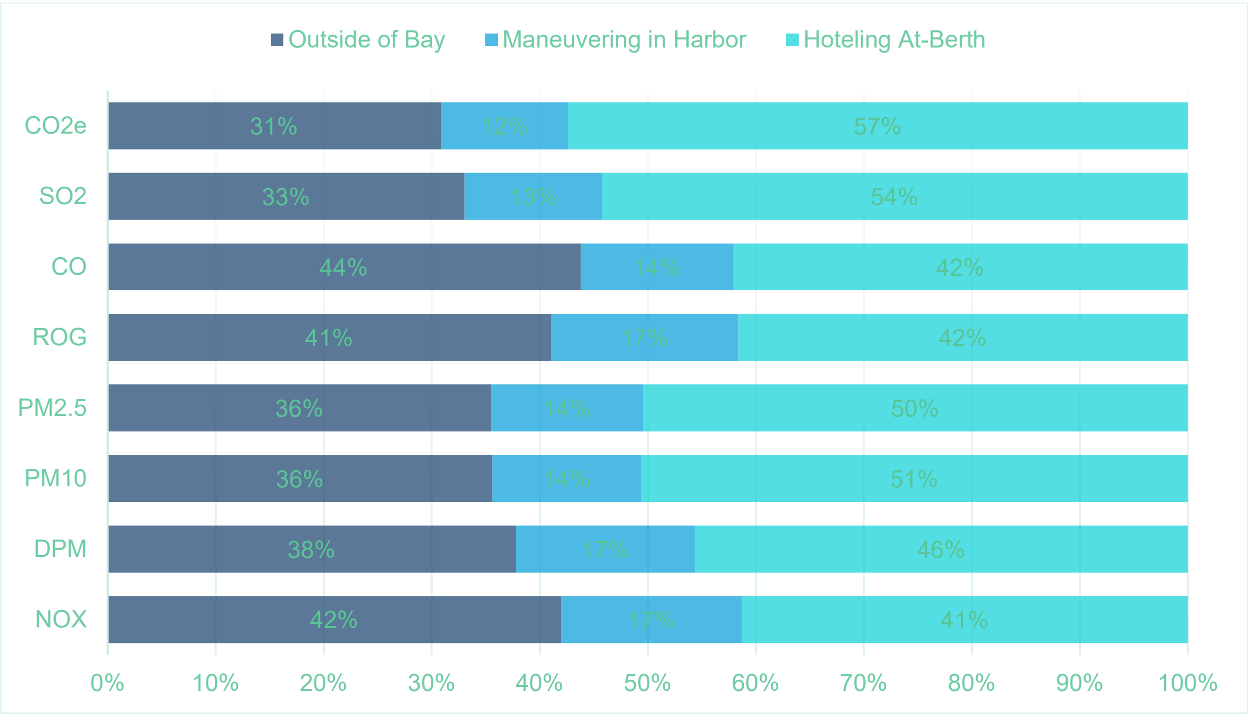
Table A-3. Emissions from OGVs by Type (tons)

Ship Type	NOx	DPM	PM10	PM2.5	ROG	CO	SO_2	CO_2e (tons)	CO_2e (MT)
Auto Carrier	180.5	2.9	3.2	3.0	8.0	16.4	7.2	10,383	9,420
Bulk Carrier	4.5	0.1	0.1	0.1	0.2	0.5	0.2	349	316
Container Ship	17.7	0.2	0.4	0.3	0.8	1.2	1.2	2,386	2,164
General Cargo	19.3	0.4	0.4	0.4	0.8	1.9	0.9	1,371	1,243
Passenger Ship	154.3	3.0	3.3	3.1	7.6	13.3	6.2	11,157	10,122
RoRo	1.9	0.0	0.0	0.0	0.1	0.2	0.1	123	112
Total	*378.3*	*6.7*	*7.5*	*6.9*	*17.5*	*33.4*	*15.8*	*25,769*	*23,378*

Table A-4. Emissions from OGVs by Mode in 2019 (tons)

Ship Type	NOx	DPM	PM10	PM2.5	ROG	CO	SO_2	CO_2e (tons)	CO_2e (MT)
Transit	29.7	0.4	0.5	0.4	1.3	3.1	0.8	1,282	1,163
VSR	109.5	1.7	1.7	1.6	5.0	9.8	3.2	4,936	4,478
Maneuver	63.2	1.1	1.0	1.0	3.0	4.7	2.0	3,039	2,757
Hotel	156.1	3.1	3.8	3.5	7.3	14.1	8.5	14,784	13,412
Anchor	19.8	0.4	0.5	0.5	0.8	1.8	1.2	1,728	1,568
Total	*378.3*	*6.8*	*7.5*	*6.9*	*17.5*	*33.4*	*15.8*	*25,769*	*23,378*

Figure A-1. Portion of OGV Emissions Inside and Outside of the Bay in 2019



A.4 Harbor Craft

The CHC emissions inventory was updated based on 2019 conditions for all harbor craft except for the commercial and sport/charter fishing fleet. Information on the number, vessel types, location, operating radius, engine size, model year, and general operating activity of CHC was obtained from tenants through a Port-issued survey. The scope of the Inventory includes all CHC operating in the Bay, including those that not only visited the three marine terminals (CST, TAMT, and NCMT), but also those that visited the various boatyard and other tenants in 2019. This is the fourth CHC Inventory conducted by the Port, past inventories were conducted in 2006, 2012 and 2016. Emissions were calculated based upon CARB's CHC methodology.

Port Table 5 summarizes the activity metrics for the various types of vessels considered, including the equipment counts, average engine model year, horsepower by engine type, and annual hours both within the Bay and outside the Bay (but within 24 nautical miles). As shown, there were 94 harbor craft vessels included the fleet, not including commercial and sport fishing. All harbor craft are diesel powered.

CHC emissions for all 2019 activity (regardless of location) are summarized in Table A-6 by vessel type.

The contribution of each pollutant both within and outside the Bay by pollutant type is shown in Figure A-2. The majority (62-71%) of CHC emissions are emitted within the Bay. Figure A-3 summarizes DPM emissions by vessel type in bay versus outside the Bay. As shown, the majority of DPM emissions from ferries, excursion vessels, and assist tugs occur within the Bay.

Table A-5. Characteristics of Commercial Harbor Craft at the Port in 2019

Vessel Type	No. of Vessels	Model Year	Average Engine Power (HP)		In Port Hours		Outside Port Hours	
			Propulsion	Auxiliary	Propulsion	Auxiliary	Propulsion	Auxiliary
Crew Supply	9	1994	1690	165	64	1824	84	225
Dredge	2	1996	3475	1700	5	26	20	47
Escort/Ship Assist Tug	6	2003	1508	79	337	2559	11	12
Excursion	24	2000	779	456	389	1601	71	73
Ferry	2	1976	368	74	2343	5093	0	0
Bunker Barge	1	2010	-	201	1	171	11	11
Pilot Boat	2	2010	625	220	285	1757	223	226
Push Tow Tug	26	1994	1035	86	120	852	126	139
Research Boat	10	1993	1565	602	14	636	100	114
Work Boat	12	2009	1236	535	53	308	151	321
Total [a]	**94**	**1998**	**1163**	**338**	**224**	**1237**	**97**	**138**

[a] Total vessels; all other values are averages, weighted by number of vessels of each type.

Table A-6. Summary of Commercial Harbor Craft Emissions in 2019 (tons)

Type	ROG	NOx	CO	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Crew Supply	4.21	28.38	25.96	0.66	0.64	0.66	0.04	3,202	2,905
Dredge	0.28	2.07	1.85	0.07	0.06	0.07	0.00	227	206
Escort/Ship Assist Tug	1.32	9.32	8.31	0.24	0.23	0.24	0.01	1,043	946
Excursion	6.08	44.82	36.56	1.29	1.26	1.29	0.05	4,259	3,864
Ferry	1.10	8.15	6.31	0.26	0.26	0.26	0.01	728	661
Other Barge	0.02	0.16	0.12	0.00	0.00	0.00	0.00	13	12
Pilot Boat	0.38	3.34	2.60	0.09	0.09	0.09	0.00	310	281

Type	ROG	NOx	CO	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Push Tow Tug	4.41	39.87	23.40	1.72	1.67	1.72	0.03	3,161	2,867
Research Boat	4.09	51.00	23.30	1.63	1.59	1.63	0.03	2,618	2,375
Work Boat	3.69	34.97	24.41	1.12	1.09	1.12	0.03	3,004	2,725
Total	**25.57**	**222.07**	**152.81**	**7.11**	**6.89**	**7.11**	**0.21**	**18,565**	**16,842**

Figure A-2. Portion of Commercial Harbor Craft Emissions Inside and Outside of the Bay in 2019

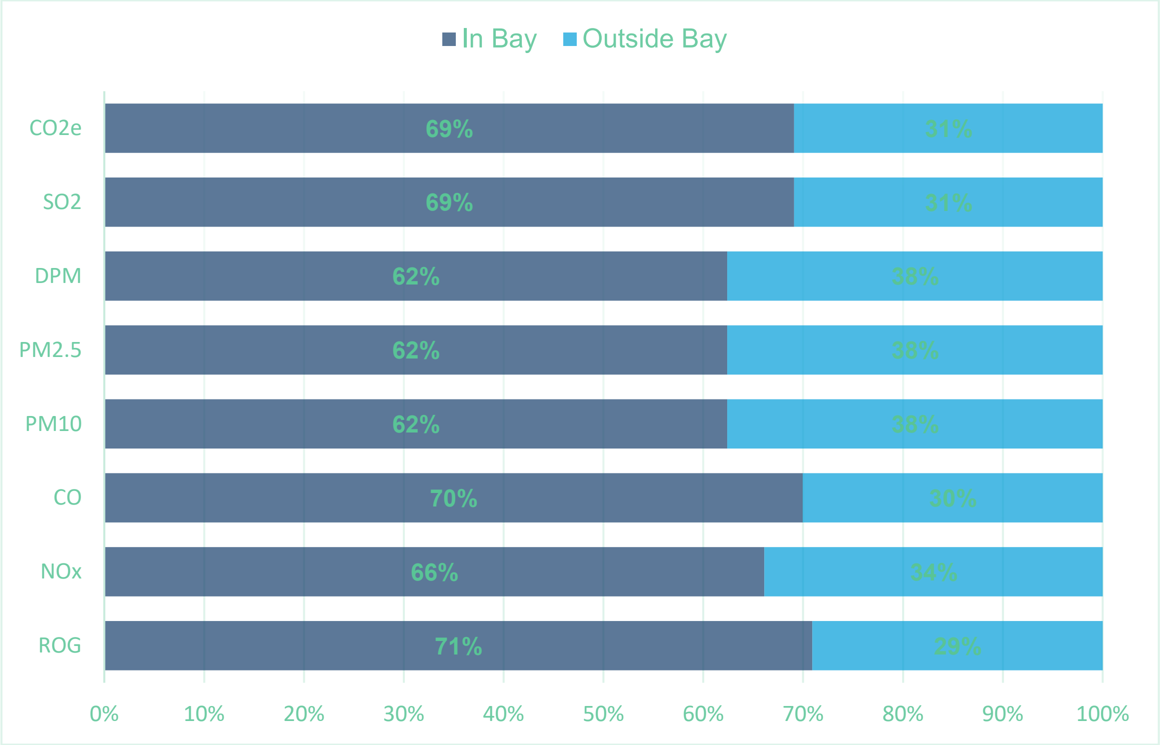
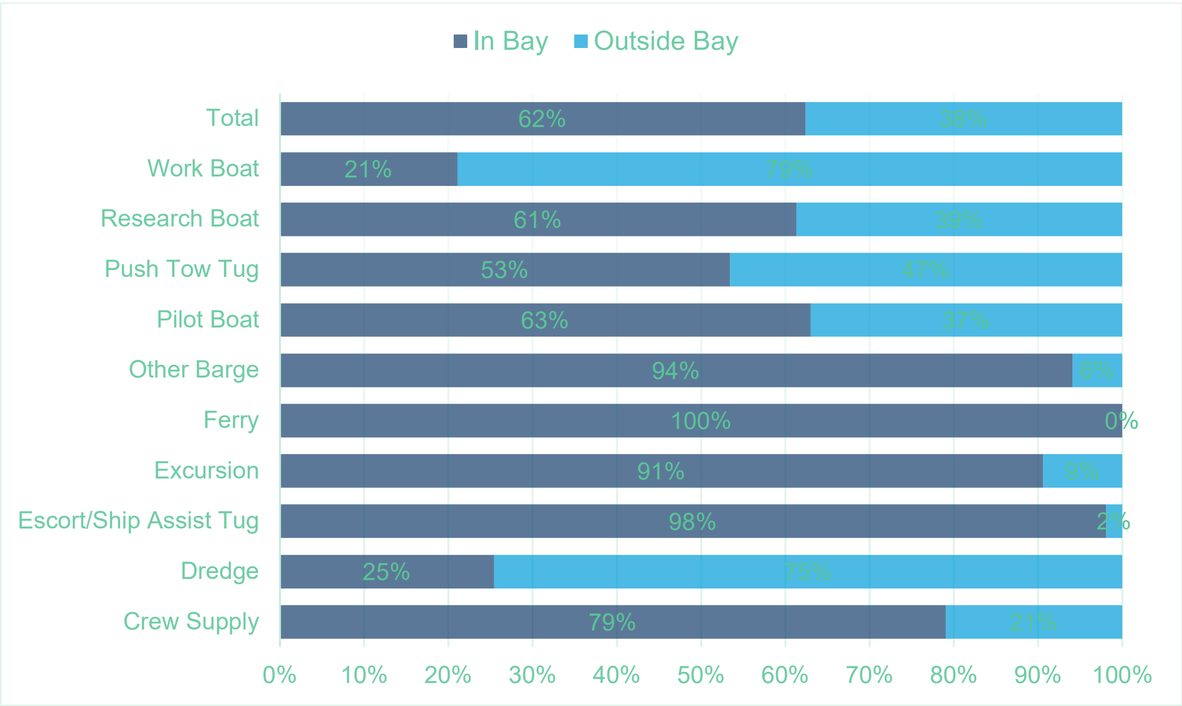


Figure A-3. Portion of Commercial Harbor Craft Diesel Particulate Matter Emissions Inside and Outside of the Bay by Vessel Type in 2019



A.5 Cargo Handling Equipment

The scope of the Inventory includes all CHE utilized by the Port and participating tenants at the three marine terminals (CST, TAMT, and NCMT) in 2019. This is the fourth Maritime Cargo Handling Equipment Inventory conducted by the Port, past inventories were conducted in 2006, 2012 and 2016. Emissions were calculated based upon CARB's CHE methodology.

This inventory includes all equipment at all terminals, even if not part of MCAS or unrelated to cargo handling.

A summary of CHE specifications by equipment type is shown in Table A-7. A summary of CHE emission by equipment type and fuel for existing pieces is shown in Table A-8. A summary of CHE emissions by terminal is shown in Table A-9.

The contribution of each pollutant by terminal is shown in Figure A-4. The majority of CHE emissions for all by CO occurs at TAMT, which has the largest and most active diesel CHE pieces.

Table A-7. Summary of Cargo Handling Equipment Activity in 2019

Equipment	Fuel	Count	Power (hp)			Model Year			Annual Activity Hours		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
ATV	G	18	13	32	17	2007	2017	2013	479	479	479
Cart	E	11	10	40	21	2005	2012	2008	479	479	479
	G	1	9	9	9	2007	2007	2007	10	10	10
Crane	D	1	1030	1030	1030	2002	2002	2002	245	245	245
Compressor	E	7	5	15	9	2003	2003	2003	566	566	566
	G	1	13	13	13	2003	2003	2003	566	566	566
Forklift	D	27	67	250	187	2007	2016	2010	25	925	314
	E	21	28	149	133	2004	2019	2011	25	1409	529
	G	1	23	23	23	2015	2015	2015	400	400	400
	P	10	60	149	92	2000	2014	2007	48	520	229
Stationary Lift	E	21	2	2	2	2003	2017	2008	375	375	375
Loader	D	1	125	125	125	1999	1999	1999	200	200	200
	G	3	138	138	138	2002	2002	2002	63	63	63
Reach Stacker	D	4	315	400	344	2008	2016	2011	150	710	328
	E	1	354	354	354	2010	2010	2010	1300	1300	1300
Segway	E	2	2	2	2	0	0	0	375	375	375
Signal Board	S	6	0	0	0	2004	2008	2005	0	0	0
Sweeper	G	1	83	83	83	1998	1998	1998	479	479	479
Top Handler	D	2	280	280	280	1999	2005	2002	405	1300	853
Yard Tractor	D	27	164	238	201	2007	2015	2011	176	1487	578
	E	3	241	241	241	2017	2017	2017	102	715	308
Other	E	12	1	6	2	2003	2003	2003	375	375	375
Lighting	D	3	14	14	14	2019	2019	2019	10	10	10

Notes: D = Diesel, E = Electric, G = Gas, P = Propane, S = Solar

Table A-8. Summary of Cargo Handling Equipment Emissions by Fuel and Equipment Type in 2019 (tons)

Fuel	Type	ROG	CO	NOx	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Diesel	Crane	0.01	0.11	0.48	0.01	0.01	0.01	0.00	68	62
	Forklift	0.05	0.79	0.93	0.04	0.04	0.04	0.00	207	188
	Loader	0.01	0.05	0.11	0.01	0.01	0.01	0.00	9	8
	Reach Stacker	0.03	0.24	0.57	0.02	0.02	0.02	0.00	163	148
	Top Handler	0.04	0.16	2.12	0.02	0.01	0.02	0.00	178	162
	Yard Tractor	0.44	3.13	3.40	0.04	0.03	0.04	0.02	1,399	1269
	Lighting	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Electric	Cart	-	-	-	-	-	-	-	16	15
	Forklift	-	-	-	-	-	-	-	124	112
	Reach Stacker	-	-	-	-	-	-	-	72	65
	Segway	-	-	-	-	-	-	-	0	0
	Yard Tractor	-	-	-	-	-	-	-	23	21
	Other	-	-	-	-	-	-	-	2	1
	Compressor	-	-	-	-	-	-	-	5	5
	Lift	-	-	-	-	-	-	-	2	2
Gasoline	ATV	0.13	10.92	0.25	0.01	0.01	0.00	0.00	90	82
	Cart	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
	Forklift	0.00	0.21	0.01	0.00	0.00	0.00	0.00	2	2
	Loader	0.02	0.34	0.12	0.00	0.00	0.00	0.00	12	11
	Sweeper	0.25	4.33	0.26	0.00	0.00	0.00	0.00	24	21
	Compressor	0.03	1.18	0.04	0.00	0.00	0.00	0.00	4	3
Propane	Forklift	0.02	1.17	0.13	0.00	0.00	0.00	0.00	38	35
Solar	Signal Board	-	-	-	-	-	-	-	0	0
Grand Total		1.03	22.64	8.41	0.15	0.13	0.13	0.02	2,439	2,213

Table A-9. Summary of Cargo Handling Equipment Emissions by Terminal in 2019 (tons)

Terminal	ROG	CO	NOx	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
TAMT	0.52	3.74	6.78	0.10	0.09	0.10	0.02	1,776	1,611
NCMT	0.50	18.66	1.53	0.04	0.04	0.03	0.00	523	474
CST	0.01	0.23	0.10	0.01	0.01	0.01	0.00	141	128

Figure A-4. Portion of Cargo Handling Equipment Emissions by Terminal in 2019

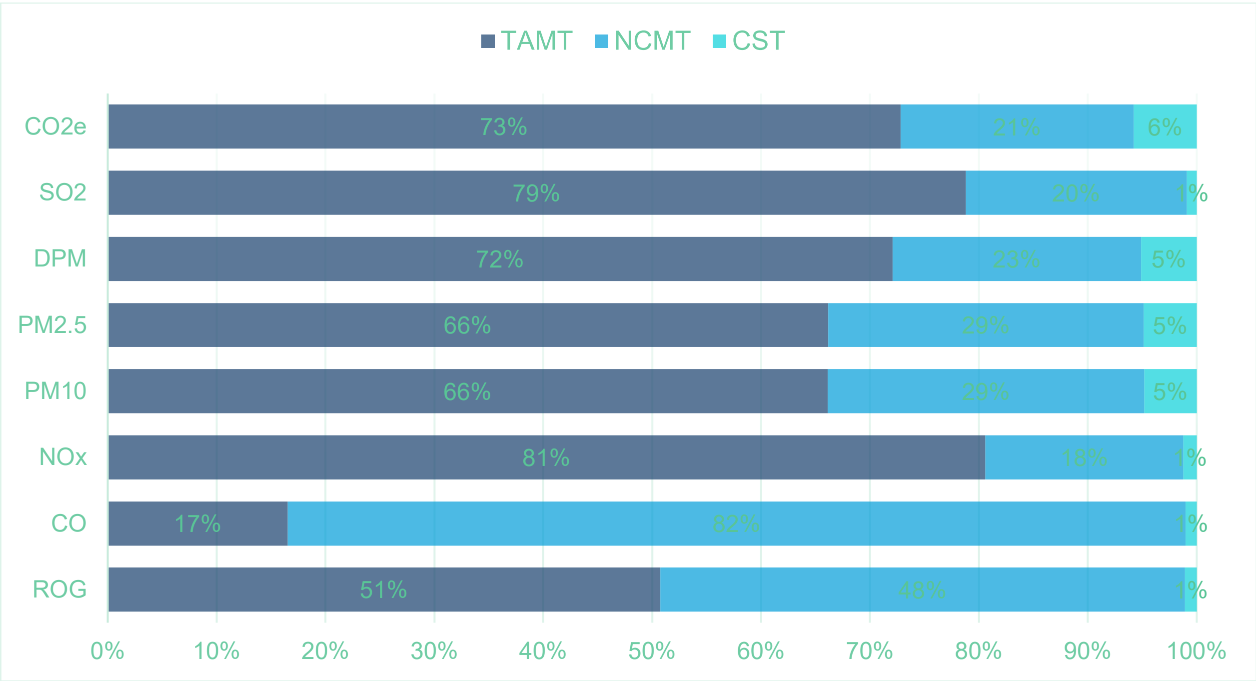
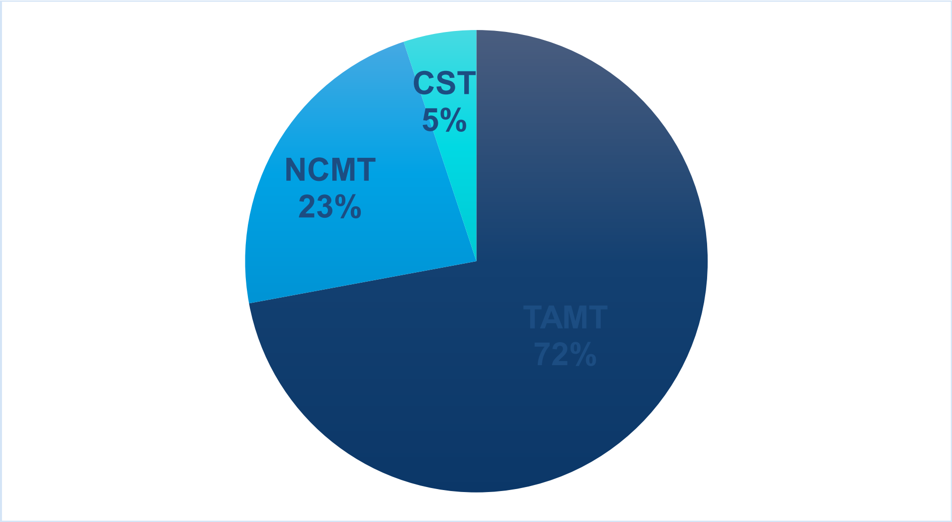


Figure A-5. Portion of Cargo Handling Equipment Diesel Particulate Matter by Terminal in 2019



A.6 Rail

Freight rail emissions were not updated for 2019 conditions. Summary of emissions below is based on the 2016 Inventory. Rail emissions by activity mode (regional line haul and near-terminal switching) is shown in Table A-10. Rail emissions by terminal is shown in Table A-11.

Table A-10. Summary of Freight Rail Emissions by Activity Mode in 2016 (tons)

Activity Mode	ROG	CO	NOx	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Line Haul	1.46	5.7	23.0	0.94	0.91	0.94	0.40	2,215	2,009
Switching	0.46	1.8	7.3	0.30	0.29	0.30	0.13	702	637

Table A-11. Summary of Freight Rail Emissions by Terminal in 2016 (tons)

Terminal	ROG	CO	NOx	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
TAMT	0.03	0.1	0.5	0.02	0.02	0.02	0.01	42	39
NCMT	1.89	7.4	29.8	1.22	1.18	1.22	0.52	2,874	2,607

A.7 Trucks

Emissions from heavy-duty trucks servicing the Port's marine cargo terminals were calculated for calendar year 2019. A summary of these emissions by marine cargo terminal is provided in Table A-12. As described in Chapter III.3, truck operating modes are defined as follows:

- On-Port: These include truck movement and idling within the terminal boundary as trucks move into position to pick up or drop off cargo;
- Local: These include truck trips to and from the Port's marine cargo terminals and locations within San Diego County; and
- Regional: These include truck trips to and from the Port's marine cargo terminals which originate or end outside of San Diego County.

Table A-12. Summary of Truck Emissions by Mode by Terminal in 2019 (tons)

Type	Location	ROG	CO	NOx	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
TAMT Trucks	On-Port	<0.01	0.01	0.09	<0.01	<0.01	<0.01	<0.01	38	34
	Local	0.02	0.07	0.86	0.03	0.01	0.01	<0.01	347	314
	Regional	0.44	1.39	16.32	0.59	0.26	0.11	0.06	6,613	6,000
NCMT Trucks	On-Port	<0.01	0.01	0.12	0.01	<0.01	<0.01	<0.01	44	40
	Local	0.05	0.18	1.63	0.07	0.04	0.03	0.01	607	551
	Regional	0.52	1.91	17.36	0.77	0.44	0.31	0.06	6,309	5,724
Total		1.04	3.57	36.38	1.47	0.76	0.46	0.13	13,958	12,662

B.1 Background and Context

On-road vehicles at the Port of San Diego (Port) include heavy-duty trucks that are used to transport port-related cargo between National City Marine Terminal (NCMT) and Tenth Avenue Marine Terminal (TAMT) and local and regional destinations, as well as vehicle on-loading and off-loading at NCMT. For purpose of this report, heavy-duty trucks are defined as Class 7 and Class 8 trucks (with a gross vehicle weight rating (GVWR) greater than 26,000 pounds). This report provides additional background information that helped inform the discussion in the Trucks chapter, which addresses emissions from all heavy-duty trucks that travel to and from TAMT and NCMT, including trucks that move containers, bulk, break-bulk, and Roll-on/Roll-off cargo.

According to CARB, typical port drayage operations may transport freight less than 100 daily vehicle miles traveled (VMT) with multiple stops at the Port, and a significant number of them are domiciled at a regular depot overnight[1,2]. In these cases, typical port drayage operations may serve as early adopters for zero emission vehicles with currently available Class 8 electric truck technology. However, depending on supply chains and freight logistics, Port of San Diego data suggests that the majority of trucks servicing the Port's marine cargo terminals travel well beyond 100 miles per day. In addition, many fleets operating drayage trucks in California are small fleets that may not have a depot location. As will be discussed later in the chapter, this presents a challenge to typical overnight charging setups. It should also be noted that as transload and freight facilities are being located farther from the ports, the typical daily VMT for these trucks may increase going forward.

Transitioning the commercial heavy-duty truck market to zero- and near-zero (ZE/NZE) emission technologies is occurring at different stages. CALSTART's Beachhead Strategy[3] estimates how ZE/NZE technologies for on- and off-road vehicles will progress through different applications overtime. The first vehicle market segments to successfully transition are operated in largely urban applications where vehicles travel along established routes and over relatively short distances, and importantly, can recharge overnight at depots. Going forward, ZE/NZE emission technologies will advance from first-success beachhead applications and expand to larger-volume, longer-distance, and more demanding applications which still make use of core zero-emission commercial vehicle (ZECV) powertrain components and supply chains. For zero-emission freight vehicles, (including heavy-duty trucks), the Beachhead Strategy diagram shows that commercialization will start with smaller and lower-range vehicles, cargo vans and yard tractors, as first-success applications in receptive markets around the world. The components and supply chains for these vehicles is then leveraged and scaled-

[1] California Air Resources Board. 2019. Advanced Clean Truck Regulation—Staff Report: Initial Statement of Reasons. October 2019. Available at: https://ww2.arb.ca.gov/sites/default/files/classic/regact/2019/act2019/isor.pdf

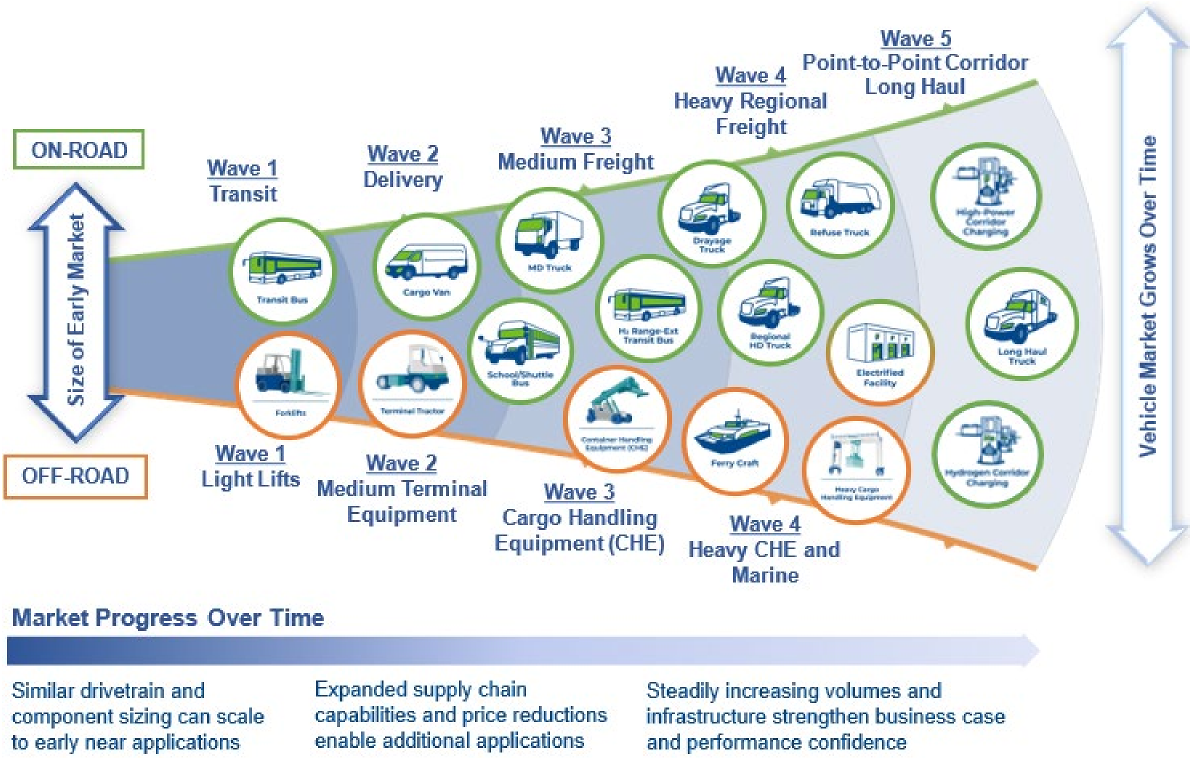
[2] California Air Resources Board. 2021.Proposed Advanced Clean Fleet Regulation December 9, 2020 Workshop Presentation. Slide 31. https://ww2.arb.ca.gov/sites/default/files/2020-12/201209drayagepres_ADA.pdf

[3] CALSTART: 2020. *The Beachhead Model: Catalyzing Mass-Market Opportunities for Zero-Emission Commercial Vehicles*. Available online at https://globaldrivetozero.org/public/The_Beachhead_Model.docx.

up so that ZE/NZE freight vehicle technology can advance into applications that meet longer-range, and more rigorous duty cycles in heavier vehicles. This progression is shown in TRK-B Figure 1.

B.2 Technologies and Strategies

TRK-B Figure 1. "Beachhead Pathways" for Zero-Emission Vehicle Commercialization[4]



Based on the Beachhead Strategy, the zero-emission vehicle market is approaching the end of Wave 3. It is projected that Wave 4 applications, including drayage trucks, will be commercially available in 2023 based on data in the Zero Emission Technology Inventory (ZETI)[5], as discussed below.

Related to the Beachhead Strategy is CARB's Long-Term Heavy-Duty Investment Strategy[6], within which CARB created high-level technology readiness assessments for heavy-duty vehicles. A simple scoring methodology for technology readiness level (TRL) is used from 1 through 9 to identify the maturity and commercial

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[4] CALSTART: 2020. *The Beachhead Model: Catalyzing Mass-Market Opportunities for Zero-Emission Commercial Vehicles*. Available online at https://globaldrivetozero.org/public/The_Beachhead_Model.docx.
[5] *Drive to Zero's Zero-emission Technology Inventory (ZETI) Tool Version 5.5*. Available online at https://globaldrivetozero.org/tools/zero-emission-technology-inventory/. Accessed December 2020.
[6] CARB. 2020. *Appendix D: Long-Term Heavy-Duty Investment Strategy*. Available online at: https://ww2.arb.ca.gov/sites/default/files/2020-11/appd_hd_invest_strat.pdf. Accessed January 2021.

readiness of the technology. Technologies with TRL scores from 1-4 are considered to be in their earliest stage of commercialization, where the technology is assessed for its feasibility. Technologies with TRL scores from 5-6 are undergoing early demonstrations for research, design, and development. Technologies with TRL scores from 7-8 are in the precommercial stage, where pilot projects happen. Lastly, technologies with TRL scores of 9 are either early market entries accelerated through financial incentives, or at market scale accelerated by fleet turnover incentives. More information about TRLs and how they relate to the trucks operating at the Port is covered in the Commercial Availability section.

B.2.1 Emission Reduction Technology Options

Drayage trucks have a very specific use case, which is to transport containerized, bulk, and break-bulk cargo from ports and railyards to their next location. The term *drayage truck* is defined by CARB as Class 7 and 8 trucks (trucks with a gross vehicle weight rating of greater than 26,000 pounds) that are used for transporting cargo, such as containerized bulk, or break-bulk goods, that operates (a) on or transgresses through port of intermodal rail yard property for the purpose of loading, unloading or transporting cargo, including transporting empty containers and chassis or (2) off port or intermodal rail yard property transporting cargo or empty containers or chassis that originated from or is destined to a port or intermodal rail yard property.[7]

Currently, there exist multiple emission reduction technologies for heavy-duty trucks that are at different levels of commercialization. While some are fully commercialized, others are in research and development phases and are being tested through demonstrations and pilots. This section describes the different emission reduction technologies that are available. The Costs and Emissions Reductions section will include information about the emissions associated with each technology, and the Commercial Availability section will include more information on how developed each technology is and where it stands in the market.

Natural Gas

Heavy-duty natural gas vehicles (NGV) operate similarly to that of their diesel or gasoline counterparts, depending on the type of NG used. Natural gas is stored in tanks, and it is produced in two forms: compressed natural gas (CNG) and liquefied natural gas (LNG). In CNG trucks, high-pressure gas travels via fuel lines to a pressure regulator which adjusts the pressure of the gas to a suitable level for the engine fuel injection system. The gas is then mixed with air, compressed and ignited by a spark plug.[8] LNG fuel systems store the liquidized fuel in large tanks. LNG has a greater energy density and thus a longer range compared to CNG, but due to its higher cost CNG remains the more commonly used natural gas type.

Low-NOx natural gas engines have been a major technological innovation as it reduces both particulate matter and NOx emissions. Low-NOx NGVs produce roughly similar levels of NOx emissions as battery-electric trucks. However, natural gas produces the second highest lifecycle GHG emissions on a grams per mile basis, slightly

[7] 13 CCR § 2027(c)(15).
[8] Alternative Fuels Data Center. n.d. *How Do Natural Gas Class 8 Trucks work?* Available online at: https://afdc.energy.gov/vehicles/how-do-natural-gas-class-8-trucks-work. Accessed January 2021.

less than conventional diesel.[9] It should be noted that heavy-duty low NOx standards in the state of California means natural gas used in trucks operating in the state is considered to be low NOx.

Renewable Natural Gas

Renewable Natural Gas (RNG) is derived from organic waste material, which can come from many sources including manure, food waste, landfill gas, wastewater treatment sludge, forest and agricultural residues, and organic municipal solid waste.[10] Anaerobic digestion of these materials produces a variety of gases including carbon dioxide and biomethane. Once separated from the carbon dioxide, the remaining biomethane and trace gases, known simply as "RNG", can be blended with fossil natural gas or substituted entirely. RNG meets existing required fossil natural gas pipeline and vehicle specifications, meaning RNG and fossil natural gas are interchangeable in NGV applications.[11]

While RNG emits comparable levels of GHGs as fossil fuels, the differences in upstream processes, such as methane capture, result in an overall reduction of lifecycle GHG emissions with its use. Some CARB-certified RNG pathways are even considered carbon-negative.[12] Overall, Low NOx RNG has been found to reduce GHG emissions by more than 60 percent, and criteria air pollutant emissions by 90 percent in Class 8 vehicles when compared to conventional diesel.[13]

In 2019, Californians consumed approximately 162 million gasoline gallon equivalents of RNG, accounting for approximately 77 percent of the total NGV demand, and 7 percent of the total alternative fuel demand in California.[14] According to a UC Davis study, California has enough organic waste material to increase the state's production of RNG to at least 94.6 billion cubic feet (Bcf) per year.[15] As of June 2020, the Proposition 1B: Goods Movement Emission Reduction Program has resulted in 561 natural gas drayage truck replacements and 891 retrofits statewide.[16]

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[9] ICF. 2019. *Comparison of Medium- and Heavy-Duty Technologies in California*. Available online at: https://caletc.com/comparison-of-medium-and-heavy-duty-technologies-in-california/

[10] Jaffe, AM and Dominguiz-Faus, Rosa. 2016. The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute Contract No. 13-307. UC Davis ITS. Available online at: *https://ww2.arb.ca.gov/sites/default/files/classic//research/apr/past/13-307.pdf.*

[11] UC Davis ITS. 2017. *Policy Brief—Renewable Natural Gas Provides Viable Commercial Pathway for Sustainable Freight*. Available online at: https://steps.ucdavis.edu/wp-content/uploads/2017/10/RNG-policy-brief-FINAL-WITH-ABSTRACT-Sep2017.pdf.

[12] California Air Resources Board. 2020. *LCFS Pathway Certified Carbon Intensities*. Available online at: https://ww2.arb.ca.gov/resources/documents/lcfs-pathway-certified-carbon-intensities.

[13] ICF. 2019. *Comparison of Medium- and Heavy-Duty Technologies in California*. Available online at: https://caletc.com/comparison-of-medium-and-heavy-duty-technologies-in-california/.

[14] CARB. n.d. *Data Dashboard: 2011-2019 Performance of the Low Carbon Fuel Standard*. Available online at: https://ww3.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm. Accessed August 2020.

[15] Jaffe, M, A. 2016. *The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute*. Available online at: https://ww2.arb.ca.gov/sites/default/files/classic/research/apr/past/13-307.pdf.

[16] CARB. 2020. *Proposition 1B: Goods Movement Emission Reduction Program June 220 Semi Annual Status Report.* June 30. Available online at: https://ww2.arb.ca.gov/sites/default/files/2020-06/Proposition%201B%20-%20Goods%20Movement%20June%202020%20Semi-Annual%20Report_0.pdf. Accessed September 2020.

A recent demonstration of 20 RNG-fueled Class 8 trucks, funded by CARB, CEC, and South Coast Air Quality Management District (SCAQMD), confirmed that RNG can be a feasible option for port drayage and regional trucking. Seven trucking companies operating at the Ports of Los Angeles and Long Beach were outfitted with Cummins ISX12N engines and fueled with RNG. The ISX12N engine is certified by CARB to reduce NOx emissions by 90 percent compared to the current engine standard. By the end of 2019 over 100 trucks were outfitted with the ISX12N engine and operating at the Ports of Los Angeles and Long Beach.[17]

Battery Electric

As the battery electric vehicle market matured through the past decade, there was a large focus on developing the technology, supply chains, and marketing strategies to accelerate adoption of light- and medium-duty electric vehicles. As a result, heavy-duty electric vehicles have been slower to evolve and implement, however, recent focus has shifted to electrifying heavy-duty vehicles with a particular emphasis on drayage trucks in the near-term. Drayage may be an attractive near-term application because current electric heavy-duty vehicles are well positioned to handle short range, regular duty cycles. Transit buses, school buses, urban delivery vehicles, and yard tractors have all seen success partially due to their regular duty cycles; drayage trucks are well positioned for future success as the technology for heavy-duty trucks advances.

Battery electric technology is in development for multiple applications, including heavy duty drayage and non-drayage trucks. Electric trucks use a battery for propulsion and refuel with electricity generated from the grid or by distributed energy resources (DERs) such as solar power. Battery electric technologies therefore do not produce any air pollutant or GHG emissions at the tailpipe, so any related emissions are from upstream processes. Although even when considering the upstream emissions associated with electricity generation, the energy efficiency of electric batteries and the emissions profile of the San Diego region's electric grid, result in lower emissions than comparable fossil fuel alternatives. According to the California Energy Commission, San Diego Gas & Electric generated 43% of its 2018 electricity sales from renewable generation, 29% from natural gas generation, and 27% from unspecified power sources.[18] Further, since the state is required to meet a goal of 100% carbon-free retail electricity sales by 2045, the upstream emissions profile associated with electric vehicles in California is expected to continue to decline.[19] At present, electric drayage truck technology is able to achieve 80 to 100 percent reduction in GHG emissions when compared to conventional diesel.[20]

Battery electric technologies are significantly more energy efficient than conventional diesel vehicles for different weight classes, vehicle types, and duty cycles. Battery electric vehicles have energy efficiency ratios

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[17] San Pedro Bay Ports. 2018. *San Pedro Bay Ports – Clean Air Action Plan.* Available online at: https://cleanairactionplan.org/documents/final-drayage-truck-feasibility-assessment.pdf/. Accessed September 2020.
[18] *SDG&E 2018 Power Content Label. Available online at:* https://www.energy.ca.gov/sites/default/files/2020-01/2018_PCL_San_Diego_Gas_and_Electric.pdf. Accessed January 2021.
[19] California Energy Commission. n.d. *Senate Bill 100 Joint Agency Report*. Available online at: https://www.energy.ca.gov/sb100
[20] ICF. 2019. *Comparison of Medium- and Heavy-Duty Technologies in California*. December.

approximately 3.5-7 times greater than conventional diesel engines depending on vehicle speed, with greater efficiency improvements at lower speeds due to losses during idling and coasting with conventional engines.[21]

In 2019, Californians consumed approximately 114 million gasoline gallon equivalents of electricity for transportation, accounting for approximately 5 percent of the total alternative fuel demand in California.[22] While vehicle electrification for heavy-duty vehicles has been slower to evolve than light- and medium-duty applications, several technology demonstrations for Class 7-8 trucks have been deployed across the country, and at ports within the state specifically.

The Port is working to prepare itself to support the electrification of vehicles by providing the infrastructure necessary for these technologies. For example, chargers have been installed at the National City Marine Terminal to power drayage trucks as well as electric cars and yard tractors. Working with agency partners such as San Diego Gas and Electric, the Port is piloting additional EV Charging for medium- and heavy-duty freight equipment.

Hydrogen

Another viable alternative fuel for Class 8 heavy duty trucks is hydrogen. Fuel-cell electric trucks operate similarly to battery electric trucks where an electric motor is responsible for propulsion. The main difference between the two is that in a fuel cell electric truck on-board hydrogen is processed through a fuel cell to produce electricity, which is then stored in a battery and used to power an electric motor. While it is still too early to say whether battery electric trucks or hydrogen fuel cell trucks will capture greater market share, fuel cell trucks may be well-positioned for long-haul operations due to longer range and quicker refueling compared to battery electric trucks.

Hydrogen is currently mainly produced from natural gas through a process called natural gas reforming, or gasification. The process works by reacting natural gas with high-temperature steam and it produces three end products: hydrogen, carbon monoxide, and carbon dioxide. There are a handful of other production techniques including electrolysis, renewable liquid reforming, and fermentation (e.g., landfill methane). As it stands, gasification is the least expensive and efficient of the current production techniques.[23] However, hydrogen fuel cell vehicle emissions will vary depending on the hydrogen production process used. Hydrogen from natural gas has the highest amount of emissions compared to electrolysis and fermentation. Electrolysis,

[21] CARB. 2018. *Battery Electric Truck and Bus Energy Efficiency Compared to Conventional Diesel Vehicles*. May. Available online at: https://ww2.arb.ca.gov/resources/documents/battery-electric-truck-and-bus-energy-efficiency-compared-conventional-diesel Accessed August 2020.
[22] CARB. n.d. *Data Dashboard: 2011-2019 Performance of the Low Carbon Fuel Standard*. Available online at: https://www.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm. Accessed August 2020.
[23] Alternative Fuels Data Center. n.d. *Hydrogen Production and Distribution*. Available online at: https://afdc.energy.gov/fuels/hydrogen_production.html. Accessed January 2021.

which is the splitting of water into hydrogen and oxygen, using electricity will have lower emissions when renewable energy (e.g., solar or wind electricity) is used compared to non-renewable generated electricity.[24]

There are less heavy-duty hydrogen fuel cell vehicle pilots to point to compared to battery electric projects, but more are expected. One existing pilot project is taking place at the Ports of Los Angeles and Long Beach and is assessing the feasibility of the technology. This project tested Two Kenworth T680 Class 8 trucks utilizing Toyota fuel cell electric drivetrains in 2020, with an additional 8 trucks coming in 2021.[25] The Port of Houston started to launch a fuel-cell electric hybrid demonstration project in 2017 and 2018 with the intention of using Navistar International drayage trucks, however the project fell apart due to the lack fleet partner.[26] The joint CARB and CEC Zero-Emission Drayage Truck and Infrastructure Pilot Project described in previous sections of this chapter is open to both battery and fuel cell electric trucks.

Renewable Diesel

Renewable diesel is an alternative fuel made of agricultural waste products including natural fats, vegetable oils, and greases. Renewable diesel is not a fossil fuel, but is chemically similar, and effectively identical in performance characteristics to conventional petroleum diesel.[27] Renewable diesel can also be blended with other biofuels produced from biogenic sources. For these reasons, renewable diesel can be used in conventional diesel engines, pipelines, and storage tanks with no need for blending with petroleum-based diesel.

When compared to conventional diesel, Class 8 vehicles operating with renewable diesel can achieve GHG emission reductions of 50 to 70 percent. Relative to conventional diesel, renewable diesel used in California resulted in a reduction of 5.8 and 9.4 tons of NOx per day in 2018 and 2019, respectively.[28]

In 2019, Californians consumed approximately 692 million gasoline gallon equivalents of renewable diesel for transportation, accounting for approximately 30 percent of the total alternative fuel demand in California.[29] According to the U.S. Energy Information Administration (U.S. EIA), California is the greatest consumer of both U.S. produced and imported renewable diesel due to the economic benefits of the State's Low Carbon Fuel Standard (LCFS). The import of renewable diesel to California is currently limited mainly to the Neste and

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[24] UCS. 2014. *How Clean Are Hydrogen Fuel Cell Electric Vehicles*. Available online at: https://www.ucsusa.org/sites/default/files/attach/2014/10/How-Clean-Are-Hydrogen-Fuel-Cells-Fact-Sheet.pdf. Accessed January 2021.

[25] Toyota. 2020. *First Heavy Duty Fuel Cell Electric Trucks Set for Delivery to Pilot Program Customers at Ports of L.A. and Long Beach*. December 10. Available online at: https://pressroom.toyota.com/first-heavy-duty-fuel-cell-electric-trucks-set-for-delivery-to-pilot-program-customers-at-ports-of-l-a-and-long-beach/. Accessed January 2021.

[26] Houston-Galveston Area Council. 2018. *Hydrogen Fuel Cell Electric Hybrid Truck Demonstration – Final Technical Report.* November 2018. Available online at: https://www.osti.gov/servlets/purl/1496037. Accessed January 2021.

[27] CARB. 2018. *Renewable diesel is increasingly used to meet California's Low Carbon Fuel Standard*. November 13. Available online at: https://www.eia.gov/todayinenergy/detail.php?id=37472#. Accessed August 2020.

[28] CARB. 2020. *Public Hearing to Consider the Proposed Amendments to the Regulation on the Commercialization of Alternative Diesel Fuels.* January 7. Available online at: https://ww3.arb.ca.gov/regact/2020/adf2020/isor.pdf. Accessed September 2020.

[29] CARB. n.d. Data Dashboard: 2011-2019 Performance of the Low Carbon Fuel Standard. https://www.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm. Accessed August 2020.

Diamond Green companies. Neste Oil is a Finnish company that supplies renewable diesel to California from a refinery in Singapore. Since 2010 when operations began, production capacity of the Singapore refinery has increased from 800,000 to 1.3 million tons annually.30 There are currently eight cardlock fueling stations offering Neste renewable diesel in Northern and Central California.31 Diamond Alternative Energy is a U.S. based company and subsidiary of the Valero Energy corporation. Diamond Green Diesel is a joint venture, which operates a renewable diesel plant in Norco, Louisiana.[32] The plant is the largest of its kind in North America, and at capacity produces approximately 275 million gallons of renewable diesel annually. There are significant investments occurring in both of these dedicated renewable diesel plants and co-processing plants. By 2021, Diamond Green Diesel is expected to expand production to 675 million gallons of renewable diesel annually, and process approximately 20% of the animal fats and used cooking oil generated in the U.S.33 Neste has also announced plans to more than double the output of their refinery in Singapore to meet the global demand for renewable energy.34 Interest in policies similar to the California LCFS may present competition from other states for renewable diesel in the foreseeable future.

B.2.2 Vehicles

There are zero-emission, heavy-duty truck models currently available, and more expected to come in the short- and mid-term. Several traditional truck and engine manufacturers have each developed zero-emission trucks and there are numerous OEMs entering the market.

An informative tool for understanding the current and future commercial availability of zero emission vehicles for medium- and heavy-duty applications is the Global Commercial Vehicle Drive to Zero Initiative Zero Emission Technology Inventory tool.[35] Commercial availability is defined as when vehicle manufacturers are positioned – through established manufacturing facilities, supply-chain agreements, and logistics – to begin production due to orders placed. As of this writing, 15 truck manufacturers are anticipated to have commercial available zero emission products for Class 7 and Class 8 applications in the next three years. These vehicles include both battery electric trucks as well as hydrogen fuel cell trucks. However, as this database is initially populated by manufacturers with projected dates of availability, schedules for production often change and may not be reflected in the latest information. Nevertheless, the database provides insight into

[30] Neste. 2020. *Production: Singapore*. Available online at: https://www.neste.com/about-neste/who-we-are/production/singapore. Accessed September 2020.
[31] Biodiesel Magazine. 2020. *Neste Opens 4 New Renewable Diesel Fueling Stations in California.* July. Available online at: http://www.biodieselmagazine.com/articles/2517085/neste-opens-4-new-renewable-diesel-fueling-stations-in-california. Accessed September 2020.
[32] Diamond Green Diesel. 2019. *About Diamond Alternative.* Available online at: https://www.diamondgreendiesel.com/about-diamond-alternative. Accessed September 2020.
[33] DAR PRO Bio Energy. 2020. *Diamond Green Diesel.* Available online at: https://www.darpro-bioenergy.com/solutions/diamond-green-diesel. Accessed September 2020.
[34] Jaganathan and Samanta. 2019. *Finland's Neste expands Singapore refinery as it taps renewable growth.* July 30. Available online at: https://www.reuters.com/article/us-singapore-neste-interview/finlands-neste-expands-singapore-refinery-as-it-taps-renewable-growth-idUSKCN1UQ0OW. Accessed September 2020.
[35] *Drive to Zero's Zero-emission Technology Inventory (ZETI) Tool Version 5.5.* Available online at https://globaldrivetozero.org/tools/zero-emission-technology-inventory/.

the types of zero emission vehicles including their expected operational characteristics, such as range, which may be commercially available in the near future.

The Hybrid and Zero Emission Voucher Incentive Project (HVIP), administered by CARB, contains perhaps the most up-to-date information regarding zero emission vehicle availability. HVIP provides purchasing incentives for consumers to lower the initial procurement cost of zero emission vehicles. These vehicles have been vetted by CARB for specific requirements, such as warranties and servicing facilities. As of this writing, 6 vehicle manufactures of Class 7 and Class 8 tractor trailer trucks, which are drayage capable, have eligible vehicles listed on the HVIP website[36]. All of these vehicles are battery electric vehicles with expected range between 100 miles to 260 miles based on battery capacity. Although the HVIP purchasing incentive is available, production of some of the vehicle models may not occur until 2023.

Table TRK-B Table 1 shows what battery electric and fuel cell trucks anticipated to be commercially available in the next three years. The availability dates listed are reported in ZETI and based on manufacturer announcements. Those vehicles available for an HVIP purchasing incentive are provided. As noted previously, vehicles could potentially be offered in limited quantities and actual product availability may change depending on how OEMs progress with vehicle development.

Vehicle ranges for heavy-duty trucks operating on longer routes are expected to increase as manufacturers develop higher energy density, longer-range truck batteries. For example, the Tesla Semi is projected to exceed 500 miles near the 2023 timeframe. Also, fuel cell electric vehicles are likely to play a role in long-haul applications where the high capital cost of the vehicle and the cost of the fuel could make a better business case given higher vehicle utilization. In addition, fuel cell electric trucks may be positioned to serve operations that demand refueling which is quicker than current electric vehicle chargers are able to provide.

[36] Hybrid and Zero Emission Vehicle Incentive Project (HVIP). Accessed on July 22, 2021. Available at: https://californiahvip.org/

TRK-B Table 1. Anticipated Availability of Zero Emission Trucks

Manufacturer	Model	Energy Storage (EV: kWh, H2: kg H2)	Estimated Range (miles)	ZETI Availability or Expected Availability*	HVIP Eligible
Electric					
Meritor	Tractor	215	100	2020	Not at this time
BYD	8TT	435	150	2020	Yes
Peterbilt	579EV	396	150	2021	Yes
Volvo	VNR Electric	264	150	2021	Yes
Lion	Lion8T	480-653	180-260	2021	Yes
Kenworth	T680E	396	150	2021	Yes
Mercedes-Benz	EActros (U.S.)	240	124	2021	Not at this time
Freightliner	eCascadia	550	250	2022	Yes
Tesla	Semi	Unknown	300/500	TBD	Not at this time
Nikola	Tre EV	753	300	2021	Not at this time
XOS	ET-One	Unknown	300	TBD	Not at this time
Rousch Clean Tech	Ford F-750	Unknown	Unknown	2021	Not at this Time
Fuel Cell					
Hyundai	Xcient	32	249	2021	Not at this time
Toyota	Beta	40	300	TBD	Not at this time
Kenworth	T680 FCEV	NA	350	TBD	Not at this time
Nikola	Tre FC / Two FC	NA	500-900	2023-2024	Not at this time
Hyundai	HDC-6 Neptune	NA	800	2023	Not at this time

Source: Compiled from ZETI tool and manufacturer websites, August 2021.
* Dates of availability are subject to change based on manufacturer production schedules

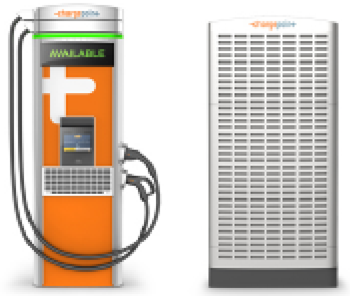
B.2.3 Charging and Fueling Infrastructure

Charging

Charging infrastructure for heavy-duty electric trucks requires a higher power output than light-duty and medium-duty EVs in order to charge larger batteries in a constrained amount of time. The appropriate power level of a charger depends on vehicle resting time, vehicle operations, and the size of the vehicle's battery. For example, a vehicle with a depleted battery pack of 250 kilowatt hours (kWh) can charge up to 80% in approximately 90 minutes at 150 kW or in 4–5 hour at 50 kW. TRK-B TRK-B Figure 2 and TRK-B TRK-B Figure 3 show examples of vehicle chargers capable of charging medium- and heavy-duty vehicles. Some real world examples of charging stations include the ABB HVC (TRK-B TRK-B Figure 2), which has a power range of 100–150 kW with a voltage range from 150–850 V DC and sequential charging with up to three outlets with 100 kW and 150 kW per vehicle; and the ChargePoint Express Plus (TRK-B TRK-B Figure 3) has a modular and scalable architecture that allows for up to four Power Blocks to serve each station and send up to 500 kW to a single vehicle. While there is currently no standard for appropriate battery size. Battery sizes will vary, but it is likely that battery sizes will increase as a response to reductions in battery costs.

TRK-B Figure 2. ABB HVC 150 kW

TRK-B Figure 3. ChargePoint Express Plus



The figures above represent only a couple examples of charging infrastructure available for medium- and heavy-duty vehicles. Other models exist and more are being developed. Research is also ongoing to develop innovative charging solutions that address an increasing number of functional requirements as a result of a growing set of charging use cases. In addition to plug-in chargers, wireless (inductive) and overhead chargers have been used for medium- and heavy-duty EVs in some existing markets, including transit buses and urban delivery vans. For example, Oak Ridge National Laboratory (ORNL) released results from a demonstration project with UPS that deployed a 20-kW bi-directional wireless charging system for a medium-duty electric parcel delivery van. ORNL found that power transfer from the wireless charging pad to the truck was greater than 92 percent efficient.[37] It is expected that this technology will continue to improve in its power capacity, which will be necessary to charge heavy duty drayage and non-drayage trucks in a reasonable timeframe. While plug-in EV charging is expected to serve a sizeable truck population, drayage trucks often idle in queues and while loading and unloading, which could make strategically placed opportunity charging using technology such as wireless chargers an option for fleets and the Port to consider.

Critical for enabling heavy-duty charging was the international standard for three-phase charging, which is common at commercial and industrial locations in the U.S. and Canada. The standard, SAE J3068, was instituted in 2018 and was designed specifically for medium-duty and heavy-duty vehicle charging. SAE J3068 is similar to the European IEC 62196 (aka Type 2 or CCS Combo). SAE J3068 was designed to enable the use of three-phase 480 volts (V) (up to 133 kW at 160 amperes), as well as 600 V alternating current (AC) (up to 166 kW at 160A). Additionally, SAE J3105 applies to overhead charging and SAE J2954/2 to HD wireless charging. However, to date overhead and wireless have been used for electric buses but not for electric trucks.

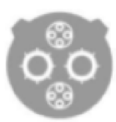
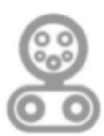
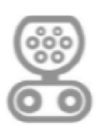
CCS1 connectors are expected to be used widely in North America. However, CCS2 connectors have been used in some electric truck pilot projects. The need for higher power charging has created a shift toward direct current (DC) charging as well. It also shifts some costs away from vehicles toward infrastructure because

[37] Edelstein, Stephen. 2020. *Wireless Charging Demo for Trucks: 20 kW Across 11 inches, 92% Efficiency*. Available online at: https://www.greencarreports.com/news/1127954_wireless-charging-demo-for-trucks-20-kw-across-11-inches-92-efficiency. Accessed January 2021.

higher charging power rates are typically more expensive, and vehicles charging solely by DC fast charging will not bear the added costs of on-board AC-to-DC inverters.

TRK-B Table 2 lists the most common types of charging connectors, with added details including charger level categories and power levels. Proprietary stations and connector types, such as those for Tesla, are not included.

TRK-B Table 2. Examples of Different Chargers and Charging Stations[38]

Charging Station Level (Electric Current Type)	U.S. Connector Type	Power	Fill Time for a 100kWh Battery (80% Fill)	Voltage	Best Commercial Use Case Example
Level 2 (Alternative Current (AC) 1-phase)	 SAE J1772	> 3.7 kW ≤ 22kW	7 kW = 12.5 hours 22kW = 4 hours	208/240V	Medium- and heavy-duty vehicles that sit parked for 5+ hours at a time
Level 3 (Direct Current (DC) Fast Charging)	 CHAdeMO	> 22 kW ≤ 43.5 kW	2+ hours	277/480V	Medium- and heavy-duty vehicles with shorter routes/smaller battery packs that have a natural pause in their duty cycle of around 2 hour or more; medium- and heavy-duty vehicles with a longer route / larger battery packs that can charge over several hours
Level 3 Combo (AC, DC Fast Charging) Note: Combined Charging System (CCS1) Combo 1 Connector is currently used in North America, but the CCS2 combo 2 may be used in North American MD/HD applications.	 J1772 CCS1  J3068 CCS2	Today, <450 kW, projected up to 1 MW	15+ minutes (future) 40+ minutes (today)	Industrial voltage levels (speak with your utility)	Medium- and heavy-duty vehicles that have a natural pause in their duty cycles (e.g. while waiting at a loading dock) that is less than 2 hours
Inductive Charging (DC)		Inductive charging equipment uses an electromagnetic field to transfer electricity to a plug-in electric vehicle without a cord. In HD applications, inductive charging is often used for in-route charging on bus routes with 150-300 kW charging capability.			

[38] CALSTART. 2020. *Chicago Commercial Electric Vehicle Readiness Guidelines*. Available online at https://www.chicago.gov/content/dam/city/progs/env/MDHDCommercialEVReadiness.pdf.

The energy capacity of electric truck batteries is expected to increase; therefore, a concurrent need for higher power charging can be expected. Current standards allow for charging up to 350-kW, but research on very high-power charging is underway. CharIN and the High-Power Commercial Vehicle Charging Task Force are currently developing a charging standard for chargers rated at one to three megawatts of power.[39] Similarly, Tesla trucks are expected to charge at 500 kW with their proprietary charging system.

Beyond technological specifications, the ownership model of certain charging options is important for stakeholders to consider. Charging infrastructure for many trucks is expected to be located at a fleet depot as fleets are expected to charge at the end of their workday. This will be true for fleets that operate predictable routes, can allow their trucks to sit overnight, and have depots. However, many fleets in California are small and that may not have such a facility. Innovative options for delivering electricity to these fleets will need to be developed, such as public, shared, or limited-access charging sites.

Importantly, entities that deploy charging infrastructure at their facilities (e.g., fleet depots, warehouses, Port properties) may require facility and grid upgrades to accommodate new power demand, depending on how extensive their deployment plans are. Although the cost of these upgrades can be significant, the State of California and its investor-owned utility companies have implemented 'make-ready' programs to help entities deploy this infrastructure at low or zero cost. In make-ready programs, like **San Diego Gas & Electric (SDG&E):** *Power Your Drive for Fleets*, utilities cover the make-ready costs of charging infrastructure development, which generally includes infrastructure between the grid interconnection and the charger. Other costs covered by available make-ready programs vary somewhat by utility. Through the programs, utilities help fleets and infrastructure site hosts with infrastructure planning, design, construction, and maintenance. SDG&E has set a goal to service 3,000 medium- and heavy-duty vehicles (on- and off-road) at 300 sites in their service area.

In addition to the make-ready programs, utilities are also developing special commercial electricity rates that are aimed to incentivize electric vehicle adoption. SDG&E will make a specific rate available for heavy-duty electric vehicle charging applications. The High-Power Electric Vehicle Rate (EV-HP) will give flexibility and transparency to customers to determine the amount of power necessary to charge their fleet and pay this in the form of a subscription fee each month. Notably, customers in the EV-HP plan will not pay demand charges.[40]

As stated above, public charging may be required in some situations. Public charging for heavy-duty electric trucks is currently not available. However, individual stations and corridor electrification for MD and HD electric trucks are in the planning stage. One public charging station for electric trucks is planned at a Loves station in Southern California as part of the Volvo LIGHTS project and should be installed in 2021.[41] Other

[39] CharIN. 2019. *CharIN Steering Committee paves the way for the development of a CCS compliant plug for commercial vehicles with >2MW*. Available online at: https://www.charinev.org/news/news-detail-2018/news/charin-steering-committee-paves-the-way-for-the-development-of-a-ccs-compliant-plug-for-commercial-v/.

[40] *SDGE Power Your Drive for Fleets.* Available online at: http://semprasdande.prod.acquia-sites.com/sites/default/files/sdge.pydff_-_rate_waiver_fact_sheet.pdf.

[41] Volvo Lights. n.d. Available online at: https://www.lightsproject.com/project-map/. Accessed January 2021.

locations are being planned along and around important corridors. US West Coast utilities recently completed a study to map out optimal charging infrastructure locations along the Interstate (I-) 5 corridor.[42] The study proposes installing charging infrastructure at 27 sites to serve both MD and HD truck in a first phase. In the second phase, about half of these sites are proposed to be expanded to accommodate higher power charging for HD electric trucks.

Hydrogen Fueling

As part of Assembly Bill 8, California set a goal to build a network of 100 light-duty hydrogen fueling stations across the state. At this time, hydrogen fueling station development is still in its early stages, with approximately 44 stations currently in operation in California.[43] So far these stations are designed for light-duty vehicles, but much can be learned from these developments in preparation for building out hydrogen infrastructure for heavy-duty applications.

There are three different hydrogen delivery system options available: delivered gaseous hydrogen, delivered liquid hydrogen, and on-site hydrogen generation via electrolysis. In the delivered gaseous hydrogen system, hydrogen is produced at central steam reforming production facilities, and is then transported to the station within high-pressure tube trailers before it is stored in pressurized underground storage vessels. Delivered liquid hydrogen systems are similar to gaseous systems. Hydrogen gas is generated from natural gas at a central steam reforming plant, and is then it is chilled until it takes liquid form before it is pumped into a pressurized and temperature-controlled trailer. The trailer is then transported to the station and pumped into an on-site tank where it is stored until use. Finally, electrolysis is the process of generating hydrogen from water and electricity. Water molecules are split with an electric current inside of an electrolyzer, and then the H2 gas is captured and compressed within storage tanks before being dispensed into a vehicle.

From an infrastructure development standpoint, hydrogen stations require pressurized tubes and storage tanks, chillers, compressors, a dispenser, an electrolyzer, and the utility interconnection.[44] This poses additional space considerations for the Port, fleets, and/or any other stakeholder involved in infrastructure development. Hydrogen fueling can be completed faster than EV charging, depending on charger power levels and the setup of the hydrogen fueling station, making hydrogen fuel cell trucks a possible option for operations that require fast re-fueling.

Hydrogen infrastructure costs vary depending on delivery system design, hydrogen storage capacity, and scale. Early cost estimates indicate hydrogen fueling stations for heavy-duty vehicles can cost in the millions. A March 2020 infrastructure development study for the West Coast Collaborative, which obtained survey

[42] *West Coast Clean Transit Corridor Initiative, 2020*. Available online at: https://www.westcoastcleantransit.com/.
[43] AFDC. n.d. *Hydrogen Fueling Station Locations.* Available online at: https://afdc.energy.gov/fuels/hydrogen_locations.html#/find/nearest?fuel=HY&hy_nonretail=true&location=california&page=5. Accessed January 2021.
[44] CEC & CARB. 2015. *Join Agency Staff Report on Assembly Bill 8: Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California*. Available online at: https://ww2.energy.ca.gov/2015publications/CEC-600-2015-016/CEC-600-2015-016.pdf. Accessed January 2021.

responses from fleets and fuel providers on their desired medium- and heavy-duty alternative fuel infrastructure sites and scope, shows that respondents reported H2 infrastructure capex estimates ranging from $4M to $10M with varying station sizes.[45,46] Another important factor to consider is that the cost of hydrogen is significantly higher relative to other alternative transportation fuels (e.g., electricity, renewable diesel). For example, the average retail price of hydrogen in Q3 2019 was $16.54/kg, with a range from $14.99 to $18.71/kg, according to CEC and CARB.[47]

B.2.4 Truck Demonstration and Pilot Projects

Current and Recent Projects

In 2019, Californians consumed approximately 114 million gasoline gallon equivalents of electricity for transportation, accounting for approximately 5% of the total alternative fuel demand in the state.[48] While vehicle electrification for HD trucks has been slower to evolve than light- and medium-duty applications, several technology demonstrations for Class 7-8 trucks have been deployed across the country.

TRK-B Table 3 summarizes the heavy-duty truck demonstration projects currently ongoing or recently completed statewide. Project funding also includes matching funds in many cases.

TRK-B Table 3. Current Heavy-Duty Truck Demonstration and Pilot Projects

Demonstration Program	Year and Cost	Location	Trucks	Types of Cargo
California Collaborative Advanced Technology Drayage Truck Demonstration	2018 $40M	Ports of Stockton, Oakland, Los Angeles, Long Beach, and San Diego	44 HD pre-commercial Class 8; 37 battery electric trucks 25 EV trucks with 100-124 mile range; 12 Peterbilt/Transpower trucks with 110–150 mile range	Containerized cargo
Daimler Trucks North America (also known as Freightliner)	April 2019 $16M	Throughout Southern California	20 battery-electric trucks	Containerized cargo

[45] CALSTART. 2017. *Best Practices in Hydrogen Fueling and Maintenance Facilities for Transit Agencies*. Available online at: https://www.energy.gov/sites/prod/files/2017/05/f34/fcto_bop_workshop_sokolsky.pdf. Accessed January 2021.
[46] CALSTART. 2020. *Alternative Fuel Infrastructure Corridor Coalition (AFICC).* Available online at: https://westcoastcollaborative.org/files/sector-fuels/wcc-aficc-mhd-infrastructure-development-plan-2020-03-12.pdf. Accessed January 2021.
[47] CEC & CARB. 2019. *Join Agency Staff Report on Assembly Bill 8: 2019 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California*. Available online at: https://ww2.energy.ca.gov/2019publications/CEC-600-2019-039/CEC-600-2019-039.pdf. Accessed January 2021.
[48] CARB. 2019. *Data Dashboard: 2011-2019 Performance of the Low Carbon Fuel Standard.* Available online at: https://www.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm. Accessed August 2020.

Demonstration Program	Year and Cost	Location	Trucks	Types of Cargo
CARB Zero and Near Zero-emissions Freight Facilities	Late 2018 $205 million	Throughout California	10 projects: zero emission HD truck and off-road equipment	Containerized cargo/ Food & Beverage
Volvo Low Impact Green Heavy Transports Solutions ("LIGHTS") Project	March 2019 $90.7 million	Ports of Long Beach and Los Angeles	23 HD battery electric trucks; up to 175 mile range with charging	Containerized cargo
Sustainable Terminals Accelerating Regional Transformation ("START") Project	January 2019 Unknown	5 at the Port of Long Beach; 10 at the Port of Oakland	Peterbilt and Transpower battery electric Class 8 drayage	Containerized cargo
Frito Lay Transformative Zero and Near-Zero Emission Freight Facility Project	March 2019 $30.8 million	Modesto, California	15 HD Tesla battery-electric tractors along with 38 Low NO_X trucks and 8 Peterbilt e220 battery-electric trucks.	Food & Beverage
Zero-Emission Beverage Handling and Distribution at Scale	March 2018 $11.3 million	Four Anheuser-Busch facilities: Pomona, CA, Riverside, CA, Carson CA	21 battery-electric Class 8 BYD trucks 40 kW BYD chargers	Food & Beverage
San Diego Port Tenants Association Sustainable Freight Demonstration	August 2016 $8.2 million	Port of San Diego	4 Class 8 BYD Trucks	Autos; Break-bulk products

These demonstration and pilot projects are helping the industry surrounding ZE/NZE, heavy-duty trucks to advance this technology. Below are status updates on some of the projects listed above.

The California Collaborative Advanced Technology Drayage Truck Demonstration began in 2016 and deployed 44 heavy-duty pre-commercial Class 8 zero- and near-zero emission trucks across the Ports of Stockton, Oakland, Los Angeles, Long Beach, and San Diego. The deployed fleet consisted of 37 battery electric trucks including 25 BYD trucks with 100-124-mile range, and 12 Peterbilt/Transpower trucks with 110-150 mile range. The project is currently in Phase 2, which will support deployments informed by lessons learned during the Phase 1 field demonstrations. Phase 2 vehicles are anticipated to have faster onboard charging and an energy storage redesign, among other improvements.[49]

[49] CARB. 2015. *California Collaborative Advanced Technology Drayage Truck Demonstration Project.* Available online at: https://ww3.arb.ca.gov/msprog/lct/pdfs/drayagedemo.pdf?_ga=2.35440545.1444818296.1599075411-2062905748.1586389966 Accessed September 2020.

The Volvo Low Impact Green Heavy Transports Solutions ("LIGHTS") Project began in March of 2019, and deployed 23 heavy-duty battery electric trucks to the Ports of Long Beach and Los Angeles for goods movements routes from Port to four freight handling facilities located in disadvantaged communities. The Volvo battery electric technology features multiple truck configurations with electric ranges of up to 250 miles, and charging technology that includes the nation's first publicly accessible fast charging truck stations, integration of onsite solar panels, and use of second-life batteries which offset total cost of ownership.[50]

The Sustainable Terminals Accelerating Regional Transformation ("START") Project began in January 2019 and features various zero- and near-zero emissions port technologies that are anticipated to reduce emissions by approximately 13,000 MT CO_2e, 26 tons NOx, and marginal amounts of ROG and diesel PM annually. Among these technologies are fleets of Peterbilt and Transpower battery electric Class 8 drayage trucks including five 500-hp trucks at the Port of Long Beach, and ten 400-hp trucks at the Port of Oakland.[51]

Planned and Approved Projects

To continue to prove the feasibility of Class 8 zero-emission trucks, future pilot projects are expected in the state of California. TRK-B Table 4 shows two CARB and CEC program solicitations that were either released recently or planned to be released soon. In addition to this, State funding for infrastructure development is expected to be made available in the near future. The CEC issued a Notice of Proposed Award on December 16, 2020 with CALSTART proposed to administer its Block Grant for Medium-Duty and Heavy-Duty Zero-Emission Vehicle Refueling Infrastructure Incentive Projects. This program is expected to fund $20 million to support development of medium- and heavy-duty, zero-emission vehicle charging and fueling infrastructure.[52]

[50] Volvo Lights. 2020. *Battery Electric Vehicle Technology.* Available online at: https://www.lightsproject.com/vehicle-technology/ Accessed September 2020.
[51] CARB. 2020. *Sustainable Terminals Accelerating Regional Transformation (START) Project Phase 1*. Available online at: https://ww3.arb.ca.gov/msprog/lct/pdfs/start.pdf Accessed September 2020.
[52] California Energy Commission. n.d. *GFO-20-603 - Block Grant...Infrastructure Incentive Projects*. In *California Energy Commission*. Retrieved January 25, 2021, from https://www.energy.ca.gov/solicitations/2020-07/gfo-20-603-block-grant-medium-duty-and-heavy-duty-zero-emission-vehicle

TRK-B Table 4. Planned and Announced Heavy-duty Truck and Infrastructure Projects and Programs

Demonstration Program	Year and Funding	Location	Trucks	Types of Cargo
Zero-Emission Drayage Truck and Infrastructure Pilot Project	Submission deadline: 02/16/21 $44.1M	Throughout California	Zero-emission Class 8 drayage and regional haul trucks (Note: large-scale deployment of 50+ trucks or more is preferred)	Containerized cargo Bulk cargo
Research Hub for Electric Technologies in Truck Applications (RHETTA)	Submission deadline: 03/29/21	Throughout California	High power charging systems; corridor charging strategies	N/A

The Zero-Emission Drayage Truck and Infrastructure Pilot Project solicitation is was recently released. This joint project between CARB and CEC seeks to deploy and test a relatively large number of zero-emission trucks and infrastructure. In workshops about the solicitation, CARB and CEC officials expressed a preference to have 50 or more trucks deployed within one fleet so that the study could test the ability of the fleet and the local electric grid in handling a large-scale deployment.[53] The San Diego Air Pollution Control District partnered with Duran Freight Corporation, which met the preferred fleet size requirements, and submitted its application on February 15, 2021. The Port coordinated with SDAPCD on its application and will continue to work with SDAPCD and other regional partners if grant monies are awarded.

Though it is not technically a demonstration or pilot project, the Research Hub for Electric Technologies in Truck Applications (RHETTA) solicitation is also currently open with a submission deadline of March 29, 2021. This CEC project aims to create a research hub to conduct applied research on high power charging systems and corridor charging.[54]

B.2.5 Costs and Emissions Reductions

Cost

The cost of heavy-duty ZE trucks can be assessed based on the capital cost; however, considering the total cost of ownership (TCO) is a more thorough metric in order to understand what the total cost to purchase, operate, and maintain the vehicle. TCO is case specific and depends on a number of variables, including the

[53] CEC. 2020. *GFO-20-606 - Zero-Emission Drayage Truck and Infrastructure Pilot Project*. Available online at: https://www.energy.ca.gov/solicitations/2020-11/gfo-20-606-zero-emission-drayage-truck-and-infrastructure-pilot-project.
[54] CEC. 2020. *GFO-20-306 – Research Hub for Electric Technologies in Truck Applications (RHETTA)*. Available online at: https://www.energy.ca.gov/solicitations/2020-12/gfo-20-306-research-hub-electric-technologies-truck-applications-rhetta.

purchase price of the baseline vehicle and the vehicle that is expected to replace it, the fueling and maintenance costs for both, the incentive amounts for the clean fuel vehicle, infrastructure costs, and insurance. While TCO is case specific and depends on the variables identified above, there is potential for electric trucks to have lower lifetime TCO (Total cost for the life of the vehicle) than diesel or natural gas trucks if the conditions are right. The payback period, or breakeven point, when the clean fuel vehicle becomes less expensive than the conventionally fueled vehicle will vary as well. Currently, the California's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program (HVIP) incentives improve the TCO of Class 8 drayage trucks but going forward there is uncertainty to what degree incentive programs will be available.[55]

Understanding how the Port's investments lead to reductions in emissions can help inform what level of investment and what timeframe is necessary to achieve emissions reductions goals. TRK-B Table 5 presents varying levels of investment over the 7-year lifetime of a truck and how a truck's VMT impacts the cost to reduce one pound of diesel particulate matter per day. A simple method where the investment amount divided by pounds of DPM produced depending on daily VMT was used to calculate estimates. These results show that with high investments – which are necessary at the moment to cover the incremental cost of electric trucks – the cost to reduce daily DPM is relatively high. As investments increase as well as other industry mechanisms that narrow the price gap between conventional and electric trucks, which lower the amount of investment needed, the cost to reduce daily DPM lowers. In addition, as truck utilization increases (e.g., miles/day) the cost effectiveness improves across all investment amounts.

TRK-B Table 5. Summary of Investment Levels on DPM Emission Reductions ($/lb/day DPM Reduced)

	Miles/day					
$/invested in ZEV	25	50	100	150	200	500
$10,000	$15,528	$7,764	$3,882	$2,588	$1,941	$776
$25,000	$38,820	$19,410	$9,705	$6,470	$4,853	$1,941
$50,000	$77,641	$38,820	$19,410	$12,940	$9,705	$3,882
$75,000	$116,461	$58,231	$29,115	$19,410	$14,558	$5,823
$100,000	$155,282	$77,641	$38,820	$25,880	$19,410	$7,764

Note: Analysis based on dollars invested per vehicle per year. Trucks are assumed to operate 26 days per month or 312 days per year.

A summary of technology capital cost and cost per emissions saved for zero-emission trucks is presented in

TRK-B Table Technology costs were obtained from analyses by the California Electric Transportation Coalition, as well as from conversations with OEMs. It is important to note that technology cost is for 2020 and, while capital costs for battery electric trucks are the highest, costs are expected to decrease significantly in the near- and mid-term as economies of scale lowers the cost of key vehicle components, namely batteries.

Currently, cost-effectiveness per pound of emissions suggests that renewable natural gas may be more cost effective than electric. However, this does not tell the whole story because technology cost here is based

[55] ICF. 2019. *Comparison of Medium- and Heavy-Duty Technologies in California*. December.

solely on the capital cost of the vehicle and does not consider any costs associated with refueling infrastructure, fuel and operating costs, incentives, and insurance costs. In particular, operations and maintenance costs for EVs are lower than diesel, which over the lifetime of the vehicle can significantly improve the difference in upfront cost compared to diesel.[56]

TRK-B Table 6. Summary of Cost and Emission Savings per Cost

Vessel	Option	Technology Cost[ƚ]	Cost Per Pound of Emissions Saved		
			NOx	DPM	CO_2e
Class 8 Trucks	Renewable Natural Gas	$140,000	$234	$85,069	$996
	Renewable Diesel*	$110,000	-	-	$615
	Electric	$350,000	$526	$170,138	$1,809
	Hydrogen	$375,000	$609	$182,291	$3,682

*Renewable diesel is considered a drop-in fuel and can be used in conventional diesel engines without modification.

ƚ Technology costs do not include state or federal taxes applicable for heavy-duty trucks. Although state taxes may vary, the federal excise tax for a Class 8 vehicle is 12% of total sale price. As a result, a battery electric truck with a sale price of $350,000 will be approximately $430,000 including state and federal taxes.

Emission Reductions

In this section, the emission reduction potential of three technologies – renewable natural gas, renewable diesel, and battery electric – are estimated and compared for trucks. For fleets operating diesel trucks, using renewable natural gas or battery electric technology means truck replacement or repowering. For renewable diesel, however, existing diesel vehicles can be utilized because renewable diesel is a drop-in fuel such that no modifications or vehicle replacements are necessary.

Emission reductions are based on the average specifications for each technology type. As shown in TRK-B Table replacing Class 8 diesel trucks with battery electric trucks would result in the elimination of all NOx and DPM emissions, while emissions of CO_2e would decrease substantially. Importantly, grid emissions in these calculations are based on SDG&E's emission rate as of 2018. Because SDG&E's procurement of carbon-free renewable energy sources will increase over time, so too will the GHG benefit of electric trucks, leading to expected increases in GHG reduction compared to estimates presented below. As previously mentioned, natural gas used in trucks is considered low NOx due to heavy-duty low NOx standards.

While other fuels for heavy-duty trucks do exist, such as biodiesel, the Port did not evaluate their emission reduction capability in this report. Emissions generated from combustion of biodiesel are similar to those which occur from use of renewable diesel. Future biennial analyses of heavy-duty truck technologies may further evaluate the emission reduction capability of biodiesel.

[56] ICF. 2020. Zero Emission Truck Feasibility Study for Mitsubishi Cement Corporation.

TRK-B Table 7. Summary of Annual Average Emissions per Truck (metric tons per year)

Vessel	Option	Emissions Per Year (MT)		
		NOx	DPM	CO_2e
Class 8 Trucks	Existing Diesel	0.302	0.001	0.119
	Renewable Natural Gas	0.030	0.0002	0.055
	Renewable Diesel	0.302	0.001	0.038
	Electric	-	-	0.031
	Hydrogen	-	-	0.073

B.2.6 Truck Survey Results and Potential Routes for Short-Haul Pilot Projects

Port staff conducted a Truck Survey in the spring of 2020 to better understand the number of truck trips that transport goods to/from the Port and the distances they travel. The primary goal of the survey was to identify any regular, short-haul trucking routes that could potentially be performed with ZE/NZE trucks (e.g., less than 120 miles per day). Port staff conducted the survey, which involved interviewing terminal operators, tenants, and trucking companies that handle refrigerated containers, bulk, and break bulk at TAMT, as well as those who handle roll-on/roll-off cargo (RORO, or vehicles) at NCMT. The survey results were shared with the Board of Port Commissioners at their July 11, 2020 Board meeting and were used by the AB 617 Truck Subcommittee (June 19, 2020), and MCAS Subcommittee (December 15, 2020) to help develop recommendations for accelerating the advancement of ZE/NZE trucks that transport cargo to and from the Ports marine cargo terminals.

TAMT to National City

Refrigerated Containers

Refrigerated containers are one of three major cargo types that are processed at the TAMT, which results in approximately 700 containers per week. Of the 700 containers, about 130 containers are moved by truck from TAMT to the National Distribution Center (NDC) in National City, approximately five miles south. The remaining containers are transported outside of San Diego, toward Los Angeles and beyond. Once at NDC, produce is transferred from 40-foot containers to 53-foot long-haul trailers before being transported out of the Port to cities further than the Los Angeles region. The truck survey determined that currently, one company is responsible for the five-mile route to NDC, and it uses both company-owned and contracted vehicles. This route is a potential candidate to test electric truck and charging technologies give that it is relatively short and regular.[57]

TAMT to Otay Mesa/Working Waterfront

Dry Bulk

The primary bulk products passing through TAMT are bauxite, sugar, and fertilizer. Unlike the refrigerated container cargo that has a vessel call every week, none of the bulk carriers arrive with a regular cadence. The fertilizer has the shortest trip of two to three miles depending on the route; however, the trucking company handling this commodity also does many long hauls in the region. The bauxite goes to Victorville, California (roughly 164 miles one way) and Tucson, Arizona (roughly 408 miles one way). Sugar is hauled to a plant in Otay Mesa, approximately 30 miles away. Staff have learned that these operations require each truck to drive four or five trips per shift and to change drivers so that two shifts can be performed in one day. This sugar route may be another good candidate for testing electrification.

Break Bulk

Cargo that arrives at TAMT includes steel for shipbuilding, wind turbine blades and tower pieces, military ordnance, and electrical gear. The locations where trucks haul break bulk include the Working Waterfront, which is three miles away; Riverside, approximately 100 miles away; Tehachapi, approximately 235 miles away; and Palm Springs, approximately 140 miles away. There is a current terminal service provider that is located at TAMT and has equipment that can move heavy, break bulk items. The short-haul route along the Working Waterfront may be a possible candidate for electrification.

NCMT to Otay Mesa

Approximately 400,000 vehicles pass through NCMT per year. The site is a confluence of ships, trains, and trucks that import vehicles from foreign ports. About 37% of cargo leaves NCMT by train, 18% leave by ship to Hawaii, and 45% leave by truck. Of those that leave by truck, roughly 5% are delivered within San Diego County, 80% go north toward Los Angeles, and 15% go east toward Arizona and Nevada. A good route candidate for electrification is one used to transport vehicles from NCMT to an offsite storage facility in Otay Mesa, roughly 15 miles away. Currently, Pasha, the NCMT terminal operator, has three BYD electric Class-8 trucks that can haul eight cars at a time on this route. Pasha does not currently need another truck for this route, but there may be an opportunity to electrify with trucking companies that are subcontracted.[58]

The route candidates highlighted above are good starting options as the Port pursues ways to pilot electric trucks and charging infrastructure. Given their lengths, they are strong project candidates to help the Port accomplish the actions and goals set forth by the SDAPCD in its Community Emissions Reduction Plan, which aims to develop and implement a short-haul, on-road electric truck pilot, displace between 3,000 and 10,000

[57] San Diego Unified Port District. 2020. Presentation and Direction to Staff on Clean Air and Emission Reduction Advancements.
[58] San Diego Unified Port District. 2020. Presentation and Direction to Staff on Clean Air and Emission Reduction Advancements.

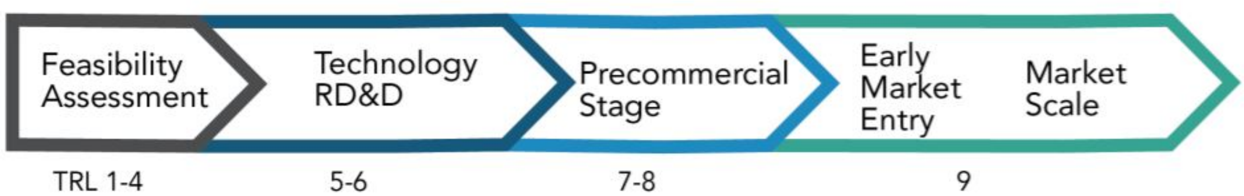
diesel VMT annually, install needed charging infrastructure, and develop a strategy to support electric truck and infrastructure expansion beyond pilots.[59]

B.3 Commercial Availability

B.3.1 Technology Readiness Levels

CARB lays out a typical commercialization path that new technologies follow on their way to commercial availability. TRK-B Figure 4 shows the various stages in this path along with their associated Technology Readiness Levels (TRLs). Originally developed by NASA, TRLs are used to indicate the maturity of a given technology.

TRK-B Figure 4. CARB Commercialization Path Stages and TRLs



The Feasibility Assessment stage is first and consists of preliminary studies and standards development. After that, technology enters the Technology Research, Design, and Development stage which consists of early demonstration projects. Demonstrations are continued in the Precommercial stage and over time they transition into pilots, which differ in scale and technology maturity compared to demonstrations. Once a technology reaches TRL 9, it is considered to be commercially available and the focus turns to scale-up of the technology within the market. As part of the Low Carbon Transportation Investments and Air Quality Improvement Program (AQIP) Funding Plan, CARB regularly maintains and updates its Long-Term Heavy-Duty Investment Strategy. Among other things, the strategy reports on the status of certain technologies in the ZE HD vehicle market.

According to CARB, ZE HD trucks are out of the early demonstration phase and currently in the pilot stage as they move toward commercial availability. TRK-B Figure 4 shows CARB's assessment of on-road battery electric vehicles, per the 2020-2021 version of the strategy. According to CARB, both battery electric HD delivery and drayage trucks are currently in this Pilot stage and quickly approaching early market availability (TRK-B Figure 5). This rating by CARB is based on a few things, including the fact that several prominent HD truck OEMs are nearing production of battery electric models. This includes Volvo, Kenworth, Meritor, and others. Additionally, there are several HD battery electric truck pilot projects happening or planned to take

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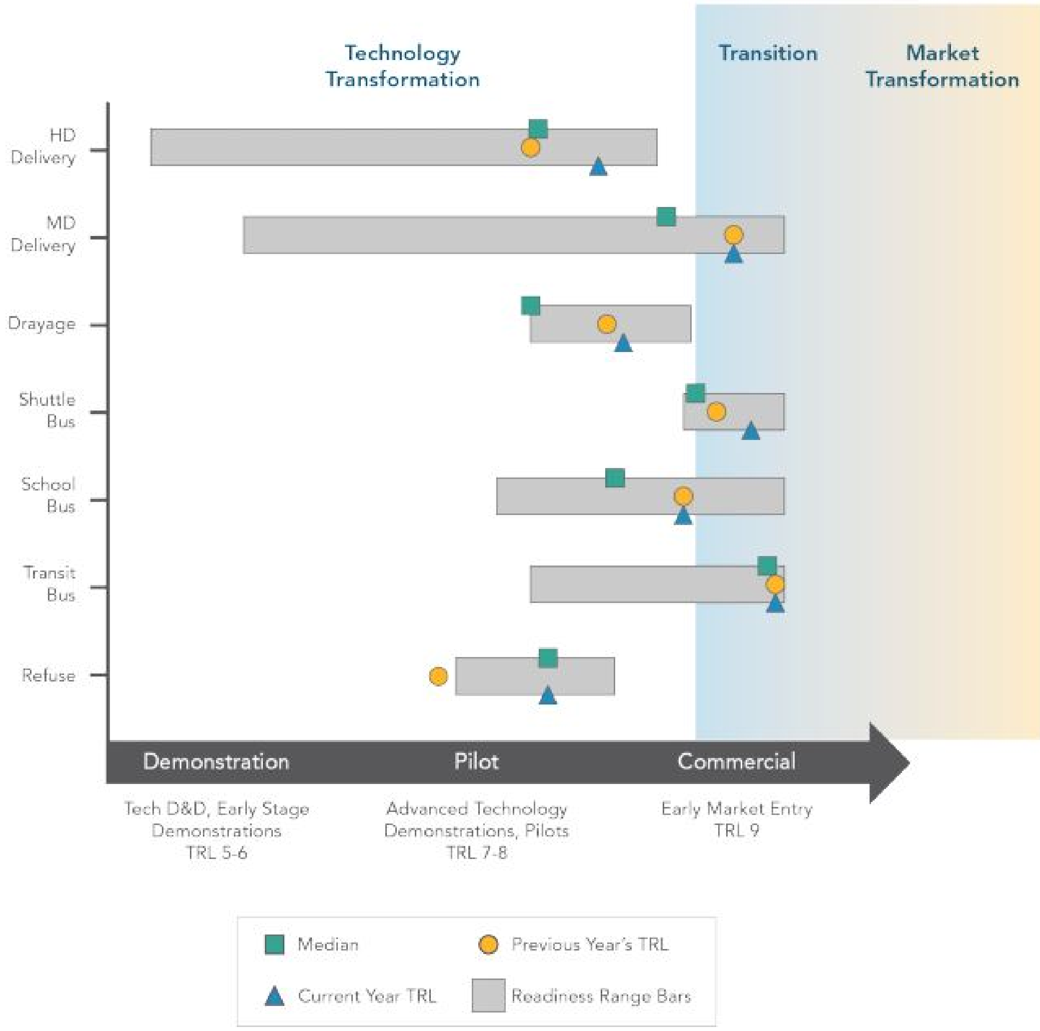
[59] San Diego Air Pollution Control District. 2020. *2020 Draft Community Emissions Reduction Plan*. Available at: https://www.sdapcd.org/content/dam/sdc/apcd/PDF/AB_617/Portside%20Environmental%20Justice%20DRAFT%20CERP%20Oct%202020.pdf

place, such as the Volvo LIGHTS project,[60] the ZANZEFF project,[61] and CEC's Zero-Emission Drayage Truck and Infrastructure Pilot Project.[62]

TRK-B Figure 5. On-Road Battery Electric Vehicles Technology Status Snapshot



On-road, HD, fuel cell (FC) electric trucks for delivery and drayage are also working their way through the Pilot stage (TRK-B Figure 6). As mentioned in previous sections, fuel cell trucks are likely to work best in applications

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[60] Volvo LIGHTS. n.d.. About Volvo LIGHTS. In Volvo LIGHTS. Available online at: https://www.lightsproject.com/about/

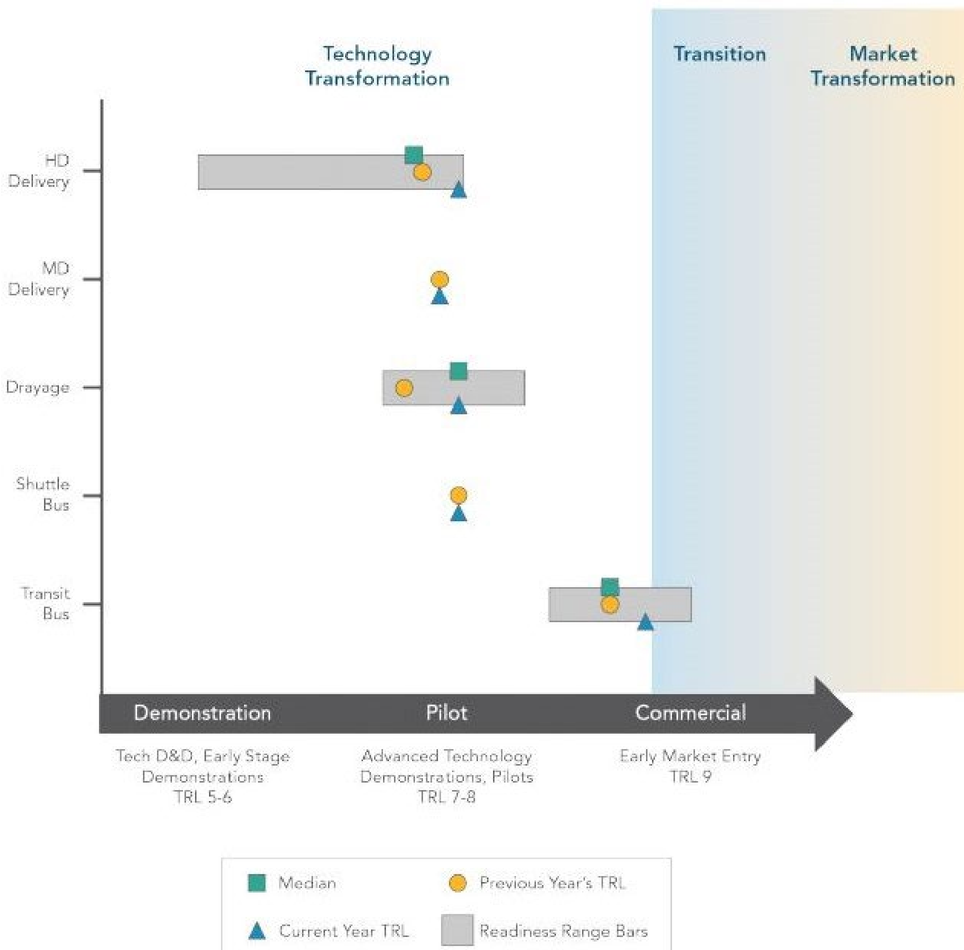
[61] California Air Resources Board. 2018. *CARB announces more than $200 million in new funding for clean freight transportation*. Available online at: https://ww2.arb.ca.gov/news/carb-announces-more-200-million-new-funding-clean-freight-transportation#:~:text=The%20goal%20of%20CARB's%20Zero,commercialization%20of%20these%20technologies%20statewide.

[62] California Energy Commission. n.d. Available online at: https://www.energy.ca.gov/solicitations/2020-11/gfo-20-606-zero-emission-drayage-truck-and-infrastructure-pilot-project.

that require longer range, longer duration of operations, quicker refueling, or other demanding duty cycles. This makes them a good compliment to battery electric vehicles in the right applications.

Their current place in the commercialization path is based on recent activity by OEMs in the market, including Hyundai's delivery of their Xcient FC electric truck in Switzerland,[63] and Daimler and Volvo's agreement to jointly produce fuel cell powertrains.[64]

TRK-B Figure 6. On-Road Fuel Cell Electric Vehicles Technology Status Snapshot

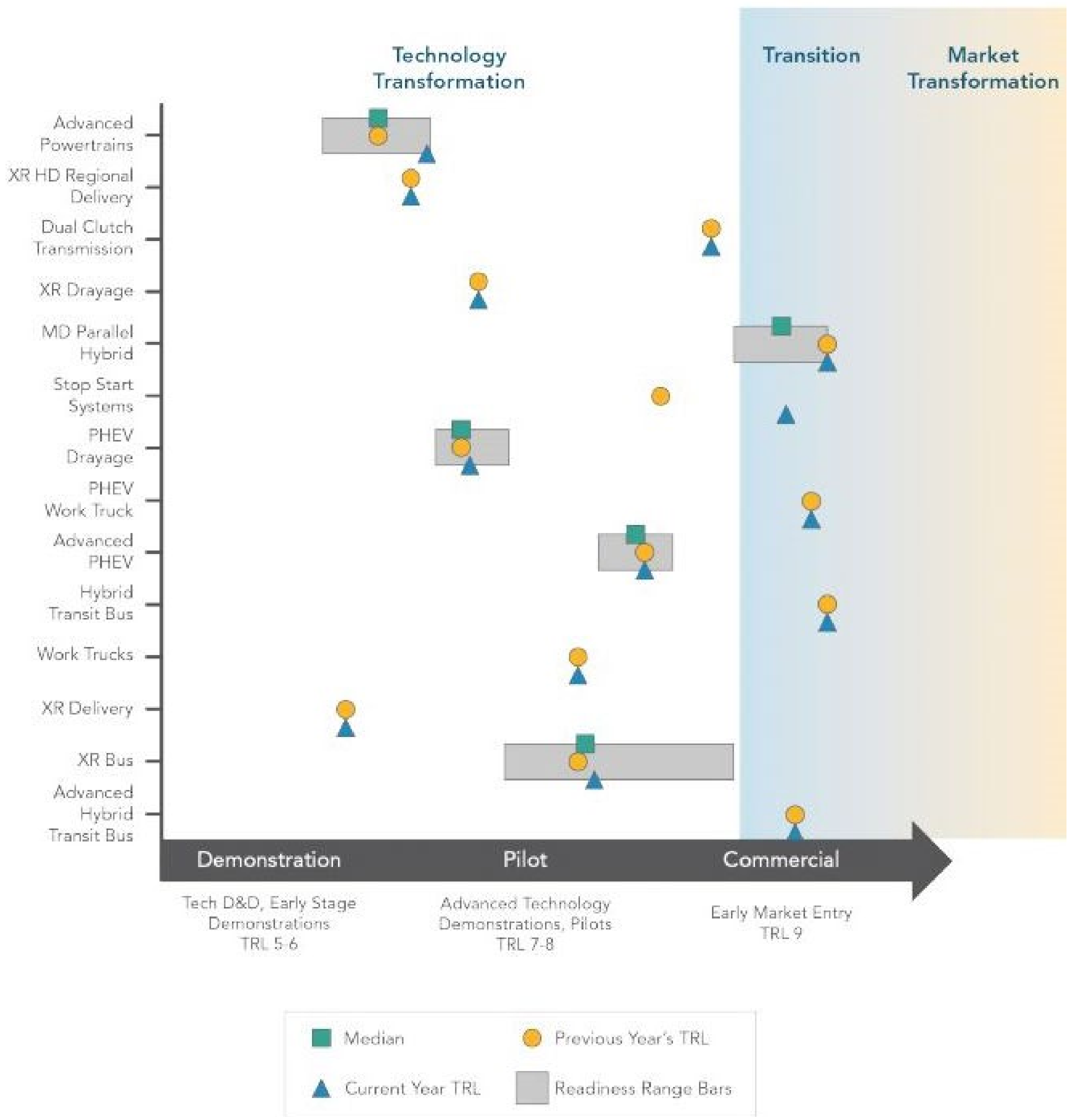


[63] Reuters Staff. 2020. *Hyundai delivers first fuel cell trucks to Switzerland.* Available online at: https://www.reuters.com/article/hyundai-switzerland-hydrogen-trucks/hyundai-delivers-first-fuel-cell-trucks-to-switzerland-idUSKBN26S1FM.

[64] Daimler. 2020. *Joint venture for large-scale production of fuel-cells: Volvo Group and Daimler Truck AG...joint venture*. Available online at: https://media.daimler.com/marsMediaSite/en/instance/ko/Joint-venture-for-large-scale-production-of-fuel-cells-Volvo-Group-and-Daimler-Truck-AG-sign-binding-agreement-for-new-fuel-cell-joint-venture.xhtml?oid=47981806.

In general, hybrid electric technology development in heavy-duty applications has slowed due to the rapid growth of fully electric technology (TRK-B Figure 7). Start-stop hybrid systems are becoming increasingly available for terminal tractors, however not much progress is currently being made for hybrid systems in drayage trucks, largely due to the focus on fully electric systems.

TRK-B Figure 7. On-Road Hybrid Electric Vehicles Technology Status Snapshot



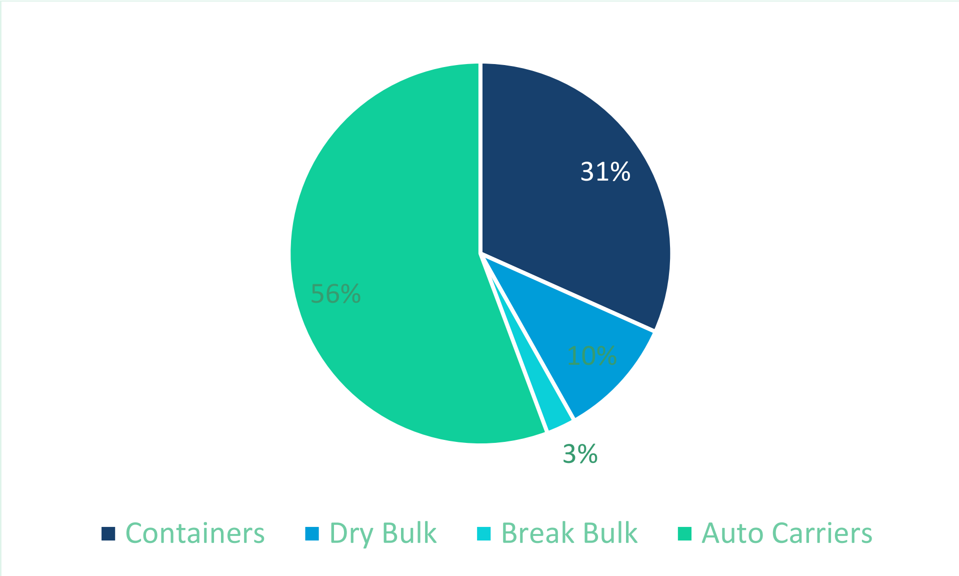
B.3.2 Vehicle Types at the Port

TRK-B Table shows the count of vehicles that visited the Port's marine cargo terminals, TAMT and NCMT, in 2019 by truck type and the typical mileage they travel (one-way distance). TRK-B Figure 8 shows the same information in percentages rather than discrete counts.

TRK-B Table 8. Port of San Diego 2019 Heavy Duty Truck Counts by Type, Cargo, and Mileage

Truck Type	Counts	Cargo	Percent of Truck Trips and Typical Mileage from Terminals (one-way)
TAMT	**37,886**	-	
Container	27,099	Refrigerated Containers	<100: 21% 100-150: 24% 151-250: 0% 251-400: 15% >400: 40%
Dry Bulk	8,680	Bauxite/Cement/Fertilizer	<100: 31% 100-150: 0% 151-250: 47% 251-400: 0% >400: 23%
Break Bulk	2,107	Project Cargo/Wind Turbines	<100: 67% 100-150: 26% 151-250: 6% 251-400: 0% >400: 0%
NCMT	48,260	-	
Car Carriers	47,619	Automobiles	<100: 55% 100-150: 38% 151-250: 0% 251-400: 7% >400: 0%
Break Bulk	641	Bulk Products	<100: 100%

TRK-B Figure 8. Port of San Diego 2019 Marine Cargo Terminal Truck Trips by Cargo Type



Although truck counts vary from year to year based on the volume of cargo, the majority of trucks that visited the Port's marine cargo terminals in 2019 were auto carrier trucks at NCMT, followed by container trucks at TAMT.

As the Port examines opportunities for implementing ZE trucks, it is important to understand the types of trucks that visit the Port and their typical operational demands, such as mileage. A comparison of these trucks and their mileages to the electric and fuel cell models that are either available today or are planned to be released in the near future is useful to understand opportunities and limitations for zero emission capability. TRK-B Table 1 in the Technologies and Strategies Section, above, shows several heavy-duty truck models that are either available now or are planned to be made available in the near future, using data from the Global Commercial Vehicle Drive to Zero Program's Zero-Emission Technology Inventory (ZETI)[65] and HVIP eligible vehicles. As shown in TRK-B Table 8, trucks leaving the Port's marine cargo terminals transport freight well beyond the average duty-cycle CARB predicts for most port drayage operations (<100 miles). Opportunities do exist for ZE truck trips given the typical miles trucks which service the Port's marine cargo terminals travel when considering the current and next generation of ZEVs planned to become available. With the information known today about ZEVs coming to market in the next few years, battery electric trucks may be suitable, from a range perspective, for routes up to 250 miles or less. In fact, manufacturers of these vehicles have stated that their current target market are those fleets which transport freight between 150-200 miles[66]. Beyond

[65] CALSTART. 2020. Zero-Emission Technology Inventory. In Global Commercial Vehicle Drive to Zero. Available online at: https://globaldrivetozero.org/tools/zero-emission-technology-inventory/. Accessed January 2021.
[66] Voets, Alex. Diamler Freightliner. May 20, 2020, California Energy Commission IEPR workshop on Medium- and Heavy-Duty ZEVs transcript: https://efiling.energy.ca.gov/getdocument.aspx?tn=233611 Accessed July 2021.

these distances, hydrogen fuel cell vehicles may be the more suitable ZEV option. In either case, feasibility for owners of trucks to convert to ZEVs will based on many factors which may include, but are not limited to, the state of technology and range, costs, maintenance servicing facilities, and infrastructure availability. These factors will be discussed below.

B.3.3 Available Incentives

For technologies that are in pre-commercial stages, government subsidies and other incentives are helpful methods for accelerating adoption of that technology, and ZE HD trucks are no different. California HVIP, a first-come first-serve voucher incentive program for ZE/NZE medium- and heavy-duty vehicles, is one program in California that can help fleets offset the purchase price of these vehicles. The vouchers are applied at point-of-sale, effectively creating a discount on the purchase price of new and eligible vehicles. TRK-B Table 9 shows a breakdown of the HVIP incentive amounts for ZE trucks by GVWR.[67]

TRK-B Table 9. California HVIP Zero-Emission Truck Voucher Amounts FY 20-21

Vehicle Weight Class	Base Vehicle Incentive	Base Vehicle Incentive in Disadvantaged Community (+10% in funding)
Class 2b	TBD	TBD
Class 3	$45,000	$49,500
Class 4-5	$60,000	$66,000
Class 6-7	$85,000	$93,500
Class 8	$120,000	$132,000
Class 8 Drayage Truck Early Adopter	$150,000	$165,000

Finally, TRK-B Table 10 shows the funding caps for electric power takeoff units (ePTOs),[68] based on their energy storage capacity. Like the funding structure for plug-in hybrids, ePTO vouchers will cover up to 50 percent of incremental costs between the ePTO and the existing technology, up to the caps shown in the table below.

TRK-B Table 10. California HVIP Eligible ePTO Voucher Caps FY 19-20

Energy Storage Capacity	Base Vehicle Incentive*
3 – 10 kWh	$20,000
10 – 15 kWh	$30,000
> 15 kWh	$40,000

[67] California Air Resources Board. n.d. FY *20-21 HVIP Funding Tables*. Available online at: https://www.californiahvip.org/how-to-participate/. Accessed March 2021.
[68] Power take-off (PTO) is used in cement and other bulk material trucks to denote power and energy requirements when a trailer's power needs are supplied by the engine of the truck. For an electric PTO (ePTO), this power need would be powered by the vehicle's electric battery.

Note: *According to CARB, "ePTO funding amounts may cover up to 50 percent of the incremental cost of the ePTO vehicle, not to exceed the funding levels listed in this table." Funding n 20/21 remains the same as previous years.

Recently, CARB launched a new voucher program for off-road vehicles, the California Clean Off-Road Equipment Voucher Incentive Project (CORE). Like HVIP, this program offers point-of-sale vouchers applied to the purchase of eligible off-road equipment. As seen in TRK-B Table 11, CORE provides funding for on- and off-road terminal tractors, TRUs, forklifts, container handling equipment, airport cargo loaders, aircraft tugs, railcar movers, mobile power units, ground power units, and mobile shore power cable management systems[69].

TRK-B Table 11. California CORE Voucher Amounts (as of January 2021)

Equipment	Description	Base Voucher Amounts
On- and Off-Road Terminal Tractor	New Battery-Electric Tractor (less than or equal to 160 kWh)	$150,000
	Battery-Electric Conversion Kit (less than or equal to 160 kWh)	$100,000
	New Battery-Electric Tractor or Conversion Kit (over 160 kWh)	Additional $400 per kWh over 160 kWh up to an additional $50,000
	Fuel Cell (New or Conversion)	Up to $200,000
Truck and Trailer Mounted TRU	New Truck-Mounted TRU	Up to $50,000
	New Trailer-Mounted TRU	Up to $65,000
Large Forklift	New 8,000-12,000 lbs. lift capacity	Up to $15,000
	New 12,001-20,000 lbs. lift capacity	Up to $20,000
	New 20,001-33,000 lbs. lift capacity	Up to $90,000
	New > 33,000 lbs. lift capacity	Up to $200,000
Container Handling Equipment (New or Conversion)	> 33,000 lbs. capacity	Up to $500,000
Airport Cargo Loader (New or Conversion)	10,000-20,000 lbs. capacity	Up to $50,000
	> 20,000 lbs. capacity	Up to $100,000
Wide-body Aircraft Tug (New or Conversion)	Lead Acid	Up to $80,000
	Lithium-ion or Fuel Cell	Up to $200,000
Railcar Mover	20,000-35,000 lbf tractive effort	Up to $225,000
	> 35,000 lbf tractive effort	Up to $500,000
Mobile Power Unit (MPU) and Ground Power Unit (GPU)	Battery-electric (lithium-ion only)	$400/kWh up to $300,000 total
	Fuel Cell	Up to $300,000
Mobile Shore Power Cable Management System	6.6 kV minimum; Land-Slide Only	Up to $500,000

In addition to the incentives available for the off-road equipment, CORE also offers infrastructure enhancements for certain types of equipment, as shown in TRK-B Table 12.

[69] California Air Resources Board. n.d. CORE Resources. Available online at: https://californiacore.org/resources/. Accessed January 2021.

TRK-B Table 12. California CORE Infrastructure Enhancements (as of January 2021)

Infrastructure Enhancements		
Equipment	**Description**	**Base Voucher Amount**
On- and Off-Road Terminal Tractor, Container Handling Equipment, Airport cargo Loader, Widebody Aircraft Tug, Railcar Movers, MPUs, and GPUs	Charging < 50 kW	$3,000
	Charging (greater than or equal to 50 kW)	$30,000
	Hydrogen Fueling	$30,000
Truck and Trailer-Mounted TRUs (Up to 3 units per trailer-mounted battery-electric TRU funded through CORE)	Charging	$3,000
	Hydrogen Fueling	$9,000
Large Forklift (greater than or equal to 8,001 lb lift capacity)	Charging < 50 kW	$3,000
	Charging (greater than or equal to 50 kW and less than or equal to 20,000 Pound Lift Capacity)	$3,000
	Charging (greater than or equal to 50 kW and greater than 20,000 Pound Lift Capacity)	$30,000
	Hydrogen Fueling	$30,000
Mobile Shore Power Cable Management System	Infrastructure Enhancement	Not Applicable

CORE also provides an enhancement for equipment that is deployed in disadvantaged or low-income communities (DACs). This takes the form of a 10% enhancement from the given equipment's base voucher amount.

Finally, California's Low Carbon Fuel Standard (LCFS) represents an additional source of potential funding support. The California LCFS is a market-based program developed to incentivize low-carbon fuel production and use. Credits are traded within a market program between fuel consumers and fuel producers in which consumers, including fleets, can earn credits for low-or no-emission fuel use. Consumers can then sell those credits to fuel producers that do not meet certain emissions standards. This encourages fuel producers to either develop fuels with lower carbon intensities or offset their compliance deficit with credits. One credit represents one metric ton of carbon emissions reduced, and their price fluctuates based on market dynamics. For the week of January 11, 2021 to January 17, 2021 the average price of a credit was $199.55.[70]

B.4 Overall Feasibility

The commercial availability of ZE HD trucks lags slightly behind other vehicle types which have been targeted in earlier markets, however HD truck technology is not very far behind. Battery electric and fuel cell drayage

[70] California Air Resources Board. n.d. Weekly LCFS Credit Transfer Activity Reports. Available online at: https://ww3.arb.ca.gov/fuels/lcfs/credit/lrtweeklycreditreports.htm. Accessed January 2021.

trucks are currently participating in pilot projects within California and beyond. As these pilot projects continue, the vehicle and charger manufacturers are expected to improve their technology as the vehicles approach full commercial availability. California's regulatory environment is also evolving: CARB's Advanced Clean Trucks (ACT) regulation was instituted in 2020, and this will put pressure on manufacturers to achieve increasing zero emission truck sales targets over time. CARB is also working on a medium- and heavy-duty ZE fleet regulation, including drayage trucks, to complement the ACT regulation as it seeks to achieve the State's ZE truck goals by 2045. Given the State's goals for accelerating the adoption of ZE HD trucks, the state of the market with an increasing list of technology available, and the momentum that ZE HD trucks are seeing in California, the Port of San Diego has several vehicle options as they consider piloting this technology in the near future, and it can expect to see a rapidly maturing market for on-road ZE HD trucks.

B.4.1 Short-Haul Zero / Near-Zero Truck Route

California has ambitious plans for vehicle electrification and is developing regulations and incentive programs to support a transition to ZE transportation. This includes heavy-duty trucks, with drayage trucks and infrastructure development expected to take priority in the near-term. Technically, deployment of ZE trucks for a short-haul pilot appears to be technically feasible, and the routes identified as part of the Port's Truck Survey (Spring 2020) may be good starting points for the Port to consider. This includes the following:

TAMT to National City: Approximately 130 refrigerated containers are transported per week by truck from TAMT to NDC, five miles south. This route may be a potential candidate for electrification.

TAMT to Otay Mesa (Bulk): Sugar is hauled regularly from TAMT to Otay Mesa, approximately 30 miles away. With four to five trips per truck per shift and two shifts per day, the daily operations amount to 480 to 600 miles of driving per truck in a 24-hour period. Longer than the TAMT to NDC route above, this would be a good candidate for testing electric trucks and infrastructure on a haul that would increase the test vehicles' daily range, comparatively.

TAMT to Otay Mesa (Break Bulk): A equipment operator has equipment at TAMT which can move heavy items, including hauling steel to the working waterfront and other items for temporary storage in Otay Mesa. The working waterfront route is within close proximity to TAMT and may be a good candidate for electrification.

NCMT to Otay Mesa: Car carriers regularly transport vehicles from NCMT to an offsite storage facility in Otay Mesa, about 15 miles away. The NCMT terminal operator currently has three class-8 electric trucks that can haul eight cars at a time, and while they do not currently need another truck for this route, there may be an opportunity for a pilot with subcontracted trucking companies.

B.4.2 Estimated Emissions Reduction from VMT Reduction at 3,000 and 10,000 VMT Intervals

To get a sense of the potential emissions reduction from replacing a heavy-duty diesel truck with a battery electric truck, the Port used the following emissions factors and assumptions from CARB's EMFAC 2017 web database. These factors were generated using EMFAC data from calendar year 2020 on trucks in San Diego with a model year of 2020 under EMFAC's T7 Other Port vehicle type. T7 Other Port is defined by the EMFAC 2017 User Guide as "Heavy-Heavy Duty Diesel Drayage Truck at Other Facilities"[71], and can also be defined as a standard tractor trailer. The factors shown in the table below were derived by aggregating separate factors for when trucks are running, idling, or on start-up. PM factors do not include brake and tire emissions.

TRK-B Table 13. Aggregated EMFAC 2017 Emissions Factors

EMFAC Vehicle Category: T7 Other Port Trucks (Rounded to Thousandths)			
	Diesel (g/mile)	Natural Gas (g/mile)	EV (g/mile)
NOx	2.187	0.219	0
DPM (PM10)*	0.006	0.001	0
ROG	0.026	0.026	0
GHG	2,057	1,803	541

Note: *Does not include brake and tire PM

TRK-B Table 13 shows the estimated emissions associated with operating a standard tractor trailer for 3,000 VMT and 10,000 VMT. For all emissions types except GHG, the values shown under the Diesel and Natural Gas columns can be assumed as the total potential emissions reduction associated with replacing 3,000 and 10,000 VMT with an electric vehicle. For GHG, one must subtract the EV emissions from the diesel or natural gas emissions to calculate the net reduction. For a diesel to EV replacement, that results in a reduction of roughly 4,549,377 grams of GHG for 3,000 VMT and 15,164,590 grams of GHG for 10,000 VMT. For a natural gas to EV replacement, the reductions equal 3,785,039 grams of GHG for 3,000 VMT and 12,616,796 grams of GHG for 10,000 VMT.

[71] California Air Resources Board. 2018. *EMFAC2017 Volume 1 – User's Guide V1.0.2*. California Air Resources Board. Available online at: https://ww3.arb.ca.gov/msei/downloads/emfac2017-volume-i-users-guide.pdf.

TRK-B Table 14. Estimated Emissions Associated with VMT Reduction for One Truck (EMFAC Vehicle Type: T7 Other Port)

Grams per 3,000 Miles			
	Diesel	Natural Gas	EV
NOx	6,560.84	656.08	-
DPM (PM10)*	16.79	3.36	-
ROG	78.55	78.55	-
GHG	6,172,396	5,408,058	1,623,019
Grams per 10,000 Miles			
	Diesel	Natural Gas	EV
NOx	21,869.46	2,186.95	-
DPM (PM10)*	55.97	11.19	-
ROG	261.83	261.83	-
GHG	20,574,653	18,026,860	5,410,064

Note: *Does not include brake and tire PM

The percent emissions reduction from any given baseline will depend upon the baseline's value. As an example, one diesel truck traveling 100 miles per day, 365 days per year (36,500 miles per year) would see a roughly 8% reduction in diesel NOx, DPM, and ROG emissions from an annual reduction in 3,000 diesel VMT, and it would see a roughly 27% reduction in the same emissions from a 10,000 diesel VMT reduction. A truck that incurs more VMT per year but reduces diesel VMT by the same amounts will see lower percentages.

TRK-B Table 1 provided earlier identifies several HD class-8 battery electric and fuel cell electric trucks that are either on the market today or expected to become available within the next couple years. In the current stage of market development, these trucks are being built primarily to serve shorter routes for drayage, local, and regional delivery operations. The Beachhead Strategy and CARB's Long-Term Heavy-Duty Investment Strategy suggest that now is the time for ZE HD trucks to be piloted in short-haul operations, and the learnings and best practices from those pilots will inform stakeholders as they refine technology and operations to enable long-haul ZE trucking.

From a technical and operational standpoint, a short-haul ZE/NZE route will require a few things to be successful. Obviously, ZE trucks and charging or hydrogen fueling infrastructure will need to be deployed. The type and setup of infrastructure will depend on the operational profile for the project, including items like route structure, daily mileage, and expected stopping or idling locations. For EVs, overnight plug-in charging is generally recommended for fleets that can do so, but for others opportunity charging is available, and future public charging development is being discussed by industry stakeholders. For fuel cell trucks, hydrogen infrastructure can also be developed on-site or off-site with varying types of equipment. Infrastructure setup will be a challenge for small owner-operators in particular, and so thorough planning will be required to address their needs. Strong and early communication between project partners – including the Port, fleets, OEMs, and funders – will ensure that a pilot is developed and executed successfully. In addition to proper vehicles and infrastructure, project partners are recommended to test vehicles on routes that are within the range capabilities of the vehicles, and on routes that are used in a predictable way on a regular basis.

Financially, a short-haul pilot is currently feasible, but only under certain conditions and not without the help of incentives. Generally, lifetime total cost of ownership (TCO) for electric vehicles can be lower than that of internal combustion engine (ICE) vehicles in certain applications. While the upfront purchase price of ZE vehicles is significantly higher than ICE vehicles, operating costs can often be lower due to reduced maintenance costs and with attractive electricity rates. Heavy-duty ZE trucks in California have several incentives available to make them more financially viable, including:

- California HVIP
- California CORE
- LCFS credits
- Utility make-ready infrastructure programs
- Anticipated: CEC's block grant for MHD ZE vehicle infrastructure

In addition to that, there are several government-funded HD ZE truck and infrastructure demonstration and pilot projects currently underway. CARB and CEC's solicitation for a ZE drayage truck and infrastructure pilot project is open and is designed to pilot a large-scale (50+ vehicles) deployment of this technology to test the ability of fleets and the grid to handle it. There are other government programs announced and proposed to further support ZE truck deployment, including CEC's solicitation to establish a research hub to test high-power and corridor-based charging, and Governor Newsom's proposed 2021 budget which sets aside over $1.5 billion of investment into ZE vehicles and infrastructure development. These government incentives and programs paired with maturing vehicle and infrastructure options make a short-haul pilot project feasible. The longer-term feasibility of scaling-up the number of ZE trucks will depend on when ZE trucks reach price parity to ICE trucks, and how the technology improves to handle a growing set of use cases.

B.4.3 Future Long-Haul Opportunities

According to the Beachhead Strategy, zero-emission trucks capable of performing long-haul operations are expected to be developed by leveraging existing components and supply chains used for trucks operating drayage or regional routes. As stated in previous sections, heavy-duty battery electric and fuel cell electric trucks are currently in pilot stages with a focus on meeting the demands of short-haul and regional routes. Over the next couple years, the learnings from these pilots will inform all involved stakeholders, especially fleets and OEMs, and will help those stakeholders improve vehicle and infrastructure technology such that it can meet the demands of long-haul routes. In the meantime, planning for scale is an important step that must be taken in order to increase the capacity of fleets, ports, and other facility partners to enable zero-emission vehicle use on long-haul routes. The scale-up of carefully planned and deployed charging and fueling infrastructure is particularly important, as it will be needed to enable long-haul operations.

B.5 Conclusion

Overall, zero- and near-zero emission, heavy-duty trucks are an option for the Port to reduce emissions. Given the technology's rapid development, the State of California's focus on supporting zero-emission vehicle and infrastructure technology development, and the presence of multiple incentives, there are a significant amount of resources available for the Port and its fleet partners to transition to this technology. Given the state of technology and State funding priorities the recommended next step is to test this technology by applying it to a consistent and predictable short-haul drayage route. From there, the Port can identify key lessons learned and plan to expand the application of battery electric and fuel cell electric truck technologies into longer-range and more demanding operations. In cases where the operational needs of a fleet are greater than the capability of zero emission technologies or the commercial availability of zero emission vehicles lags, alternative fuels such as renewable natural gas (used with low NOx engines), renewable diesel, and/or biodiesel blended fuels may serve as interim solutions to improve air quality and/or reduce GHG emissions.

Appendix C – AB 617 CERP and MCAS Comparison Table

Draft Final MCAS October 2021

The following comparison table provides informational guidance to allow the reader to compare the AB 617 CERP and the Port's MCAS. This table is provided at the request of stakeholders to understand the alignment between these complementary efforts. Strategies are considered aligned when they identify the same or similar activities to be completed within the same timeframe, whereas complementary items are those initiatives that will help complete or fulfill a broader and/or more specific emission reduction strategy. In some cases, the AB 617 CERP has broader strategies that are more specific than the Port's MCAS. In other cases, the Port's MCAS identifies goals and objectives that are more specific than the AB 617 CERP. Both documents provide the necessary guidance and direction that will be necessary to reduce emissions and improve the health of everyone who lives, works and plays within and around the Portside Community.

AB 617 CERP (July 2021) CERP GOALS		Draft Final MCAS (October 2021)	Aligned / Complementary
Goal 1	By 2031, reduce Diesel PM from 2018 levels by 80% in ambient air at all Portside Community locations.	**CARGO HANDLING EQUIPMENT OBJECTIVE 1:** Reduce emissions from cargo handling equipment by approximately 90% for NOx, 80% DPM, and 50% for CO2e below 2019 levels by January 1, 2025. *Note: In addition, Health Objective 1 commits the Port to estimating the Diesel Particulate Matter (DPM) at the TAMT and NCMT as part of a health risk assessment by October 2021, which may be used to inform an emission reduction goal.*	Complementary
Goal 2	Medium-Duty and Heavy-Duty trucks servicing Portside Community to be 100% ZEV five years ahead of the California State requirements.	**TRUCKS (2030 Goal):** In advance of the State's goals identified in Executive Order No. N-79-20, attain 100% ZE truck trips by 2030 for ***all*** heavy-duty trucks that call to the Ports two marine cargo terminals. **CARGO HANDLING EQUIPMENT (2030 Goal):** In advance of the State's goals identified in Executive Order No. N-79-20, facilitate the transition of diesel cargo handling equipment to 100% ZE by 2030. **TRUCK OBJECTIVE 1A**: 20% of the Port's annual truck trips will be performed by zero emission trucks by June 30, 2026. **ENABLING OBJECTIVE 1A**: Pursue a potential Memorandum of Understanding (MOU) with the San Diego Air Pollution Control District (SDAPCD) to administer CARB Funding to help fund ZE/NZE trucks and/or cargo handling equipment terminals.	Aligned
Goal 3	Establish ZEV HD/MD truck charging infrastructure in Portside, by specified dates in	**TRUCK OBJECTIVE 1B:** By the end of 2022, staff will develop and present a short-haul, on-road, Zero Emission Truck Program for the Board's	Aligned

AB 617 CERP (July 2021) CERP GOALS		Draft Final MCAS (October 2021)	Aligned / Complementary
	Action E1, with 4 sites operational by 2026	consideration that includes at least one collaborating trucking company and that targets having the necessary charging infrastructure in place by 2024, in order to displace approximately 65,000 diesel vehicle miles traveled. **TRUCK OBJECTIVE 2A:** Within fourth quarter of calendar year 2022, present a concept plan to the Board for its consideration that identifies four potential public-facing MD/HD charging locations within the San Diego Region to support deployment of ZE trucks, which may include locations in close proximity to the Tenth Avenue Marine Terminal and/or the National City Marine Terminal. **TRUCK OBJECTIVE 2B:** Collaborate and coordinate with community residents, stakeholders, and agencies to ensure that the MD/HD ZE truck charging facilities identified in Objective 2A are aligned with and connect to the regions larger ZE vehicle charging infrastructure system.	
Goal 4	Reduce emissions from HD/MD trucks servicing indirect sources by 100% 5 years in advance of regulatory requirements.	**HEALTH OBJECTIVE 4:** Collaborate with the San Diego Air Pollution Control District (SDAPCD) as they evaluate and consider developing a new rule to control emissions from indirect sources, in accordance with the timelines and dates established by the SDAPCD.	Complementary
Goal 5	By December 2021, APCD to present the cumulative cancer risk for Portside Communities from Health Risk Assessments and modeling of cumulative risk (including freeways, rail, vessels, stationary sources, etc.) to inform Goal #6. APCD can achieve this modeling goal with CARB assistance and input from the Portside Community Steering Committee including methodology and input data.	**HEALTH OBJECTIVE 2:** Assist the San Diego Air Pollution Control District (SDAPCD) and the California Air Resources Board (CARB) with preparing a cumulative or community health risk analysis for the AB 617 Portside Community by providing them with the Port's HRA (October 2021) and other operational related information.	Complementary
Goal 6	By February 2022, establish an estimated cancer risk	**HEALTH OBJECTIVE 2:** Assist the San Diego Air Pollution Control District (SDAPCD) and the	Complementary

AB 617 CERP (July 2021) CERP GOALS		Draft Final MCAS (October 2021)	Aligned / Complementary
	reduction goal based on the modeling that is done in Goal #2. Estimated cancer risk at all census tracts in Portside Community from locally generated emissions, including both stationary and mobile sources, to meet goals of ___/ million by 2026 and ___ /million by 2031.	California Air Resources Board (CARB) with preparing a cumulative or community health risk analysis for the AB 617 Portside Community by providing them with the Port's HRA (October 2021) and other operational related information.	
Goal 7	Conduct a Health Risk Assessment (HRA) at the Port's two marine cargo terminals to establish an updated baseline that relies on the most recent source characterization and activity from the Port's 2019 Emissions Inventory to inform aspirational goals in support of public health community priorities: 1) By October 2021, identify existing health risk levels generated from the Port's Tenth Avenue Marine Terminal (TAMT) and the National City Marine Terminal (NCMT) for Diesel Particulate Matter (DPM) and other Toxic Air Contaminant (TAC) emissions. a. Reduce Health Risk: The HRA may be used to inform an aspirational goal of reducing cancer risk b. Reduce DPM Emissions: The HRA may be used to inform an aspirational emission reduction goal c. Assist the San Diego Air Pollution Control District (SDAPCD) and the California Air Resources Board (CARB) with preparing a cumulative cancer risk analysis for the	**HEALTH OBJECTIVE 1:** By October 2021, identify existing health risk levels generated from the Port's TAMT and the NCMT for Diesel Particulate Matter (DPM) and other Toxic Air Contaminant (TAC) emissions. a. Reduce DPM Emissions: The HRA may be used to inform an emission reduction goal b. Reduce Health Risk: The HRA may be used to inform an aspirational goal of reducing cancer risk **HEALTH OBJECTIVE 2:** Assist the San Diego Air Pollution Control District (SDAPCD) and the California Air Resources Board (CARB) with preparing a cumulative or community health risk analysis for the AB 617 Portside Community by providing them with the Port's HRA (October 2021) and other operational related information.	Complementary

AB 617 CERP (July 2021) CERP GOALS		Draft Final MCAS (October 2021)	Aligned / Complementary
	AB 617 Portside Community by providing them with the Port's HRA (October 2021) and the other operational related information		
Goal 8	By 2026 reduce cancer risk below 10/million for each permitted stationary source, including portable equipment, in the Portside Environmental Justice Community	**SHIPYARD GOAL 1:** Collaborate with the San Diego Air Pollution Control District (SDAPCD) as they review and propose modifications to applicable rules, regulations, and/or programs. **SHIPYARD OBJECTIVE 1:** Collaborate with the San Diego Air Pollution Control District (SDAPCD) as they a evaluate and consider potentially lowering the health risk in Rule 1210, that establishes the threshold for stationary sources that reduce their estimated cancer risk.	Complementary
Goal 9	By 2031 complete Harbor Drive 2.0 truck freight improvements, including enforcement and signage of truck route for National City.	**TRUCK OBJECTIVE 3A:** Work with partners to continue advancement of the connected and flexible freight and transit haul route concept to provide more efficient freeway access and encourages truck drivers to avoid residential neighborhoods by leveraging technology to support dedicated lanes and signal prioritization.	Complementary
Goal 10	By 2031 increase tree canopy in the Portside Community to 35%.	**COMMUNITY OBJECTIVE 3:** Port staff will convene a group of stakeholders to explore increasing tree canopy in the Portside Community and continue to work with groups like Urban Corps to advance this objective.	Complementary
Goal 11	Develop a new vision for park/green space for the Portside Community to increase park space by 30% by December 2022.	**COMMUNITY OBJECTIVE 3:** Port staff will convene a group of stakeholders to explore increasing tree canopy in the Portside Community and continue to work with groups like Urban Corps to advance this objective.	Complementary

AB 617 CERP (July 2021) **CERP Actions – Heavy Duty Truck Strategies** *For related strategies, goals, timelines, and responsibilities, please see pages 169 to 175 by clicking on the link below:* https://www.sandiegocounty.gov/content/dam/sdc/apcd/PDF/AB_617/7.2021%20Portside%20Environmental%20Justice%20CERP%20July%202021.pdf		**Draft Final MCAS (October 2021)**	**Aligned / Complementary**
E1	Advance the deployment of heavy-duty on-road electric trucks	**TRUCK GOAL 1:** Improve the air quality in the Portside Community by accelerating the implementation of ZE/NZE trucks. **TRUCK OBJECTIVE 1A:** 20% of the Port's annual truck trips will be performed by zero emission trucks by June 30, 2026. **TRUCK OBJECTIVE 1B:** By the end of 2022, staff will develop and present a short-haul, on-road, Zero Emission Truck Program for the Board's consideration that includes at least one collaborating trucking company and that targets having the necessary charging infrastructure in place by 2024, in order to displace approximately 65,000 diesel vehicle miles traveled.	Complementary
E2	Fair outcome for small fleet owners and truck drivers	**TRUCK OBJECTIVE 1E:** Provide Status Report to the Board with recommendations on ZE truck technologies, as well as an evaluation of potential impacts to small fleets and/or independent truck drivers, as part of a biennial emissions reporting to better understand the transition ZE truck technology.	Complementary
E3	Support dedicated truck route and avoid truck impacts to local community	**TRUCK GOAL 3:** Support the designated truck route to avoid truck impacts to the local community. **TRUCK OBJECTIVE 3A:** Work with partners to continue advancement of the connected and flexible freight and transit haul route concept to provide more efficient freeway access and encourages truck drivers to avoid residential neighborhoods by leveraging technology to support dedicated lanes and signal prioritization.	Aligned

AB 617 CERP (July 2021) CERP Actions – Heavy Duty Truck Strategies *For related strategies, goals, timelines, and responsibilities, please see pages 169 to 175 by clicking on the link below:* https://www.sandiegocounty.gov/content/dam/sdc/apcd/PDF/AB_617/7.2021%20Portside%20Environmental%20Justice%20CERP%20July%202021.pdf		Draft Final MCAS (October 2021)	Aligned / Complementary
E4	Increase number of truck parking and staging facilities with electric charging capabilities	**TRUCK OBJECTIVE 2A:** Within fourth quarter of calendar year 2022, present a concept plan to the Board for its consideration that identifies four potential public-facing MD/HD charging locations within the San Diego Region to support deployment of ZE trucks, which may include locations in close proximity to the Tenth Avenue Marine Terminal and/or the National City Marine Terminal. **TRUCK OBJECTIVE 2B:** Collaborate and coordinate with community residents, stakeholders, and agencies to ensure that the MD/HD ZE truck charging facilities identified in Objective 2A are aligned with and connect to the regions larger ZE vehicle charging infrastructure system.	Complementary

AB 617 CERP (July 2021) **CERP Actions – Working Waterfront Activities (Port, Navy, and Shipyards)** *For related strategies, goals, timelines, and responsibilities, please pages 189 to 196 by clicking on the link below:* *https://www.sandiegocounty.gov/content/dam/sdc/apcd/PDF/AB_617/7.2021%20Portside%20Environmental%20Justice%20CERP%20July%202021.pdf*		**Draft Final MCAS (October 2021)**	**Aligned / Complementary**
G1	Reduce diesel emissions from cargo handling equipment	**CARGO HANDLING EQUIPMENT (2030 Goal)**: In advance of the State's goals identified in Executive Order No. N-79-20, facilitate the transition of diesel cargo handling equipment to 100% ZE by 2030. **CARGO HANDLING EQUIPMENT GOAL 1:** Attain substantial reductions for cargo handling equipment related emissions by facilitating upgrades ZE/NZE equipment alternatives. **CARGO HANDLING EQUIPMENT OBJECTIVE 1:** Reduce emissions from cargo handling equipment by approximately 90% for NOx, 80% DPM, and 50% for CO2e below 2019 levels by January 1, 2025.	Complementary
G2	Reduce emissions from ships at berth	**OCEAN-GOING VESSELS (2030 Aspiration):** Equip marine terminals with shore power and/or an alternative technology to reduce ocean-going vessel emissions for ships that call to the Port. **OCEAN-GOING VESSELS OBJECTIVE 2A:** At Cruise Ship Terminal, add one additional plug to existing shore power system by 2023. **OCEAN-GOING VESSELS OBJECTIVE 2B:** At National City Marine Terminal, add new shore power system with at least two plugs and/or an alternative technology that reduces OGV emissions at berth by 2025.	Complementary

AB 617 CERP (July 2021) CERP Actions – Working Waterfront Activities (Port, Navy, and Shipyards) *For related strategies, goals, timelines, and responsibilities, please pages 189 to 196 by clicking on the link below:* https://www.sandiegocounty.gov/content/dam/sdc/apcd/PDF/AB_617/7.2021%20Portside%20Environmental%20Justice%20CERP%20July%202021.pdf		Draft Final MCAS (October 2021)	Aligned / Complementary
G3	Reduce emissions from harbor craft	**HARBOR CRAFT GOAL:** Reduce emissions from Harbor Craft by advancing emerging zero emission technologies **HARBOR CRAFT OBJECTIVE 1:** Facilitate implementation of the first all-electric tugboat in the United States by June 30, 2026. **HARBOR CRAFT OBJECTIVE 2:** Identify suitable projects to assist with advancing the State's goals for commercial harbor craft by supporting: a. Existing fuel docks with the transition to renewable diesel by January 1, 2023; b. Installation and maintenance of landside shore power for all facilities that receive more than 50 visits per year by 2024; c. All new excursion vessels transition to zero emission capable hybrid technologies starting on January 1, 2025; and d. Short run ferry-operators' transition to zero emission technologies for all new and in use short-run (under 3 NM) trips starting on January 1, 2026.	Complementary
G4	Reduce DPM and NOx emissions from portable air compressors and other diesel sources at shipyards	**SHIPYARD OBJECTIVE 2:** Continue to work with the shipyard facilities to identify and implement emission reduction projects and support the shipyard-related actions that are identified in the Portside	Aligned

AB 617 CERP (July 2021) **CERP Actions – Working Waterfront Activities (Port, Navy, and Shipyards)** *For related strategies, goals, timelines, and responsibilities, please pages 189 to 196 by clicking on the link below:* *https://www.sandiegocounty.gov/content/dam/sdc/apcd/PDF/AB_617/7.2021%20Portside%20Environmental%20Justice%20CERP%20July%202021.pdf*		**Draft Final MCAS (October 2021)**	**Aligned / Complementary**
		Community's AB 617 Draft CERP (June 2019). **AB 617 Draft CERP Action G4** – Reduce DPM and NOx Emissions from Portable Air Compressors and Other Diesel Sources at Shipyards.	
G5	Promote best practices for reducing diesel, VOC and other emissions from ship repair activities	**SHIPYARD OBJECTIVE 2:** Continue to work with the shipyard facilities to identify and implement emission reduction projects and support the shipyard-related actions that are identified in the Portside Community's AB 617 Draft CERP (June 2019). **AB 617 Draft CERP Action G4** – Reduce DPM and NOx Emissions from Portable Air Compressors and Other Diesel Sources at Shipyards.	Aligned
G6	Reduce emissions from shipyard employee transportation	**SHIPYARD OBJECTIVE 2:** Continue to work with the shipyard facilities to identify and implement emission reduction projects and support the shipyard-related actions that are identified in the Portside Community's AB 617 Draft CERP (June 2019). **AB 617 Draft CERP Action G6** – Reduce Emissions from Shipyard Employee Transportation.	Aligned
G7	Promote adoption of ZE technologies by Port tenants, truckers, and other users of equipment	**ENABLING OBJECTIVE 2E** – Promote adoption of ZE technologies by Port tenants, truckers, and other users of equipment.	Aligned

AB 617 CERP (July 2021) **CERP Actions – Working Waterfront Activities (Port, Navy, and Shipyards)** *For related strategies, goals, timelines, and responsibilities, please pages 189 to 196 by clicking on the link below:* *https://www.sandiegocounty.gov/content/dam/sdc/apcd/PDF/AB_617/7.2021%20Portside%20Environmental%20Justice%20CERP%20July%202021.pdf*		**Draft Final MCAS (October 2021)**	**Aligned / Complementary**
G8	Reduce emissions associated with traffic at Naval Base San Diego	The Navy is a federal entity that is separate from the Port.	Not Applicable