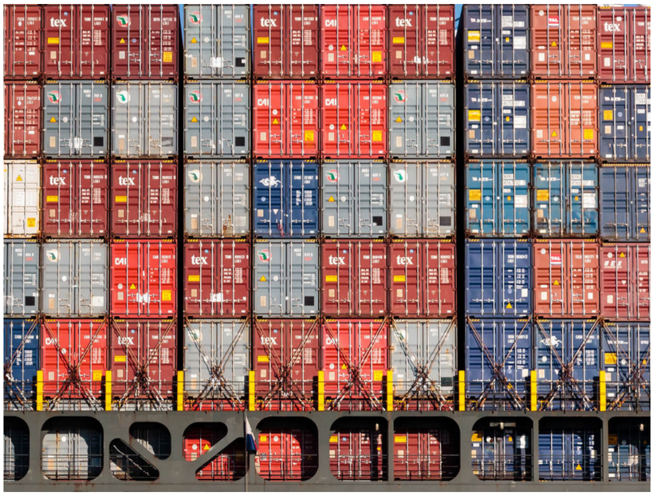



PORT OF OAKLAND

Final - June 13, 2019

Seaport Air Quality 2020 and Beyond Plan

The Pathway to Zero Emissions

Volume I: Main Plan and Appendices

Seaport Air Quality 2020 and Beyond Plan

Dedication

To the vibrant health and well-being of Oakland – its people and environment.

Acknowledgment

The Port of Oakland gratefully acknowledges all who contributed to the development of the Seaport Air Quality 2020 and Beyond Plan. Regulatory agencies, Port businesses, community-based organizations and trade associations all played a vital stakeholder role. The Port acknowledges the 2020 and Beyond Task Force members and Co-Chairs who spent countless hours guiding the Task Force and reviewing and providing comments.

Port staff and consultants performed the technical analyses, conducted the research and wrestled with the complex regulatory and policy issues to create a technically sound and feasible Plan. The Plan would not have been possible without their boundless energy, professionalism, creativity, skill and dedication.

Richard Sinkoff
Director of Environmental Programs and Planning
Port of Oakland

Oakland, California
May 23, 2019

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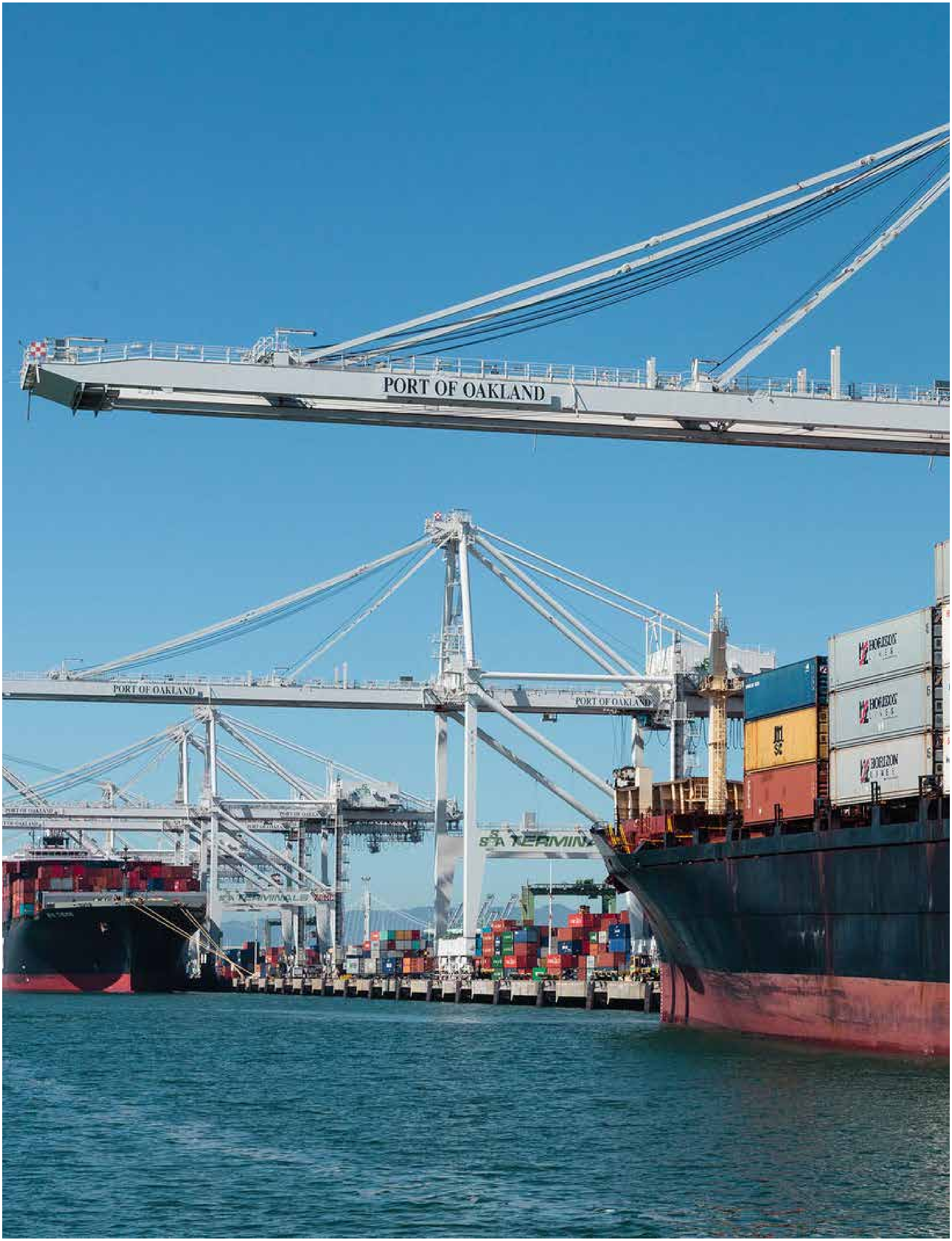
Abbreviations and Acronyms

AB 617	Assembly Bill 617
AB 1341	Assembly Bill 1341
BAAQMD	Bay Area Air Quality Management District
CAAP	Clean Air Action Plan
CARB	California Air Resources Board
CBP	Customs and Border Protection
CEC	California Energy Commission
CHE	Cargo-Handling Equipment
DPM	Diesel Particulate Matter
Draft PEP	Draft Public Engagement Plan
EI	Emissions Inventory
FITS	Freight Intelligent Transportation System
GGRP	Greenhouse Gas Reduction Plan
GHG	Greenhouse Gas
HVIP	State of California Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
LCFS	Low Carbon Fuel Standard
MAQIP	Maritime Air Quality Improvement Plan
MARPOL	International Convention for the Prevention of Pollution from Ships
NOx	Oxides of Nitrogen
NTAP	Near-Term Action Plan
OICT	Oakland International Container Terminal
OGV	Ocean-Going Vessels
PETF	Port Efficiency Task Force
PG&E	Pacific Gas & Electric Company
PM	Particulate matter
RTG	Rubber-Tired Gantry Crane
SPBP	San Pedro Bay Ports
SSA	Stevedoring Services of America
TAC	Toxic Air Contaminant
TIGER	Transportation Investment Generating Economic Recovery
WOCAAP	West Oakland Community Air Action Plan
WOEIP	West Oakland Environmental Indicators Project
ZANZEFF	Zero- and Near-Zero-Emissions Freight Facilities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Introduction: Air Quality Planning for the Future – the Pathway to Zero Emissions

Improving air quality is a strategic priority for the Port of Oakland (Port). This *Seaport Air Quality 2020 and Beyond Plan* (2020 and Beyond Plan or Plan) is the Port's master plan for achieving its vision of a zero-emissions Seaport.

Why is a zero-emissions Seaport so important? At present, operations at the Seaport are primarily based on the use of diesel fuel. Combustion of diesel fuel creates diesel particulate matter (DPM) and greenhouse gases (GHGs). Exposure to toxic air contaminants (TACs), like DPM, increases cancer risk for people living and working nearby, and GHG emissions contribute to climate change, which is an urgent global concern. Diesel equipment operating at the Seaport is one of the sources of DPM emissions affecting West Oakland.

2020 and Beyond Plan Framework

The **2020 and Beyond Plan** is a master plan that provides a policy framework to guide decision-making and actions. The framework consists of the Plan vision, purpose, goals, strategies, actions, and time frame.

Plan Vision

The vision of the **2020 and Beyond Plan** is the pathway to zero-emissions Seaport operations through changes in equipment, operations, fuels, and infrastructure.

Purpose of the Plan

The purpose of the **2020 and Beyond Plan** is to provide a common framework and guidance for all stakeholders involved in moving towards a zero-emissions Seaport.

Guiding Principles

All aspects of the Plan, including Plan development, stakeholder participation, and Plan implementation, are founded on the following principles:

- Planning is a joint fact-finding and co-learning process.
- All stakeholders share the desire and intention to develop knowledge to promote informed decision-making.
- Pragmatic and cost-effective solutions advance Plan progress.
- The pursuit of near-term "wins" delivers verifiable air quality benefits and adds value to long-term planning.
- Strong partnerships among stakeholders are a critical element of Plan implementation.

Goals

The Plan has five goals:

- Keep the Port competitive and financially sustainable, and ensure that the Port remains a catalyst for jobs and economic development.
- Minimize emissions of criteria air pollutants and TACs, with a focus on reducing DPM emissions, thereby reducing community exposure to pollutants that are harmful to public health.
- Reduce GHG emissions.
- Build and strengthen partnerships among the Port, Port tenants, equipment manufacturers, equipment owners and operators, community organizations, regulatory agencies, and the public.
- Provide opportunities for meaningful stakeholder engagement.

Strategies and Actions

The Plan's building blocks are its strategies and Implementing Actions. The **2020 and Beyond Plan** relies on six strategies to guide action and process. The six strategies consist of three strategies that focus on actions that the Port can take to reduce GHG and DPM emissions and three strategies that address the process of achieving the transition to a zero-emissions Seaport. The strategies are put into effect through Implementing Actions, which are specific projects or activities. The Plan identifies Implementing Actions for all six strategies.

Plan Implementation and Time Frame

Plan implementation reflects changing conditions over time, especially in technology, financial resources, and regulations. Consequently, the Plan includes three planning horizons: the Near-Term Phase (2019-2023), the Intermediate-Term Phase (2023-2030), and the Long-Term Phase (2030-2050). During its implementation, the Plan's overall framework of visions, goals, and strategies will remain stable; however, Implementing Actions will continue to change as technology evolves and infrastructure is built out. Accordingly, the Port intends to regularly update the Plan, and the first Plan Update will be in 2023.

Relationship of the Plan to other Plans, Programs, and Projects

The **2020 and Beyond Plan** goals and strategies are designed to complement concurrent and future plans and studies by federal, State, regional, and regulatory agencies and organizations to address air quality, community health risk, and climate change. In West Oakland, the Bay Area Air Quality Management District (BAAQMD) and West Oakland Environmental Indicators Project (WOEIP) are developing the West Oakland Community Air Action Plan (WOCAAP). The WOCAAP intends to integrate, as appropriate, specific strategies from relevant concurrent planning efforts, including the 2020 and Beyond Plan, the West Oakland Truck Management Plan, and the West Oakland Specific Plan. Appendix B: Background provides a more detailed description of key related plans, programs, and projects.

Use of the Plan by Other Parties

The implementation of this Plan relies in part on actions by stakeholders, which the Port does not control. The Port anticipates that stakeholders will take action as necessary based on their organizations' needs, and that these actions will be guided by this Plan.

Improving Air Quality at the Port: A Record of Progress and Engagement

Since 2009, the framework for the Port's Seaport-related air quality efforts has been the Maritime Air Quality Improvement Plan (MAQIP), the master plan that the Board of Port Commissioners (Board) adopted in April 2009 (Port 2009). The MAQIP established a vision, goals, strategies, and targets to reduce emissions from Seaport-related equipment sources. The MAQIP set a 12-year time frame—from 2009 to 2020—for implementation.

Two pillars define the MAQIP: (1) the Maritime Air Quality Policy Statement and (2) stakeholder engagement. On March 18, 2008, the Board adopted the Maritime Air Quality Policy Statement (Port of Oakland Resolution No. 09057): "*Reduce excess cancer health risk related to exposure to diesel particulate matter (DPM) emissions by 85% from 2005 to 2020.*" The MAQIP expressed this goal as an 85% reduction in DPM emissions. To pursue this goal as well as comply with State of California (State) regulations, the Port and the maritime industry undertook large-scale emissions reductions programs and projects. As a result, DPM emissions at the Port have decreased 81% since 2005, according to the Port's 2017 Seaport Emissions Inventory (Ramboll 2018).

The MAQIP was developed through an extensive public stakeholder participation process. The Port convened the MAQIP Task Force in 2007 to develop goals and actions to guide air quality improvement efforts at the Seaport. A Steering Committee of Co-Chairs led the 35-member Task Force in developing guiding principles, goals and implementation measures for the MAQIP. The MAQIP Task Force transitioned to the 2020 and Beyond Task Force in May 2018.

Building on the MAQIP

To achieve the MAQIP's 85% DPM emissions reduction goal by 2020, the Port will continue to focus on existing MAQIP programs and emissions reduction measures that go beyond regulatory compliance requirements. The Port, community, regulatory organizations, and the public share a common focus on reducing criteria air pollutant and DPM emissions as a means of reducing exposure to these pollutants.

The Port is also looking ahead to address new factors that are shaping long-term planning for air quality. The State of California has established ambitious GHG emissions reductions targets for 2030 and 2050. Technology changes, including advances in batteries, are creating the potential for zero-emissions equipment and operations in the goods movement industry. Business growth, revenue generation, and financial capacity remain critical factors in long-term air quality planning.

The Port is responding to all these factors in this **2020 and Beyond Plan**, which builds on the foundation established by the MAQIP. In incorporating the MAQIP's focus on emissions reduction measures, the Plan places emissions reductions measures within the context of the State's Years 2030 and 2050 GHG targets and zero-emissions initiatives.

Plan Development Milestones

The Plan was developed with input from stakeholders. Six Task Force meetings were held in conjunction with the development of the Plan, and stakeholders provided comments on both the *Draft Seaport Air Quality 2020 and Beyond Plan* published June 29, 2019 (Draft Plan) and the *Revised Draft Seaport Air Quality 2020 and Beyond Plan* (Revised Draft) published December 14, 2019.

Important milestones in the development of the Plan are summarized below.

- **February 23, 2018 - Task Force Meeting #1:** This meeting focused on technical studies pertaining to the MAQIP, including the status of emissions reductions.
- **May 9, 2018 - Task Force Meeting #2:** The Port provided a MAQIP update, and the Task Force pivoted to its new focus on the *2020 and Beyond Plan*.
- **June 21, 2018 - Task Force Meeting #3:** The Port presented an overview of the Draft Plan, with a focus on policy issues and the Port's proposed approach to these issues.
- **June 29, 2018:** The Port published the Draft Plan for public review and comment. The public comment period was open from June 29, 2018 through August 31, 2018.
- **September 26, 2018 - Task Force Meeting #4:** The Port presented a summary of the comments received on the Draft Plan, proposed revisions, and the schedule for the release of the Revised Draft, and held roundtable discussions on the Plan.
- **December 14, 2018:** In response to requests from stakeholders for an opportunity to review new appendices and revisions to the Plan based upon comments received on the Draft Plan, the Port published the Revised Draft for public review and comment. The public comment period was open from December 14, 2018, through January 17, 2019. In response to stakeholder requests, the Port extended the public comment period through January 24, 2019.
- **January 10, 2019 - Task Force Meeting #5:** The Port presented an overview of the Revised Draft, provided an opportunity for stakeholders to discuss four key topics (Equipment Operations for Electric Infrastructure Planning and Costs, Work Force Development, Public Participation, and the Revised Near-Term Action Plan [NTAP]) with staff, and accepted written comments.
- **April 23, 2019 - Task Force Meeting #6:** The Port presented an overview of the *Final Seaport Air Quality 2020 and Beyond Plan* (Final Plan). The meeting also included a discussion regarding the continued work of the Task Force and public engagement as the Plan is implemented. In addition, attendees received updates on other related projects and programs, including Assembly Bill 617 (AB 617).
- **May 10, 2019:** The Port published the Final Plan. The Final Plan reflects the technical studies and policy discussions conducted during the Plan development, including stakeholder comments on both the Draft Plan and the Revised Draft.

2020 and Beyond Plan Action Categories

The MAQIP focuses primarily on actions to reduce emissions from existing maritime equipment. The 2020 and Beyond Plan includes equipment, but it has an increased scope, broader purview, and more complexity. For this reason, the Plan includes a total of seven action categories. By using these seven categories, the Port ensures that the Plan is thorough, that Implementing Actions are effectively organized, and that interested parties can focus on categories of their choosing. The seven categories of actions are the following:

Document Structure

The Plan is presented in two volumes. Volume I presents the main Plan text, organized into the following sections:

- Plan Strategies and Implementing Actions
- Stakeholder Engagement
- Timeline and Phased Action Plan
- Near-Term Action Plan
- Plan Management
- Monitoring the Plan
- Funding the Plan
- Conclusion

A glossary of terms and a list of the sources and references used in developing the Plan follows the Conclusion section.

Volume I includes seven appendices providing the factual details and technical studies which support the Plan's recommended actions and goals.

Appendix A: Planning Assumptions
Appendix B: Background
Appendix C: Suggested Actions
Appendix D: Screening and Evaluation Criteria for Implementing Actions
Appendix E: Workforce Development Plan
Appendix F: Equipment Operations and Cost Assessment to Assist with Electric Infrastructure Planning
Appendix G: Public Engagement Plan

Volume II, Responses to Comments, is a comprehensive compilation of the comments received on both the Draft Plan and Revised Draft Plan. Comments were categorized into master response topics. The Responses to Comments document indicates how each comment informed Plan content so that commenters can understand the reasoning supporting Plan changes, where applicable.


credit: Kyle Mortara


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Plan Strategies and Implementing Actions

The Plan relies on six strategies to guide Plan implementation. Implementing Actions contribute to the execution of the six strategies; each Implementing Action must support one or more strategies.

Strategies

Figure 1 shows the six strategies.

Figure 1: **Seaport 2020 and Beyond Plan Strategies**

Source: Port of Oakland 2019

Strategy #1: Continue Emissions Reduction Programs and Projects

Strategy #1 applies primarily during the Near-Term Phase (2019-2023) and the Intermediate-Term Phase (2023-2030). Actions under Strategy #1 consist of both ongoing programs and new measures, and focus on programs and projects to achieve DPM emissions reductions to meet the MAQIP's 85% DPM reduction goal and on compliance with State air quality regulations. Using the 2017 Seaport Emissions Inventory (Ramboll 2018) as a baseline, it also includes emissions reduction measures or programs that go above and beyond regulatory compliance and that may contribute to further emissions reductions.

As part of Strategy #1, the Port will continue to prioritize actions that can be implemented in the Near-Term Phase, that contribute to attainment and maintenance of federal and State ambient air quality standards, and that prevent significant deterioration in air quality. The Port will also prioritize cost-effective actions (see the feasibility criteria in Table 1) that may be eligible for grant or incentive funding.

The combined residual DPM emissions from ocean-going vessels (OGV) and harbor craft account for 95% of the residual DPM emissions (Ramboll 2018). Most of the residual Seaport-related DPM emissions (83%) come from OGV, primarily OGV in transit. The Port has no direct control over emissions reductions for OGV in transit and harbor craft, and its ability to influence OGV and harbor craft reductions is limited. Implementing Actions for Strategy #1 focus on actions that can be taken by the Port or its tenants. However, the Port will continue to track and support, where applicable, new standards for OGV, such as the recent GHG emissions reductions targets in the International Convention for the Prevention of Pollution from Ships (MARPOL) guidance of April 18, 2018 (IMO 2018).

Examples of Implementing Actions that support Strategy #1 include:

- Convert a portion of the Port's fleet to battery-electric vehicles.
- Use renewable diesel in the Port's diesel-powered equipment.
- Retrofit rubber-tired gantry (RTG) cranes to hybrid equipment.
- Adopt voluntary or incentivized vessel speed reduction.

Strategy #2: Promote the Pathway to Zero Emissions Equipment and Operations

Strategy #2 focuses on equipment, fuel, and operational actions to reduce GHG emissions and localized exposure to criteria air pollutants and TACs. Implementing Actions under Strategy #2 would occur during all three phases of Plan implementation.

The key methods for reducing GHG emissions and localized exposure to the TACs resulting from diesel emissions are (1) reducing fossil fuel consumption and (2) replacing existing fossil fuels with lower carbon or carbon-free fuels, such as renewable liquid fuels, GHG-free electricity, and hydrogen from renewable sources. Some of these fuels are now commercially available, cost-effective, and operationally feasible. For example, fossil fuel consumption can be reduced by using more efficient engines and operations, including using hybrid technologies to recover energy lost during activities such as braking, and by implementing measures that will make Seaport operations more efficient.

While GHG emissions reductions are the primary focus of Implementing Actions under Strategy #2, the Port will give preference to those actions that provide larger reductions of TACs. The Port will prioritize actions that result in immediate or localized reductions in emissions, that fit with a long-term transition to zero-emissions operations, and that are needed to clarify the requirements for moving to a zero-emissions Seaport. Studies and further planning efforts will be a crucial part of the near-term actions under Strategy #2.

Examples of Implementing Actions that support Strategy #2 include:

- Conduct engineering and operational feasibility studies for zero-emissions cargo-handling equipment (CHE).
- Implement the use of renewable diesel for the Port vehicle fleet.
- Develop battery-electric equipment demonstration projects funded by grants and/or equipment manufacturer.

Strategy #3: Develop Infrastructure to Support the Pathway to Zero Emissions

Strategy #3 addresses the infrastructure needs of a zero-emissions Seaport, which must have adequate systems to support new power and alternative fuel demands, as well as the fiber optic communications systems for more efficient maritime operations. Under Strategy #3, investments in information technology (IT) systems are critical to more efficient maritime operations.

Based on the status of technology development, as well information regarding equipment manufacturers' focus on battery-electric equipment, Strategy #3 assumes that the Seaport's predominant power source will be electricity. It therefore focuses on upgrading the existing electrical systems, increasing resiliency[1] (e.g., system backup capacity), and constructing new infrastructure. Strategy #3 provides flexibility by supporting other technological options, such as hydrogen-powered equipment.

[1] *The more Port operations are dependent on electricity, whether for cargo-handling equipment or smart technology/communications systems, the more important it becomes to have backup systems in place to ensure that the Port can continue to operate if there is a disruption to the electrical grid. Having adequate backup is also referred to as reliability or resiliency.*

Figure 2: **Seaport Electrical Infrastructure**

Source: Port of Oakland 2019

The Plan envisions that both the Port and its tenants will invest in upgrades to existing infrastructure and systems in the Seaport Area. The Port will plan and coordinate electrical system upgrades with terminal operators, off-dock tenants, and equipment owners in areas the Port serves as a utility. The Port and its tenants will coordinate with Pacific Gas and Electric Company (PG&E) in PG&E's service area. Figure 2 shows the two service areas.

Examples of Implementing Actions that support Strategy #3 include:

- Develop a guide for electric vehicle charging infrastructure projects in the Seaport Area.
- Perform engineering feasibility studies for container terminal electrification.
- Expand the electrical charging infrastructure for the Port's vehicle fleet.
- Track the development of uniform charging standards for zero-emissions equipment, and advocate for Port-specific needs.
- Conduct feasibility studies for other alternative fuels, such as hydrogen fuel cells.

Strategy #4: Build and Strengthen Partnerships

To implement the **2020 and Beyond Plan**, the Port will collaborate with a wide range of organizations and entities inside and outside the Port, especially Port tenants and truckers serving the Port. The Plan refers to these organizations and entities as partners and to the collaborations as partnerships.[2]

The Port's many partners bring valuable knowledge and perspectives. Strategy #4 is designed to encourage partners to (1) contribute to Plan development, (2) engage in and contribute to Plan implementation, (3) provide subject matter expertise, and (4) make financial and other necessary organizational and operational commitments.

To achieve the Plan's goals, Strategy #4 focuses on building and strengthening the Port's partnerships with Port tenants, equipment owners, operators, other businesses, community organizations, original equipment manufacturers, researchers, the community, and agencies, as well as with other ports. Besides collaborating with the Port on Implementing Actions, partners may independently carry out actions that support the goals of the Plan, such as purchasing zero-emissions equipment for their own operations.

As part of Strategy #4, the Port will expand existing partnership networks to increase Port-to-partner and direct partner-to-partner information exchange and to keep partners informed about Implementing Actions they could carry out.

Strategy #4 also includes workforce development, and is aligned with Goal #1: "Keep the Port competitive and financially sustainable, and ensure that it is a catalyst for jobs and economic development" (see Appendix E: Workforce Development Plan).

Examples of Implementing Actions that support Strategy #4 include:

- Continue to participate in working groups, such as the Trucker Working Group and the Port Efficiency Task Force (PETF).
- Conduct regular meetings with tenants as well as shipping lines and other customers.
- Collaborate with regulatory, resource and public health agencies.
- Partner with other ports on grant applications.
- Advocate for cleaner OGVs and fuels.

[2] *The terms "partner" and "partnership" as used in the Plan are not intended to convey a specific legal relationship among the parties and entities.*

Strategy #5: Engage Stakeholders

Under Strategy #5, the Port designed and continues to implement a stakeholder engagement program that keeps stakeholders informed and engages them in the Plan's development and implementation. Strategy #5 includes specific outreach to organizations and residents who may not have previously participated in the Port's air quality planning efforts (see Appendix G: Public Engagement Plan).

Stakeholders offered various ideas for the design of the stakeholder engagement process. For example, they suggested separate working groups to screen Implementing Actions, to focus on electrical infrastructure and charging, to design and implement a high-emitting truck detection system, and to conduct an independent review of emissions calculations. As Plan implementation progresses, Strategy #5 will engage stakeholders in the implementation process and provide ongoing opportunities for meaningful input and authentic involvement in decision-making.

Examples of Implementing Actions that support Strategy #5 include:

- Conduct regular Task Force meetings.
- Hold Community Town Hall meetings.
- Engage stakeholders in the development of the Plan Update in 2023.
- Coordinate with Task Force Co-Chairs to conduct Working Sessions regarding topics of interest to stakeholders.

Strategy #6: Pursue External Funding

To support the implementation of technology, equipment, fuels, and infrastructure for a zero-emissions Seaport, Strategy #6 focuses on external (non-Port) funding sources, which will likely include public and regulatory agencies that provide grants and other incentives, such as the State of California Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project [HVIP]). Where specific grant programs require a match, both the Port and its tenants may contribute to meeting the match. For example, pursuant to a Memorandum of Understanding with the Port of Long Beach dated February 7, 2019, the Port agreed to provide at least $1,250,000 in match funds in the form of out-of-pocket costs to vendors for the design and construction (including acquisition of any necessary parts or equipment) of infrastructure for 10 zero-emissions drayage trucks as part of the Zero- and Near-Zero-Emissions Freight Facilities (ZANZEFF) grant. Stevedoring Services of America (SSA) is contributing a cost share of more than $800,000 as part of a Carl Moyer grant to repower 13 RTG cranes.

The Port will typically seek grants and incentive funding for priority actions identified through the screening and evaluation process for Implementing Actions (prioritization of Implementing Actions is conducted as part of the screening and evaluation process described in Screening and Evaluation Process for Implementing Actions). The Port may also accelerate some projects based on the availability of grants and other incentives (for further discussion of infrastructure funding, see Volume II: Responses to Comments on the Revised Draft *Seaport Air Quality 2020 and Beyond Plan*, Topic #10: Infrastructure). The Port may team with tenants to pursue certain grant funding opportunities and will also share information regarding grant and incentive funding with interested stakeholders.

Examples of Implementing Actions that support Strategy #6 include

- Track the websites of the California Air Resources Board (CARB), California Energy Commission (CEC), and BAAQMD for information on upcoming grant and incentive funding programs, and develop a thorough understanding of each grant and incentive program's requirements.
- Advocate for new or expanded State and federal grant opportunities.
- Collaborate with tenants to pursue grant funding for specific projects.

Implementing Actions

Implementing Actions are specific, time-bound, measurable activities or initiatives that support the six Plan strategies. Some Implementing Actions support a single Plan strategy while others support multiple strategies. For example, equipment converted to zero emissions (Strategy #2) will provide both local DPM and criteria air pollutant reduction benefits (Strategy #1) in addition to GHG emissions reductions. Similarly, educating Port partners about grant opportunities is both a partnership and a funding-related action (i.e., this action supports both Strategies #4 and #6).

Categories

The Port has organized Implementing Actions into seven categories. The Port or its partners may carry out Implementing Actions in any of these categories:

1. Equipment
2. Infrastructure
3. Fuels
4. Operations (including efficiency improvements)
5. Partnerships
6. Stakeholder Engagement
7. Funding

The Implementing Actions identified to date are presented in Appendix C: Suggested Actions, Table C-2: Initial Implementing Actions and Table C-3: New Suggested Actions.

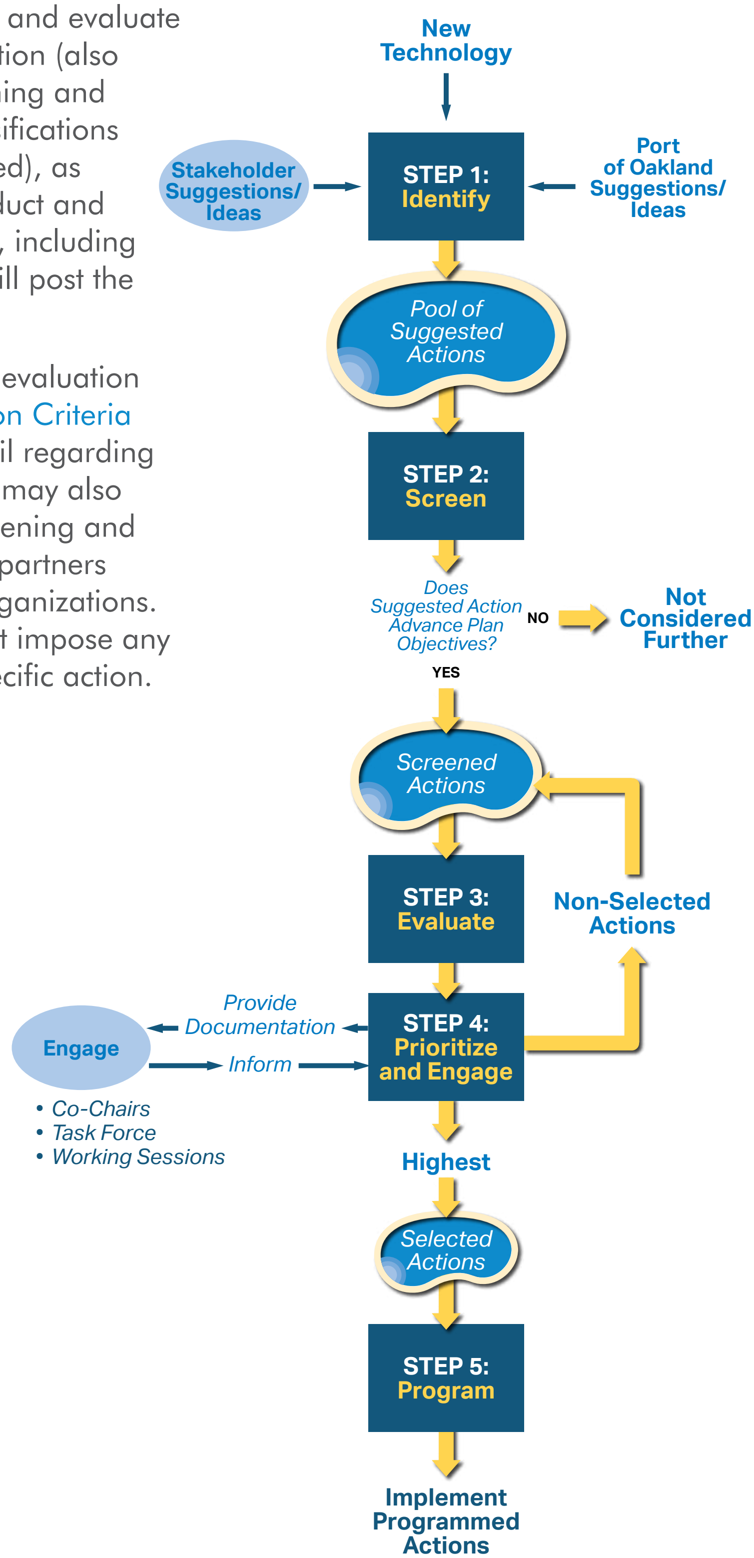
Screening and Evaluation Process for Implementing Actions

The Plan includes a five-step process to screen and evaluate Implementing Actions. As an Implementing Action (also known as an action) moves through the screening and evaluation process, it is given one of four classifications (Suggested, Screened, Selected, or Programmed), as explained below. The role of the Port is to conduct and manage the screening and evaluation process, including the documentation of that process. Port staff will post the documentation on the Port's website.

Figure 3 illustrates the five-step screening and evaluation process. (Appendix D: Screening and Evaluation Criteria for Implementing Actions provides added detail regarding Steps 2 and 3.) Port partners, such as tenants, may also elect to pursue Implementing Actions. The screening and evaluation process provides guidance for Port partners seeking to identify suitable projects for their organizations. The screening and evaluation process does not impose any obligation on Port partners to implement a specific action.

STEP 1: Identify
In Step 1, Port staff and stakeholders suggest concepts, ideas, and actions that could contribute to achieving the goals of the Plan. For example, in their comments on the Draft Plan and the Revised Draft, stakeholders provided numerous suggestions for Implementing Actions, such as (1) initiate a work group to develop and implement a high-emitting truck detection system, (2) pursue low-carbon fuel standard credits, and (3) convene a workshop on private financing opportunities for electric drayage trucks for truckers. The screening and evaluation process classifies these concepts and ideas as "Suggested Actions" (see Appendix C: Suggested Actions). Port staff will compile the Suggested Actions into a pool (Pool #1) for screening in Step 2.

Figure 3: **Screening and Evaluation Process**



STEP 2: Screen

In Step 2, Port staff screen the Suggested Actions against five criteria (see Appendix D, Table D-1: Screening Criteria) to determine whether the Suggested Actions support the Plan goals. This is a pass/fail screen. To pass, a Suggested Action has to satisfy all applicable screening criteria; not all screening criteria are applicable to all actions. Suggested Actions that pass Step 2 are classified as "Screened Actions." Port staff will compile the Screened Actions into a second pool (Pool #2). Suggested Actions that fail one or more of the applicable screening criteria in Step 2 are removed from further consideration. Port staff will screen the pool of Suggested Actions on a periodic basis. However, should a new Suggested Action be sufficiently compelling, or if the available time to respond is limited, Port staff may screen a new Suggested Action on an individual basis.

STEP 3: Evaluate

In Step 3, Port staff evaluate each Screened Action in Pool #2 against seven feasibility criteria: (1) exposure reduction, (2) affordability, (3) cost-effectiveness, (4) commercial availability, (5) operational feasibility, (6) acceptability and (7) need (see Table 1: Feasibility Criteria for Screening and Evaluation Process).[3] In contrast to the screening in Step 2, this is not a pass/fail evaluation; it is an assessment of relative performance against the feasibility criteria.

STEP 4: Prioritize and Engage

In Step 4, following the feasibility evaluation, Port staff conduct a qualitative assessment of each Screened Action to select the highest-priority actions. These highest-priority actions are classified as "Selected Actions."

Selected Actions comprise the third and final pool (Pool #3). Selected Actions that are to be implemented by another organization (e.g., a licensed motor carrier or an ocean carrier) or that require the participation of another organization are considered guidance. Non-selected Screened Actions will remain in Pool #2 (Screened Actions). Screened Actions may be updated or revised as new information becomes available. Port staff may remove a specific Screened Action from Pool #2 if it continues to perform poorly against the feasibility criteria. For example, a specific technology may fail to mature, or be overtaken by a more favorable technology.

Port staff will then provide the Task Force Co-Chairs with documentation for Steps 1 through 4 for their review and feedback. Where needed or desired, the Co-Chairs may convene a Working Session, which will include Task Force members, for collaborative problem-solving on specified Selected Actions. The Co-Chairs will document the Working Sessions to inform the qualitative assessment of specified Selected Actions. Task Force Co-Chairs will present the results of Steps 1 through 4 to the Task Force.

[3] *Some feasibility criteria may not be applicable to some Screened Actions. For example, the cost-effectiveness criterion would not be applicable to studies because studies do provide any emissions reductions or return on investment.*

STEP 5: Program

In Step 5, Port staff analyze and recommend the Selected Actions for project and budget approval by the Board. The staff recommendation is informed by the Co-Chairs and Task Force engagement undertaken in Step 4. The Board retains sole and absolute discretion to decide whether to approve or disapprove the recommendation. Following Board approval, the Selected Action is classified as a Programmed Action and implementation can begin. If the Board does not approve the recommendation, Port staff will respond to the Board's direction. Other organizations may choose to fund and schedule an Implementing Action; Port staff will also classify these non-Port-sponsored actions as Programmed Actions.

Table 1: Feasibility Criteria for Screening and Evaluation Process

Criterion	Description
Exposure Reduction	Does the Screened Action contribute to efforts to reduce community exposure to pollutants that are harmful to public health?
Affordability	Has the Board of Port Commissioners approved Port of Oakland (Port) funds for the Screened Action, or do the Port's budget projections indicate that sufficient funding is likely to be available given all other budget considerations? How does the cost of any zero-emissions equipment compare to its diesel-powered counterpart? Do projected Port net revenues support any long-term associated costs? If the action will be implemented by an organization other than the Port, has that organization decided that the Screened Action is affordable according to its criteria? Is grant or other incentive funding available, and what is the level of effort required to apply for the funding? Would the Screened Action potentially result in stranded equipment or infrastructure, or jeopardize usage requirements for any grant-funded equipment already in place? Would the Screened Action impose an additional expense on the Port or Port-related business which would result in job losses, slowed job growth or other unacceptable, significant economic impacts?
Cost-Effectiveness	Does the Screened Action provide cost-effective emissions reductions? (See detailed description of cost effectiveness evaluation in Appendix D: Screening and Evaluation Criteria for Implementing Actions.)
Commercial Availability[4]	Has the proposed technology or system associated with the Screened Action reached commercial availability (Technological Readiness Level [TRL] 9 or, at a minimum, the pre-production stage (TRL 7)? (For Technological Readiness Levels, see Table D-3 of Appendix D: Screening and Evaluation Criteria for Implementing Actions.) Is the equipment readily available from multiple vendors, and is there adequate competition in the marketplace?
Operational Feasibility	Is there sufficient experience with the technology or equipment to determine that its operational performance is acceptable? Are parts readily available and are repair and maintenance services available nearby? Does the existing workforce have sufficient training and experience to operate the new technology or equipment? Can routine maintenance be performed in-house?

[4] *This is the Port's working definition used in this Plan.*

Criterion	Description
Acceptability	Is there a party or entity willing to undertake the Screened Action, given the range of other considerations, such as availability of land, constraints on current or future operations, or financial capability? Does the Screened Action allow for continued reliable and satisfactory service delivery to customer(s)?
Need	To support the qualitative assessment: • Is the Screened Action needed to keep the Port operational, or has a Port tenant or Port-related business determined that the Screened Action is required to keep it operational? • If the Screened Action provides emissions reductions benefits, do the associated emissions reductions benefits accrue in the local community? • How urgent is the Screened Action? (For example, is lack of electrical infrastructure preventing further deployment of battery-electric equipment?) • Is the Screened Action part of a planned program, such as an ongoing investment in capital equipment? • Will the Screened Action result in a delay or cancellation of other (non-air-quality-focused) priority projects? • Will the Screened Action substantially advance experience with a certain type or class of equipment? • Does the Screened Action complement other initiatives or programs that aim to reduce emissions-related health risk in the local community? • Will the action build capacity (such as expanding maintenance and repair services for battery-electric equipment or providing training for electric vehicle mechanics)?

Source: Port of Oakland 2019


PORT OF OAKLAND
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Stakeholder Engagement

The Port is committed to stakeholder engagement in both the development and implementation of the **2020 and Beyond Plan**. Stakeholder engagement activities (i.e., public information meetings, consultations, and social media outreach) took place prior to and during development of the Draft and Revised Draft, as well as for this Final Plan. Stakeholder review and comments played a substantive role in the development of the Plan. The Port added a draft Public Engagement Plan (draft PEP) as Appendix G to the Revised Draft. The final Public Engagement Plan reflects stakeholder input on the draft PEP and describes the stakeholder community, stakeholder concerns, and planned outreach and engagement activities. The final PEP is provided in Appendix G.

The Port documented how stakeholder input influenced decisions to date. Volume II of the Revised Draft summarizes all the comments received on the Draft Plan. It includes the Port's response to each comment and information on changes made to the Plan in response to the comments. Similarly, Volume II of this Final Plan summarizes all the comments received on the Revised Draft and includes the Port's response to each comment along with a description of where changes were made. Stakeholders will continue to have opportunities to give input during implementation of the Plan.

The Task Force is the central element of stakeholder engagement. The Port held six Task Force meetings during the development of the Plan. The Task Force's steering committee of Co-Chairs is helping the Port determine the types of stakeholder engagement needed for implementing the Final Plan, with a focus on screening and evaluating Implementing Actions. Following the publication of the Final Plan, the Port plans to convene Task Force and Community Town Hall meetings, as described in the final PEP. At the future Task Force meetings, the Port will report on the status of Implementing Actions that are in progress. The Task Force Co-Chairs will report on the screening and evaluation of Implementing Actions. The Task Force Co-Chairs will determine whether Working Sessions are needed to discuss specified Selected Actions, and will develop criteria for the Working Sessions.

The Task Force Co-Chairs are also supporting efforts to engage other stakeholders, including organizations and residents who may not have participated in the Port's previous air quality planning efforts. Stakeholder feedback from the public comment process on the Draft Plan and Revised Draft identified other organizations for outreach and engagement. The feedback also included recommendations for ways to engage residents who are unable to attend Task Force meetings. These recommendations are reflected in the final PEP (see Appendix G).


8

Timeline and Phased Action Plan

The **2020 and Beyond Plan** looks beyond the MAQIP Year 2020 planning horizon to the years 2030 and 2050 as its planning horizons. The years 2030 and 2050 correspond to the target years in the State's policies for GHG emissions reductions (i.e., 40% reduction in GHGs below the 1990 baseline by 2030 and 80% reduction in GHGs below the 1990 baseline by 2050).

Timeline

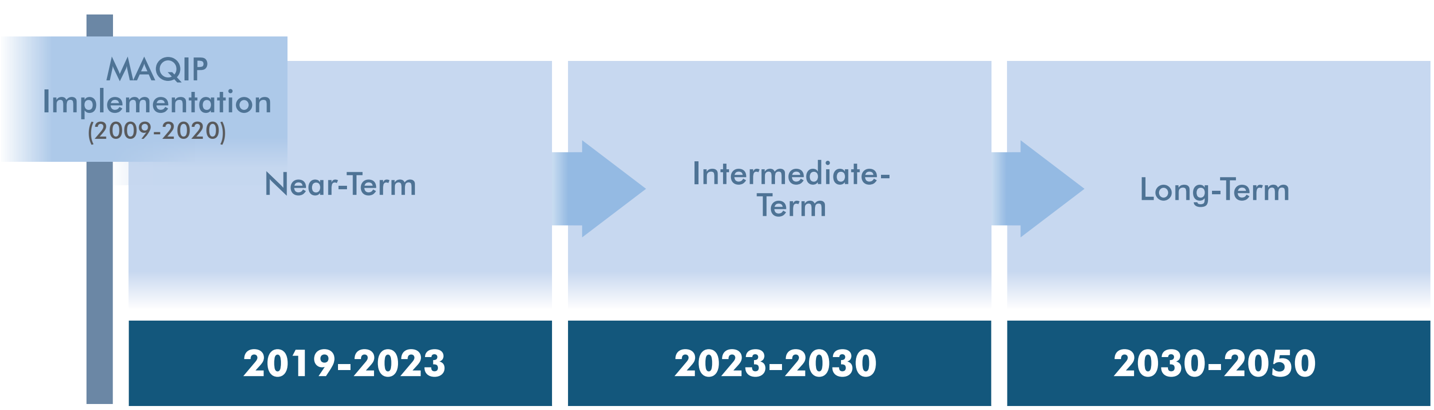
Because the transition to a zero-emissions Seaport is dependent upon interrelated factors, such as the commercial availability of new technologies, funding, and operational feasibility, the Plan foresees a decades-long implementation process. Accordingly, the Port will implement the **2020 and Beyond Plan** in phases:

- **Near-Term Phase** (2019-2023), which overlaps with and incorporates MAQIP implementation through 2020
- **Intermediate-Term Phase** (2023-2030)
- **Long-Term Phase** (2030-2050)

Figure 4 shows the Plan Phases.

The pathway to a zero-emissions Seaport can begin with *early actions*[5], as Port tenants begin deploying commercially available and operationally feasible equipment for which adequate infrastructure exists. Similarly, the Port can begin the needs assessment and feasibility studies for the infrastructure to support future deployment of zero-emissions equipment. During the Plan development period, the Port has taken steps to develop and implement air emissions reductions projects. For example, the Port began certain early actions, such as implementation of the ZANZEFF grant, in support of the pathway to a zero-emissions Seaport.

Figure 4: **Timeline and Action Plan Phases**



Source: Port of Oakland 2019

[5] *An early action is an action that promotes the Plan's goals and is undertaken in advance of Final Plan approval.*

Action Plan

The **2020 and Beyond Plan** identifies Implementing Actions for each of the three implementation phases. Given the rapid rate of technological development, however, the Implementing Actions for the Intermediate-Term and Long-Term Phases are less certain and likely to evolve and change.

During all phases, Implementing Actions may depend on available funding and staff resources. Some of the Implementing Actions will be ongoing, such as monitoring shore power compliance, while others are specific projects with specific project delivery dates.

Near-Term Phase (2019-2023)

Near-Term Implementing Actions

The Near-Term Phase overlaps with the existing MAQIP implementation through the Year 2020 and incorporates existing MAQIP programs as well as new Implementing Actions begun during the development of the Plan. An example is the hybrid RTG crane project at the Oakland International Container Terminal (OICT), which is supported by a Carl Moyer grant program through BAAQMD. Another example is the Port's component of the Port of Long Beach ZANZEFF grant, which includes evaluation of demonstration-level battery-electric CHE and drayage trucks. Near-Term Implementing Actions may include any of the seven categories of Implementing Actions.

Some actions in progress or recently completed include:

- Continued monitoring of shore power systems usage and compliance
- Repowering of existing RTG cranes to hybrid RTG cranes at OICT
- Tracking of grants and incentives and seeking partnerships
- Emissions inventory (the Year 2017 Seaport Emissions Inventory was completed in July 2018 [Ramboll 2018])
- Purchase of a 10-passenger, battery-electric van for the Port's vehicle fleet
- Seaport Air Quality 2020 and Beyond Task Force meetings

Near-Term Action Plan

The Port has identified 36 Implementing Actions for 2019 to 2023 (see Table 2) and three Intermediate-Term goals (see Table 3). These Implementing Actions comprise the NTAP, that is, the work program for years 2019-2023. For each Implementing Action, the NTAP provides a brief description, the Implementing Action category, the lead(s) to carry out the action, and the proposed schedule by year. As Implementing Actions are completed and Port and/or tenant resources are freed up, further Implementing Actions may be selected through the screening and evaluation process and added to the NTAP. As a guiding principle for the Plan, the Port will continue to focus on practicable technology, meaning technology that is commercially available and operationally feasible. The NTAP includes concrete actions as well as studies and tracking of technology development. The intermediate-term goals consist of two equipment-focused goals and one infrastructure goal to support the two equipment goals.

The Implementing Actions in the Near-Term Phase fall into two classifications: (1) Programmed Actions for which required funding and resources have been approved by the Board, and (2) Suggested Actions.

Depending on available resources and other factors, such as commercial availability of equipment, additional Implementing Actions may be undertaken during the 5-year period covered by the NTAP. Priorities will be set based on the screening and feasibility evaluation process, which will reflect the success of earlier Implementing Actions and the outcomes of technology demonstration projects and feasibility studies. The NTAP will be reviewed and updated annually to include additions, changes to classification, and status.

Related Projects

In addition to the Implementing Actions specifically designed to reduce Seaport-related emissions of GHGs and TACs, there are several projects that are programmed to be undertaken in the Seaport Area as part of the Alameda County Transportation Commission GoPort Program (see Appendix B: Background). These projects focus on freight movement efficiency, safety, and information technology, and are also expected to have air quality benefits (e.g., from reduced idling, etc.[6]). Table 4 provides a summary of these related projects.

Intermediate-Term Phase (2023-2030)

Implementing Actions undertaken in the Intermediate-Term Phase will build on the Implementing Actions conducted in the Near-Term Phase. Some Near-Term Implementing Actions must be completed before certain Intermediate-Term Implementing Actions can be implemented. For example, the Port will need to upgrade or replace its substations before capacity for extensive deployment of battery-electric equipment is feasible at some locations within the Seaport Area.

Examples of Implementing Actions that may occur in the Intermediate-Term Phase include:

- Continued upgrades and/or construction of Port-owned and PG&E-owned[7] substations
- Continued expansion of electrical infrastructure to support equipment charging at terminals
- Increased use of hybrid and zero-emissions CHE
- Continued conversion of the Port-owned fleet to zero-emissions vehicles
- Continued use of grants and incentive funding to replace or convert existing CHE and drayage trucks to zero-emissions or hybrid equipment, as appropriate

[6] *These actions are being implemented under separate processes, and are not subject to the 2020 and Beyond Plan's screening and evaluation process.*

[7] *The Port does not have control over the PG&E's infrastructure, so Port tenants served by PG&E need to communicate their needs to PG&E.*

By 2030, the Seaport Area will reflect a mosaic of zero-emissions technologies and associated infrastructure. Based on the proposed CARB rule-making schedule for freight movement activities, new or amended emissions regulations would take effect between 2023 and 2030 (see Appendix B: Background). The anticipated regulations pertain to OGV (expected to take effect in 2023), harbor craft (expected to take effect in 2023), drayage trucks at seaports and rail yards (expected to take effect between 2026 and 2028), CHE (expected to take effect after 2026), and rail yard idling emissions restrictions (expected to take effect after 2025).

These new regulations will likely drive additional innovation in the regulated equipment sectors and operations. Zero-emissions technologies will continue to mature and incremental costs for zero-emissions technology are expected to decrease.[8] This will change the feasibility of deploying zero-emissions technologies and equipment during the Intermediate-Term Phase. New Suggested Actions will continue to be identified and screened, and Suggested and Screened Actions in Pools #1 and #2 will be screened and evaluated on a periodic basis.

Long-Term Phase (2030-2050)

During the Long-Term Phase, the construction of required infrastructure will continue to support the pathway to zero emissions. Port partners are expected to continue to replace fossil-fuel-based equipment with zero-emissions equipment as resources, regulations, equipment replacement cycles, and technological developments allow. Grants and incentives will continue to be important factors affecting the rate at which zero-emissions equipment is adopted. Without HVIP vouchers or other incentive or grant funding, zero-emissions yard tractors, for example, are not expected to reach cost parity with diesel-powered tractors until the late 2030s (see Appendix F: Equipment Operations and Cost Assessment to Assist with Electric Infrastructure Planning).

The Port will continue to carry out Implementing Actions and work with stakeholders to identify new Suggested Actions and implement the screening and evaluation process. The Port will also continue to advocate for cleaner OGVs, as OGVs in transit will probably remain the largest source of Seaport-related DPM emissions.

[8] *Incremental costs are costs above the cost of equivalent diesel equipment. Over time, as battery technology improves and zero-emissions equipment is produced on a commercial scale, the costs of zero-emissions equipment will approach that of diesel equipment.*

Table 2: Near-Term Action Plan (Years 2019-2023)

#	Specific Implementing Action	Appendix C Implementing Action Number and Name	Category	Lead	Classification	Summary of Implementing Action	2019	2020	2021	2022	2023
1	13 Hybrid Rubber-Tired Gantry (RTG) Cranes at SSAT	E-CHE-3. Expand Use of Hybrid Cargo-Handling Equipment Where Zero-Emissions Equipment is Not Commercially Available or Affordable	Equipment	T	P	The Bay Area Air Quality Management District (BAAQMD) awarded a Carl Moyer grant to Stevedoring Services of America Terminals (SSAT), the terminal operator at the Oakland International Container Terminal (OICT), for the purchase of 13 hybrid RTG cranes. SSAT is using this grant to replace the diesel engines in its entire fleet of RTG cranes at OICT. Phase-in is expected to require approximately 2 years. The first RTG crane was repowered in February 2019, and subsequent repowers are expected to occur approximately every 2 months. Overall criteria air pollutant emissions from the hybrid RTG cranes are reduced 99.5% compared to the existing diesel units.	Implementation / Construction	Implementation / Construction	Operation	Operation	Operation
2	90% Shore Power Use	E-OGV-1. Shore Power Improvements - Achieve 90% Shore Power Use	Infrastructure, Operations	PO	P	As part of its grant requirements, the Port will continue to work with ocean carriers and tenants to improve plug-in rates to achieve an overall 90% plug-in rate in 2020.	Impl./Constr.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity
Zero- and Near-Zero-Emissions Freight Facilities (ZANZEFF) Project Components											
3	10 Electric Class 8 Trucks plus Charging Infrastructure at Shippers Transport Express (STE)	E-T-4. Short-Haul Drayage Truck Demonstration Testing	Equipment	PO, T	P	The Port of Long Beach, in collaboration with the ports of Oakland and Stockton, was recently successful in obtaining a ZANZEFF grant from the California Air Resources Board (CARB). The Oakland component of the grant includes deploying 10 electric drayage trucks at Port tenant Shippers Transport Express (STE), and five electric yard tractors and one battery-electric top-pick at the Matson Terminal (Berths 60-63). Testing will assess the performance of the various types of equipment, including operating time between charges, time required to recharge the vehicles, performance under load, maintenance requirements, and more. Pursuant to the Memorandum of Understanding between the Port of Oakland and the Port of Long Beach dated February 7, 2019, the Port committed to construct the necessary charging infrastructure for the drayage trucks to be deployed at STE.	Impl./Constr.	Impl./Constr.	Operation	Operation	Operation
4	1 Battery-Electric Top-Pick Plus Charging Infrastructure at Matson Terminal (SSA)	E-CHE-5. Demonstration Testing of Electrically-Powered Cargo Handling Equipment	Equipment	T	P		Impl./Constr.	Impl./Constr.	Operation	Operation	Operation
5	5 Electric Yard Tractors plus Charging Infrastructure at Matson Terminal (SSA)	E-CHE-5. Demonstration Testing of Electrically-Powered Cargo Handling Equipment	Equipment	T	P		Impl./Constr.	Impl./Constr.	Operation	Operation	Operation

Equipment   Infrastructure   Operations

T Tenant   PO Port of Oakland   P Programmed[9]

Impl./Constr. = Implementation / Construction

[9] *Programmed Actions are those that have passed the feasibility evaluation and for which funding has been approved. See Step 5 of Screening and Evaluation of Implementing Actions for a description of Programmed and Suggested Actions. Suggested Actions are actions that have not been screened or evaluated.*

Table 2: **Near-Term Action Plan (Years 2019-2023)** (cont.)

#	Specific Implementing Action	Appendix C Implementing Action Number and Name	Category	Lead	Classification	Summary of Implementing Action	2019	2020	2021	2022	2023
Port Fleet Electrification											
6	10-passenger Electric Van	E-M-1. Port Fleet Conversion and Charging Infrastructure	Equipment	PO	P	In June 2018, the Port purchased a 10-passenger electric van for use at the Seaport.	Operation	Operation	Operation	Operation	Operation
7	Large Capacity Forklifts (1)	E-M-1. Port Fleet Conversion and Charging Infrastructure	Equipment	PO	P	The Port used the screening and evaluation process for Implementing Actions to assess the viability of purchasing battery-electric vehicles and equipment for its fleet. Although the electric equipment is considerably more costly, the Port decided to purchase six electric vehicles and equipment as a pilot test in Fiscal Year 2019 (Board Resolution 18-117). Three of the battery-electric vehicles will be assigned to the Seaport Area; the specifications for these vehicles are expected to go to bid in Spring 2019.	Impl./Constr.	Operation	Operation	Operation	Operation
8	Work Trucks (2)	E-M-1. Port Fleet Conversion and Charging Infrastructure	Equipment	PO	P		Impl./Constr.	Operation	Operation	Operation	Operation
Infrastructure											
9	Replace Electrical Infrastructure That is Beyond its Serviceable Life	I-9. Future Infrastructure Modifications.	Infrastructure	PO	S	Certain components of the Seaport electrical grid are nearing the end of their serviceable life and need to be replaced and potentially upgraded. The Port will identify high-priority components and integrate the replacement of these components into its budget planning cycle.			Impl./Constr.	Impl./Constr.	Operation
10	Port Electrical Grid Reliability and Capacity Upgrades	I-9. Future Infrastructure Modifications.	Infrastructure	PO	S	In addition to replacing electrical grid components that have reached the end of their serviceable life, the Port will also undertake specific actions to increase the resilience and capacity of the Seaport's electrical grid.			Impl./Constr.	Impl./Constr.	Operation
11	Charging Infrastructure - Harbor Facilities	E-M-1. Port Fleet Conversion and Charging Infrastructure	Infrastructure	PO	P	In June 2018, the Port installed charging infrastructure at its Harbor Facilities building to charge fleet and personal vehicles. Additional charging infrastructure may be installed to accommodate the battery-electric equipment described in Items 6, 7, and 8 above.	Impl./Constr.	Operation	Operation	Operation	Operation
12	Charging Infrastructure - Impact Transportation	I-9. Future Infrastructure Modifications	Infrastructure	T	P	Impact Transportation has installed charging equipment and placed an order for an electric yard tractor.	Impl./Constr.	Operation	Operation	Operation	Operation

Equipment Infrastructure

T Tenant PO Port of Oakland P Programmed S Suggested

Impl./Constr. = Implementation / Construction

Table 2: **Near-Term Action Plan (Years 2019-2023)** (cont.)

#	Specific Implementing Action	Appendix C Implementing Action Number and Name	Category	Lead	Classification	Summary of Implementing Action	2019	2020	2021	2022	2023
Other Demonstration Projects											
13	BYD[10] Phase I: Electric Drayage Truck at GSC Logistics	E-T-4. Short-Haul Drayage Truck Demonstration Testing	Equipment	T	P	Since February 2018, GSC Logistics has been operating a first-generation electric short-haul drayage truck.	Operation	Operation	Operation	Operation	Operation
14	BYD Phase II: Electric Drayage Trucks (up to 10 trucks total)	E-T-4. Short-Haul Drayage Truck Demonstration Testing	Equipment	T	S	Deploy up to 10 BYD electric short-haul drayage trucks at Port tenant locations. The testing will assess the performance of the trucks, including operating time between charges, time required to recharge the vehicles, performance under load, maintenance requirements, and more. Phase II provides improved technology compared to Phase I.	Impl./Constr.	Operation	Operation	Operation	Operation
Studies and Plans											
15	Maritime Power Capacity Study for Terminal Electrification	I-3. Maritime Power Capacity Study for Terminal Electrification	Infrastructure	PO	P	The scope of the study includes: • Existing system loads; existing distribution system model; and future system needs • Terminal cargo handling equipment electrification needs • Distribution system capacity and upgrade requirements • Transmission system capacity and upgrade requirements • Pacific Gas and Electric Company (PG&E) transmission system capacity	Impl./Constr.				
16	Future Infrastructure to Support Zero-Emissions Port Fleet	E-M-1. Port Fleet Conversion and Charging Infrastructure	Infrastructure	PO	S	The Port will continue to assess its infrastructure needs as it continues to convert its fleet to zero-emissions equipment over time.			Pot.Impl./Const.	Pot.Impl./Const.	Pot.Impl./Const.
17	Track Tenant Equipment Purchases and Respond to Tenant Needs for New Infrastructure	Technology Tracking and Performance Monitoring	Equipment, Infrastructure	PO	S	Monitor equipment used by tenants and encourage the purchase of cleanest technologies. As tenants decide to purchase zero-emissions equipment, the Port will work with the tenants to determine the need for any new supporting infrastructure. Tenants will need to work with PG&E at locations served by PG&E.	Pot.Impl./Const.	Pot.Impl./Const.	Pot.Impl./Const.	Pot.Impl./Const.	Pot.Impl./Const.
18	Electric Vehicle Infrastructure Guide for Port Tenants	I-5. Electric Vehicle Infrastructure Guide for Port Tenants	Infrastructure	PO	P	To facilitate Port tenants' ability to install electrical charging infrastructure, Port staff are preparing a guide that includes relevant information regarding permit and other requirements, and that provides the necessary forms for permit applications.	Impl./Constr.				

Equipment Infrastructure

T Tenant PO Port of Oakland P Programmed S Suggested

Impl./Constr. = Implementation / Construction
Pot.Impl./Const. = Potential Implementation / Construction

[10] *BYD is an original equipment manufacturer of, among other products, battery-electric drayage trucks.*

Table 2: **Near-Term Action Plan (Years 2019-2023)** (cont.)

#	Specific Implementing Action	Appendix C Implementing Action Number and Name	Category	Lead	Classification	Summary of Implementing Action	2019	2020	2021	2022	2023
19	Investigate Use of Renewable Diesel for Land-Based and Marine Equipment	F-4. Renewable Diesel Fuel	Fuels	PO	S	The Port is continuing to coordinate with CARB, fuel producers, and fuel users to assess the benefits of implementing renewable diesel for Port tenants and partners. Depending on the outcome of this assessment, the Port will work to educate appropriate users about the benefits of using renewable diesel.	Pot.Impl./Const.	Pot.Impl./Const.			
20	Investigate Use of Renewable Diesel in Port-Owned Diesel-Powered Vehicles	F-4. Renewable Diesel Fuel	Fuels	PO	P	The Port's fleet manager is evaluating the switching from petroleum diesel to renewable diesel for the Port's fleet. A new contract would have to be put in place to purchase renewable diesel.	Impl./Constr.	Impl./Constr.			
21	Evaluate Vessel Speed Reduction (VSR) Program	O-4. Evaluate Vessel Speed Reduction Program	Operations	PO	S	In consultation with the San Francisco Bar Pilots and other partners, the Port will evaluate the potential for a voluntary and an incentivized VSR program after the results of the BAAQMD pilot study are available. An incentivized VSR program could be included as part of an overall environmental incentive program. VSR in the outer Precautionary Zone would reduce Seaport-related diesel particulate matter (DPM) emissions by about 2 tons per year and greenhouse gases (GHGs) by approximately 4,200 to 4,500 metric tons of carbon dioxide equivalents (CO_2e) per year in 2020 (Starcrest 2018).	Potential Implementation / Construction	Potential Implementation / Construction			
Monitoring and Tracking											
22	Track Hybrid RTG Crane Installation at OICT	Technology Tracking and Performance Monitoring	Equipment	PO	P	The Port will coordinate with SSAT to track the performance of the hybrid RTG cranes as they are implemented at the OICT. Tracking will assess items such as fuel consumption, operability, and manufacturer performance.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity
23	Track Development of Uniform Charging Standards for Electrically-Powered CHE at San Pedro Bay Ports (SPBP), and Advocate for Specific Port Needs as Applicable	I-7. Uniform Charging Standards for Electrically-Powered Terminal Equipment and Drayage Trucks	Infrastructure, Equipment	PO	P	Manufacturers of electric terminal equipment are using different methods and equipment design specifications for equipment charging, resulting in different infrastructure requirements depending on the equipment and specific manufacturer selected. As more terminal equipment is transitioned to electric power, these different equipment charging approaches may lead to significant challenges. The SPBP have been working with regulatory agencies, technology developers and equipment operators to establish uniform charging standards for yard tractors and other CHE. The Port will continue to track the development of the uniform charging standards, and assist with the review of the standards.	Potential Implementation / Construction	Potential Implementation / Construction	Potential Implementation / Construction		

Fuels Operations Equipment Infrastructure PO Port of Oakland P Programmed S Suggested

Table 2: **Near-Term Action Plan (Years 2019-2023)** (cont.)

#	Specific Implementing Action	Appendix C Implementing Action Number and Name	Category	Lead	Classification	Summary of Implementing Action	2019	2020	2021	2022	2023
24	Monitor Shore Power Use	0-5. Monitor Shore Power Use	Operations	PO	P	The Port tracks shore power usage on a monthly basis to identify problems and opportunities for increasing shore power use.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity
25	Track Port Tenant Incentive-Funded Zero-Emissions Equipment and Associated Infrastructure (e.g., Prop 1b and Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project [HVIP] Funding)	Technology Tracking and Performance Monitoring	Operations	PO	P	The Port will continue to track the progress of tenant deployment of zero-emissions and other alternatively fueled equipment and vehicles, and tenants' success with obtaining grant and incentive funding for their equipment and charger purchases.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity
26	Conduct Emission Inventories	Monitoring and Reporting	Operations	PO	S	The Port prepared Seaport Emission Inventories (EIs) for the years 2005, 2012, 2015, and 2017. The Port will continue to prepare EIs to evaluate the progress of emissions reductions efforts. The next EI is intended to be completed for the Year 2020.		Impl./Constr.			Impl./Constr.
27	Continue to Coordinate with Port Efficiency Task Force (PETF) (or future equivalent) and Others to Identify and Implement Efficiency Measures	P-6. Participate in Industry Stakeholders Groups	Operations	PO	P	The Port will continue to coordinate with the PETF and others to identify new potential efficiency measures to reduce the overall emissions per ton of cargo over time.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity
28	Track Clean Air Action Plan (CAAP) Technology Advancement Program Results	P-1. Track San Pedro Bay Ports' CAAP Progress and Technology Advancement Program	Parnerships	PO	P	The Port will continue to proactively reach out to SPBP to stay informed regarding various initiatives under the CAAP, including incentive programs and technology demonstrations.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity

Operations   Parnerships

PO Port of Oakland   P Programmed   S Suggested

Impl./Constr. = Implementation / Construction

Table 2: **Near-Term Action Plan (Years 2019-2023)** (cont.)

#	Specific Implementing Action	Appendix C Implementing Action Number and Name	Category	Lead	Classification	Summary of Implementing Action	2019	2020	2021	2022	2023
29	Track SPBP Zero/ Near-Zero Emissions Feasibility Studies	P-1. Track San Pedro Bay Ports' CAAP Progress and Technology Advancement Program	Partnerships	PO	P	The Port will track the CAAP feasibility studies.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity
30	Track SPBP Truck Rate Study	FG-4. Track SPBP Truck Rate Study	Funding and Grants	PO	P	The SPBP have started a study of the potential implementing considerations, including costs, and implications, such as effects on independent owner-operator truckers, of a truck rate. The Port will track the outcome of this study to determine whether a similar study at the Port of Oakland is appropriate.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity
31	Meet with Port Tenants Annually to Discuss Current Air Quality Measures and Room for Improvement	P-5. Meet with Port Tenants	Partnerships	PO	P	On an annual basis, the Port will meet with selected tenants (marine terminal operators, rail yard operators, and tenants with more than 100,000 square feet of building space) to receive an update on the tenant's efforts to reduce air emissions associated with its operations and to provide an update to the tenant on recent technological improvements. The annual update will include an inventory update of all CHE from all tenants with more than 100,000 square feet.	Implementation / Construction	Implementation / Construction	Implementation / Construction	Implementation / Construction	Implementation / Construction
Other Actions											
32	Encourage Railroads to Use Cleanest Possible Equipment in Oakland	E-L-5. Encourage Railroads to Use Cleanest Engines in Oakland	Partnerships	PO	P	The Port will send a letter to railroads operating in the Seaport Area and encourage their use of the cleanest equipment at their local rail yards and use of their cleanest engines to haul trains that pass through their local rail yards.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity
33	Actively participate in Trucker Work Group, Harbor Trucking Association (HTA), and Western States Trucking Association (WSTA)	P-6. Participate in Industry Stakeholders Groups	Partnerships	PO	P	The Port will continue to actively participate in trucker associations to share information on recent technological improvements and available grant and incentive programs, and to receive feedback on equipment cost and performance.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity
34	Port Environmental Office Hours for Trucking Companies and Truckers	P-3. Port Environmental Office Hours for Trucking Companies and Truckers	Partnerships	PO	P	The Port has established weekly office hours to provide truckers with information pertaining to servicing modern trucks and grant and incentive programs for zero-emissions vehicles.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity

Parnerships   Funding and Grants

P Programmed   PO Port of Oakland

Table 2: Near-Term Action Plan (Years 2019-2023) (cont.)

#	Specific Implementing Action	Appendix C Implementing Action Number and Name	Category	Lead	Classification	Summary of Implementing Action	2019	2020	2021	2022	2023
35	Participate with PETF, Pacific Merchant Shipping Association, and Other Industry Stakeholders to Keep Informed and Provide Updates on Zero-Emissions Technologies	P-6. Participate in Industry Stakeholders Groups	Partnerships	PO	P	The Port will continue to coordinate with industry stakeholders to receive and share updates on new technologies, equipment performance and operability experience, and costs.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity
36	Implement Workforce Development Plan	P-12. Workforce Development Plan	Partnerships	PO	S	The Port will implement the Workforce Development Plan in Appendix E.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity
37	Pursue Low Carbon Fuel Standard Credits	FG-2. Financing Mechanisms and Sources	Funding and Grants	PO	S	The Low Carbon Fuel Standard (LCFS) was amended in January 2019 to allow for credits from fuel use by heavy-duty mobile equipment. The Port will pursue credits for the electrical power it supplies to support this equipment. The Port has registered its shore power substations as sources eligible for LCFS credits.	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity	On-Going Activity

Parnerships   Funding and Grants

PO Port of Oakland   P Programmed   S Suggested

Source: Port of Oakland 2019

Table 3: **Intermediate-Term Equipment and Infrastructure Goals**

#	Goal	Appendix C Implementing Action Number and Name	Category	Lead	Summary of Implementing Action
I-1	Deploy 44 Pieces of Zero Emissions Cargo-Handling Equipment by 2025[11]	E-CHE-4. Electrically-Powered Cargo-Handling Equipment		T	The Port will work with its tenants to facilitate implementation of battery-electric and/or other zero-emissions cargo-handling equipment(CHE). This action assumes State of California Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) funding remains in place and is dependent on the actual development of technology and cost differential for zero-emissions CHE over time. This Implementing Action includes equipment that has been demonstrated, is in demonstration, and/or is in operation. Six pieces of CHE will be deployed as part of the Zero- and Near-Zero-Emissions Freight Facilities (ZANZEFF) grant (see Items 4 and 5 in Table 2).
I-2	Deploy 21 Zero-Emissions Drayage Trucks by 2027[11]	E-T-4. Short-Haul Drayage Truck Demonstration Testing		T	The Port will work with its tenants and conduct outreach to truckers to facilitate implementation of zero-emissions drayage trucks. This action assumes HVIP funding remains in place and is dependent on the actual development of technology and cost differential for zero-emissions drayage trucks over time. This Implementing Action includes equipment that has been demonstrated, is in demonstration, and/or is in operation. Eleven yard tractors are currently in demonstration testing, and up to 10 additional yard tractors may be deployed for demonstration as part of BYD's Phase II evaluation (see Items 3, 13, and 14 in Table 2).
I-3	Infrastructure to Support Deployment of Zero-Emissions Equipment for Goals I-1 and I-2	I-8. Charging Infrastructure to Support Zero-Emissions Equipment		PO	The Port will coordinate with tenants to provide supporting infrastructure for zero-emissions CHE and drayage trucks for equipment deployed pursuant to Goals I-1 and I-2. This may include installation of spare infrastructure where appropriate and when opportunities arise (e.g., spare conduits and stub-outs).

Equipment Infrastructure

T Tenant PO Port of Oakland

Source: Port of Oakland 2019

11 *This goal includes equipment that has been demonstrated, is in demonstration, or is in commercial operation, and includes equipment that has recently been deployed and equipment that is currently on order.*

Table 4: **Related Projects**

#	Specific Implementing Action	Category	Lead	Classification	Summary of Implementing Action	2019	2020	2021	2022	2023
GoPort Project - Proposed 7th Street Grade Separation										
1	7th Street Grade Separation – East	Infrastructure	A	P	This proposed project will replace the existing railroad underpass between Interstate 880 (I-880) and Maritime Street to increase clearance for trucks and improve the shared pedestrian/bicycle pathway. In combination with the 7th Street Grade Separation - West project, this proposed project is intended to improve traffic flow in the Port area, thereby reducing truck idling times. Construction is expected to begin in 2020.		Pot.Impl./Const.	Pot.Impl./Const.	Pot.Impl./Const.	Operation
2	7th Street Grade Separation – West	Infrastructure	A	P	This proposed project will realign and grade separate the intersection of 7th Street and Maritime Street and construct a rail spur underneath to improve access and minimize conflicts between rail, vehicles, pedestrians, and bicyclists. In combination with the 7th Street Grade Separation - East project, this proposed project is intended to improve traffic flow in the Port area, thereby reducing truck idling times. The expected construction duration is 2 to 2.5 years beginning in 2021.			Pot.Impl./Const.	Pot.Impl./Const.	Pot.Impl./Const.
GoPort Project - Proposed Freight Intelligent Transportation System										
3	Project 1: Joint Transportation Management Center and Emergency Operations Center (TMC/EOC)	Equipment, Infrastructure, Operations	A	P	Reconfigure/modify existing TMC at the Port's Harbor Facilities building for the efficient operation of a Joint TMC/EOC, which will maintain and operate the Intelligent Transportation System elements to be deployed by the Freight Intelligent Transportation System (FITS) Project.	Pot.Impl./Const.	Operation	Operation	Operation	Operation
4	Project 2: Radio-Frequency Identification (RFID) Readers	Equipment, Infrastructure, Operations	A	P	Install RFID readers in and near the Seaport facilities on existing and new poles to monitor truck movement, including truck turn-time within the Port. The readers will transmit the truck information to a central location that can be accessed through a server.	Pot.Impl./Const.	Operation	Operation	Operation	Operation

Infrastructure Equipment Operations

A ACTC P Programmed

Pot.Impl./Const. = Potential Implementation / Construction

ACTC = Alameda County Transportation Commission

Table 4: **Related Projects** (cont.)

#	Specific Implementing Action	Category	Lead	Classification	Summary of Implementing Action	2019	2020	2021	2022	2023
5	Project 3: Advanced Traffic Management System (ATMS) - Phase 1		A	P	Install and/or implement the following: • Signal improvements including video detection (intersection only) • Advanced Rail Grade Crossing System (for determining train activity and delays) • Advanced Traffic Management System (ATMS) software platform • Changeable Message Signs (CMS) • Queue detection • Closed-circuit television (CCTV) upgrade to high-definition (HD) • Communications (fiber) • Center to Center (C2C) connection between the Port, the City of Oakland, and the California Department of Transportation (Caltrans) • Additional RFID readers (not installed by Project No. 2) requiring communication network via a fiber backbone • Supplemental Vehicle Detection (for determining vehicle speeds and traffic patterns) • Weigh-in-Motion (WIM) technology (for determining truck weights)	Potential Implementation / Construction	Potential Implementation / Construction	Operation	Operation	Operation
6	Project 4: Basic Smart Parking System		A	P	Installation of software system/application that monitors parking availability that can be shared via GoPort Freight ITS Information System/App, CMS and other system technology, as well as provide parking payment options.		Pot.Impl./Const.	Pot.Impl./Const.	Pot.Impl./Const.	Operation
7	Project 5: Communications (Wi-Fi)		A	P	Install Wi-Fi capabilities in the Seaport Area as a backup communications system and a means for addressing cellular dead spots and enhancing security and emergency response functions. Offers amenities to truckers in queue or within the Port (e.g., Port traffic and gate queue videos and improved access to GoPort Freight ITS information System/Application).		Pot.Impl./Const.	Pot.Impl./Const.	Pot.Impl./Const.	Operation
8	Project 6: System Integration and GoPort Application – Phase 1		A	P	A systems integrator (SI) will develop software to integrate existing and new intelligent transportation systems (ITS) applications. In addition, the SI will develop graphical user interface application for the basic GoPort application. The application will be made available for the end users (truck and other service providers) so that it can be used, for example, to find travel time, including turnaround time within the Port; find container information, such as availability and yard information; make appointments for container pickups/drop-offs or parking within the Port complex; and pay fees.		Pot.Impl./Const.	Pot.Impl./Const.	Pot.Impl./Const.	Operation

Infrastructure Equipment Operations

A ACTC P Programmed

Pot.Impl./Const. = Potential Implementation / Construction

ACTC = Alameda County Transportation Commission

Source: Port of Oakland 2019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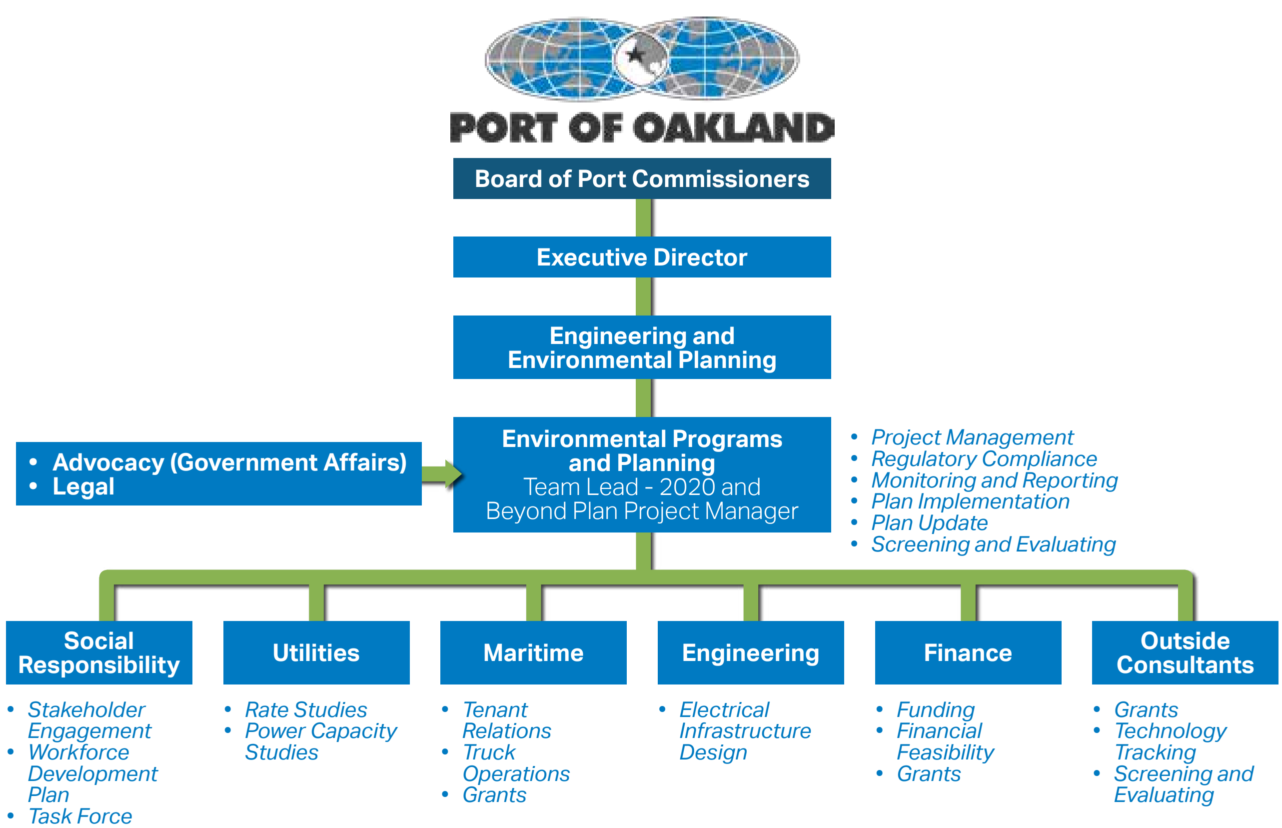
Plan Management

Management of the Plan during implementation requires a flexible process in a rapidly changing technological and regulatory environment. The Port has designed an internal implementation team that provides a broad range of expertise. To address anticipated rapid changes in zero-emissions technology and regulatory requirements, the Port will update the Plan in 2023 (see Plan Update, below). The Plan update may propose changes to the implementation team structure.

Plan Implementation Team

The Port's Environmental Planning and Programs Division (EPP), through a designated 2020 and Beyond Plan Program Manager, will manage the Plan on an ongoing basis and track the progress of the Implementing Actions undertaken by the Port and its partners. Other Port divisions will contribute to implementation of the Plan, as shown in Figure 5: Implementation Team Structure. EPP is domiciled within the Port's Engineering and Environmental Planning Division, which reports directly to the Executive Director. Figure 5 illustrates the reporting relationship and roles for Plan implementation.

Figure 5: **Implementation Team Structure**



Source: Port of Oakland 2019

Plan Implementation Scope of Effort

The Port identified 150 discrete tasks within the Plan. The Port organized these tasks into 10 broad categories, which are listed below in alphabetical order.

- Advocacy
- Coordination
- Engineering Studies and Design
- Grants, Incentives, and Funding
- Monitoring and Reporting
- Plan Management
- Screening, Feasibility Evaluation, and Implementation of Implementing Actions
- Stakeholder Engagement
- Technology Tracking
- Workforce Development

Within these categories, the Port identified six critical functions that are essential to successfully implementing the Plan:

1. Plan management
2. Utilities demand and infrastructure planning
3. Electrical engineering for electrical system and charging infrastructure
4. Grant-making and grant compliance
5. Stakeholder engagement
6. Coordination of various efforts related to drayage trucks

The Port anticipates that 75% of the effort to implement the Plan will be spent on these six critical functions. The Port will use Port staff, who are anticipated to be supported by specialized technical consultants to help with stakeholder engagement, development of grants and incentives, technology tracking, screening and evaluation of Implementing Actions, and engineering studies and design.

The Plan's implementation approach is designed to be flexible and responsive to changing conditions. Information gathered and lessons learned will be disseminated to stakeholders and incorporated into the overall implementation effort.

As part of Plan implementation, the Port is conducting studies to assess the potential costs associated with Seaport electrification. Adequate infrastructure is a prerequisite for deployment of zero-emissions technology at the Port. The studies provide support and information for the Port's infrastructure planning and are critical to ensuring that the right kind of infrastructure is constructed in the right locations at the right time. Data-gathering through needs assessments and feasibility studies will be an important component of the Plan's implementation during the Near-Term Phase.

Plan implementation is distinct from implementation of specific projects. The Port follows a systematic project implementation process. The project implementation process consists of project definition, feasibility analysis, programming (i.e., budget and schedule approval), and execution of the scope of work. For infrastructure projects, project execution would typically entail construction, commissioning (i.e., testing), and initiation of operations. For smaller projects such as studies, execution of the project would consist of completion of the study or a specific task.

All major projects are subject to specific Board approval. Smaller projects, such as developing the electric vehicle infrastructure guide (see Table 2, Action 18), are included in the Port's operating budget, which is approved annually by the Board.

Plan Update

Technology is changing rapidly and State regulations and policy are increasingly targeting zero-emissions requirements and substantial reductions in GHG emissions as well as the public's exposure to TACs. The overall technology and regulatory landscape is shifting and is expected to be more fully developed in 5 years. At that time, many of the Near-Term Implementing Actions will have been implemented and data will be available to evaluate their benefits. The **2020 and Beyond Plan** will therefore be updated in 2023, the final year of the Near-Term Phase, to reflect these changes, the lessons learned from the initial set of Implementing Actions, changes to economic conditions, and the stakeholder engagement process. As part of the Plan Update, the Port will discuss proposed changes to the Plan with stakeholders and present the proposed update to the Board for its consideration and approval.

The Port intends to review and, as appropriate, update the NTAP on an annual basis. The review, which will be conducted in collaboration with stakeholders, will consider equipment changes, infrastructure and operating process improvements, regulatory and other developments, experience with Implementing Actions conducted to date, the results of the annual evaluation and prioritization of Implementing Actions, and the overall trajectory of DPM and GHG emissions reductions associated with Seaport operations. The NTAP review will be part of the Port's annual progress report (see the following section on monitoring the Plan).

Monitoring the Plan

Monitoring and reporting are critical components of the implementation process for the **2020 and Beyond Plan**. Monitoring includes tracking the progress of Implementing Actions and conducting periodic emissions inventories to evaluate reductions in criteria air pollutants, DPM, and GHGs. Compared to the MAQIP, the monitoring program designed for the **2020 and Beyond Plan** includes a greater focus on lessons learned, in part because much of the needed technology has yet to be fully developed and made commercially available and in part because the Plan intends to build capacity and share knowledge for future actions.

Monitoring the Execution and Results of Implementing Actions

The Port will monitor the execution and results of Implementing Actions. The Port may also choose to monitor certain Implementing Actions during implementation, for example, to understand the complexity of implementing new equipment. In addition, the Port may monitor the performance of certain Implementing Actions over time (e.g., the performance of zero-emissions equipment or certain types of chargers).

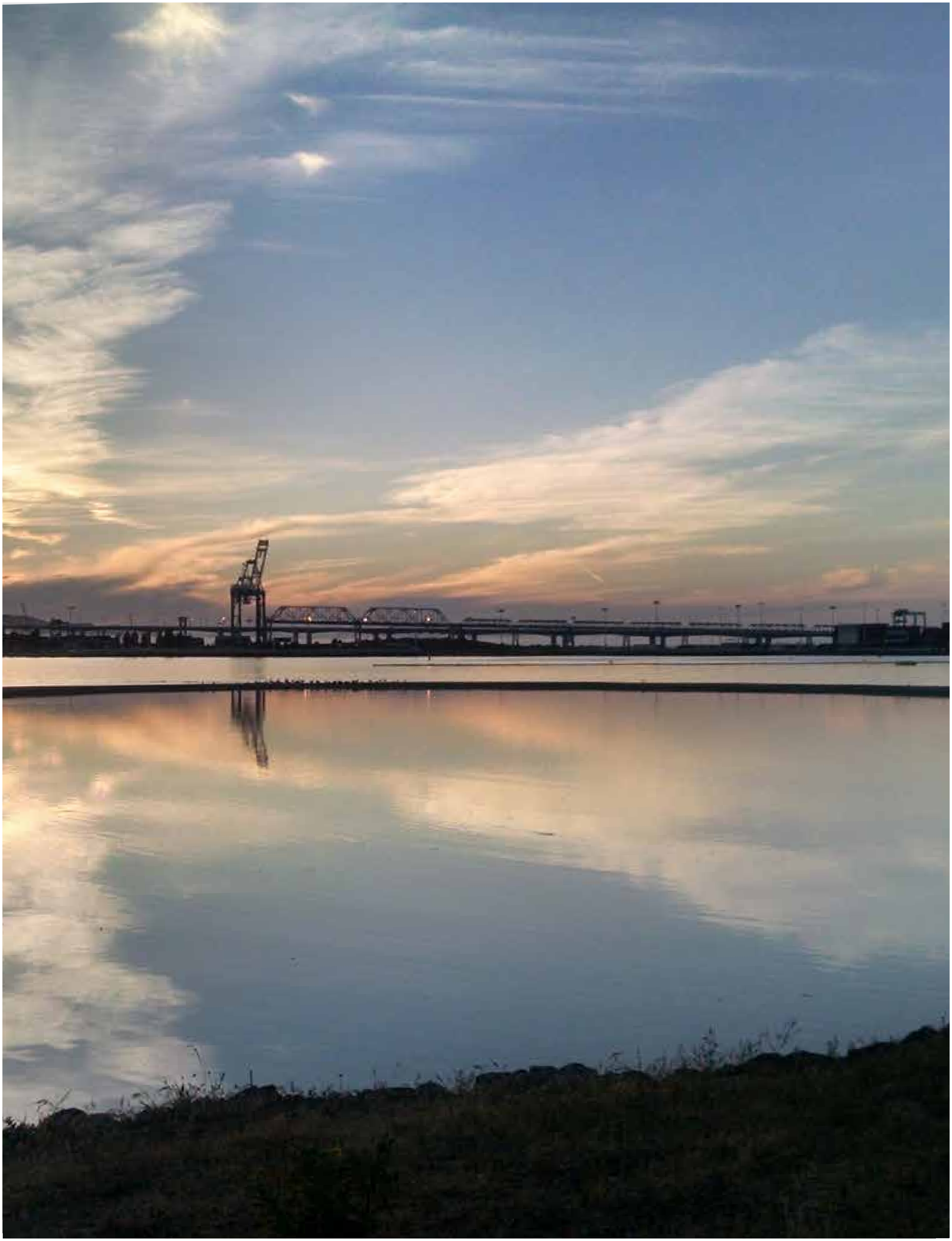
Determining Emissions Reductions

The Port will conduct periodic emissions inventories to estimate the emissions reductions from Seaport mobile sources. Development of a full inventory for sources at the Port is a time-intensive process involving collection of data on all emissions-generating activities (e.g., ship calls, berthing times, and truck trips), equipment (e.g., engine types and sizes, and exhaust after-treatment devices), operating parameters (e.g., engine loads, travel speeds, and idling times), and associated emissions factors. Emissions inventories address criteria air pollutants, DPM, and GHGs. The Port will compare the results of the emissions inventories to the Year 2005 baseline. In addition, the Port will evaluate the trend in total DPM and GHG emissions relative to Port growth over time.

Reporting

The Port will report to the Board on the progress of Plan implementation on an annual basis. The annual progress report will include the results of the NTAP review and update, and data and information from stakeholders and other parties. For example, Port staff will periodically ask tenants to report on the status of air quality improvements. To update stakeholders on NTAP results and facilitate continued stakeholder involvement, the Port will post annual progress reports on its website. The Port will also share the reports at Task Force meetings, Community Town Halls, and other public forums (see the final PEP in Appendix G).

In addition, the Port will provide documentation regarding the screening and evaluation process on the Port's website and will update this documentation following each screening and evaluation cycle. When the Task Force Co-Chairs convene a Working Session on a specific action, the Port will post the notes from the Working Session on the Port website.



Funding the Plan

Implementation of the **2020 and Beyond Plan** will require significant financial resources from the Port and its tenants and other businesses. The Plan provides the framework to assist agencies, businesses, and the Port in ascertaining how best to apply their respective resources in support of Plan goals. Implementation of the Plan will proceed incrementally as funding and resources for various actions become available and the cost of new zero-emissions or hybrid equipment approaches parity with diesel-fueled equipment. For infrastructure, the Port anticipates that major improvements will be programmed into the Port's budget. Smaller projects would be completed in response to tenant requests as tenants develop specific plans to deploy zero-emissions equipment.

Even though Plan implementation will proceed incrementally, the Port and its tenants and other business partners are unlikely to be able to provide all the required funding. External funding will be essential for investments in zero-emissions and hybrid technology, equipment, fuels, and infrastructure, as well as for Plan management and workforce development. For example, if HVIP funding continues to be available under the current terms, battery-electric yard tractors could reach cost parity with diesel-fueled equipment by 2022, as shown in Appendix F: Equipment Operations and Cost Assessment to Assist with Electric Infrastructure Planning. If incentive funding is not available, cost parity may not be achieved until 2038 or later. Private financing may also be an option for some equipment owners, and the Port welcomes all means that increase equipment owners' access to zero-emissions equipment.

External Funding

The Port, its business partners, and tenants will consider and evaluate a broad range of funding options for major infrastructure improvements. The implementation team will work with agencies and organizations (such as CARB and PG&E), equipment vendors, and potential grant recipients to secure grants or other funding (such as the Low-Carbon Fuel Standard [LCFS] credits) for eligible equipment, infrastructure upgrades, and other efforts that advance the goals of the Plan. Any decision by the implementation team to pursue a particular grant or funding source will be based on the likelihood that the effort will be successful, the value of the grant or funding opportunity, and other Port priorities and constraints. The implementation team may also provide information and assist other grant applicants with a grant application.

To support Strategy #6: Pursue External Funding, the Plan identifies implementation team departments to pursue future grant funding opportunities for the Port and its business partners. The Port will also coordinate with its tenants on estimates of their specific power needs, development of designs, and costs. Where major system upgrades such as a substation or new transmission line are required, the Port will conduct a focused cost assessment and develop a specific financing strategy.

The Port has designated an internal lead department to pursue LCFS credits and has also registered its shore power substations to be eligible for LCFS credits. Once the Port obtains LCFS credits, it will sell them on the LCFS market.[12]

[12] *LCFS credits can only be sold if there is demand for the credits, and the price that can be obtained for the credits depends on the demand.*

Grants and Incentives

External funding in the form of grants and incentives from local, State, and federal sources will be key to the incremental implementation of the Plan and to achieving cost parity with conventional diesel-fueled equipment. Transitioning from the current diesel-fueled equipment to zero-emissions equipment will take time, and the cost premium associated with zero-emissions equipment that currently exists will likely persist over the next decade or more. During the transition period, the State is encouraging new technologies through grant and incentive programs such as voucher programs. Grants and incentive funding are also available from the federal government and regulatory agencies, and potentially from utility providers.

Incentive funding is unlikely to be adequate to support conversion of all equipment serving the Seaport to zero emissions. The Port anticipates that the majority of zero-emissions equipment will be deployed as such equipment becomes cost-competitive with diesel-powered equipment, including used diesel trucks for drivers who purchase used trucks. Each organization or individual owner-operator will determine when it makes sense to replace diesel equipment with zero-emissions equipment, taking into consideration the availability of incentive funding and the effort associated with obtaining that incentive funding.

The Port anticipates that Port tenants and business partners as well some community-based organizations will seek grant and incentive funding to support eligible projects and activities. In some cases, the Port may apply for grants or incentive funding directly for its own electrical system upgrades and charging infrastructure. For example, the Port previously applied for and/or received CARB, BAAQMD, and Transportation Investment Generating Economic Recovery (TIGER) grants (from the US Department of Transportation) to accelerate installation of electrical infrastructure to support the implementation of shore power. The Port could also apply for grants and incentive funding directly if the Port were to be the lead applicant on behalf of multiple tenants or if the grant required the applicant to be a public agency. The Port will evaluate suitable financing options to fund major infrastructure improvements and select the one that is most favorable to the Port.

The administrative burden and complexities that may accompany the grant process are important considerations for grant applicants. Some grant program requirements may be so burdensome and carry such high uncertainty that they fail to make economic or business sense (e.g., application deadlines that are too short, complex applications that require more resources than an applicant can devote, difficult reporting requirements, vague or onerous non-performance provisions, unclear guidelines, and excessively demanding cost-effectiveness criteria).

Grant applicants will consider the emissions reduction benefits of the potential action funded by any grant. The amount of emissions reductions achievable will factor into the decision of whether to proceed with a grant application.

New forms of grant and incentive funding, such as the recent amendments to the LCFS, are likely to become available over time, and the Port's implementation team will continue to keep abreast of these and other changes to grant and incentive opportunities.

Joint Development of Eligible Projects

Grant-making has been an integral part of the MAQIP implementation process (e.g., Proposition 1B Goods Movement grants for shore power and United States Environmental Protection Agency grants for trucks). Port staff have focused their efforts on meeting with Port tenants, equipment owners, and manufacturers to develop grant-eligible projects. Port staff have identified and publicized numerous grant programs and other agencies' incentive programs at the Port's Trucker Working Group and the PETF, at ad hoc meetings, at the Port's office hours for truckers, and at recent events specifically targeted at truckers. These grant and incentive programs are potentially applicable to Port tenants, equipment owners, and/or manufacturers.

For incentives involving new equipment provided by external (non-Port) agencies, the Port is generally not the equipment owner. For these types of grants, the Port can play a supporting role, for example, by identifying grant opportunities, conducting feasibility studies, preparing grant applications, or encouraging partnerships between tenants, equipment manufacturers, and grant-making agencies. Coordination and cooperation among the Port, tenants, and the agencies are essential for these grants to be successful.

Grants to Tenants and Local Equipment Operators

Port tenants have also applied independently for State and BAAQMD grants. For example, CenterPoint Oakland Development, LLC, which entered into a 66-year lease with the Port covering approximately 27 acres of the Port-owned former Oakland Army Base, applied for a CEC grant to provide charging infrastructure for its future warehouse development. Similarly, several truckers serving the Port have received Proposition 1B grants from BAAQMD for additional low-NOx (oxides of nitrogen) and zero-emissions trucks.

Other Funding Opportunities

Some funding or equipment may also be available from equipment vendors or other proponents of specific technologies. For example, BYD is proposing to provide 10 Phase 2 electric drayage trucks for evaluation by Port tenants. This type of funding or equipment, which is typically linked to the testing or demonstration of specific technologies, would generally be applicable to equipment or systems that would be purchased and implemented by Port partners, and vendors may directly approach partners for opportunities to test their new technologies.

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Conclusion

According to the 2017 Seaport Emissions Inventory (Ramboll 2018), Seaport-related DPM emissions have decreased by 81% relative to the 2005 baseline, and the Port is continuing to make progress towards its MAQIP target of an 85% reduction in DPM emissions. The **2020 and Beyond Plan** builds on this foundation of emissions reductions, and substantially expands beyond the MAQIP with its vision for a zero-emissions Seaport. In addition to continuing the MAQIP's focus on reducing emissions of DPM, the **2020 and Beyond Plan** targets reductions in GHG emissions and emphasizes localized emissions reductions. The **2020 and Beyond Plan** incorporates seven categories of actions: the equipment actions that were the primary focus of the MAQIP and six additional categories.

A zero-emissions Seaport will require a new technological operating basis built on new equipment powered by electricity rather than diesel, and new power and information technology infrastructure. In the Near-Term Phase (2019-2023), actions such as the deployment of hybrid-electric RTG cranes can provide significant emissions reductions. Near-term actions based on commercially available technologies are an important focus of the Plan.

The full transition to a zero-emissions Seaport will require substantial financial and resource investments and commitments by the Port and its partners. The transition will occur in phases over decades. It will require the sustained engagement and commitment of all stakeholders during all phases of Plan implementation.


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Glossary

Ancillary Maritime Services: Services such as federal Customs and Border Protection (CBP), agricultural inspection, truck repair, truck parking, fueling, and other services that support Seaport operations.

Applicability of the Plan: The Seaport Air Quality 2020 and Beyond Plan applies to emissions arising from the five major equipment categories in the Emissions Inventory (Ramboll 2018) and emissions from Port-led development activities at the Seaport.

Assembly Bill 617 (AB 617): Making use of new air pollution monitoring technologies capable of detecting elevated exposures at a much more localized scale than conventional ambient air quality monitors, Assembly Bill 617 (AB 617) (C. Garcia, Chapter 136, Statutes of 2017) aims to establish a new community-scale emissions abatement program; updates air quality standards for certain stationary sources located in or contributing to non-attainment areas; and provides for improved enforcement and ensures community participation in the process.[13] In response to AB 617, the California Air Resources Board (CARB) established the Community Air Protection Program (CAPP or Program) to develop a new community-focused action framework for community air protection. In addition, the State Legislature has appropriated AB 617 funding to support early actions to address localized air pollution through targeted incentive funding to deploy cleaner technologies in these communities as well as grants to support community participation in the AB 617 process. AB 617 also includes new requirements for accelerated retrofit of pollution controls on industrial sources, increased penalty fees, and greater transparency and availability of air quality and emissions data. These requirements will help advance air pollution control efforts throughout the State.

Call (or Vessel Call): A visit by a ship to a port. A vessel may call a given port only once or multiple times during a calendar year.

Cargo-Handling Equipment (CHE): Equipment used to move containers within a marine terminal. Cargo-handling equipment in use at the Port of Oakland includes rubber-tired gantry (RTG) cranes, yard tractors, side-picks, and top-picks. The large ship-to-shore cranes that move containers from the vessel to the container yard and vice-versa are not included in the definition of CHE.

Co-benefit: A benefit derived from an action that addresses another concern. In the context of this Plan, reducing GHG emissions typically provides a co-benefit of reducing diesel particulate matter emissions.

Community: The residents and businesses in West Oakland and in other areas near the Seaport.

Concrete Action: An Implementing Action that results in reductions in air emissions through deployment of equipment or construction of infrastructure (contrasted with studies and monitoring that would be required to plan or evaluate the concrete actions).

[13] *Center for Clean Air Policy: California's AB 617: A New Frontier in Air Quality Management… if funded. August 2, 2017.*

Drayage Truck: A truck used to haul containers to and from the container terminals. It consists of the tractor unit and a semi-trailer consisting of the container on a chassis (wheeled base).[14]

Electrolysis: Electrolysis is the process of using electricity to split water into hydrogen and oxygen. Electrolysis using GHG-free electricity is a means of generating renewable hydrogen for use in vehicles and equipment powered by hydrogen fuel cells.

Emissions Inventory: An emissions inventory is an estimate of the quantity of pollutants that a group of sources produces in a given area over a prescribed period of time.

Fiber Optic Communications Systems: Fiber optic communications systems transmit information from one place to another by sending pulses of light through an optical fiber. Optical fiber is used by many telecommunications companies to transmit telephone signals, Internet communication, and cable television signals.

Greenhouse Gas (GHG)-Free Energy: Energy produced without emitting GHGs into the atmosphere. GHG-free energy includes solar power, wind power, geothermal power, and hydroelectric power.

GoPort Program: A program that is being led and implemented by the Alameda County Transportation Commission. The GoPort (Global Opportunities at the Port of Oakland) Program is designed to improve truck and rail access at the Port of Oakland. It includes three components designed to reduce congestion and increase efficiency to improve sustainability and economic competitiveness. The three components are the 7th Street Grade Separation East, 7th Street Grade Separation West, and the Freight Intelligent Transportation System (FITS).

Harbor Craft: Smaller vessels, including tugs, survey boats, and work boats that are used in water-based Seaport operations.

Heavy-Duty Diesel: A heavy-duty diesel truck is also known as a Class 8 truck. It has a gross vehicle weight rating of more than 33,000 pounds. The typical 5-axle tractor-trailer truck combination, also called a "semi" or "18-wheeler," is a Class 8 vehicle. Class 8 vehicles are the most common trucks at the Seaport, and they are also referred to as drayage trucks (see above).

Hybrid: An engine that runs partially on electrical power recovered from braking or other sources (e.g., when an RTG crane lowers a container) that is wasted in conventional engines. Hybrid equipment runs on battery power until the battery is exhausted, and may then use an internal combustion engine to either power the engine directly or to recharge the battery.

Implementing Action: A specific action that contributes to the achievement of the Plan's goals and vision.

Marine Terminal: A site where vehicles that transport containers load and unload containers.

Maritime Area: See Seaport Area.

[14] *CARB defines a drayage truck as "any in-use on-road vehicle with a gross vehicle weight rating (GVWR) greater than 26,000 pounds that is used for transporting cargo, such as containerized, bulk, or break-bulk goods, that operates: (A) on or transgresses through port or intermodal rail yard property for the purpose of loading, unloading or transporting cargo, including transporting empty containers and chassis; or, (B) 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" (CARB 2018a).*

Near-Zero-Emissions: A term that is applied to many different types of equipment, including low-NOx trucks and hybrid equipment, that have relatively low emissions. As defined by the State of California in Assembly Bill 1341 (AB 1341) *"near-zero-emissions vehicle' means a vehicle that utilizes zero-emission technologies, enables technologies that provide the pathway to zero-emissions operations, or incorporates other technologies that significantly reduce criteria pollutants, toxic air contaminants, and greenhouse gas emissions, as determined by the State Air Resources Board in consultation with the State Energy Resources Conservation and Development Commission, consistent with meeting the State's mid- and long-term air quality standards and climate goals."*[15] Given the variety of equipment that may be classified as near-zero-emissions equipment, this Plan refers to these types of equipment by their specific type, such as low-NOx or hybrid.

Ocean Carrier: A company operating a vessel that visits the Seaport.

Ocean-Going Vessel: A large vessel used in transoceanic commerce. Almost all of the ocean-going vessels[16] visiting the Seaport are container ships.

Partner: A business, public agency, non-governmental organization (NGO), community, or other organization working collaboratively with the Port to accomplish the goals of the *Seaport 2020 and Beyond Plan*.

Programmed Action: An Implementing Action that has been selected for implementation and for which funding has been approved. (See *Screening and Evaluation of Implementing Actions* for more details on Programmed Actions.)

Pool of Implementing Actions: The Implementing Actions that have been assembled for screening (Pool #1, Suggested Actions), have passed Step 2 of the screening process (Pool #2, Screened Actions), or have been selected for implementation but have not yet been funded (Pool #3, Selected Actions).

Renewable Electricity: Electricity produced from renewable sources, which may include solar power, wind power, and power from small hydroelectric sources. Electricity from large hydroelectric projects and municipal waste incineration is specifically excluded from this definition.[17]

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[15] *Bill introduced by Assembly Member Calderon, February 17, 2017. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB1341*

[16] *The CARB definition of ocean-going vessel is as follows "'Ocean-going vessel (OGV)' means a commercial, government, or military vessel meeting any one of the following criteria: (A) a non-tanker vessel greater than or equal to 400 feet in length overall (LOA) as defined in 50 CFR § 679.2, as adopted June 19, 1996; (B) a non-tanker vessel greater than or equal to 10,000 gross tons (GT ITC) per the convention measurement (international system) as defined in 46 CFR 69.51-.61, as adopted September 12, 1989; (C) a non-tanker vessel propelled by a marine compression ignition engine with a per-cylinder displacement of greater than or equal to 30 liters; or (D) a tanker that meets any one of the criteria in subsections (A)-(C)" (CARB 2018b).*

[17] *The California Energy Commission defines renewable electricity as being produced by a facility that "uses biomass, solar thermal, photovoltaic, wind, geothermal, fuel cells using renewable fuels, small hydroelectric generation of 30 megawatts or less, digester gas, municipal solid waste conversion, landfill gas, ocean wave, ocean thermal, or tidal current, and any additions or enhancements to the facility using that technology" (SB 2, Simitian 2011).*

Renewable Fuels: Fuels produced from renewable sources. Examples include renewable diesel, renewable natural gas, hydrogen (if generated using GHG-free electricity), and biodiesel, among others. Renewable liquid fuels, primarily renewable diesel and biodiesel, can often be used directly in place of petroleum diesel in existing engines or require only minor operating changes.

Residual Emissions: The emissions remaining after the substantial reductions from the 2005 baseline emissions that result from implementation of the Maritime Air Quality Improvement Plan (MAQIP).

Screened Action: An Implementing Action that has passed Step 2 of the screening and evaluation process.

Seaport: The Port of Oakland's maritime operations, including the berths, wharves, and marine terminals.

Seaport Area: Consists of the Seaport and immediately adjacent areas associated with the Seaport, including warehouses and truck support facilities, and ancillary maritime services. The Seaport Area includes tidelands under the Port's jurisdiction. The Seaport Area, as the term is used in this document, excludes the Union Pacific Railroad rail yard, the Schnitzer Steel facility, and City-owned portions of the former Oakland Army Base.

Selected Action: An Implementing Action that has been selected for implementation but for which funding has not yet been identified. Selected Actions were ranked highly in Step 4 of the screening and evaluation process.

Semi-Trailer: A trailer having wheels at the back, but that is supported at the front by a tractor unit (the part of a truck that includes the cab). A semi-trailer does not have a front axle and associated front wheels. A large proportion of a semi-trailer's weight is supported by the front tractor unit (see Tractor Unit, below.)

Stakeholder: An organization or individual with an interest in, or potentially affected by, implementation of this Plan, including but not limited to local residents, community-based organizations, regulatory agencies, Port tenants, equipment owners and operators, and Seaport-related businesses.

Steamship: A ship that is propelled by a steam engine.

Suggested Action: An action that has been identified by the Port or one of the stakeholders as potentially contributing to one or more of the goals of this Plan but that has not yet been screened to determine if it supports the goals of the Plan.

Tenant: A business renting land or facilities at the Seaport. Current tenant examples include Impact Transportation, GSC Logistics, Central Valley Ag Grinding (CVAG), and PCC Logistics.

Terminal Operator: A company operating a terminal; sometimes also known as a Cargo Terminal Operator or Marine Terminal Operator (MTO) for terminals located at ports.

Terminal Velocity: The rate at which containers can be moved into and out of a marine terminal; the higher the terminal velocity, the more efficient the marine terminal.

Throughput: The volume of cargo passing through a marine terminal or a port over a given period of time. Seaports generally measure business activity based upon throughput volumes.

Tractor-Trailer: The combination of a tractor unit and one or more semi-trailers to carry freight. A semi-trailer attaches to the tractor with a fifth wheel hitch, and much of its weight is borne by the tractor.

Tractor Unit: A heavy-duty towing engine that provides the power to haul a towed or trailered load; also referred to as a prime mover or traction unit.

Yard Tractor: A tractor unit designed specifically for use in a container yard; also referred to as a yard truck, utility tractor rig, yard goat, yard hostler, or prime mover.

Zero-Emissions Equipment: Per AB 1341,[18] equipment that does not emit any criteria air pollutants, toxic air contaminants, or GHGs while stationary or in operation, as determined by the State Air Resources Board. However, the fuel source (e.g., electricity or hydrogen) may still generate emissions at the point of production or in transport.

[18] *Bill introduced by Assembly Member Calderon, February 17, 2017. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB1341*

References

California Air Resources Board (CARB). 2018a. Drayage Truck Regulation. California Code of Regulations Article 4.5, Chapter 1, Division 3, title 13, section 2027.
Available at: https://www.arb.ca.gov/msprog/onroad/porttruck/finalregdrayage.pdf.
Accessed November 2, 2018.

_____. 2018b. 17 CCR, section 93118.2. Airborne Toxic Control Measure for Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels Within California Waters and 24 Nautical Miles of the California Baseline.
Available at: https://www.arb.ca.gov/ports/marinevess/documents/fuelogv17.pdf.
Accessed November 2, 2018.

International Maritime Organization (IMO). 2018. UN body adopts climate change strategy for
http://www.imo.org/en/mediacentre/pressbriefings/pages/06ghginitialstrategy.aspx.
Accessed April 14, 2018.

Port of Oakland (Port). 2009. Final Maritime Air Quality Improvement Plan. April.

Ramboll. 2018. Port of Oakland 2017 Seaport Air Emissions Inventory Final Report. August.
Available at: https://www.portofoakland.com/files/PDF/Port_Oakland_2017_Emissions_Inventory.pdf.

Starcrest Consulting Group, LLC (Starcrest). 2018. Technical Memorandum: MAQIP Update - Emissions Forecast and Potential Additional Reduction Strategies. July.

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Appendix A:

Planning Assumptions

Credit: Kyle Mortara

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ACRONYMS AND ABBREVIATIONS

2020 and Beyond Plan	Seaport Air Quality 2020 and Beyond Plan
DPM	Diesel Particulate Matter
MAQIP	Maritime Air Quality Improvement Plan
Plan	Seaport Air Quality 2020 and Beyond Plan
Port	Port of Oakland

INTRODUCTION

The Seaport Air Quality 2020 and Beyond Plan (the 2020 and Beyond Plan or Plan) incorporates and reflects a set of planning assumptions, which are summarized in Table A-1. Table A-2 provides a comparison of the Port of Oakland's (Port's) existing Maritime Air Quality Improvement Plan (MAQIP) to the 2020 and Beyond Plan and presents the geographic scope of the Plan (see Figure A-1).

TABLE A-1: PLANNING ASSUMPTIONS	
Planning Assumption	**Basis for Assumption**
Primary Geographic Area	Implementation of actions identified in this Seaport Air Quality 2020 and Beyond Plan (2020 and Beyond Plan or Plan) will occur in the Seaport Area, including areas of the Oakland Army Base (OAB) owned by the Port of Oakland (Port). The Port is not proposing any emissions reduction initiatives on OAB property owned by the City of Oakland (City), the Union Pacific rail yard, or Schnitzer Steel as part of this Plan. These areas fall under the primary jurisdiction of the City. The Maritime Air Quality Improvement Plan (MAQIP) (Port 2009) and the California Air Resources Board's (CARB's) 2008 Health Risk Assessment (HRA) focused on a specific geographic area, West Oakland (Figure A-1) (CARB 2008). The 2020 and Beyond Plan has benefits to a larger local area that may also be affected by Seaport-related air emissions (including downtown Oakland and Chinatown, as well as the city of Alameda).
Volume Growth and Net Revenue	Pursuant to the Port's business projections, performed in 2019, cargo volume is expected to grow at a rate between 1% and 2% per year, based on the most current forecasts. Maritime growth is measured as growth in both activity and net revenue.
Criteria Air Pollutant and Toxic Air Contaminant (TAC) Emissions	As a result of continued improvements in technology driven by existing and prospective regulations, projected emissions of criteria air pollutants and diesel particulate matter (DPM), absent any specific actions by the Port, will remain relatively flat compared to current emissions even though cargo volume is expected to increase (Starcrest 2018).
Greenhouse Gas (GHG) Emissions	Unless specific action is taken to reduce emissions of GHGs, GHG emissions will increase with cargo growth, although at a lower rate than total growth due to improvements in engine and operational efficiency (Starcrest 2018).
Port Air Quality Funding Capability - Improvements Consistent with Cargo Volume and Net Revenue	Implementation of the 2020 and Beyond Plan will depend on available Port net revenue, which are partially dependent on overall cargo volume. The Plan relies on leveraging grants, incentives, and partnerships (such as the State of California Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project [HVIP], and Low Carbon Fuel Standard [LCFS] credits). New grant programs and incentive opportunities are expected to emerge over time. Following the projected retirement of the Port's current debt in 2033, additional Port funding may become available.

TABLE A-1: PLANNING ASSUMPTIONS	
Planning Assumption	**Basis for Assumption**
Technological Paradigm Shift Requires Phased Transition	The path to a zero-emissions Seaport is based on a transformative change in technology in contrast to the gradual changes in existing technology (such as implementation of improved diesel particulate filters) that have occurred over the past decade. The shift from fossil fuel combustion will be an important factor in continuing to reduce DPM emissions and the community health risk associated with Seaport operations and to achieve GHG reductions in support of the State's GHG reduction efforts. The transition to a zero-emissions Seaport will occur in phases over time, reflecting natural replacement cycles for equipment and the evolution of zero-emissions technology.
Relationship of Emissions Reductions to Health Risk Reduction	Reductions in DPM emissions from Seaport operations will result in an associated reduction of community exposure to DPM. This reduction in exposure to DPM will in turn result in a health risk reduction for the local community. The Port will continue to focus on DPM emissions reductions and will rely upon CARB, the Bay Area Air Quality Management District, and the Alameda County Department of Public Health to assess health risk.
Increased Efficiency through Use of Smart Technology	Use of "smart technology" to drive efficiency improvements is increasing at ports all over the world. As both data transmission and data management capabilities increase, use of smart technology is expected to increasingly drive the container management process and cargo operations, thus reducing fuel use, truck trips, and idling. Workforce development is likely to be required to address the impacts of increased reliance on smart technology as well as the change in technology to zero-emissions equipment (see Appendix E: Workforce Development Plan).
Flexibility and Adaptability	All aspects of technology required for the implementation of this Plan are evolving rapidly; there will be constant change throughout the life of this Plan. A flexible, adaptable approach is required to be able to meet the goals set out in this Plan.
Changing Regulatory Environment	The regulatory environment is expanding from a focus on criteria pollutants to an approach encompassing both GHG emissions and exposure to TACs. Many of the regulations currently contemplated by CARB would take effect in 2023 or later.
Building Knowledge and Capability	As the Port and its partners make progress toward achieving a zero-emissions Seaport, increased knowledge will be developed regarding the performance, operability, and maintenance requirements of various types of equipment, as well as regarding infrastructure needs and monitoring processes. This Plan explicitly seeks to increase the knowledge base of the Port and its stakeholders (see Guiding Principles) so that each step in the transition to a zero-emissions Seaport can be informed by the previous step and so that the effectiveness of each step can be evaluated objectively.
Pragmatic and Results-Oriented Approach	The Port of Oakland takes a pragmatic, hands-on approach with a focus on tangible results in its planning and development processes. For this reason, the Plan emphasizes technologies that are commercially available and proven to perform in maritime and cargo-handling operations in contrast to demonstration or pilot-scale technologies.

TABLE A-1: PLANNING ASSUMPTIONS	
Planning Assumption	**Basis for Assumption**
Compliance with Regulatory Requirements	The Port and its partners are committed to full compliance with all regulations regarding air pollutant emissions. The Port's effort (i.e., the MAQIP's focus) on regulatory compliance is central to the 2020 and Beyond Plan. The 2020 and Beyond Plan strives to identify actions above and beyond regulatory compliance in anticipation of future CARB regulations.
Continuous Learning through Monitoring	The Port will monitor the success of various Implementing Actions in reducing air pollutants and track the implementation challenges associated with the Implementing Actions. The results of the monitoring and lessons learned from implementing various actions will help determine the most appropriate and successful future actions, and will inform the Plan Update.
Plan Update	Technology is expected to change and mature considerably during the life of the Plan. In addition, community-based science will progress and new regulations may be enacted. The Plan will be updated in 2023, with an emphasis on developing the Intermediate-Term (years 2023-2030) Phase actions.
Approach to Infrastructure Development	Infrastructure development to support deployment of zero-emissions technology will progress on multiple tracks. Major improvements in the electrical infrastructure system serving the Port are expected in accordance with overall electrical system master planning efforts. Electrical system master planning reflects Maritime growth projections. Smaller improvements that can be accommodated within the existing electrical grid capacity will be made based on electrical demand generated by tenants. In addition, infrastructure development may be driven by major new grant programs.
Uncertainties	Zero-emissions technology is in the early stage of development. As a result, there is considerable uncertainty with regard to the time frame, cost, and specific technology for the pathway to zero emissions. This uncertainty will be reduced as technological development progresses and more refined studies and projections can be made.
Use of Feasibility Studies	Feasibility studies and assessments are a requisite first step in the project delivery process. In this early stage of zero-emissions technology development, feasibility studies regarding deployment of zero-emissions equipment, infrastructure needs, and the timing of technological development exhibit considerable variation in assumptions and outcomes. This range of outcomes will build knowledge, frame the overall scope of the pathway to zero emissions, assist with decision-making and inform subsequent, more refined analyses.

Source: Port of Oakland 2019.

MOVING FROM THE MAQIP TO THE 2020 AND BEYOND PLAN

The MAQIP (2009) has been successful in substantially reducing diesel particulate matter (DPM) emissions from Seaport sources. Compared to the Year 2005 baseline, the Port's 2017 emissions inventory showed a decline in total DPM emissions of 81% (Ramboll 2018). The 2020 and Beyond Plan builds on this foundation of emissions reductions from Seaport sources to provide a framework for the transition to zero-emissions operations.

The MAQIP focused on incremental improvements to existing internal-combustion technology (diesel-fueled equipment) that relied on an existing infrastructure. The transition to a zero-emissions Seaport will include new technologies and, importantly, infrastructure. Thus, while the MAQIP focused primarily on compliance with regulations, the 2020 and Beyond Plan requires changes to equipment, operations, fuels and infrastructure.

Table A-2 outlines the primary differences between the factors addressed by the MAQIP and the 2020 and Beyond Plan.

TABLE A-2: COMPARISON OF MAQIP AND 2020 AND BEYOND PLAN		
Factor	**MAQIP**	**2020 and Beyond Plan**
Technology	• Incremental improvements to long-established equipment technology • Existing fuel source (diesel) • Known and well-defined control technology	• New and rapidly changing technology; most equipment types not yet commercially available • Battery- and grid-electric systems are the most likely future power sources; the Plan also provides technological flexibility
Infrastructure	• Existing infrastructure • Shore power project focused on providing power to berths.	• Comprehensive improvements to the electric grid • Expansion of the electrical grid throughout the terminals • Increased resilience of the electric grid • Upgraded and new substations • Additional fiber communications line capacity • Possible application of advanced infrastructure solutions, such as distributed energy resources (DERs)[1] and microgrids • Possible need for new infrastructure to support the use of fuels free of greenhouse gases (GHG), such as hydrogen storage for hydrogen fuel cells • Possible need for infrastructure improvements outside the Port footprint and in areas not subject to Port control
Goals	• 85% reduction in Seaport- related diesel particulate matter (DPM) emissions relative to the 2005 baseline	• Pathway to zero-emissions Seaport • Programmed and Suggested Actions in the Near-Term Action Plan (NTAP) • Intermediate-term equipment targets • Alignment with State of California GHG goals
Scope of Effort	• Temporal only: Implement specific actions by 2020	Temporal and spatial: • Temporal: Implement specific actions within the time frame of this Plan. • Spatial: 2020 and Beyond Plan applies to Seaport Area infrastructure (not just mobile sources and equipment). Improvements to, or addition of, new or upgraded infrastructure are needed to deploy new equipment.
Regulatory Environment	• Regulatory requirements drive technological innovation	• Fewer current regulatory drivers for new technology • Substantial new regulatory drivers (new rules) expected between 2023 and 2028, with unknown final compliance deadlines.

Source: Port of Oakland 2019.

[1] Distributed generation, also known as distributed energy, on-site generation (OSG), or district/decentralized energy, is electrical generation and storage performed by a variety of small, grid-connected devices referred to as distributed energy resources (DERs).

FIGURE A-1: PRIMARY GEOGRAPHIC AREA

Source: Port of Oakland 2019.

REFERENCES

California Air Resources Board (CARB). 2008. Diesel Particulate Matter Health Risk Assessment for the West Oakland Community. December. Available at: https://www.arb.ca.gov/ch/communities/ra/westoakland/documents/westoaklandreport.pdf.

Port of Oakland (Port). 2009. Final Maritime Air Quality Improvement Plan. April. Available at: https://www.portofoakland.com/community/environmental-stewardship/maritime-air-quality-improvement-plan/.

Ramboll (Ramboll). 2018. *Port of Oakland 2017 Seaport Air Emissions Inventory Final Report*. August. Available at: https://www.portofoakland.com/files/PDF/Port_Oakland_2017_Emissions_Inventory.pdf.

Starcrest Consulting Group, LLC. 2018. Technical Memorandum: MAQIP Update - Emissions Forecast and Potential Additional Reduction Strategies. July.

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Appendix B:

Background

Credit: Kyle Mortara

CONTENTS

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

2020 and Beyond Plan	Seaport Air Quality 2020 and Beyond Plan
7SGSE	7th Street Grade Separation East
7SGSW	7th Street Grade Separation West
AB 617	Assembly Bill 617
ATMS	Advanced Traffic Management System
BAAQMD	Bay Area Air Quality Management District
Bay Area Air Basin	San Francisco Bay Area Air Basin
BC	Black Carbon
California EPA	California Environmental Protection Agency
C	Celsius
CAAP	Clean Air Action Plan
CAP	Clean Air Plan
CARB	California Air Resources Board
CARE	Community Air Risk Evaluation
CCTV	Closed Circuit Television
CEC	California Energy Commission
CES	California EnviroScreen
CHE	Cargo-Handling Equipment
City	City of Oakland
CMS	Changeable Message Sign
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CTMP	Comprehensive Truck Management Plan
DERA	Diesel Emissions Reduction Act
DPF	Diesel Particulate Filter

DPM	Diesel Particulate Matter
Draft Plan	Draft Seaport Air Quality 2020 and Beyond Plan
ECA	Emission Control Area
EDF	Environmental Defense Fund
EER	Energy Efficiency Ratio
EI	Emissions Inventory
Final Plan	Final Seaport Air Quality 2020 and Beyond Plan
FITS	Freight Intelligent Transportation System
GGRP	Greenhouse Gas Reduction Plan
GHG	Greenhouse Gas
GVW	Gross Vehicle Weight
HC	Harbor Craft
HRA	Health Risk Assessment
I-580	Interstate 580
I-880	Interstate 880
I-980	Interstate 980
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
ISR	Indirect Source Rule
ITS	Intelligent Transportation System
kW	Kilowatt
kWh	Kilowatt-Hour
lb(s)	pound(s)
LFP	Lithium-Iron-Phosphate
LNG	Liquefied Natural Gas
MAQIP	Maritime Air Quality Improvement Plan
NAAQS	National Ambient Air Quality Standards

N_2O	Nitrous Oxide
NO_x	Nitrogen Oxides
NO_2	Nitrogen Dioxide
NREL	National Renewable Energy Laboratory District
NTAP	Near-Term Action Plan
NWSA	Northwest Seaport Alliance
OAB	Oakland Army Base
OEHHA	Office of Environmental Health Hazard Assessment
OEM	Original Equipment Manufacturer
OGV	Ocean-Going Vessel
OIG	Oakland Intermodal Gateway
Plan,	Seaport Air Quality 2020 and Beyond Plan
PM	Particulate Matter
$PM_{2.5}$	Fine Particulate Matter
PN	Particle Number
Port	Port of Oakland
Revised Draft	Revised Draft Seaport Air Quality 2020 and Beyond Plan
RFID	Radio-Frequency Identification
SB 32	Senate Bill 32
SCA/MMRP	Standard Conditions of Approval/Mitigation Monitoring and Reporting Program
SCAQMD	South Coast Air Quality Management District
SCR	Selective Catalytic Reduction
Seaport EI	Seaport Emissions Inventory
SI	Systems Integrator
SIP	State Implementation Plan
SLR	Sea Level Rise
SPBP	San Pedro Bay Ports

SSA	Stevedoring Services of America
SSAT	SSA Terminals and SSA Terminals (Oakland)
STI	Sonoma Technology, Inc.
TAC	Toxic Air Contaminant
TMC/EOC	Transportation Management Center and Emergency Operations Center
TMP	Truck Management Plan
TRL	Technological Readiness Level
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WIM	Weigh-in-Motion
WOCAAP	West Oakland Community Air Action Plan for West Oakland
WOEIP	West Oakland Environmental Indicators Project
ZANZEFF	Zero- and Near Zero-Emissions Freight Facilities
ZE	Zero-Emissions
ZEV	Zero-Emissions Vehicle

INTRODUCTION

Appendix B provides background information on the Seaport Air Quality 2020 and Beyond Plan (2020 and Beyond Plan or Plan). It describes regulations, community research, existing Seaport emissions, the status of zero-emissions technology, and the challenges that may be encountered in implementing the Plan.

AIR QUALITY CONTEXT

The 2020 and Beyond Plan addresses emissions reductions for three types of pollutants: criteria air pollutants, diesel particulate matter (DPM), which is a toxic air contaminant (TAC), and greenhouse gases (GHGs).

Criteria Air Pollutants

The Clean Air Act requires the United States Environmental Protection Agency (U.S. EPA) to set National Ambient Air Quality Standards (NAAQS) for common air pollutants, known as criteria air pollutants. The Clean Air Act then requires states to establish regulations and other controls designed to maintain or achieve compliance with the NAAQS. Regulation of criteria air pollutants, which include nitrogen oxides (NOx) and ozone, may include NAAQS pollutant precursors such as volatile organic compounds (VOCs) that react in the atmosphere to form ozone and organic particulate matter. Many criteria air pollutants contribute to regional air quality concerns, such as smog. The U.S. EPA, the California Air Resources Board (CARB), and the Bay Area Air Quality Management District (BAAQMD) all regulate criteria air pollutants through different programs, depending on the source category.

Diesel Particulate Matter

Diesel particulate matter is listed as a known carcinogen and designated a TAC by the State of California. Like other TACs, DPM is also associated with acute and chronic health effects. The reduction of DPM emissions is a primary consideration in the Port’s air quality planning efforts.

Greenhouse Gases

Greenhouse gases contribute to global climate change and its attendant consequences, such as sea level rise and increases in severe weather. In California, CARB and BAAQMD have regulatory authority over GHG emissions. State executive orders and legislation have set goals for GHG reductions.

SAN FRANCISCO BAY AREA AIR QUALITY

In 2019, the San Francisco Bay Area Air Basin (Bay Area Air Basin) is not in attainment of federal and State ambient air quality standards for ozone and particulate matter (PM). The Bay Area Air Basin is designated as in Marginal Nonattainment of the 8-hour ozone NAAQS and in Moderate Nonattainment of the 24-hour fine particulate matter ($PM_{2.5}$) NAAQS.

The 2017 BAAQMD Clean Air Plan (CAP) (BAAQMD 2017) states:

> "On January 9, 2013, EPA issued a final rule to determine that the Air District attains [sic] the 24-hour $PM_{2.5}$ national standard. This EPA rule suspends key State Implementation Plan (SIP) requirements as long as monitoring data continues [sic] to show that the Air District attains [sic] the standard. Despite this EPA action, the Air District will continue to be designated as non-attainment for the national 24-hour $PM_{2.5}$ standard until the Air District submits a redesignation request and a maintenance plan to EPA, and EPA approves the proposed redesignation."[1]

To achieve attainment with NAAQS, BAAQMD adopts rules for stationary sources (such as refineries) of NOx, VOCs, and PM. CARB regulates mobile sources (such as trucks and ships) of ozone precursors and PM through fuel and engine standards. CARB also requires turnover to newer equipment through in-use fleet rules. Rulemaking is guided by the priorities and analysis of the SIP for each pollutant. Both CARB and BAAQMD may provide grant funding to incentivize actions, such as the purchase of cleaner equipment or the installation of retrofit devices, in advance of regulations or for source categories over which CARB and BAAQMD do not have regulatory authority, such as rail transportation[2] and ocean-going vessels (OGVs) outside the jurisdictional waters of the United States.

Ocean-going vessels calling the Port are subject to CARB regulation within 24 nautical miles of the California baseline.[3] CARB currently limits the type of fuel used by these vessels to distillate fuels containing less than 0.1% sulfur. The International Maritime Organization (IMO) North American Sulfur Emission Control Area (ECA) limits OGVs to fuels containing no more than 0.1% sulfur within 200 miles of the U.S. and Canadian coastlines. Starting in 2020, IMO regulations will limit the sulfur content of distillate fuels to 0.5%; however, the lower limit of 0.1% will still apply within the North American Sulfur ECA.

CITY OF OAKLAND AND PORT OF OAKLAND ROLES IN LOCAL AIR QUALITY MANAGEMENT

The City of Oakland (City) and the Port contribute to air quality management in the local area. The Port develops and implements plans, programs, and projects for regulatory compliance and, where feasible, to exceed regulatory compliance targets. The City regulates land use through zoning, including the location of industrial activities that may be sources of emissions. The City also has authority over truck routes, rules regarding where trucks can park on city streets, enforcement of truck routes and parking rules. As a landlord port, the Port does not own or control most of the equipment operating in the Seaport Area.

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[1] Note that "EPA" in this statement refers to U.S. EPA

[2] States are pre-empted from issuing regulations that could affect interstate commerce. The Class 1 railroads that provide interstate rail transport are regulated at the federal level only.

[3] "Baseline" in this context means the lower low water line along the California coast.

Therefore, the Port can only directly control a very small percentage of air emissions (those directly associated with its own operations). Other reductions must be achieved through the Port's efforts to influence other businesses in the Seaport Area.

The Port influences its tenants, shippers, truckers, and other Port-related businesses through policy and planning, such as the MAQIP and Seaport Air Quality 2020 and Beyond Plan, the ban on non-compliant trucks, lease terms, contractual requirements, and involvement in the regulatory process. The Port may also have access to a wider range of grants or more favorable grant terms than private entities. For example, the Port is eligible for grant funding sources, such as U.S. EPA Diesel Emissions Reduction Act (DERA) grants, which private entities may not be able to access directly. In other cases, such as for a recent California Energy Commission (CEC) grant,[4] private entities may be required to provide a cost match, whereas public agencies are exempt from providing matching funding. As appropriate to implementing the Near-Term Action Plan (NTAP), the Port will consider using these grant opportunities as a possible means of supplementing grant opportunities that are accessible to private businesses.

WEST OAKLAND HEALTH RISK: CARB HEALTH RISK ASSESSMENT AND RELATED STUDIES

The Port continues to take action to reduce DPM emissions associated with Seaport operations, as stated in Appendix A: Planning Assumptions. The Port relies upon CARB, BAAQMD, and the Alameda County Public Health Department to assess health risk. The available information pertaining to the community health risk is presented below.

CARB Human Health Risk Assessment (2008)

In 2005, the Port prepared a Seaport Emissions Inventory (Seaport EI) to identify and quantify air emissions from maritime activities. In 2008, CARB used the 2005 Seaport EI to conduct the West Oakland human health risk assessment (HRA). The 2008 HRA reported that West Oakland residents were exposed to high concentrations of DPM—almost three times higher than the average background levels in the Bay Area at that time. CARB's 2008 HRA attributed 16% of the DPM-related cancer risk in West Oakland to Seaport sources, while other sources (primarily over-the-road trucks not associated with the Seaport) and the Union Pacific Railroad operations, accounted for 80% and 4% of the health risk, respectively (CARB 2008). Thus, the largest source of potential cancer risk was from non-Port trucks. A summary of the findings of the 2008 HRA is presented in Table B-1.

[4] The Advanced Freight Vehicle Infrastructure Deployment Grant administrated by CEC (paid out of the Alternative and Renewable Fuel and Vehicle Technology Program). The Port applied for this grant, but did not win it. Private entities were required to provide a cost match; public entities were not.

Table B-1: Population-Weighted Potential Cancer Risks in West Oakland Community by Parts and Source Category (2005 Baseline)				
Source Category	**Part I (Port)**	**Part II (UP)**	**Part III (non-Port)**	**Combined**
Ocean-Going Vessel (OGV) Transiting, Maneuvering, and Anchoring	57	0	23	81
OGV Hoteling	57	0	10	67
Harbor Craft	15	0	78	93
Trucks	42	7	795	844
Cargo-Handling Equipment	16	21	7	43
Locomotives	4	15	37	56
Others	0	0	2	2
Total	**192 (16%)**	**43 (4%)**	**951 (80%)**	**1,186 (100%)**

Notes: Total area for the West Oakland Community = 1,800 acres; total population = 22,000. Part III anchorage activities are included with impacts from Part III hoteling.
Source: *Diesel Particulate Matter Health Risk Assessment for the West Oakland Community* (CARB 2008)

The 2008 HRA is the most recent CARB HRA. Since 2008, emission standards have changed. Also, the Port of Oakland has conducted three additional Seaport emissions inventories since the baseline Seaport EI in 2005. The most recent Seaport EI (2017) shows an 81% reduction in total DPM from Seaport mobile sources, and a 98% reduction in DPM from Port trucks. BAAQMD used data for OGVs, harbor craft, and cargo-handling equipment (CHE) collected in support of the 2017 Seaport EI as part of an updated HRA (see 2019 BAAQMD Health Risk Assessment).

BAAQMD West Oakland Truck Survey (2009)

Following the 2008 HRA, BAAQMD conducted the West Oakland Truck Survey in 2009 (2009 Truck Survey, BAAQMD 2009) in partnership with Sonoma Technology, Inc. (STI), Wiltec, and the West Oakland Environmental Indicators Project (WOEIP). The 2009 Truck Survey was intended to address uncertainties identified in the 2008 HRA. The 2008 HRA noted that there were significant uncertainties associated with (1) estimates of truck volumes and routes in West Oakland and (2) estimates of the percentage of truck traffic (and therefore emissions and risk) attributable to activity at the Port of Oakland. The 2008 HRA concluded that the "data limitations may have led to a potential *overestimate* of overall trucking emissions within the modeling domain and a potential *underestimate* of the overall fraction of trucking emissions that are attributable to the Port of Oakland [italics for emphasis added]."

The 2009 Truck Survey concurred with the 2008 HRA regarding the age distribution, average speed, and idling activity of trucks. The 2009 Truck Survey authors also concluded that the results confirmed the concerns raised in the HRA regarding an overall overestimate of trucking emissions and an underestimate of the fraction of trucking emissions attributed to the Port. The main differences in traffic volumes found between the two studies were that:

- The 2009 survey found significantly fewer trucks on surface streets, but a higher percentage of Port trucks.
- The 2009 survey counted fewer trucks on these freeways: Interstate 980 (I-980) and Interstate 580 (I-580).
- The 2009 survey estimated a higher number of Port[5] and non-Port trucks on Interstate 880 (I-880).

Using the information from the survey, BAAQMD developed revised estimates of the level of cancer risks in West Oakland attributable to DPM from trucks. First, BAAQMD compared the HRA assumptions and modeling inputs to the 2009 West Oakland Truck Survey results and then adjusted the inputs in accordance with the survey results to derive new risk estimates that approximately reflect the findings of the survey. Table B-2 shows the revised estimates. Based on the truck survey, the overall cancer risk due to DPM in West Oakland was lower than the risk estimated in the 2008 HRA; however, a higher fraction of the cancer risk was attributed to the Port. BAAQMD did not rerun the HRA with the revised truck traffic estimates, but estimated that the Port's contribution to local health risk was 29% rather than 16%, which was the percentage attributed to Port sources in the 2008 CARB HRA.

Table B-2: Summary of the Adjusted Population-Weighted Cancer Risks (Cases per Million) Based on the 2009 West Oakland Truck Survey

Source Category	Part I Port	Part II Union Pacific	Part III Non- Port and Non-UP	Combined
Ocean-Going Vessel (OGV) Transiting, Maneuvering, and Anchoring	57	0	23	80
OGV Hoteling	57	0	10	67
Harbor Craft	15	0	78	93
Trucks	**103** (42)	7	**415** (795)	**525** (844)
Cargo-Handling Equipment	16	21	7	44
Locomotives	4	15	37	56
Others	0	0	2	2
Total	**252** (192)	43	**572** (951)	**867** (1,186)
% Risk	**29%** (16%)	**5%** (4%)	**66%** (80%)	100%

Note: Revised risks are noted in bold text. The values in parentheses ( ) are the original population-weighted cancer risks presented in Table 7 of the 2008 HRA (CARB 2008).
Source: BAAQMD 2009

The West Oakland Truck Survey further concluded that the revised risk from all trucking operations decreased from 844 cases in a million to 525 cases in a million, and that truck emissions were the single highest source of diesel emissions in West Oakland. The survey further stated that compliance with

[5] All chassis, container, and bobtail trucks were classified as "Port trucks."

regulations adopted by CARB was an essential mitigation strategy and that the Port had a significant role to play in reducing these emissions (BAAQMD 2009). More recent studies, as discussed below, show that the engine model year for the diesel truck fleet serving the Port turned over on an accelerated basis due to incentives provided by CARB, BAAQMD, and the Port.

2019 BAAQMD West Oakland Health Risk Assessment

To address the need for a current understanding of the DPM-related local health impacts on the West Oakland Community, BAAQMD performed a health risk assessment from 2018 to 2019, and presented the findings of the Draft HRA at the West Oakland Community Air Action Plan (WOCAAP) Steering Committee meeting on March 6, 2019 (BAAQMD 2019a), and updated risk estimates to the Board of the Bay Area Air Quality Management District on May 1, 2019 (BAAQMD 2019b). [6] The Draft 2019 BAAQMD HRA looked at more recent emissions and used exposure assumptions that were updated since the CARB 2008 HRA. Current exposure assumptions lead to higher estimates of risk than estimates based on the same pollutant concentrations under previous exposure assumptions. Thus, the estimated risks are not directly comparable to the 2008 HRA. The results of the Draft 2019 BAAQMD HRA indicated that the overall cancer risk to the West Oakland community from air pollution is approximately 600 cases per million people. Of this total cancer risk, local sources (sources in or in the immediate vicinity of West Oakland, including the Seaport) contribute approximately 179 cases per million, or approximately 30% of the total risk (BAAQMD 2019).

Direct comparison of the 2008 CARB and Draft 2019 BAAQMD HRA results is also difficult due to changed assumptions in the population distribution in West Oakland. However, Port staff reviewed the population-weighted average concentrations of DPM in ambient air and calculated a 94% reduction in local health risk impacts due to all modeled local sources of DPM between the 2008 CARB HRA and the Draft 2019 BAAQMD HRA.

BAAQMD calculated population-weighted concentrations and impacts on a 20-meter grid. The model allows the user to extract information regarding contributions of DPM from each of the local source categories for each grid cell. The availability of detailed information at the grid-cell level is consistent with the overall trend to increasingly refined air quality information (see the Air Quality Planning section).

The Draft 2019 BAAQMD HRA found that the primary sources of local DPM are emissions from non-Port trucks. The combined highway and local street DPM concentration from non-Port trucks comprises 47% of the local DPM concentration. Drayage (i.e., Port-related) trucks contributed an estimated 2% of the total local DPM concentration. The estimate of DPM associated with drayage trucks included emissions from these trucks while on local freeways. The total local DPM concentration contribution

[6] As of the completion of the Final Plan, a draft report had not yet been released.

from Port-related sources was estimated to be 30%. Harbor craft (tugs) made up the biggest percentage (10% of the total local contribution), followed closely by OGVs at berth (8%), and OGV maneuvering (5%). Cargo-handling equipment contributed 2% of the total local DPM concentration (BAAQMD 2019a). Table B-3 summarizes the local percentage concentration contributions from each source.

Health risk modeling indicated that 24% of the combined highway and street incremental local cancer risk was attributable to heavy- and medium-duty non-Port trucks; Port drayage truck were estimated to contribute 2% of the incremental local cancer risk. The Draft 2019 BAAQMD HRA also estimated that 38% of the total incremental local cancer risk was attributable to DPM emissions from Seaport operations; 28% was attributable to OGV and HC (BAAQMD 2019a,b).

Table B-3:Modeled Impact of Local Sources on Residential Diesel PM

Local Source	Percent Contribution	
	DPM	Cancer Risk
Highway (Non-Port)		
Heavy/Medium Heavy-Duty Trucks	19%	11%
Passenger Vehicles	2%	3%
Light Heavy Duty Trucks	1%	1%
Street (Non-Port)		
Heavy/Medium Heavy-Duty Trucks	23%	13%
Passenger Vehicles	2%	3%
Light Heavy-Duty Trucks	1%	1%
Port (All Port-Related Sources)		
Harbor Craft	10%	13%
Ocean-Going Vessels (Berthing)	8%	9%
Ocean-Going Vessels (Maneuvering)	5%	6%
Cargo-Handling Equipment	2%	3%
Drayage Trucks	2%	2%
Dredging	1%	2%
Rail Yard (OGRE)	1%	1%
Rail Yard (BNSF Railway Company)	1%	1%
Bunkering (Tugs and Pumps)	0%	1%
Rail (Non-Port)		
Union Pacific (UP) Rail Yard	8%	10%
Rail Lines	7%	8%
Permitted (Non-Port)		

Table B-3:Modeled Impact of Local Sources on Residential Diesel PM		
East Bay Municipal Utility District (EBMUD)	1%	1%
Other Facilities	0%	1%
Other (Non-Port)		
Schnitzer (Trucks)	3%	4%
Schnitzer (Ships at Berth)	1%	1%
Ferries	3%	1%
Truck-Related Businesses	0%	1%

Note:
DPM = particulate matter
The table presents the percent DPM emissions contribution estimate from the March 6, 2019 presentation, and the percent cancer risk contribution estimate from the May 1, 2019 presentation
Source: Port of Oakland based on BAAQMD 2019a,b

California EnviroScreen

The California EnviroScreen (CES) model developed by the California Environmental Protection Agency (California EPA) (CalEPA 2018), which is used to identify "highly burdened" communities under AB 617, uses a broader set of criteria to assess health impacts than traditional health risk assessments, and is not comparable to the 2008 CARB HRA or Draft 2019 BAAQMD HRA. In addition to air quality, the CES model includes a wide range of factors, such as socioeconomic and sensitive population indicators.

GREENHOUSE GAS EMISSIONS, CLIMATE CHANGE AND CO-BENEFITS

In addition to its emphasis on reducing DPM, the 2020 and Beyond Plan focuses on reducing GHG emissions. Scientists understand GHG emissions to be the primary factor causing global climate change. Reducing GHGs is an urgent priority for the State of California. The most recent report from the Intergovernmental Panel on Climate Change (IPCC) concluded that an average temperature increase of only 1.5° Celsius (C) would have significant adverse effects around the world (IPCC 2018). This level is below the 2°C target set by the 2015 Paris Climate Accord (UNFCCC 2015).

According to the IPCC, climate change is contributing to more severe weather (including both more severe and prolonged droughts as well as higher-intensity rainfall events), and increasing the risks of heat-related illnesses. Climate change is also resulting in adverse air quality effects due to both an increase in wildfires and increases in smog formation resulting from higher temperatures (OEHHA 2018).

Coastal areas, like the Bay Area, are particularly vulnerable to sea level rise (SLR). As part of its climate change resiliency planning, the Port is currently working on its Assembly Bill 691[7] resiliency assessment. The Port is evaluating the potential costs associated with infrastructure damage and replacement for 2030, 2050, and 2100. The completed SLR assessment is due to the State Lands Commission in July 2019. The

[7] Assembly Bill 691 - Proactively Planning for Sea-Level Rise Impacts (Muratsuchi) Chapter 592, Statutes of 2013.

initial assessment focuses on mapping of SLR effects (i.e., projected flooding), and identifying critical infrastructure.

Any zero-emissions technology that relies on GHG-free fuels from renewable or other non-carbon sources (i.e., that eliminates the use of diesel and other petroleum-based fuels) also eliminates DPM. Technologies and fuels that provide a reduction in GHGs (but do not eliminate GHGs completely) typically also result in reductions in DPM. Therefore, reducing GHG emissions from Seaport sources provides the co-benefit of also reducing DPM emissions in the West Oakland community.

EXISTING AND PENDING REGULATORY ACTION AND POLICIES

As discussed above, this Plan addresses three forms of air pollutants: criteria air pollutants, TACs (specifically DPM), and GHGs. Although all three categories of air pollutants are associated with diesel engine emissions, they are subject to separate regulations. In the context of diesel emissions, criteria air pollutants and TACs are closely linked because DPM, which comprises a portion of the criteria pollutant PM, is a TAC. Similarly, GHG emissions are directly linked to fuel consumption by diesel engines. Engines fueled by compressed natural gas (CNG) or liquefied natural gas (LNG) also emit PM. However, the difference in the fuel source means that natural gas-fueled engines emit different constituents that do not pose the same types of health risks as DPM.

REGULATORY SETTING

Since the Port of Oakland approved the 2009 Maritime Air Quality Improvement Plan (MAQIP), the regulatory setting for maritime equipment has changed. As the Bay Area Air Basin gets closer to attainment of federal and State ambient air quality standards, CARB and BAAQMD regulations are increasingly focused on GHG and TAC reductions. Table B-4 (on the following page) summarizes some of the relevant policies.

MOBILE SOURCES AT PORTS

In 2006, CARB announced its intention to establish emissions regulations and health risk goals to protect public health from the adverse impacts of ports and goods movement operations.[8] To achieve these goals, CARB promulgated new regulations for the five main mobile sources associated with ports and goods movement: (1) ships, (2) commercial harbor craft (HC), (3) CHE at ports and intermodal yards, (4) heavy-duty (Class 7 and Class 8) diesel trucks, and (5) non-exempt locomotives. These regulations have been implemented, and they have led to substantial reductions in DPM emissions from Seaport-related sources (see the Emissions Estimates section). Businesses that have invested in equipment to meet these

[8] State of California, Air Resources Board, Resolution 06-14, April 20, 2006.

regulatory requirements or are investing to meet near-term requirements may be less likely to invest in zero-emissions technology in the Near-Term Phase because their equipment still has useful life remaining.

The Port responded to the new CARB air rules by developing and implementing the MAQIP, which the Board of Port Commissioners approved in April 2009. The MAQIP created a comprehensive 12-year policy and planning framework to reduce criteria pollutants from Port mobile sources, with a focus on reductions in DPM.

Table B-4: Policy , Statutory, and Regulatory Measures	
Executive Orders	
Executive Order B-30-15	Sets a statewide goal for a 40% reduction in GHG emissions from 1990 levels by 2030. This interim goal was adopted by CARB in its 2017 California Climate Action Plan, approved December 14, 2017. The State's 2030 and 2050 GHG emissions reduction goals create a long-term framework for implementation of this Plan.
Executive Order B-32-15 and the Sustainable Freight Action Plan	Interagency development of a guidance document to establish freight efficiency targets, transition to zero-emissions technologies, and increase the competitiveness of California's freight system. The Sustainable Freight Action Plan has three targets: (1) increase freight system efficiency 25% by 2030; (2) transition to zero-emissions technology; and (3) increase California's competitiveness and future economic growth in the freight and goods movement industry. The targets are not mandates but rather aspirational measures of progress toward sustainability for the state to meet and try to exceed.
Executive Order B-48-18	This Executive Order is designed to boost the supply of zero-emissions vehicles and charging and refueling stations in California. It includes a new 8-year, $2.5 billion initiative to help bring 250,000 vehicle charging stations and 200 hydrogen fueling stations to California by 2025, and has the goal of 5 million zero-emissions vehicles by 2030. It also continues the State's clean vehicle rebates.
Legislation	
Senate Bill 1 (SB 1) (Beall 2017)	Provides for transportation funding and restricts in-use truck fleet requirements to allow in-use equipment to remain in use for either 800,000 miles or 18 years.
Senate Bill 350 (de León 2015)/ Senate Bill 100 (de León 2018)	Extends the Renewable Portfolio Standard to require 50% of California electricity to be from renewable sources by 2030. Requires building energy efficiency to double by 2030, and requires larger publicly owned utilities to develop Integrated Resource Plans and invest in transportation electrification. Senate Bill 100 increases the 2030 renewables content standard from 50% to 60% and requires 100% carbon-free electricity by 2045.
Assembly Bill 617 (Garcia 2017)	Requires community-focused air quality planning through the Community Air Risk Evaluation (CARE) program to reduce exposure to existing sources. The CARE goal is to eliminate air quality disparities and reduce health burdens.
Regulation and CARB Policy	
State Strategy for the State Implementation Plan (SIP), including the Mobile Source Strategy	CARB's 2016 Mobile Source Strategy focuses on light-duty equipment. However, when adopting the State Strategy for the SIP for ozone and fine particulate matter ($PM_{2.5}$) in 2017, CARB directed staff to revisit the At-Berth Regulation and the Cargo-Handling Equipment Regulation as well as to develop concepts for Indirect Source Rules. Staff returned in March 2018 with a proposed schedule for updating regulations regarding freight activity.

Table B-4: Policy , Statutory, and Regulatory Measures	
2030 Scoping Plan	Describes California's path to a 40% reduction in GHG emissions from 1990 levels by 2030 (CARB 2018a).[9]

Source: Port of Oakland 2019

In Southern California, the Port of Los Angeles and the Port of Long Beach (collectively referred to as the San Pedro Bay Ports [SPBP]) developed an air quality plan—the Clean Air Action Plan (CAAP). The SPBP developed the original CAAP in 2006, updated it in 2010, and approved significant updates to it in November 2017 (2017 CAAP, also referred to as CAAP 3.0).

NEW AIR QUALITY RULES BEING DEVELOPED BY CARB

On March 23, 2017, CARB adopted Resolution No. 17-8, which requires CARB staff to take the following actions, among others:

- Within 18 months, develop amendments to the existing At-Berth Regulation to achieve up to 100% compliance by 2030 for SPBP and ports in or adjacent to the top 10% most impacted areas based on the CES.[10]
- Within 24 months, develop amendments to the CHE regulations to achieve up to 100% compliance with zero-emissions vehicle (ZEV) requirements by 2030 for the ports identified above.
- Within 1 year, return to CARB with concepts for an Indirect Source Rule (ISR) to control pollution from large freight facilities, including ports, rail yards, warehouses and distribution centers, as well as any alternatives to the ISR that can achieve similar levels of emission reductions.

On March 23, 2018, rather than proposing an ISR, CARB staff recommended a schedule of freight rulemaking. Amendments to the At-Berth Regulation are under way, and the CARB staff's goal is to present these amendments to their board in 2019. Amendments to the CHE regulation are anticipated to go to CARB in 2022, and the earliest implementation is expected to begin no earlier than 2026. Although CARB staff did not recommend a statewide ISR, CARB acknowledged that local air districts have the authority to develop their own ISR. Table B-5 shows the proposed regulations and dates applicable to the

9 In 2006, the Legislature passed the California Global Warming Solutions Act of 2006 (Assembly Bill 32 [AB 32]), which created a comprehensive, multi-year program to reduce greenhouse gas (GHG) emissions in California. AB 32 required CARB to develop a Scoping Plan that describes the approach California will take to reduce GHGs to achieve the goal of reducing emissions to 1990 levels by 2020. The Scoping Plan was first approved by CARB in 2008 and must be updated every 5 years. The First Update to the Climate Change Scoping Plan was approved by CARB on May 22, 2014. In 2016, the Legislature passed Senate Bill 32 (SB 32), which codifies a 2030 GHG emissions reduction target of 40% below 1990 levels. With SB 32, the Legislature passed companion legislation AB 197, which provides additional direction for developing the Scoping Plan. CARB is moving forward with a second update to the Scoping Plan to reflect the 2030 target set by Executive Order B-30-15 and codified by SB 32.

10 Although the Seaport is not adjacent to one of the top 10% most impacted communities pursuant to CES, Port staff assume that ships calling Oakland would be subject to any new CARB amendments to the At-Berth Regulation.

Seaport Area. The regulatory setting discussion in Appendix F: Equipment Operations and Cost Assessment to Assist with Electric Infrastructure Planning provides more detailed information regarding considerations for zero-emissions regulations and regulations pertaining to drayage trucks.

For most businesses, investment in new technologies is driven by regulatory requirements. Thus, most businesses will be increasingly likely to invest in new technology, such as zero-emissions equipment, as the regulatory deadlines shown in Table B-5 approach. Presumably, incentive funding would be unavailable when new regulations come into effect.

Table B-5. CARB Actions to Further Reduce Emissions from Freight Sources and Facilities

Sector and/or Facility Type	Action	Potential Time Frame: CARB to Consider (Year)	Potential Time Frame: Begin to Implement (Year)
Drayage Trucks at Seaports and Rail Yards	Drayage truck regulation to transition to zero-emission operation.	2022	2026-2028+
Commercial Harbor Craft at Seaports	Commercial harbor craft regulation amendments.	2020	2023+
Cargo-Handling Equipment at Seaports and Rail Yards	Cargo-handling equipment regulation to transition to zero emissions.	2022	2026+
Rail Yards, Rail Stations, Rail Sidings, Seaports, Warehouses, and Other Hubs	Evaluation and potential development of regulation to reduce idling emissions from all rail yard sources and emissions from other stationary locomotive operations.	2020	2023+
Locomotives	Evaluation and potential development of regulation to reduce emissions from locomotives not pre-empted under the Clean Air Act.	2022	2025+
Locomotives	Petition to U.S. Environmental Protection Agency for more stringent national locomotive (Tier 5) emission standards.	2017 (completed)	2023
Transport Refrigeration Units (TRUs)	TRU regulation to transition to zero emissions	2020	2020+
Trucks	Heavy-duty on-board diagnostics amendments	2018	2019
Trucks	Heavy-duty vehicle zero-emissions certification procedures	2019	2023
Trucks	Advanced clean local trucks regulation (last-mile delivery)	2018	2023
Trucks	Medium- and heavy-duty greenhouse gas phase 2	2018	2018+
Trucks	Zero-emissions trucks – manufacturers sales percentage	2019	2024+
Trucks	Zero-emissions truck – fleets purchase percentage	2022	2026-2028+
Ships	Ships at-berth amendments	2019	2023
Ships	Advocate for Tier 4 vessel standards	Ongoing	
Forklifts	Zero-emission forklift regulation	2021	2023
All On-Road Engines	Heavy-duty omnibus regulation for new engines	2020+	2024+

Table B-5. CARB Actions to Further Reduce Emissions from Freight Sources and Facilities			
		Potential Time Frame	
Sector and/or Facility Type	Action	CARB to Consider (Year)	Begin to Implement (Year)
All	Low-emissions diesel fuel requirement	2021	2023

Note:
CARB = California Air Resources Board
Source: CARB Board Staff: Update on Concepts to Minimize the Community Health Impacts from Large Freight Facilities ADVANCE MATERIALS (Revised) and CARB March 21, 2019 presentation entitled *Update on California Actions to Minimize Community Health Impacts from Freight* (CARB 2019)

AIR QUALITY PLANNING

Historically, air quality was regulated with a focus on individual constituents, such as criteria air pollutants and TACs. Regulations were designed to reduce excess levels of specific constituents identified as being of concern, with a goal of reducing ambient concentrations within a given region (air basin). Consistent with the regional approach to air quality, data collection typically occurred on a regional level as well. Monitoring stations were designed to detect a certain limited set of parameters, and the typical monitoring interval was hourly or daily, depending on the constituents. Health risk calculations (modeling) were then performed using the regional data. These health risk calculations provided regional estimates of excess cancer and non-cancer effects associated with the modeled constituents. One of these regional monitoring stations is in West Oakland.

More recently, air quality-related regulations (such as AB 617) have begun to focus directly on localized health risks; the Draft 2019 BAAQMD HRA provides risk estimates on a 20- meter grid that reflects the effects of near-by local sources. In addition, new dynamic data collection processes provide the ability to distinguish levels of pollutants on a scale as fine as one city block (Apte et al. 2017) and even to identify specific vehicles that may not be achieving expected emission standards (Harley 2014; Preble et al. 2018a, 2018b).

COMMUNITY-BASED SCIENCE AND RESEARCH INITIATIVES

New community-based research and data provide important insights into exposures at increasingly refined scales. In recent years, there have been multiple data collection efforts conducted in or initiated by the West Oakland community. These efforts have added to the understanding of air quality and diesel truck emissions in West Oakland as well as in some other Oakland neighborhoods.

Monitoring is an important supplement to modeling efforts. Monitoring provides information that can be used to verify or calibrate modeling efforts. Assumptions used in the model may be adjusted to more accurately reflect real world conditions shown by monitoring. In general, modeling is intended to be cautious and predict more substantial adverse effects than might occur. Monitoring can help put modeled risk estimates or predicted pollutant concentrations into perspective.

The Port has supported some of these studies by providing access to Port property for placement of monitors and by coordinating with the researchers. The recent studies included:

- Distributed Monitoring of Community Black Carbon Exposure (100 x 100 Study)
- Real-Time Truck Emission Monitoring
- Street-Level Air Monitoring (Google/Aclima Study)

These studies are summarized below. Some of this new community-based science is in the developmental stage, and protocols and processes for collecting quality, reliable data are not well established. Nevertheless, in the future, data gathered through community-based initiatives will continue to inform the air quality planning process.

Distributed Monitoring of Community Black Carbon Exposure (100 x 100 Study)

The University of California, Berkeley, in collaboration with the Environmental Defense Fund (EDF), WOEIP, and the University of Texas at Austin conducted a study of the distribution of black carbon (BC) in West Oakland and in the nearby Seaport Area. The study placed 100 BC sensors in various locations and collected data for 100 days. The data compiled were compared to the BAAQMD regional air quality sensor to provide relative concentrations. Except for monitoring locations within the Seaport Area, average sensor concentrations were typically within a factor of 2 of the BAAQMD sensor. Concentrations in the Seaport Area tended to be higher. Some locations in the southwest portion of West Oakland exceeded the regional average approximately 20% to 30% of the time.

Real-Time Truck Emission Monitoring

In 2011, 2013, and 2015, the University of California, Berkeley, led by principal investigators Chelsea Preble and Robert Harley, conducted real-time air monitoring to assess the effects of diesel engine turnover and engine retrofits on total truck emissions (Harley 2014; Preble et al. 2015; Preble et al. 2018a). The researchers correlated the emissions data collected for each truck with the applicable engine and retrofit information for that truck by photographing the license plate of the truck.

Data were collected from a bridge overpass on Seventh Street at the entrance to the Seaport Area by sampling emissions from trucks passing under the bridge. Nitrogen oxides (NO_x), BC, particle number (PN), and particle size distributions were measured in the exhaust plumes of more than 2,600 drayage trucks near the Seaport Area. The researchers concluded that average NO_x, BC, and PN emission factors for newer engines (2010 to 2013 model years) equipped with both diesel particulate filters (DPFs) and selective catalytic reduction (SCR) were reduced substantially compared to engines without these technologies (2004 to 2006 model years). NO_x emissions were reduced 69% ± 15%; BC emissions were reduced 92% ± 32%; and PN emissions were reduced 66% ± 35%.

Overall, NO_x emissions decreased by 70% from 2009 to 2015. Although NO_x emissions declined overall, the NO_x constituent nitrogen dioxide (NO_2) increased.[11] Nitrous oxide (N_2O), a potent GHG, also increased. N_2O has a warming potential of nearly 300 times that of CO_2 (U.S. EPA 2018). The increasing percentage of trucks with SCR in the 2015 model year has led to a decline in NO_2 emissions relative to the 2013 fleet, but trucks equipped with SCR emitted higher levels of N_2O.

As of 2013, BC emissions had decreased by 76% from the 2009 data. However, BC emissions increased slightly between 2013 and 2015 to a total reduction of 73% relative to 2009. The researchers noted that the 2015 data showed that BC emissions from model year 2007 through 2009 trucks had increased by 50% relative to the 2011 and 2013 data (Preble et al. 2018a) and suggested that this increase may be due to deterioration of DPFs. If the emissions from all high-emitting trucks were brought into conformance with their engine model year requirements, 2015 BC emissions would have been reduced by 91% relative to 2009.

The studies concluded that increased deployment of advanced controls has resulted in a small number of high-emitting trucks emitting a disproportionately large fraction of the total BC and NO_x emissions. Most recently, the researchers estimated that 7% of all trucks emitted 67% of the total BC (Preble 2018b). Emission factor distributions for BC and PN were more skewed than those for NO_x. In 2013, the highest-emitting 10% of trucks were responsible for 65% of the total BC, 80% of the total PN, and 32% of the total NO_x emissions. The researchers noted that the percentage of NO_x emissions attributable to high-emitting trucks is increasing, and this trend is likely to continue as the number of engines equipped with SCR increases in future years. Other emissions data, collected by CARB from six locations throughout California between 2016 and 2017, indicated that 1.5% of all trucks emitted 50% of all BC, and 3.9% of the trucks in this data set emitted 50% of all NO_x (Hu et al. 2018). The emissions sensors developed for the statewide studies are being optimized to make them more portable (Hu et al. 2018). The portable sensors are considered a “mid-grade” system compared to the laboratory-quality, van-deployed sensor systems used in the Preble and Harley work described above.

The 2013 Oakland data also demonstrated the effectiveness of the Port’s incentive programs for DPF retrofits and engine replacement. The fraction of DPF-equipped drayage trucks increased from 2% to 99%, and the median engine age decreased from 11 to 6 years between 2009 and 2013. By 2015, 25% of trucks were also equipped with SCR. Model year, and consequently emission, changes occurred rapidly compared to what would have been observed due to natural (i.e., unforced and unincentivized) turnover of the truck fleet serving the Seaport. The study authors concluded that the results provide a preview of more widespread emission changes expected statewide and nationally in the coming years.

[11] NO_x is composed of NO and NO_2 (it does not include N_2O). NO comprises 82% to 97% of NO_x emissions, which explains why NO_x emissions can decrease even though NO_2 is increasing.

Street-Level Air Monitoring (Google/Aclima Study)

Affordable portable air monitors are enabling researchers to obtain near instantaneous information on local air quality. The new data collection processes are accompanied by a rapid increase in computing power, allowing the analysis of very large volumes of individual data points. For example, a joint effort by EDF, Google, the University of Texas at Austin, and Aclima equipped two Google Street View vehicles with a fast-response pollution measurement system and repeatedly sampled every street in a 11.6-square-mile area of Oakland, including West Oakland.

Each 30-meter (98.4-foot) road segment was sampled on average 31 times during the 6-month study period. Data were collected on weekdays, during mid-morning to afternoon hours. Three million data points were collected. The resulting maps of annual daytime NO, NO_2, and BC revealed stable, persistent daytime pollution patterns with sharp, small-scale variability of up to two to eight times within individual city blocks and neighborhoods. The researchers attempted to link a subset of hot spots in West Oakland to local sources, and identified potential sources for all but one of the 12 hot spots reviewed. The report also indicated that the median daytime concentration measured by this study differed from the values reported by the West Oakland BAAQMD regional monitoring location by approximately one-third for BC and NO_2, and two-thirds for NO (Apte et al. 2017).

The Environmental Defense Fund subsequently used the maps developed by the study to provide an on-line resource allowing users to assess various types of sensitive uses relative to the air pollution patterns in West Oakland (EDF 2019). The maps include locations of sensitive receptors such as schools, day care centers, senior housing, and senior centers. These maps were presented at the AB 617 meeting held on February 6, 2019, and were made available on the EDF website.

INITIATIVES BY OTHER WEST COAST SEAPORTS

Seaports along the entire West Coast from Southern California to Canada are typically visited by the same vessels, as most vessels from Asia have multiple ports of call. Therefore, the Port of Oakland can learn from the experiences of larger ports with greater operating budgets when those ports conduct pilot and demonstration tests of new technologies.

In their 2017 CAAP, the SPBP committed to achieving 100% zero-emissions CHE in both the Port of Los Angeles and the Port of Long Beach by 2030, and 100% zero-emissions drayage trucks by 2035. However, as noted in the CAAP, this commitment is subject to sufficient funding, feasibility, and availability of technology (SPBP 2017). The Ports of Seattle, Tacoma, and Vancouver, British Columbia (collectively the Northwest Seaport Alliance [NWSA]), jointly developed the Northwest Ports Clean Air Strategy in 2007. The strategy includes air emissions reduction goals and targets for 2020 (Port of Seattle 2019). In 2013, the three ports collaborated on an update to the strategy that outlined three objectives: reducing port-related air quality impacts of DPM, reducing GHG emissions, and helping meet air quality standards and objectives for the airshed (NWSA 2017). The NWSA ports are currently in the process of updating the Clean Air Strategy. The NWSA also produces an annual implementation report to track progress on the Clean Air Strategy.

MAQIP (2009) ACCOMPLISHMENTS AND CURRENT ACTIONS

The Port has substantially reduced its DPM emissions from the 2005 baseline and continues to seek out actions that could contribute to further reductions. MAQIP programs and projects support this goal through regulatory compliance and early actions before regulations come into effect, and by targeting emissions reductions that exceed legally mandated requirements. The Port calculates MAQIP progress through periodic emissions inventory updates. For 2017, the emissions inventory showed a 98% reduction in truck-related DPM emissions and an 81% reduction in DPM for all Seaport sources from the 2005 baseline. The Port is continuing to implement the MAQIP and working to achieve an 85% reduction in DPM by 2020. Certain actions will be completed by 2020; other actions will continue as part of the 2020 and Beyond Plan's NTAP. Emissions inventories are discussed in more detail in the subsequent section of this appendix. Key efforts that are currently ongoing are described below.

Shore Power Implementation

CARB's current regulations require at-berth emissions reductions from container, cruise and refrigerated cargo vessels (reefers), generally by plugging the ship into the electrical grid and turning off the auxiliary engines, which is known as *shore power*. In March 2017, CARB directed its staff to amend the At-Berth Regulation to achieve up to 100% compliance by all vessels by 2030. This new regulation would apply, if adopted, at the SPBP and at ports that are in, or adjacent to, areas defined as being in the top 10% of the most impacted communities, as determined by the CES model. This action would require at-berth emission reductions from vessels not currently subject to the regulation, such as bulk and break-bulk vessels, tankers, and auto carriers.

Shore power implementation (compliance with the CARB's At-Berth Regulation for OGVs) is a priority because OGVs are the largest source category for DPM in the Port's emissions inventory. The Draft 2019 BAAQMD HRA found that OGVs at berth were the largest Port-related source of DPM to the local community, comprising a population-weighted 8% of the total local DPM (see Table B-3). Shore power compliance has resulted in substantial emissions reductions. In 2005, OGV emissions were calculated to be 208.5 tons of DPM; in 2017, OGV emissions were 42.4 tons. This represents an 83% reduction in OGV DPM emissions between 2005 and 2017, with approximately 11.4 tons of those reductions attributable to shore power.

Although significant DPM emission reductions have been achieved using shore power, shore power compliance continues to be a challenge due to many factors. These are primarily tied to vessel capabilities outside the Port's control, such as equipment damage and failure, vessel size, and inconsistent positioning of cables on the vessel; foremost among these factors is the absence of shore power equipment on certain vessels. As a result, data show a wide range of compliance performance by the fleets at the Port. For example, in 2018, one fleet achieved 99% plug-ins, while some fleets had less than 70% plug-ins. (Note that CARB's At Berth Regulation does not apply to steamships or to fleets with fewer than 25 vessel calls per year.)

Port staff track shore power usage monthly and work with shipping lines and terminal operators to identify factors that prevent plug-ins to overcome those factors and achieve increased shore power usage. For example, to overcome cable-positioning issues, the Port evaluated the possibility of extending the reach of a vault plug from a few feet to up to 100 feet from the nearest shore power outlet. The evaluation indicated that the equipment would cost at least $2 million per berth, not including construction and other likely costs. In addition, ILWU would need to approve the design. Monitoring shore power compliance and actions to improve plug-ins will continue as part of the 2020 and Beyond Plan's NTAP. For 2018, the Port achieved 75% plug-ins, showing the value of the Port's consistent follow-up.

Hybrid Rubber-Tired Gantry Cranes

In 2018, Stevedoring Services of America (SSA), the terminal operator at the Oakland International Container Terminal, was awarded a Carl Moyer grant for the repowering of 13 rubber-tired gantry (RTG) cranes. SSA is using this grant to repower its entire fleet of RTG cranes with hybrid battery-electric drive systems. The battery stores recovered energy from lowering containers and receives supplemental charging from a small Tier 4 final diesel engine. Because of the significant energy recovery and the fact that the diesel engine is very clean and runs at a steady level, overall criteria air pollutant emissions from the RTG cranes are reduced 99.5% compared to the existing diesel engines. The first RTG crane was repowered in February 2019. Complete phase-in is expected to require approximately 2 years.

Zero-Emissions Yard Tractors and Drayage Trucks

The Port is participating in two initiatives to test CHE and drayage trucks. The Port is a participant in a Zero- and Near Zero-Emissions Freight Facilities (ZANZEFF) grant recently awarded to the Port of Long Beach. The Port of Oakland's component will include deploying 10 zero-emissions drayage trucks at Shipper's Transport Express, and 5 zero-emissions yard tractors and 1 zero-emissions top-pick at the Matson terminal. The grant will provide the equipment, but will not provide any funding for the necessary infrastructure. Instead, the Port committed to investing at least $1.25 million to install suitable charging infrastructure and chargers to support the zero-emissions drayage trucks slated for Shipper's Transport Express.

The testing will assess the performance of the various types of equipment, including operating time between charges, time required to recharge the vehicles, performance under load, maintenance requirements, and more. The test equipment is being custom-fabricated. The drayage trucks were delivered in February 2019, and the yard tractors and the top-pick are expected to be delivered in late spring of 2020. In addition, the Port is facilitating the deployment of 10 zero-emissions drayage trucks from BYD for testing at Port tenant locations.

STAKEHOLDER ENGAGEMENT FOR THE DRAFT AND REVISED DRAFT 2020 AND BEYOND PLAN

Stakeholders have been engaged in the development of the 2020 and Beyond Plan. Prior to presenting the *Draft Seaport Air Quality 2020 and Beyond Plan* (Draft Plan) at the July 12, 2018, Board Meeting, Port staff held three Seaport Air Quality 2020 and Beyond Plan Task Force (Task Force) meetings (February 23, 2018; May 9, 2018; and June 21, 2018). The February 23, 2018, meeting focused on identifying additional emissions reduction measures under the existing MAQIP (i.e., MAQIP Update). The May 9, 2018, meeting continued the MAQIP Update and included a briefing on the key elements of the proposed 2020 and Beyond Plan. At this meeting the Task Force officially transitioned from the MAQIP Task Force to the 2020 and Beyond Plan Task Force.

At the Task Force meeting on June 21, 2018, the agenda included a briefing on zero emissions by CARB. The Port presented key policy issues associated with the Draft Plan. A professional facilitator, aided by Port staff, facilitated group discussions with Task Force meeting attendees on the key policy issues. The Port also presented the process for stakeholder engagement for the 2020 and Beyond Plan.

Following the public comment period on the Draft Plan, the Port held a Task Force meeting on September 26, 2018, to summarize the major categories of comments received and present the Port's proposed approach to addressing those comments. At this Task Force meeting, the Port announced that in response to public comments requesting the opportunity to review a revised draft of the Plan and to provide comments on additional appendices that were still in development, the Port would provide a *Revised Draft Seaport Air Quality 2020 and Beyond Plan* (Revised Draft) for public review in December, followed by preparation of the *Final Seaport Air Quality 2020 and Beyond Plan* (Final Plan) in the spring of 2019. In addition, the Port compiled and responded to all comments received on the Draft Plan (see Volume II: *Responses to Comments on the June 29, 2018 Draft Seaport Air Quality 2020 and Beyond Plan*, which was posted concurrently with Volume I of the Revised Draft on December 14, 2018); the Port has done so for comments received on Revised Draft as well. The September 26, 2018 Task Force Meeting also included a presentation on equity relative to West Oakland health indicators, an industry panel discussing industry's perspectives on the Plan and the pathway to zero emissions, and roundtable discussions pertaining to four major comment areas (status of technology, funding, stakeholder engagement, and regulations and policy).

A second public comment period followed the release of the Revised Draft. On January 10, 2019, during the public comment period, the Port held a Task Force meeting to describe the major revisions to the Plan and to respond to stakeholder questions and receive preliminary input on stakeholder concerns. Stakeholders had the opportunity to provide written comments on comment cards. These comments were addressed in conjunction with other public comments received on the Revised Draft (see *Responses to Comments on the December 14, 2018 Revised Draft Seaport Air Quality 2020 and Beyond Plan*, posted in

Volume II this Final Plan). At the request of stakeholders, the Port extended the public comment period on the Revised Draft by one week to January 24, 2019.

Another Task Force meeting was held on April 23, 2019, prior to the release of this Final Plan. At this Task Force meeting, the Port presented the changes made between the Revised Draft and this Final Plan, and provided an overview of the proposed Plan implementation process should the Port Board of Commissioners approve this Final Plan. The meeting also included a discussion regarding the continued work of the Task Force and public engagement as the Plan is implemented. In addition, attendees received updates on other related projects and programs, including AB 617.

EMISSIONS ESTIMATES

DPM EMISSIONS

Baseline DPM Emissions

Since completion of the Baseline Seaport Emissions Inventory in 2005, the Port has conducted three additional emissions inventories, which were for the years 2012, 2015, and 2017. The Port is planning to conduct another emissions inventory (EI) for the year 2020 (i.e., at completion of the MAQIP) and the year 2023 (as part of the 5-Year update of the 2020 and Beyond Plan). BAAQMD and CARB helped define the methodology for the first EI in 2005. Each EI uses established methods of emissions estimation, such as those used by CARB in regulatory development. To ensure that the 2017 EI reflected regulatory agencies input, the Port convened a meeting with BAAQMD and CARB on January 25, 2018, to discuss the methodology, which included determining the geographic domain of the EI. The information used to develop emission estimates will continue to be refined as new information becomes available. For example, in the 2017 EI, the Port included emissions associated with bunkering operations[12] for the first time. In addition, the 2017 "other off-road equipment" emission inventory component includes construction and maintenance equipment at on-dock and off-dock terminals and the rail yard.

Previous Port other off-road equipment emission inventories did not include other off-road equipment operated at off-dock terminals because activities at off-dock terminals are related to functions such as transloading that are not unique to Port tenants; such activities may occur at facilities that are on or off Port property. However, to expand the Port's maritime inventory to include activities at all Port maritime tenant facilities, emissions from other off-road equipment at off-dock terminals are included in the 2017 EI.

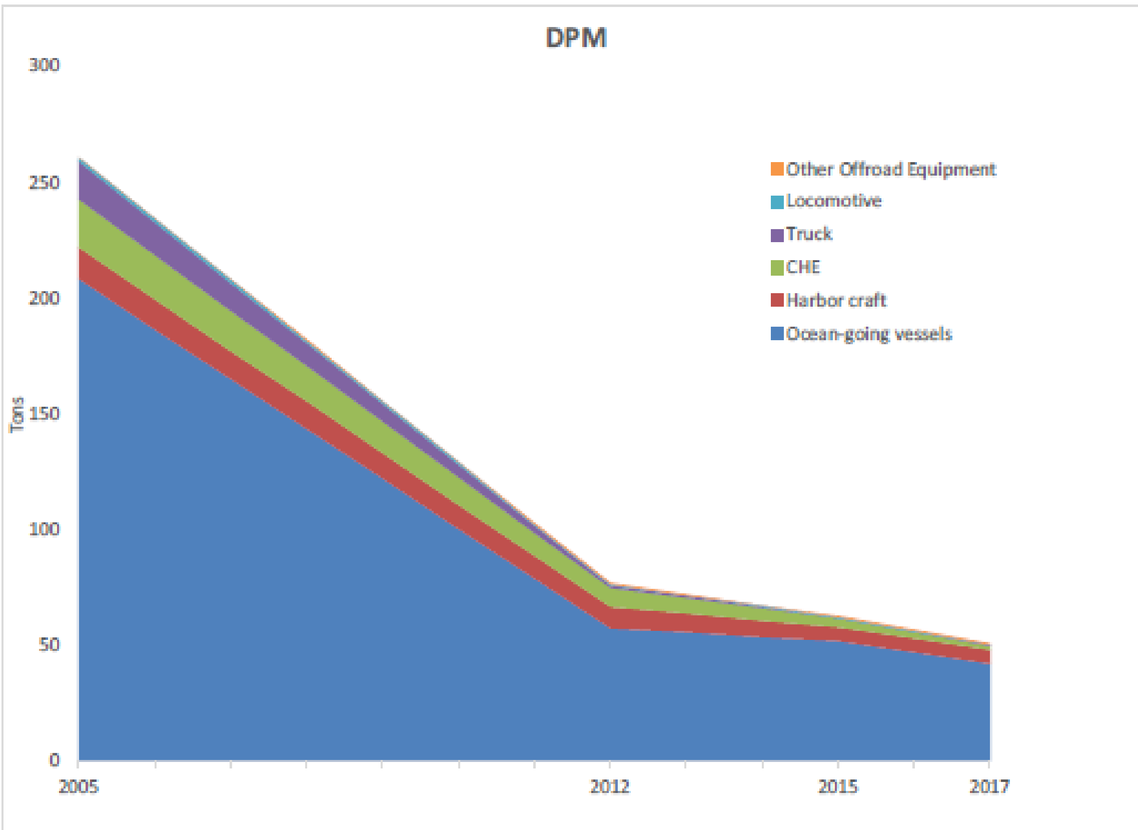
The comparison between the 2005 and 2017 Seaport emissions shows a significant decline in total DPM emissions of 81%. As shown in Figure B-1 below, the two largest source categories for 2017 residual

[12] Bunkering operations include tugs to move the bunker barges and bunker fuel pumping when necessary.

emissions are OGVs (83% of residual emissions) and HC (12% of residual emissions). Port truck emissions declined by 98%, constituting 6% of DPM emissions in 2005 and just 0.6% of the residual emissions in 2017.

BAAQMD's Draft 2019 HRA, which was previously discussed, supports the finding of the Port's EI that Port drayage trucks are a minor source of local DPM concentrations affecting West Oakland. The BAAQMD HRA included emissions from drayage trucks on local freeways, and concluded that drayage truck emissions represented 2% of the total local (population-weighted) contribution to DPM concentrations in West Oakland (BAAQMD 2019).

Figure B-1: DPM Emissions by Equipment Category



Note:
DPM = diesel particulate matter
Source: Port of Oakland 2017 Seaport Air Emissions Inventory Final Report (Ramboll 2018).

Projected DPM Emissions

The Port has forecasted Year 2020 and Year 2030 emissions to determine the additional reductions needed to achieve and then maintain the MAQIP DPM reduction goal (Starcrest 2018). The estimates were based on activity forecasts developed from a range of potential growth scenarios. The key findings of the modeling are:

- Emissions from vessels (OGVs and HC/tugs) remain the largest sources of DPM emissions.
- The Port will need to go above and beyond State regulatory requirements to reach its 85% DPM reduction goal.

After 2020, if cargo volume increases, the projections show a slight increase in DPM. Additional regulation of OGVs and HC or changes in fuel (such as ultra-low-sulfur fuel for OGVs) may affect eventual actual emissions.

GHG EMISSIONS

Baseline GHG Emissions

The first GHG emissions estimate for the Seaport was completed in 2012. Subsequent EIs also included GHGs; GHG emissions will continue to be included in future EIs. The 2017 EI indicates that GHG emissions were reduced approximately 7% from 2005 (an estimate of 2005 GHG emissions was performed as part of the 2017 EI). Carbon dioxide equivalent (CO_2e) emissions associated with shore power generation and transmission are included in the 2017 total; shore power was not used in 2005.

Projected GHG Emissions

Although diesel engine improvements have resulted in substantial reductions in criteria air pollutants and DPM, diesel engine improvements have only achieved limited reductions in GHG emissions. Improvements in diesel engine energy efficiency, improved ship hull design, and efficiencies created through larger vessels have reduced GHG emissions since 2005. However, unless further action is taken, GHG emissions are projected to increase again after 2020, assuming the cargo volume at the Port increases (Starcrest 2018).

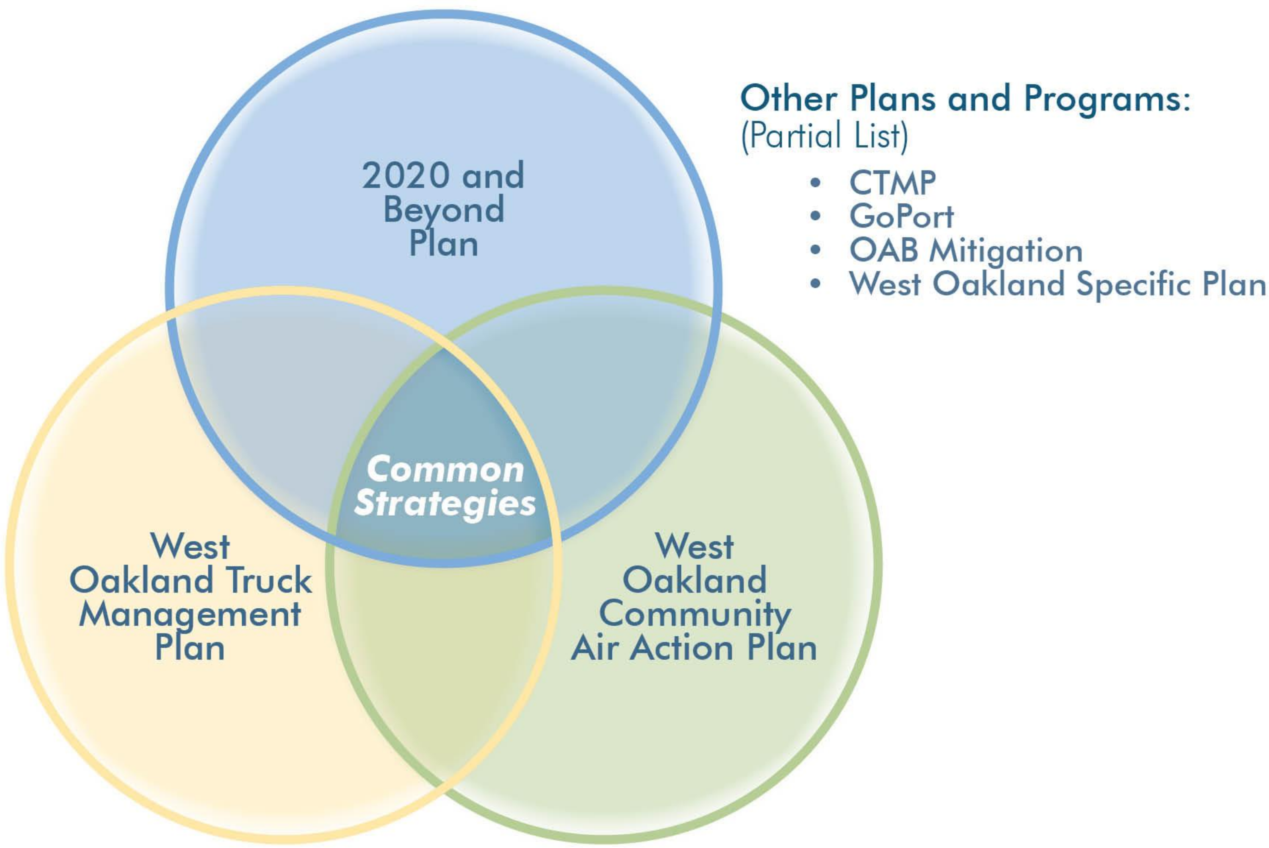
Two key actions to reduce GHG emissions—adopting zero-emissions equipment and using lower carbon-content fuels—are the focus of this Plan. Improved OGV design is another important contributor to GHG emissions reductions. On April 13, 2018, the IMO agreed to set targets to reduce the carbon intensity of global transport. The goal is to reduce CO_2 emissions per unit freight, as an average across international shipping, by at least 40% by 2030 compared to 2008, and move toward 70% by 2050. At least one major shipping line has expressed a goal of being carbon neutral by 2050 (Maersk 2018).

RELATED PLANS, PROGRAMS, AND PROJECTS

The 2020 and Beyond Plan goals and strategies are designed to complement plans and studies by federal, State, regional and regulatory agencies and community-based organizations to address air quality, community health risk and climate change. For example, in West Oakland, BAAQMD and WOEIP are leading a stakeholder planning process to develop the West Oakland Community Air Action Plan (WOCAAP, see discussion of AB 617 below). Concurrently, Port and the City are developing the Joint City-Port West Oakland Truck Management Plan (TMP) to reduce the adverse effects of truck circulation on West Oakland residential streets. The 2020 and Beyond Plan, the WOCAAP, and the TMP seek to identify and incorporate common planning strategies in their respective plans.

Other related plans, programs, and projects include implementing the Port's Comprehensive Truck Management Plan (CTMP), developing and implementing GHG Reduction Plans (required as a condition of redevelopment of the former OAB), the West Oakland Specific Plan, and coordinating with Alameda County Transportation Commission to implement the GoPort program. Figure B-2: Relationship of Concurrent Plans conceptually illustrates the relationship between concurrent planning efforts focused on improving infrastructure, truck circulation, land use, and environmental quality in West Oakland.

Figure B-2: Relationship of Concurrent Plans



Source: Port of Oakland 2019

TRUCK MANAGEMENT PROGRAM

As of October 2018, approximately 9,000 drayage trucks are registered in the Secure Truck Enrollment Program (STEP). Of these trucks serving the Seaport, up to approximately 3,000 may be in daily Port drayage operation. With the proposed new warehouses, more transfer of goods is expected to occur at the Seaport in the future. Nearby rail access will improve efficiencies and reduce truck trips and related emissions. The CTMP was successful in substantially reducing truck-related DPM emissions in West Oakland, both in advance of regulatory deadlines and overall. More detail on the CTMP is provided in Appendix C: Suggested Actions.

As part of implementing the CTMP, the Port has maintained the Trucker Working Group that was initiated in 2007 and has provided interim truck parking and container staging areas at various locations throughout the Seaport. Currently, the City is working on development of a convenient 15-acre truck parking area on the former OAB with a gas station, food court, truck repair services, and restrooms. This station will provide renewable diesel for retail sale (see Appendix C for a discussion of the emissions reductions benefits of renewable diesel) as well as several plug-in stations for trucks transporting refrigerated containers. If commercially feasible, this parking area also will provide several fast charging stations for heavy-duty trucks by 2025.

The Port and the City are currently preparing the West Oakland TMP to meet the requirements of Mitigation Measure 4.3-7 of the Standard Conditions of Approval/Mitigation Monitoring and Reporting Program (SCA/MMRP) for the 2012 Oakland Army Base Redevelopment Project. Mitigation Measure 4.3-7 states that "[t]he City and the Port shall continue to work together and shall create a truck management plan designed to reduce the effects of transport trucks on local streets." Five community workshops were held to gather input for development of the TMP. The Port and the City released the Draft TMP for public review on November 16, 2018. The public review period ended on January 4, 2019. The final TMP is anticipated in May 2019.

The goals of the West Oakland TMP are to:

- Reduce disruptions from truck circulation and truck parking on residents and businesses in West Oakland.
- Increase safety near designated truck routes.
- Have truck drivers know preferred routes to reach their destinations and know the City's parking restrictions.
- Monitor TMP implementation and modify implementation strategies to improve outcomes as needed.

To achieve the goals, the West Oakland TMP contains 10 strategies and provides a timeline for each:

1. Improve safety at street intersections near the Seaport.
2. Improve truck routing.
3. Update the network of truck routes and truck-prohibited streets.
4. Improve truck route signage.
5. Conduct traffic enforcement spot checks.

6. Use urban design to promote use of truck routes.
7. Improve training for issuing parking tickets.
8. Change parking regulations.
9. Consider increasing truck parking fines.
10. Conduct targeted parking enforcement.

GREENHOUSE GAS REDUCTION PLANS

The SCA/MMRP for the Oakland Army Base Redevelopment Project also requires the development of a Greenhouse Gas Reduction Plan (GGRP) for each major development project at the former OAB. Developers, whether on Port or City property, must submit a GGRP for Port or City review as a condition of development.

AB 617 WEST OAKLAND COMMUNITY AIR ACTION PLAN

Assembly Bill 617 (AB 617) represents a fundamental shift in air quality regulation because it focuses on local health effects, with specific attention to communities affected by a high cumulative exposure to criteria air pollutants and TACs, including DPM. CARB requires local air districts to work with communities to select all areas in the region that have a “high cumulative exposure burden” and prioritize areas for community monitoring and/or action plans over the next 6 years. The goal of the program is to eliminate air quality disparities and reduce health burdens. Staff at BAAQMD have identified West Oakland as a high-priority AB 617 community.

The AB 617 West Oakland Community Air Action Plan (WOCAAP) is among the first to be developed. A draft of the WOCAAP is expected to be available in June 2019. As appropriate, the WOCAAP intends to integrate specific strategies from relevant concurrent planning efforts, including the 2020 and Beyond Plan, the West Oakland Truck Management Plan and the West Oakland Specific Plan. The Port is fully engaged in the WOCAAP Steering Committee and is committed to the principle of improving air quality in West Oakland through participation in the Steering Committee. As a member of the WOCAAP Steering Committee, the Port supports its efforts by advising and informing the development of the WOCAAP. Coordination between the Port and the WOCAAP Steering Committee includes both the Port's 2020 and Beyond process and the TMP process. The Port regularly participates in workshops and voluntarily provided source data from the 2017 EI to BAAQMD for use in BAAQMD’s 2019 HRA, which addresses impacts from all on-road traffic, not just drayage trucks. In the future, the Port intends to continue to be a source of data for the agencies responsible for health risk.

The West Oakland community had previously been identified as an impacted community under the community air risk evaluation (CARE) program. The CARE program has now been integrated into the AB 617 process. Up to $50 million is available through a clean technology grant program in the Bay Area to address air pollution sources contributing to excess health risks in CARE[13] communities. The program requires an equipment owner cost share.

GOPORT PROGRAM

The GoPort Program, which is designed to improve the efficiency of freight movement in the Seaport Area, is composed of three projects:

- 7th Street Grade Separation West (7SGSW): Realign and grade separate the intersection of 7th Street and Maritime Street and construct a rail spur underneath to improve access and minimize conflicts between rail, vehicles, pedestrians, and bicyclists.
- 7th Street Grade Separation East (7SGSE): Replace the existing railroad underpass between I-880 and Maritime Street to increase clearance for trucks and improve the shared pedestrian/bicycle pathway.
- Freight Intelligent Transportation System (FITS): Apply intelligent transportation system (ITS) field systems along West Grand Avenue, Maritime Street, 7th Street, and Middle Harbor Road on the National and State Freight Network Systems and other technologies to cost-effectively manage Port roadways, provide truck traveler information, and improve incident management.

Although not designed as an air quality improvement program, the GoPort Program is likely to provide ancillary air quality improvements by increasing freight movement efficiency through reductions in congestion and idling. A summary of each of the three major components is provided below.

7th Street Grade Separation West

The 7SGSW project includes the construction of an elevated 7th Street/Maritime Street intersection and a tail track extension for the Burlington Northern and Santa Fe Railway Company (BNSF) Oakland Intermodal Gateway (OIG), also known as the Joint Intermodal Terminal. This will facilitate the expansion and reconfiguration of the OIG. The proposed project will reconstruct the segment of 7th Street between Maritime Street and Navy Roadway. The portion of 7th Street west of Maritime Street will be realigned to form a T-intersection at its junction with Middle Harbor Road and West Maritime Street. Maritime Street north of 7th Street will become a cul-de-sac with limited access to PG&E’s Davis and Cuthbertson Substations and the Regional Technical Training facility. Navy Roadway will be demolished and traffic on Maritime Street will use the proposed 7th Street T- intersection to access West Maritime Street, and vice versa. The project also includes a rail spur that connects the OIG to Outer Harbor Intermodal Terminal and utility infrastructure upgrades along 7th Street.

[13] CARE communities are communities that were identified under the Community Air Risk Evaluation (CARE) Program as experiencing higher air pollution levels than others.

7th Street Grade Separation East

The 7SGSE project will widen the existing four-lane underpass at the Union Pacific Railroad mainline tracks between Bay Street and Maritime Street to meet current seismic and geometric standards, increase vertical and horizontal clearances for trucks to current standards, and provide shoulders in each direction. The project also includes reconstruction of all related roadway elements, such as street lighting, storm drain infrastructure, signage, and striping, and installation of changeable message signs at the intersection of 7th and Maritime Streets. In addition, the 7SGSE will widen the existing multi-use bicycle and pedestrian path to a 10-foot pathway with 2-foot shoulders and a crash barrier separating the path from the roadway. On the rail side, the project will reconstruct railroad tracks, switches and related rail infrastructure.

Freight Intelligent Transportation System

The FITS Project consists of six individual projects that are primarily aimed at traffic management and operations of arterial roadways in and adjacent to the Seaport Facilities, and regional traveler information dissemination to and from the Port to improve safety, reduce traffic congestion, provide reliable travel time, and improve quality of life.

The FITS Project consists of non-ground disturbing, system-based improvements in addition to trenching for fiber optics, upgrading signals, constructing foundations, and removing vegetation and trees. The FITS Project also includes other related equipment installations that maximize the operation of the Port's overall roadway system and provide traffic management and associated air quality benefits. The first tier of the FITS Project is in design and is scheduled to be constructed and implemented over the next 2 to 3 years. The six individual FITS projects are summarized below.

1. Joint Transportation Management Center and Emergency Operations Center (TMC/EOC): Reconfigure/modify the existing TMC at the Port's Harbor Facilities building with interior space upgrades, new communications, and other amenities for the efficient operation of a Joint TMC/EOC to maintain and operate the ITS elements to be deployed by the FITS Project.

2. Radio-Frequency Identification (RFID) Readers: Install RFID readers in and near the Seaport facilities on existing and new poles to monitor truck movement, including truck turn-time within the Port. The readers will transmit the truck information to a central location that can be accessed through a server.

3. Advanced Traffic Management System (ATMS) – Phase 1: Install and/or implement the following:

    - Signal improvements, including video detection (intersection only)
    - Advanced Rail Grade Crossing System (for determining train activity and delays)
    - ATMS software platform

- Changeable message signs (CMSs)
- Queue detection
- Closed circuit television upgrade to high-definition
- Communications (fiber optic) lines
- Center-to-center connection between the Port, the City of Oakland, and Caltrans
- Additional RFID readers (not installed by Project Number 2) requiring a communication network via a fiber backbone
- Supplemental vehicle detection (for determining vehicle speeds and traffic patterns)
- Weigh-in-motion (WIM) technology (for determining truck weights)

4. Basic Smart Parking System: Installation of software system/application that monitors parking availability that can be shared via GoPort Freight ITS Information System/App, CMS, and other system technologies, and that also provides parking payment options.

5. Communications (Wi-Fi): Install Wi-Fi capabilities in the Seaport Area as a backup communication system and a means for addressing cellular dead spots and enhancing security and emergency response functions. Offers amenities to truckers in queue or within the Port (e.g., Port traffic and gate queue videos and improved access to GoPort Freight ITS information System/App).

6. System Integration and GoPort Application – Phase 1: A systems integrator (SI) will develop software to integrate existing and new ITS applications. In addition, the SI will develop a graphical user interface application for the basic GoPort application. The application will be made available for the end users (truckers and other service providers) so that it can be used, for example, to find travel time, including turnaround time within the Port; find container information, such as availability and yard information; make appointments for container pickups/drop-offs or parking within the Port complex; and pay fees.

STATUS OF CURRENT TECHNOLOGY FOR NEAR-ZERO- AND ZERO-EMISSIONS EQUIPMENT

The Port has been tracking the development of near-zero- and zero-emissions technology suitable for the maritime industry. Although electric drives for personal vehicles and solar collection technologies are advancing rapidly, heavy power demands, a larger variety of equipment types, and challenging operating conditions in the maritime environment create greater challenges to progress for development of zero-emissions equipment in these applications. Furthermore, most zero-emissions technology based on electrical power currently has a limited operating range or duration. Charging battery-electric equipment takes considerably longer than refueling a comparable piece of equipment with petroleum-based fuel.

Improved batteries (lighter-weight batteries capable of holding a greater charge, with a longer life span, and able to be charged more rapidly) are likely to be required to make much of the electrically powered zero-emissions equipment feasible from a commercial and operational perspective.

Key considerations regarding the feasibility of near-zero- and zero-emissions equipment include:

- Battery technology
- Charging process
- Ability to use grid electricity
- Commercial availability of hybrid, near-zero-emissions, and zero-emissions equipment

These key considerations are described below. For more detailed information on specific equipment and infrastructure considerations, see Appendix C: Suggested Actions.

BATTERY TECHNOLOGY STATUS

One important consideration for battery-electric equipment is the current state of battery technology. Although battery technology is continuing to advance, it is impossible to predict at this point when improved batteries will become available.

Traditional car batteries (lead-acid batteries) were the batteries initially used by mobile CHE, such as electric Automated Guided Vehicles. Lead-acid batteries are easy to manufacture at a low cost, are reliable, and tolerate overcharging. However, they take relatively long to recharge, emit lead into the environment, and present corrosion problems. In addition, lead-acid batteries produce acid fumes and have reduced battery life due to sulfation (M&N 2018). Furthermore, these batteries are hazardous waste once their useful life is over.

Recently, CHE manufacturers have displayed an increasing preference for lithium-iron-phosphate (LFP) batteries. Although these batteries are more expensive than lead-acid batteries, they are a safe and secure technology. They are lighter and more compact, degrade gradually, have a long life, present less risk of thermal events (as found in less expensive lithium-ion batteries, which charge much faster), and have a low environmental toxicity. During Moffatt and Nichols' review of vendors' equipment (2018), most equipment makers reported that they are now producing LFP batteries and moving away from lead-acid types. Alternately, lithium-polymer batteries (used in cell phones, tablets, and radio-controlled aircraft) provide higher energy densities and weigh less than LFP batteries, albeit at the expense of varied degradation rates and thermal activity.

In addition to technical performance and cost, the weight and size of batteries currently limit the range of battery-electric vehicles as well as the types of equipment that can be powered by batteries. In general, the weight of the batteries means that battery-electric vehicles are heavier than conventional vehicles, and the extra weight limits the number of batteries that can be installed on a vehicle or other piece of equipment.

Therefore, even the most advanced trucks are currently limited to a short range (100 miles per charge, approximately); long-range trucks running on a single battery charge are currently not feasible. Similarly, top-picks, which require approximately 900 horsepower, are in the early prototype stage due to the restrictions of current battery technology (see Appendix F: Equipment Operations and Cost Assessment to Assist with Electric Infrastructure Planning).

Manufacturers and academia are constantly innovating and the cost, energy density, and life span of batteries are expected to improve over time. In addition to bringing new battery products to the marketplace, innovation is expected to drive costs downward and result in improved reliability (M&N 2018).

CHARGING CONSIDERATIONS

The rate at which batteries can be charged is a significant consideration when using battery-powered equipment. In addition, sufficient charging infrastructure must be available to charge all battery-powered equipment. A 240-kilowatt (kW) battery can be recharged (using a direct current charger) in about 1.5 hours, provided there is sufficient amperage. For yard tractors, the estimated power consumption rate is 15 kilowatt-hours (kWh), meaning that the battery would last approximately 16 hours without recharging. This would provide no margin of error for a two-shift operation, indicating that interim recharging (e.g., during the 1-hour shift change) would be required for a viable two-shift operation (see Appendix F).

Although sufficient electrical power could theoretically be provided to charge all equipment at a marine terminal at the maximum rate, doing so could be costly. Chargers would have to be installed for each piece of equipment, and the peak power demand would occur for only approximately 4% of any given day, potentially resulting in high demand charges.[14] It would be more economical to spread out charging over a longer period. This would also reduce the number of chargers that would have to be installed, as multiple pieces of equipment could be charged by one charging station. However, extending the charging period would mean that the equipment is unavailable for a longer period. This would prevent, or greatly limit, a three-shift operation. Consequently, the operating cycle for each piece of equipment becomes a critical factor in planning infrastructure and developing cost estimates.

Equipment using hydrogen fuel cells can be charged more rapidly, but would require more extensive infrastructure investments (i.e., either a hydrogen-generating facility at the charging location or a hydrogen pipeline to a manufacturer's location). An article on one website suggests that a heavy-duty

[14] Demand charges cover electric utilities' fixed costs for providing a certain level of energy to their customers. Energy costs are the variable-costs portion (charges by kilowatt-hour). The challenge is that utilities must maintain enough capacity to satisfy all their customers' energy needs at once. Because utilities must maintain enough power plants to supply all that energy at once, they must keep a vast array of expensive equipment on constant standby, including transformers, wires, substations, and generating stations. This capacity is extremely expensive to build, and demand charges help pay the costs.

truck could be refueled in about 10 minutes (Mace 2017). Hydrogen is highly flammable, and can pose safety concerns. Although two equipment manufacturers have developed trucks powered by hydrogen fuel cells, development of new CHE powered by hydrogen fuel cell technology appears to be lagging the development of battery-electric equipment (M&N 2018). For a more detailed discussion of hydrogen fuel cell technology, see Appendix C: Suggested Actions.

USE OF GRID ELECTRICITY

Some electrical equipment can also be powered by grid electricity. However, this type of equipment is limited in its range, as it either needs to be connected to a fixed rail or a cable reel. Depending on the layout of the terminal, this type of equipment may also present operational challenges. Electric rails could limit yard tractor and truck movements within the terminal. Cables on cable reels are typically run in trenches; truck traffic on the terminal causes debris to enter the trenches, which can cause failure of the cable reel. As a result, some ports that operate their own terminals have gone to a fixed container yard layout to allow for a high level of automation in their terminals. The Port of Oakland is a landowner port and does not operate its own terminals. In addition, any such changes are subject to Port labor agreements.[15]

AVAILABILITY OF NEAR-ZERO-EMISSIONS EQUIPMENT

The term *near-zero emissions* (NZE) is applied to a wide range of equipment and has different meanings depending on the context in which it is used:

- Low-NO_x equipment: This type of equipment is defined as equipment that is powered by engines certified by the State of California to provide 90% NO_x emissions reductions compared to Model Year 2007 or later diesel-powered equipment (Tier 4-compliant engines). These standards have only been set for truck engines. For clarity, equipment using these engines is referred to as low-NO_x equipment in this Plan. The California certification for low-NO_x engines does not require any additional reductions in PM or other criteria pollutants (or GHGs) compared to Model Year 2007 or later engines.

- Tier 4 diesel engines: The literature at times refers to modern diesel engines (including engines for locomotives and harbor craft) meeting Tier 4 standards as NZE engines; this Plan refers to them as Tier 4 engines.

- Hybrid equipment: Hybrid technology recovers a portion of the energy used in braking or other equipment functions to charge a battery. The battery powers the vehicle until it is discharged, at which point a different power source, typically an internal combustion engine, takes over. Hybrid

[15] Port labor agreements are between the union and specific terminal operators, and do not involve the Port of Oakland directly.

technology is well established for light-duty vehicles, and some medium-duty fleets (e.g., delivery vans), but the technology is in the developmental stage for most heavy-duty equipment. This Plan uses the term *hybrid* for this type of equipment.

Low-NOx and hybrid equipment are discussed in more detail below.

Low-NOx Engines

Depending on the fuel source, low-NO_x engines may also reduce or eliminate emissions of DPM. When low-NO_x equipment is powered by a fuel other than diesel, emissions of DPM are eliminated, although the equipment may still emit PM. In some cases, use of low-NO_x equipment can be coupled with the use of alternative fuels, resulting in reductions of GHGs as well as criteria air pollutants and TACs. For example, a natural-gas-powered low-NO_x engine could be fueled by renewable natural gas, which would result in large reductions in GHG emissions (see the discussion of renewable natural gas in Appendix C: Suggested Actions).

Currently, there is one heavy-duty (12-liter displacement) engine that is certified as meeting the low-NO_x criteria; there are no heavy-duty (15-liter displacement) engines that are certified to the low-NO_x standard. Heavy-duty natural-gas powered trucks are available from multiple manufacturers (Hampstead 2018; SPBP 2018). However, while thousands of heavy-duty trucks with low-NO_x engines have been built in the U.S. in the last 2 years, only 22 of these are in drayage service and they are still undergoing proof of feasibility service (SPBP 2018). Much less is known about the performance of low-NO_x natural gas engines in yard tractors, which may be required to haul even heavier loads than drayage trucks. Low-NO_x natural-gas-powered engines are currently being tested at the Port of Los Angeles and in a joint demonstration project by the SPBP, which are testing a total of 42 low-NOx natural-gas-powered yard tractors (CEC n.d.; Campbell 2018).

Currently, there are no CNG- or LNG-fueled trucks in the Port's Secure Truck Enrollment Program registry, indicating that there are no natural gas trucks providing drayage services at the Port of Oakland. Natural gas-powered trucks comprise approximately 3% of the registered drayage trucks at the SPBP. Use of natural gas trucks at the SPBP has declined substantially from a peak of approximately 8 % in 2010 - 2012 (SPBP 2018).

Natural-gas-powered low-NO_x equipment relies on an infrastructure for natural gas fueling. This infrastructure is not extensively developed near the Seaport; there is only one CNG fueling station in the immediate vicinity of the Seaport. Establishing fueling locations for drayage trucks in developed areas like the Seaport can be challenging. The fueling location must be in an area with adequate traffic circulation capacity, provide sufficient space for ingress and egress, accommodate the much larger turning radius of trucks, and include wide lanes to accommodate trucks. Thus, the opportunity to develop additional fueling locations in the Seaport Area is limited.

Nonetheless, based on the status of equipment in maritime service (i.e., drayage trucks and yard tractors), it appears that the use of natural-gas-powered low-NO_x equipment is possible. The equipment must still be demonstrated in maritime use before it is considered commercially available. Additional natural gas fueling stations would also have to be developed near the Port. The East Bay Municipal Utility District (EBMUD) has expressed some interest in developing renewable natural gas as a transportation fuel at its West Oakland wastewater treatment plant, which could potentially serve as a location for natural gas fueling.

Hybrid Equipment

Hybrid technology is becoming established for RTG cranes; however, it is in the developmental stage for other applications. As noted earlier, in 2018 BAAQMD awarded a Carl Moyer grant to SSAT (SSA Terminals and SSA Terminals [Oakland]) to help fund the repower of 13 hybrid RTG cranes at the Port of Oakland. These RTG cranes provide substantial emissions reductions compared to conventionally powered RTG cranes. At least one manufacturer is providing retrofit kits to convert conventional diesel trucks to hybrid trucks (Green Car Congress 2017). In addition, hybrid natural gas/battery-electric, and hybrid fuel cell/battery-electric vehicles have also been developed by at least one manufacturer each (Hampstead 2018; Pocard 2018). The San Pedro Bay Ports' *Draft 2018 Feasibility Assessment for Drayage Trucks* also concluded that hybrid near-zero-emissions or zero-emissions technology is considerably less developed than the technology for low-NO_x natural-gas engines and battery-electric drives, and eliminated these technologies from further consideration in the assessment (SPBP 2018).

Hybrid technology is starting to be developed for tugs. There is at least one hybrid retrofit system that has been approved, and others are in development (Maritime Executive n.d.; CARB 2018c). The maximum criteria air pollutant and GHG reductions for the approved hybrid tug system are on the order of 30% over existing engine technology. More novel designs may yield more substantial emissions reductions, primarily for criteria air pollutants. There are currently no commercially available hybrid options for OGVs in transit or at berth.

Some hybrid technologies achieve near-zero criteria air pollutant emissions and provide substantial GHG reductions due to the increased efficiency resulting from energy recovery. Thus, some hybrid equipment can be deployed now on a transitional basis to provide substantial emission reductions.

AVAILABILITY OF ZERO-EMISSIONS EQUIPMENT

Battery-electric technology is well established for light-duty vehicles, and some medium-duty fleets (e.g., delivery vans), but is in the developmental stage for most heavy-duty equipment.

Zero-emissions technology for mobile CHE, HC, and OGVs is in the demonstration stage or earlier stages.[16] Zero- and near-zero-emissions CHE is currently in use (primarily in a demonstration-testing capacity) in portions of 18 ports around the world. The San Pedro Bay Ports are testing the greatest variety of mobile zero- and near-zero-emissions CHE (M&N 2018). Several types of grid-electric CHE are available. However, these types of equipment require either a fixed-yard layout or a fully automated terminal, and are not suitable for current marine terminal operations at the Port of Oakland. Electric drayage trucks' level of development is similar to that of battery-electric yard tractors.

Cargo-Handling Equipment

The status of zero-emissions CHE is discussed in detail in Appendix F: Equipment Operations and Cost Assessment to Assist with Electric Infrastructure Planning. Overall, technology based on hydrogen fuel cells is lagging the development of battery-electric technology. Yard tractors are the most advanced type of mobile battery-electric CHE; nearly 60 battery-electric yard tractors are in demonstration testing or scheduled to be entering demonstration testing within the next year at various ports in California. Provided that adequate charging infrastructure is available and sufficient incentive funding is provided to cover the large cost gap between battery-electric and conventional diesel-powered equipment, battery-electric yard tractors may become commercially viable within the next several years. Given the large cost gap between conventional diesel-powered and battery-electric yard tractors, incentive funding is critical to their adoption in the short to intermediate term (see Appendix F). Battery-electric yard tractors are at Technological Readiness Level (TRL) 6 to 7, meaning they are in the technology demonstration to early systems testing phase.

Other CHE used at the Port of Oakland consists of RTG cranes and top-picks. Top-picks require high horsepower, which is a challenge for battery-electric service. The Port will receive one battery-electric top-pick for pilot testing in 2020. Battery-electric top-picks are at TRL 5 to 6. There are currently no fully battery-electric RTG cranes, although grid-electric RTG cranes are commercially available. The fixed operating platform required for terminals using grid-electric RTG cranes is incompatible with operations at the Port of Oakland. Because hybrid RTG cranes provide substantial emissions reductions and conventional diesel-powered RTG cranes can be repowered to hybrids, hybrid RTG cranes are the most likely RTG technology to be deployed at the Port in the foreseeable future.

Harbor Craft

Currently, there are no commercially available zero-emissions technologies suitable for HC. CARB is considering issuing additional tug engine regulations in 2020, which would likely drive increased technology development in this sector. However, these regulations are not expected to take effect until 2023.

[16] See Appendix D: Screening and Evaluation of Criteria for Implementing Actions, Table D-3 for a description of the technological readiness levels.

Ocean-Going Vessels

There are currently no commercially available zero-emissions options for OGVs in transit. The Port is continuing to work with the shipping lines to increase plug-in rates for vessels at berth.[17] Due to the long distances that OGVs typically travel, it is unlikely that zero-emissions technologies for OGVs in transit will become available in the foreseeable future. Instead, reductions in OGV emissions from transiting vessels must come from improvements to OGVs. On April 13, 2018, the IMO agreed to set targets to reduce the carbon intensity of global transport. The goal is to reduce CO_2 emissions per unit freight, as an average across international shipping, by at least 40% by 2030 compared to 2008, and to move toward 70% by 2050. In addition, the IMO set a target to reduce the total annual GHG emissions by at least 50% by 2050, compared to 2008, while pursuing efforts toward phasing them out, consistent with the Paris Climate Agreement temperature goals (IMO 2018). In December 2018, Maersk set a target to be carbon neutral by 2050. The shipping line indicated that for Maersk to be able to achieve its goal, carbon-neutral OGVs would have to be commercially viable by 2030. The press release stressed the technical challenges inherent in developing a carbon-neutral container vessel and announced a substantial commitment to research and development as well as the intent to promote strong industry involvement, co-development, and sponsorship of sustainable solutions (Maersk 2018).

Drayage Trucks

As discussed earlier, the San Pedro Bay Ports, as part of their CAAP, are conducting a feasibility assessment for drayage trucks. A draft was released in December 2018 (SPBP 2018).[18] The assessment concludes that electric drayage trucks are at TRL 6 to 7 and states that five major original equipment manufacturers (OEMs) and several “emerging” OEMs are working on development of electric Class 8 trucks (SPBP 2018).

Drayage truck use falls into two primary types of service: short hauls near the Seaport (to a rail yard or an off-site container storage location) and long-haul service (e.g., to the Central Valley). Electric short-haul drayage trucks may become commercially available soon; however, the cost differential compared to modern diesel-powered trucks will be substantial, and adoption of electric drayage trucks will require substantial incentive funding. The utility of short-haul electric drayage trucks is limited because drayage trucks are typically put into both types of services, as needed, by the truck owner or licensed motor carrier. Nonetheless, once commercially available, short-haul drayage trucks may be suitable for replacing a small portion of the diesel drayage truck fleet serving the Port of Oakland.

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[17] Criteria air pollutant and DPM emissions could also be captured at the exhaust stack for vessels that are unable to use shore power (by use of a “bonnet” over the exhaust stack, coupled with filtration of the exhaust gases). However, this is not a zero-emissions technology. A bonnet does not provide any GHG reduction benefits, and operation of the barge equipped with the bonnet and the operation of the bonnet itself may increase GHG emissions compared to not using a bonnet (see discussion of *Barge-Based Exhaust Scrubber System [Bonnet]* in Appendix C: Suggested Actions).

[18] The Final Feasibility Assessment was released on April 3, 2019. Its conclusions are substantially the same as the Draft Feasibility Assessment.

The National Renewable Energy Laboratory (NREL) in collaboration with the South Coast Air Quality Management District (SCAQMD) is evaluating the in-service performance of electric drayage trucks compared to conventional diesel drayage trucks operated in and around the SPBP. The Class 8 electric drayage trucks under study transport cargo containers between the port complex and local rail yards and distribution centers. According to NREL, by using advanced batteries and high-efficiency components, electric drayage trucks can operate up to 100 miles on a single battery charge while handling gross vehicle weight (GVW) loads of up to 80,000 pounds (NREL 2018).

The utility of electric short-haul drayage trucks is also subject to charging constraints. Drayage trucks that operate for single shifts could readily be charged during their normal downtime, provided sufficient charging infrastructure is available. However, it may be more difficult to adequately charge trucks that are operating for two shifts (truck owners would face concerns like those that terminal operators would face with yard tractor fleets; see Appendix F: Equipment Operations and Cost Assessment to Assist with Electric Infrastructure Planning). Also, although electric short-haul drayage trucks would haul the same GVW loads as conventional trucks, electric trucks are heavier than conventional diesel trucks, and their weight substantially reduces the truck’s potential payload. A conventional diesel truck has a curb weight of approximately 18,000 pounds; the one pre-commercial electric truck has a curb weight of approximately 25,500 pounds (SPBP 2018).

Development of long-haul electric drayage trucks will require development of better batteries as well as a state-wide charging infrastructure. A coalition of utilities from California, Oregon, and Washington has started a study on providing viable electric trucking infrastructure from Canada to Mexico. Called the West Coast Clean Transit Corridor Initiative, the study is focused on freight transportation along Interstate 5, the north-south backbone of freight transportation on the West Coast.

Hydrogen-fuel-cell-powered long-range trucks may have a greater likelihood of becoming operationally viable in the near to intermediate term; however, development of hydrogen-fuel-cell trucks is lagging development of electric vehicles. Hydrogen-fuel-cell trucks are currently at TRL 5 to 6 (SPBP 2018). In addition, a hydrogen fueling infrastructure would have to be developed to support deployment of these trucks, and the hydrogen used in the fuel cells would have to be made from renewable sources for a hydrogen-fuel-cell truck to be a true ZEV. Also, as discussed for low-NO_x trucks, developing new fueling stations that can accommodate trucks can be challenging in a developed area like the Seaport. Thus, development of fueling infrastructure for hydrogen-fuel-cell powered trucks may also present an obstacle.

Electrification of short-haul trucks may result in greater efficiency gains than previously expected. A recent CARB study (CARB 2018e) indicated that the expected efficiency gains from electrification of trucks are better than previously estimated, especially for low-speed duty cycles. The resulting GHG emissions benefits and fuel savings would therefore also be higher than previously estimated.

The energy efficiency ratio (EER) is used to determine how many credits an electric vehicle owner can receive for using electricity as a motor vehicle fuel. Potential updates to the Low Carbon Fuel Standard program to reflect the higher EER would result in higher credits per kilowatt-hour[19] used and would lower the total cost of ownership of a given electric vehicle.

Based on the CARB study, when compared to conventional diesel vehicles, the EER of the battery-electric vehicle is about 3.5 at highway speeds and 5 to 6 when operated at lower-speed duty cycles, where idling and coasting losses from conventional diesel engines are highest. The average daily speed for near-dock drayage trucks, vans, and yard tractors is commonly below 13 miles per hour. The EER can be higher than 6 for yard tractors. CARB expects that in the next decade, electric trucks and buses are more likely to be placed in service in slower-speed operations because of battery range limitations and battery costs.

CHALLENGES

Achieving additional emissions reductions and transitioning to a zero-emissions Seaport presents challenges, which are listed and described below:

- **Sources of Residual DPM Emissions:** The majority of the remaining DPM emissions associated with Port operations arise from OGVs in transit (83%) and HC operations (12%); the Port does not own, operate, or control OGVs or HC. Few measures and only limited regulations address these sources. The recent GHG emissions targets set by IMO suggest that OGV GHG emissions, and consequently DPM emissions, are likely to be reduced in the future (IMO 2018). However, given the long life-cycles of container vessels, the changeover is likely to be a decade or more in the future.

- **Tenant- and Trucker-Owned-and-Operated Equipment:** Most of the equipment operating at the Seaport is not owned by the Port. Thus, the Port's primary role is to provide the policy framework in the 2020 and Beyond Plan and to continue to maintain strong partnerships with tenants and truckers to promote their use of cleaner equipment. The transition to cleaner equipment balances factors such as available grant funding and reduced fuel use with operational factors such as equipment downtime, maintenance, and workforce development and training.

- **Infrastructure:** The transition to a zero-emissions Seaport will require extensive improvements to infrastructure, primarily electric and potentially fiber-optic communications systems. Major infrastructure improvements (e.g., new transmission capacity or new substations) would have to be

[19] A kilowatt-hour (kWh) is a measure of how much energy is used. It does not mean the number of kilowatts used per hour, but a measurement equal to the amount of energy that would be used to keep a 1,000-watt appliance running for an hour. For example, a lit 100-watt light bulb would take 10 hours to use 1 kWh of energy.

constructed; design and construction of some required infrastructure may need to begin several years before new equipment and systems are put into operation. However, some opportunities to deploy zero-emissions equipment requiring smaller improvements can begin right away.

- **Funding:** Installing the infrastructure and replacing the mobile equipment that would have to be replaced to achieve a zero-emissions Seaport are costly undertakings. For example, a retrofit to convert a diesel RTG crane to a hybrid-electric RTG crane may cost more than $500,000, and a zero-emissions drayage truck may currently cost nearly three times as much as a comparable diesel-powered truck. Although the cost of equipment is expected to decline over time, it may take 20 years for some types of equipment to reach cost parity.

- **Technology Reliability/Failures:** Once new technology is implemented, it must be monitored regularly to ensure that it is performing as intended. Equipment users are also concerned about the overall long-term performance of expensive equipment, as none of the prototype equipment has been in service for more than a year or two.

- **Operational Impacts:** New technologies may require changes in operations that may or may not be compatible with existing operations at a terminal or other business. In addition, maintenance, labor, and safety may be significant considerations. Equipment users are concerned about the potential downtime caused by a lack of available parts and nearby maintenance facilities.

- **Stranded assets:** A stranded asset is equipment or infrastructure that has experienced unanticipated or premature write-downs, devaluations, or conversion to liabilities. The Port, its tenants, and other businesses serving the Port have made substantial investments in new, cleaner equipment and infrastructure that have a long useful life. If this recently acquired equipment or infrastructure is abandoned or replaced before the end of its useful life, businesses will not be able to capture the full benefit of their investments, resulting in waste. Smaller fleets, like those typically providing drayage service to Port tenants, are particularly vulnerable to the costs of stranded assets.

REFERENCES

A.P. Moller-Maersk (Maersk). 2018. Maersk sets net zero CO_2 emission target by 2050. December. Available at: https://www.maersk.com/en/news/2018/12/04/maersk-sets-net-zero-co2-emission-target-by-2050. Accessed February 22, 2019.

Apte, Joshua S.; Messier, Kyle P.; Gani, Shahzad; Brauer, Michael; Kirchstetter, Thomas W.; Lunden, Melissa M.; Marshall, Julian D.; Portier, Christopher J.; Vermeulen, Roel C.H.; Hamburg, Steven P. (Apte et al). 2017. High-Resolution Air Pollution Mapping with Google Street View Cars: Exploiting Big Data. Environmental Science and Technology, 51, 6999−7008. June 5.

Bay Area Air Quality Management District (BAAQMD). 2009. West Oakland Truck Survey. December.

_____. 2017. *Spare the Air and Cool the Climate: A Blueprint for Clean Air and Climate Protection in the Bay Area - Draft Clean Air Plan, Volume 2*. January. Available at: http://www.baaqmd.gov/ ~/media/files/planning- and-research/plans/2017-clean-air-plan/attachment-a_-proposed-final-cap-vol-1-pdf. pdf?la=en. Accessed May 1, 2018.

_______. 2019a. Draft 2019 Bay Area Air Quality Management District (BAAQMD) Human Health Risk Assessment. Presentation at the March 21, 2019 WOCAAP Steering Committee Meeting.

_______. 2019b. Draft 2019 Bay Area Air Quality Management District (BAAQMD) Human Health Risk Assessment. Presentation at the May 1, 2019 BAAQMD Board Meeting.

California Air Resources Board (CARB). 2008. Diesel Particulate Matter Health Risk Assessment for the West Oakland Community. December. Available at: https://www.arb.ca.gov/ch/communities/ra/ westoakland/documents/westoaklandreport.pdf.

_____. 2018a. AB 32 Scoping Plan. January 8. Available at: https://www.arb.ca.gov/cc/scopingplan/ scopingplan.htm. Accessed October 5, 2018.

_____. 2018b. Battery Electric Truck and Bus Energy Efficiency Compared to Conventional Diesel Vehicles. January. Available at: https://www.arb. ca.gov/msprog/actruck/docs/HDBEVefficiency.pdf. Accessed April 18, 2018.

_____. 2018c. CARB announces more than $200 million in new funding for clean freight transportation. September 26. Available at: https://ww2.arb.ca.gov/news/carb-announces-more-200-million-new-funding-clean-freight-transportation. Accessed December 3, 2018.

California Energy Commission (CEC). n.d. Driving Cleaner Transportation - Los Angeles Harbor Department. Available at: https://www.energy.ca.gov/transportation/tour/la_harbor/. Accessed October 13, 2018.

California Environmental Protection Agency (CalEPA). 2018. CalEnviroScreen 3.0. June. Available at: https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30.

California Office of the Governor. 2018. Governor Brown Takes Action to Increase Zero- Emission Vehicles, Fund New Climate Investments. January 26. Available at https://www.gov.ca.gov/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles- fund-new-climate-investments/. Accessed June 18, 2018.

Campbell, Todd. 2018. Near-Zero Emission Trucks Deployed in Busiest Port Complex. August 16. Advanced Clean Transportation News. Available at: https://www.act-news.com/news/deploying-near-zero-emission-trucks/. Accessed October 13, 2018.

Environ International Corporation (Environ). 2013. *Port of Oakland 2012 Seaport Air Emissions Inventory*. November 5, 2013. Available at: https://www.portofoakland.com/files/PDF/environment/maqip_emissions_inventory.pdf.

_____. 2008. Revised Port of Oakland 2005 Seaport Air Emissions Inventory. March. Available at: https://www.portofoakland.com/community/environmental-stewardship/seaport-air- emissions-inventory-2005/.

Environmental Defense Fund (EDF). 2019. Oakland Air Pollution Maps. Available at: https://edfmaps.maps.arcgis.com/home/item.html?id=94316eac9a464a03b6ef2800ca7ecf44. Accessed February 8, 2019.

Green Car Congress. 2017. Hyliion introduces hybrid upfit system for Class 8 trucks. October 19. Available at: https://www.greencarcongress.com/2017/10/20171019-hyliion.html. Accessed October 15, 2018.

Hampstead, John Paul. 2018. Natural gas-powered trucks are well ahead of electrification. May 4. Available at Freightwaves: https://www.freightwaves.com/news/green-trucking/lng-cng-trucks-ahead-of-electric. Accessed October 24, 2018.

Harley, Robert A. 2014. On-Road Measurement of Emissions from Heavy-Duty Diesel Trucks: Impacts of Fleet Turnover and CARB's Drayage Truck Regulation - Final Report, Contract No. 09-340. Prepared for: California Air Resources Board. November.

Hu, Shaohua, Smith, Jeremy D.; Ham, Walter; Burnitzki, Mark; Howard, Cody; Chernich, Don; Tao Huai, (Hu et al). 2018. Development and Establishment of a Monitoring Network Using Portable

Emissions Acquisition System to Quantify Heavy-Duty In-Use Vehicles Emissions in California. Presented at Air Sensors International Conference (ASIC), September 12-14.

Intergovernmental Panel on Climate Change (IPCC). 2018. Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C approved by governments. October 8. Available at: https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/. Accessed October 3, 2018.

International Maritime Organization (IMO). 2018. UN body adopts climate change strategy for http://www.imo.org/en/mediacentre/pressbriefings/pages/06ghginitialstrategy.aspx. Accessed April 14, 2018.

Mace, Alan. 2017. Hydrogen Fuel Cell Trucks: An Innovator's Guide to Hydrogen Truck Refueling. November 16. Available at: https://blog.ballard.com/hydrogen-truck-refueling. Accessed October 13, 2018.

The Maritime Executive. n.d. Offshore Ship Designers launches near-zero emission tug. Available at: https://www.maritime-executive.com/article/2008-05-272008-05-21-offshore-ship-designers-launches-near-zero-emission-tug. Accessed October 14, 2018.

Moffatt & Nichol (M&N). 2018. Container Yard Electrification Feasibility Study, Version 2.0. February.

National Renewable Energy Laboratory (NREL). 2018. South Coast Air Quality Management District Truck Evaluation. Available at: https://www.nrel.gov/transportation/fleettest- electric-scaqmd.html. Accessed June 1, 2018.

Northwest Seaports Alliance (NWSA). 2017. *Northwest Ports Clean Air Strategy - 2015 Implementation Report*. March. Available at: https://www.nwseaportalliance.com/sites/default/files/final_2015_implementation_report_version_3-14-2017.pdf. Accessed February 9, 2019.

Office of Environmental Health Hazard Assessment (OEHHA). 2018. Indicators of Climate Change in California. August 30. Available at: https://oehha.ca.gov/climate-change/document/indicators-climate-change-california.

Pocard, Nicolas. 2018. Hydrogen Fuel Cell Trucks: Solution to Heavy-Duty Transport Emissions? May 17. Available at: https://blog.ballard.com/fuel-cell-truck. Accessed October 24, 2018.

Port of Oakland (Port). 2009. Maritime Comprehensive Truck Management Plan - A MAQIP Program. June 16.

Port of Seattle. 2019. Northwest Ports Clean Air Strategy. Available at: https://www.portseattle.org/page/northwest-ports-clean-air-strategy. Accessed February 9, 2019.

Preble, Chelsea V.; Dallmann, Timothy R.; Kreisberg, Nathan M.; Hering, Susanne V.; Harley, Robert A.; and Kirchstetter, Thomas W. 2015. Effects of Particle Filters and Selective Catalytic Reduction on Heavy-Duty Diesel Drayage Truck Emissions at the Port of Oakland. Environmental Science and Technology, 49, 8864–8871. June 17.

Preble, Chelsea; Troy Cados, Troy; Harley, Rob; Kirchstetter, Tom (Preble et al.). 2018a. Effects of Exhaust After-Treatment and Fleet Modernization on Port of Oakland Drayage Truck Emissions. Presented at: MAQIP Meeting, Port of Oakland, February 23.

_____. 2018b. Plume Capture Method to Characterize On-Road Emissions by Heavy-Duty Diesel Trucks. Presented at ASIC Oakland September 14.

Ramboll Environ (Ramboll). 2016. Port of Oakland 2015 Seaport Air Emissions Inventory Final Report. October. Available at: https://www.portofoakland.com/files/PDF/Port%20of%20 Oakland%202015%20Seaport%20Emissions%20Inventory%20Final-11Oct2016.pdf.

San Pedro Bay Ports (SPBP). 2017. Clean Air Action Plan 2017 - Final Clean Air Action Plan Update. November.

_____. 2018. Clean Air Action Plan: *Draft 2018 Feasibility Assessment for Drayage Trucks.* December. Prepared by Tetra Tech/Gladstein, Neandross & Associates. Available at: http://www.cleanairactionplan.org/documents/draft-drayage-truck-feasibility-assesment.pdf/.

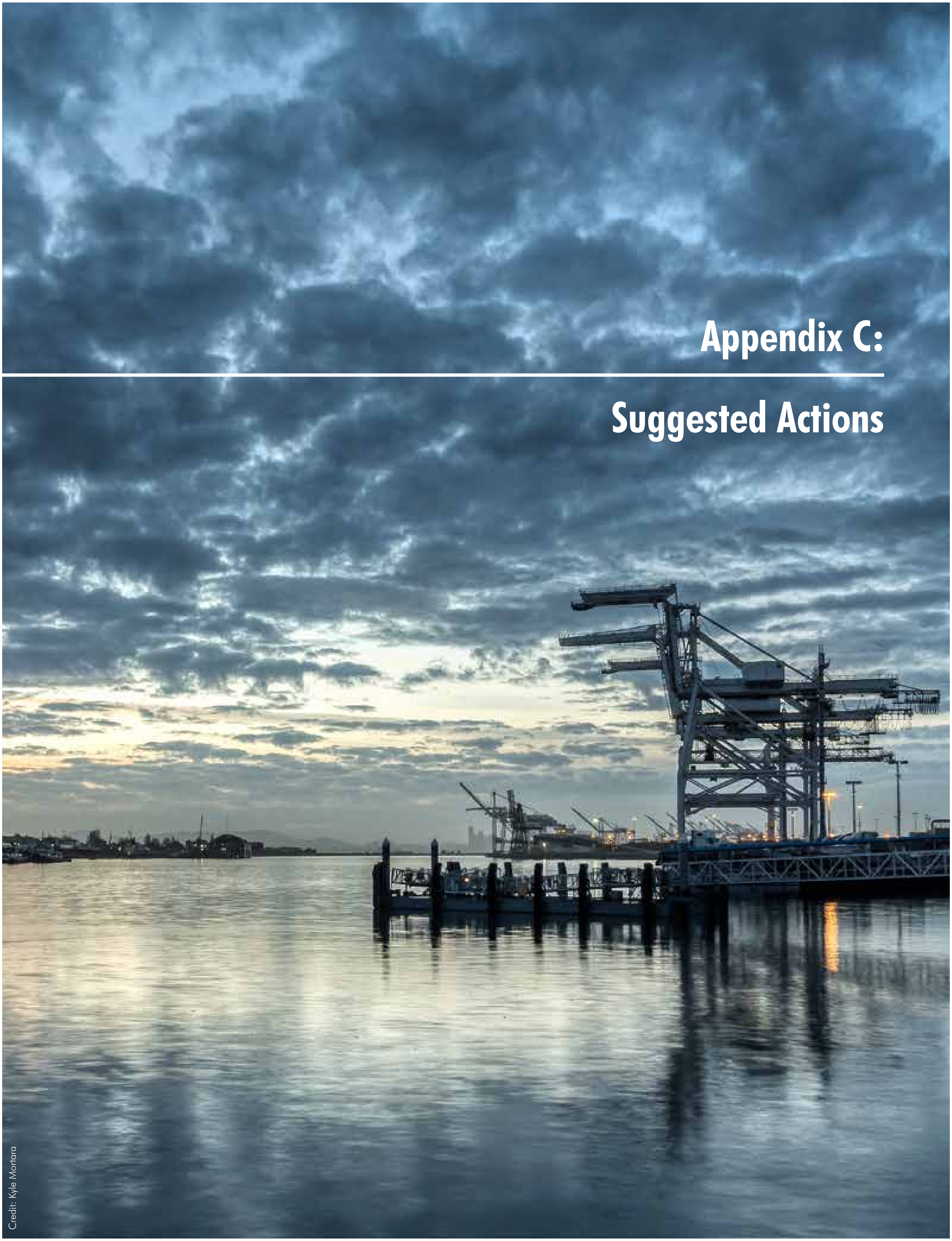
Starcrest Consulting Group, LLC (Starcrest). 2018. *Technical Memorandum: MAQIP Update - Emissions Forecast and Potential Additional Reduction Strategies*. July.

United Nations Framework Convention on Climate Change (UNFCCC). 2015. The Paris Accord. Available at: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement. Accessed October 4, 2018.

United States Environmental Protection Agency (U.S. EPA). 2018. Understanding Global Warming Potentials. Available at: https://www.epa.gov/ghgemissions/understanding-global-warming-potentials. Accessed October 21, 2018.

Appendix C:

Suggested Actions



Credit: Kyle Mortara

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ACRONYMS

2020 and Beyond Plan	Seaport Air Quality 2020 and Beyond Plan Beyond Plan
ASC	Automated Stacking Crane
BAAQMD	Bay Area Air Quality Management District
BNSF	BNSF Railway
Board	Board of Port Commissioners
CAAP	Clean Air Action Plan
CARB	California Air Resources Board
CHE	Cargo-Handling Equipment
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalents
CORE	Clean Off-Road Equipment Voucher Incentive Program
CTMP	Comprehensive Truck Management Plan
CVI	Clean Vessel Incentive
DERA	Diesel Emissions Reduction Act
DGE	Diesel-Gas-Equivalent
DPF	Diesel Particulate Filter
DPM	Diesel Particulate Matter
Draft Plan	*Draft Seaport Air Quality 2020 and Beyond Plan*
Dynergy	Dynergy Oakland Power Plant
EBMUD	East Bay Municipal Utility District
ECA	North American Environmental Control Area
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
FAME	Fatty Acid Methyl Ester
Final Plan	*Final Seaport Air Quality 2020 and Beyond Plan*
FITS	Freight Intelligent Transportation Systems
Foss	Foss Maritime Company

GHG	Greenhouse Gas
HC	Harbor Craft
hp	horsepower
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
IMO	International Maritime Organization
kWh	Kilowatt-Hour
LCFS	Low Carbon Fuel Standard
LNG	Liquefied Natural Gas
MAQIP	Maritime Air Quality Improvement Plan
MOU	Memorandum of Understanding
MT	Metric Ton
NO_x	Oxides of Nitrogen
NTAP	Near-Term Action Plan
NZE	Near-Zero-Emissions
OAB	Oakland Army Base
OEM	Original Equipment Manufacturer
OGRE	Oakland Global Rail Enterprise
OGV	Ocean-Going Vessel
OIG	Oakland International Gateway
PETF	Port Efficiency Task Force
PG&E	Pacific Gas and Electric Company
Plan	Seaport Air Quality 2020 and Beyond Plan
PM	Particulate Matter
Port	Port of Oakland
RD	Renewable Diesel
Revised Draft	*Revised Draft Seaport Air Quality 2020 and Beyond Plan*
RNG	Renewable Natural Gas
RPM	Revolutions per Minute
RPS	Renewable Portfolio Standard
RTG	Rubber-Tired Gantry
SB 100	Senate Bill 100

SCR	Selective Catalytic Reduction
7SGSE	7th Street Grade Separation East
7SGSW	7th Street Grade Separation West
SO_x	Sulfur Oxide
SPBP	San Pedro Bay Ports
SRM	Steam Reforming of Methane Gas
SSAT	SSA Terminals
STEP	Secure Truck Enrollment Program
TAP	Technology Advancement Program
Task Force	Seaport Air Quality 2020 and Beyond Task Force
TMP	Truck Management Plan
VSR	Vessel Speed Reduction
ZANZEFF	Zero- and Near-Zero-Emissions Freight Facilities
ZE	Zero-Emissions

SUGGESTED ACTIONS

The *Final Seaport Air Quality 2020 and Beyond Plan* (Final Plan), as discussed in the Main Text, provides a process to identify Implementing Actions throughout the life of the Seaport Air Quality 2020 and Beyond Plan (2020 and Beyond Plan or Plan). Appendix C provides a description of Implementing Actions that have been identified to date, including the Implementing Actions in the Near-Term Action Plan (NTAP) (years 2019-2023). The amount of information currently available about each of these actions varies. Typically, more information is available for Implementing Actions that are included in the NTAP. Appendix C also provides relevant background information regarding some categories of Implementing Actions. The screening and evaluation process for Implementing Actions is described in the Main Text (see Screening and Evaluation Process for Implementing Actions). Appendix D: Screening and Evaluation of Criteria for Implementing Actions provides supplemental information for the screening and evaluation process.

Sources of Implementing Actions

Implementing Actions may be identified by the Port of Oakland (Port) or stakeholders. As part of developing the Plan, the Port identified an initial set of Implementing Actions. Stakeholders suggested numerous additional actions in their comments on the *Draft Seaport Air Quality 2020 and Beyond Plan* (Draft Plan) and on the *Revised Draft Seaport Air Quality 2020 and Beyond Plan* (Revised Draft). For example, as part of their comments on the Draft Plan, EarthJustice (on behalf of West Oakland Environmental Indicators Project) and the Bay Area Air Quality Management District (BAAQMD) provided lists of Suggested Actions. In addition, the Port continues to track the development of new technologies, fuels, and operational measures that could lead to actions that support the Plan. Technology tracking will enable the Port to identify additional actions and to better understand the challenges associated with various technologies. Monitoring of the Implementing Actions being implemented at the Seaport and sharing that information with local stakeholders and others will enable the Port to contribute to the overall advancement of hybrid and zero-emissions technology.

Actions Included in Appendix C

Appendix C includes two types of actions: Suggested Actions (actions that have not yet been screened) and Programmed Actions (actions for which Port or other funding has been allocated). Table C-2 at the end of this appendix provides a list of the Implementing Actions originally identified by the Port. Table C-2 also indicates Implementing Action category, the location to which the action applies, the Port’s level of control and the strategies supported by the actions. Implementing Actions in Table C-2 may either be Suggested Actions or Programmed Actions. Each of the Implementing Actions in Table C-2 is described in the body of this appendix. Some of the Implementing Actions were initiated under the *Maritime Air Quality Improvement Plan* (MAQIP) and are in the process of being implemented (i.e., are Programmed Actions).

New Suggested Actions from stakeholder comments on the Draft Plan and Revised Draft are presented in Table C-3. The Table C-3 description of the action reflects the textual description provided by the commenter. The Port anticipates that as Suggested Actions undergo the screening and evaluation process described in the Main Text of the Plan, descriptions for the Suggested Actions may be expanded or revised.

Implementing Action Categories

The Plan comprises of seven categories of Implementing Actions:

- Category 1: Infrastructure
- Category 2: Fuels
- Category 3: Equipment
- Category 4: Operations
- Category 5: Partnership
- Category 6: Stakeholder Engagement
- Category 7: Funding and Grants

Selection of Implementing Actions

The Port will select Implementing Actions for implementation using the screening and evaluation process described in the Main Text of the Plan (see Screening and Evaluation Process for Implementing Actions). Implementing Actions that are selected for implementation and for which funding has been identified are considered Programmed Actions.

Implementation Process

For Port-sponsored projects, implementation will follow the Port's systematic project implementation process (see Plan Implementation Scope of Effort in the Main Text). Non-Port-sponsored actions (i.e., actions implemented by other organizations) will be implemented using the project implementation process employed by the lead organization.

Structure of an Implementing Action

Each Selected Action will include the following components:

- Description of the Selected Action, including its specific purpose and anticipated emission reductions benefits, where applicable
- Schedule of implementation with dates for completion of specific tasks, if applicable
- Related infrastructure requirements (e.g., charging infrastructure), if applicable
- Parties involved in the implementation and their respective roles and responsibilities

- Cost estimate and proposed funding source(s), including ongoing operating and maintenance costs and the ability to pay for these costs
- Monitoring and reporting

This information will be used in managing, monitoring, and reporting on the action.

As an example, the following shows the structure for use of renewable diesel (RD) in the Port's fleet. Note that this is only an example; a specific timeline, cost, and monitoring efforts have not been determined.

Selected Implementing Action Description

Replace conventional diesel used in Port diesel-powered fleet with RD to reduce greenhouse gas (GHG) and diesel particulate matter (DPM) emissions. Emissions reduction benefit: 30% to 50% reduction in DPM and 60% to 70% reduction in GHG emissions, as well as a 15% to 20% reduction in emissions of nitrogen oxides (NO_X).

Tasks and Schedule

Identify preferred RD supplier, issue contract, receive fuel, monitor fuel performance, report to Board of Port Commissioners (Board)

Participants

Port staff, including facilities, environmental, and contracting; Board approval of procurement

Cost Estimate, Operating and Maintenance Costs, and Funding Source(s)

Unit cost per gallon, Port budget amount, estimate of reduced maintenance cost

Monitoring

Fuel use and frequency of routine and non-routine maintenance

Reporting

Compare performance to petroleum diesel, and document findings and recommendations. Potentially, brief the Board and/or stakeholders on an interim basis.

Use of Feasibility Studies and Needs Assessments

For some Implementing Action categories (see Implementing Action Categories, above) it will be necessary to conduct feasibility studies and needs assessments prior to identifying specific actions. The studies described in the subsequent sections are intended to show the range of engineering studies required to support implementation of the pathway to a zero-emissions Seaport. The Port will determine the specific feasibility studies or other assessments to be conducted. Feasibility studies may also provide a neutral assessment of the state of equipment technology as a precursor to identifying specific equipment actions.

CATEGORY 1: Infrastructure

New or improved infrastructure in all categories (i.e., electrical, fueling, fiber, and physical improvements within the Port) is an underlying requirement to promote the pathway to a zero-emissions Seaport.

Infrastructure Context

Infrastructure Needs

Most types of electrical equipment will need to recharge at charging stations; some may plug directly into grid power. The Port is currently conducting a study to determine the extent of any needed electrical system upgrades to support deployment of battery-electric equipment on the marine terminals served by the Port utility (Implementing Action I-3: *Maritime Power Capacity Study for Terminal Electrification*, described below). The Port anticipates that the existing grid capacity can support initial limited deployment of battery-electric equipment, although the specific capacity at each marine terminal and other tenant locations varies. Some improvements to the electrical infrastructure, both on the terminals and to provide power to the terminals, will be needed to support a zero-emissions Seaport. For example, as vessel sizes continue to increase, the amount of power required for them to plug in (use shore power) while at berth also continues to increase. This trend will reduce the available electrical capacity over time.

With regard to drayage trucks, until a network of fast-charging stations and an established universal standard for electric truck charging are available locally and nationally, the feasibility of electric drayage trucks will be limited. For equipment using hydrogen fuel cells, a hydrogen supply and hydrogen charging infrastructure must be provided. Even for small uses of hydrogen (e.g., forklifts equipped with hydrogen fuel cells), the end user of the equipment must at minimum install a tank and charging equipment, and arrange for regular deliveries of hydrogen to the tank. Larger systems would require a hydrogen pipeline or on-site generation of hydrogen.

Other infrastructure improvements related to operational improvements at the Port, such as the GoPort Program,[1] will promote more efficient circulation within the Seaport Area and may yield ancillary emissions reductions through reduced idling. Additional infrastructure upgrades that may be needed

[1] The GoPort (Global Opportunities at the Port of Oakland) Program is a related program (see Related Plans, Programs and Projects in Appendix B: Background) designed to improve truck and rail access at the Port. It includes three components designed to reduce congestion and increase efficiency to improve sustainability and economic competitiveness: the 7th Street grade separation east (7SGSE), the 7th Street grade separation west (7SGSW), and the freight intelligent transportation system (FITS).

include an expanded fiber optics communications system to support computer systems and related smart technology, microgrids to serve specific terminals or areas within the Seaport, and other features to enable more efficient movement of containers from ships to trucks or rail. These types of infrastructure improvements may be required to meet the State of California's System Efficiency Target.[2]

The Port will play its part in the development of the infrastructure required to move to a zero-emissions Seaport. Required infrastructure upgrades will have to be constructed over time. Four factors govern the identification of infrastructure projects: (1) the Port's planning studies (e.g., Maritime Power Capacity Study for Terminal Electrification [Burns and McDonnell 2019, in preparation]), (2) tenant needs, (3) availability of grant or incentive funding, and (4) regulatory requirements. Implementation of Port projects follows the Port's systematic project implementation process. Projects are identified, scoped, incorporated into the budget, taken to the Board for project-specific approval and then implemented if approved. The time frame for implementation is related to the scope of the undertaking. The Port will seek opportunities for early action, i.e., an action undertaken in advance of Final Plan approval that promotes the Plan goals. Projects not requiring major infrastructure upgrades and where funding and power supply are available and tenants have committed to specific equipment purchases, implementation will commonly be quick.

Regulatory drivers and the availability of specific grant funding opportunities may also inform the development of infrastructure.

The development of other types of zero-emissions equipment is lagging that of electrically powered equipment, and there is insufficient information to evaluate the needs of such equipment for infrastructure (e.g., for hydrogen fueling). The Port will reassess the need for infrastructure to support other forms of zero-emissions equipment in the Intermediate-Term Phase (years 2023 and 2030).

Resilience of each system (also known as reliability) is another critical element of upgrading electrical, fuel, and fiber communications infrastructure. Resilience in infrastructure systems refers both to the ability of the system to resist hacking and the ability of the system to continue operating if part of it is disabled. Technology is increasingly integrated into the day-to-day activities associated with cargo movement and into management and operations of fuels infrastructure (electrical grid, pipelines), creating new vulnerabilities. Many organizations that are heavily reliant on smart technology systems have begun to install local electrical grids, known as microgrids, to ensure that their smart technology systems remain operational even if the main electrical grid is not functional. Local power generation could contribute to

[2] The State of California's System Efficiency target, set in the Sustainable Freight Action Plan pursuant to EO B-32-15, is to "Improve freight system efficiency 25 percent by increasing the value of goods and services produced from the freight sector, relative to the amount of carbon that it produces by 2030."

system resiliency. At present, due a variety of factors, there is limited potential for on-site power generation at the Seaport. Solar power generation is discussed in Category 2: Fuels.

Seaport Electrical Grid

The electrical grid in the Seaport Area is composed of areas served by the Pacific Gas and Electric Company (PG&E) and areas served by the Port's utility (see Figure C-1). The Port's utility serves one large container terminal and the Port-owned areas of the former Oakland Army Base (OAB). Table C-1 is a summary of the features served by PG&E's infrastructure and the Port's utility infrastructure at the Seaport. As discussed above, the Port will upgrade its infrastructure based on its studies and tenant needs. Electrical infrastructure controlled by PG&E must be upgraded by PG&E. The Port is only able to facilitate the work and to provide development permits for work on Port lands (electrical permits as well as building permits, if charging structures weigh more than 400 pounds, are provided by the City of Oakland). Work is also needed to upgrade PG&E's infrastructure.

FIGURE C-1: SEAPORT ELECTRICAL INFRASTRUCTURE

Source: Port of Oakland 2019

TABLE C-1: SUMMARY OF ELECTRICAL INFRASTRUCTURE SERVICE PROVIDER BY AREA						
	Shore Power		Crane Power		Lights, Reefer, Admin	
	Primary	Backup	Primary	Backup	Primary	Backup
Berths 20-21	N/A	N/A	PG&E	PG&E	PG&E	PG&E
Berths 22-26	Port	N/A	Port	PG&E	PG&E	Port
Berths 30-32	Port	N/A	PG&E	Port	PG&E	Port
Berths 35-38	Port	N/A	PG&E	Port	PG&E	N/A
Berths 55-59	Port	N/A	Port	N/A	Port	N/A
Berths 60-68	PG&E	PG&E	PG&E	N/A	PG&E	N/A
Oakland Army Base	N/A	N/A	N/A	N/A	Port	N/A
Joint Intermodal Terminal	N/A	N/A	N/A	N/A	Port	N/A

Source: Burns and McDonnell 2016.
Acronyms:
N/A = not applicable
PG&E = Pacific Gas and Electric Company
Port = Port of Oakland

Charging infrastructure is composed of two elements: the electrical lines and other equipment delivering power to a location where chargers are installed, and the chargers themselves. This Plan considers the electrical lines and other infrastructure (e.g., transformers) to be an infrastructure element. The chargers themselves are classified as equipment because they are more closely associated with specific types of equipment and can be relocated relatively easily.

Infrastructure Feasibility Studies

Feasibility studies provide estimates of infrastructure needs and costs based on a specific set of assumptions, under specific conditions of technological development. As such, studies conducted at different times or by different organizations may reach somewhat different conclusions. The screening and evaluation process for Implementing Actions (see Screening and Evaluation Process for Implementing Actions in the Main Text) will be informed by available feasibility studies and assessments meeting the requirements for reliable information laid out in Appendix D: Screening and Evaluation Criteria for Implementing Actions. The Port conducts feasibility studies as a necessary analytical step to determine the best course of action.

Prior Study

In 2016, the Port conducted a study to determine what the electrical loads would be if all cargo-handling equipment (CHE) was converted to battery-electric equipment (Burns and McDonnell 2016). The study found that several levels of electrical system improvements would be required to first support improved shore power access and then support the potential conversion of the marine terminals to a fully electric operation. According to the study, some upgrades to the electric transmission and electric utility distribution system, including a new transmission line and a new utility substation, are among the improvements required. Upgrades to the existing substations would also be required. Finally, specific upgrades and new electrical infrastructure would be required on the terminals (Burns and McDonnell 2016). The *Maritime Power Capacity Study for Terminal Electrification* (Burns and McDonnell 2019) is updating the 2016 study.

I-1: Engineering Feasibility Studies for Increased Cargo Movement Efficiency through Smart Technology

To gain efficiencies in cargo movement, shippers, terminal operators, and truckers will increasingly need to rely on smart technology. As described below in the Efficiency Measures subsection, data collection/processing and integration of various data systems will be vital elements of the continuing efforts to improve the efficiency of cargo movement. While it is unlikely that any terminal at the Port will be operating with 100% electrical equipment in the foreseeable future, certain elements, such as terminal gate truck-processing functions, are likely to be operated by smart technology in the near term. To function effectively, smart technology systems must be highly reliable. Any downtime can create significant delays and backups.

Fiber optic communication (fiber) infrastructure will be improved as part of the related Freight Intelligent Transportation Systems (FITS) projects shown in Table 4: Related Projects in the Main Text and described in Appendix B: Background (see Related Plans, Programs, and Projects). Further fiber infrastructure improvements may be required in the future. Future studies could include assessing the adequacy of fiber communications lines and related facilities, establishing a common data management protocol across the entire Seaport, and assessing specific electrical supply needs, such as microgrids, to support smart systems.

I-2: Engineering Feasibility Studies for Electric Drayage Truck Charging Infrastructure

Trucks in short-haul drayage services (within the Seaport and its vicinity) may be commercially available and operationally feasible within several years if adequate charging infrastructure can be constructed. (Fully electric trucks in long-distance drayage service will require additional improvements in battery technology and charging speed, and the development of a State or national charging network.) The existing charging infrastructure for these trucks is very limited. Equally critical, there are no national standards for heavy-duty electric vehicle chargers, which means that electrical chargers currently are only compatible with a specific manufacturer’s equipment. Recent experience at the Seaport indicates that even when a charger plug has the correct shape, there may be software incompatibilities that prevent one manufacturer’s equipment from charging at another manufacturer’s charging station.

As electric drayage trucks become more available, an assessment of truck charging needs and associated power demands may be needed. The study would be limited to the Seaport Area, as the Port's charter prevents it from expending funds for facilities outside the Seaport.

I-3: Maritime Power Capacity Study for Terminal Electrification

The Port studying the specific infrastructure requirements to support container terminals using 100% electrically powered equipment (Burns and McDonnell 2019, in preparation). The study is assessing the projected electrical demand, the electrical infrastructure needed to support that demand, the location of and acreage required for the charging infrastructure within the terminal, the proposed charging cycles, and the level of charging (slow charging versus fast charging) that might be used. The study is considering all anticipated future increases in loads, including increased use of shore power, additional plugs for transport refrigeration units, and cold storage warehouses. The evaluation includes the level of demand in the Port-served areas of the Seaport, the timing of that demand, and the need for new or upgraded infrastructure to serve that demand.

Specific terminal operations are a crucial component of any electrification and capacity study. The operational aspects of charging, including the location of the chargers, the amount of space required to accomplish the charging, the timing and duration of the charging, and the power demand during charging, will greatly affect the feasibility of operating a fully electrified terminal. The study considers the operational impacts of installing the necessary infrastructure within a terminal as well as the utility infrastructure outside of the terminals. The study will also develop estimated costs, as feasible, for implementing the electrical infrastructure.

The process of installing necessary infrastructure, which may require several years to complete, may be very disruptive to terminal operations. Consultation with terminal operators will be an integral element of this and any other engineering feasibility study.

I-4: Roadway and Other Hard Infrastructure Upgrade Studies

The Port regularly assesses the roadway system within and near the Seaport to identify bottlenecks. These studies would continue, as needed, to ensure that the road infrastructure in and near the Seaport area meets the long-term needs of the Seaport.

I-5: Electric Vehicle Charging Infrastructure Guide for Port Tenants

To facilitate the Port tenants' ability to install electrical charging infrastructure, the Port has prepared a guide (Port Approval of Charging Stations) that includes relevant information regarding permit and other requirements and provides the necessary forms for permit applications. This guide is available upon request.

I-6: Uniform Charging Standards for Electrically Powered CHE and Drayage Trucks

In their 2017 Clean Air Action Plan (CAAP), the San Pedro Bay Ports (SPBP) noted that manufacturers of electric terminal equipment are using different methods and different equipment design specifications for equipment charging, resulting in different infrastructure requirements depending on the equipment and specific manufacturer selected. The same issue exists with electric drayage trucks. As more equipment is transitioned to electric power, the lack of uniformity may lead to significant challenges. The SPBP identified the need for charging standards so uniform infrastructure can be built throughout the SPBP complex to deploy a range of equipment types built by different original equipment manufacturers (OEMs). Drayage trucks not only require a uniform charging standard, but they should also be able to use the same chargers that are used to charge CHE. The Port has the same needs as SPBP with respect to uniform charging standards. Charging standards may continue to evolve as battery technology improves (both battery capacity and feasible charging rates).

Since 2015, SPBP have been working with regulatory agencies, technology developers, and equipment operators to establish charging standards for yard tractors and other pieces of terminal equipment. These standards, which are currently under development, simultaneously reduce the complexity and cost of charging a large fleet of equipment (SPBP 2017). The Port will continue to track the development of the uniform charging standards and will assist with the review of the standards with respect to their utility for local implementation.

I-7: Charging Infrastructure to Support Zero-Emissions Equipment

While zero-emissions long-haul drayage trucks are unlikely to be commercially available for a number of years, short-haul electric drayage trucks may be commercially available within 5 years. Some types of battery-electric CHE may also become more commercially available during this time period, although these types of CHE will cost considerably more than conventional diesel-powered equipment. The Port will coordinate with tenants on tenants' estimates of specific power needs, design, and systems costs for the infrastructure to support planned zero-emissions equipment.

I-8: Future Infrastructure Modifications

The Port will determine the extent of necessary infrastructure modifications based on the feasibility studies described above as well as other feasibility studies that may be conducted in the future to identify tenant needs. This process is likely to be somewhat iterative as zero-emissions technology continues to mature. Once infrastructure needs have been adequately defined, the Port will identify specific projects and following its project delivery process, will program capital costs into its annual budget cycle based on available funding. The expected expenditures are in the following areas:

- Electrical grid and container terminal electrical infrastructure upgrades, including improvements related to electrical grid resilience
- Fiber optics communications systems infrastructure

- Electrical system upgrades at the Port-owned areas of the OAB
- Port fleet vehicle charging infrastructure

While the current direction of zero-emissions technology appears to be toward electrification, shifts in technology could occur in the future. The Port will continue to monitor the evolution of zero-emissions technology and will assess proposed infrastructure modifications and the need for future infrastructure modifications in the light of evolving technology. Strategy #3 provides flexibility for other technological options (such as hydrogen-powered equipment) to provide power for zero-emissions operations.

CATEGORY 2: Fuels

This Category of Implementing Actions includes alternative fuels and electricity. Shifting from petroleum diesel to alternative fuels is the fundamental step in reducing or eliminating air emissions, including DPM and GHGs. Alternative fuels include electricity made from renewable sources, renewable hydrogen for use in hydrogen fuel cells, non-petroleum diesel, natural gas (compressed natural gas (CNG) and liquefied natural gas (LNG) from fossil or renewable sources), and ultra-low-sulfur petroleum diesel.

Hydrogen and electricity are considered zero-emissions fuels provided they are made from GHG-free sources.[3] Switching to a reliance on electricity and/or hydrogen as primary fuels in the Seaport's operations will require significant investments in infrastructure as well as new equipment. In the meantime, the Port can increase the GHG-free percentage of the electrical power it provides within the Port's utility service area. The Port cannot control the GHG-free content of electrical power provided by PG&E to the areas PG&E serves. In addition, RD, natural gas (including renewable natural gas), and ultra-low-sulfur diesel all provide potential benefits, some without requiring new infrastructure, and may form part of the transition to a zero-emissions Seaport.

Seaport equipment that uses fossil fuel (gasoline, diesel, and natural gas from fossil sources) for fuel is covered under the California Air Resources Board's (CARB's) Cap-and-Trade Program, meaning that through the Year 2030, users of this equipment (such as tenants and truckers) are not required to take any further action to reduce GHGs. The Cap-and-Trade Program makes up for GHG emissions reductions that would otherwise be required in this sector. Emissions reductions from switching away from these fossil fuels will result in GHG emissions reductions beyond those achieved through the Cap-and-Trade Program.

[3] GHG-free electricity or hydrogen produced by electrolysis using GHG-free electricity.

F-1: Technology Assessment for Hydrogen and Hydrogen Fuel Cells

Hydrogen fuel cells are one of the potential primary alternatives to electricity and battery-electric technology. Fuel cell technology has significant potential for use in heavy-duty trucks and other mobile applications, and for distributed generation.[4] A fuel cell works by passing streams of fuel (such as hydrogen) and oxidants (usually oxygen from air) over electrodes that are separated by an electrolyte. This produces a chemical reaction that generates electricity without requiring the combustion of fuel or the addition of heat, which is common in the traditional generation of electricity. When pure hydrogen is used as fuel and pure oxygen is used as the oxidant, the reaction that takes place within a fuel cell produces only water, heat, and electricity.

Fuel cells have the potential to offer maintenance and operating benefits. They are completely enclosed units with no moving parts. In addition, they are quiet and safe sources of electricity. Fuel cells also do not generate electricity surges, meaning they can be used where a constant, dependable source of electricity is needed. Fuel cells have a much higher energy density than existing batteries, so that trucks equipped with fuel cells have a lower gross weight than equivalent electric trucks. In addition, refueling is rapid and comparable to refueling with liquid fuels (on the order of 6 to 8 minutes for a car). The benefit of fuel cells in this application is partially offset by the need to carry hydrogen, a flammable gas, on the vehicle. However, experience with CNG engines has provided an effective technology base for onboard storage of hydrogen.

While fuel cells can be powered by a variety of fuels, hydrogen is the preferred fuel for fuel cells in clean energy applications. Currently, hydrogen is typically generated by steam reforming of methane gas (SRM). This type of hydrogen, when used as a fuel, has a higher carbon intensity (ranging from 98 to 142) than petroleum diesel (95). Also, the cost for SRM hydrogen is approximately two times the cost of diesel on a mileage basis. The National Renewable Energy Laboratory estimates that the cost of SRM hydrogen will fall substantially in the near future, leading to cost equivalency in next 5 to 7 years (California Fuel Cell Partnership n.d.). Hydrogen can also be made by electrolysis using renewable sources of energy. Currently, hydrogen made by electrolysis is approximately 2.5 to 3 times as expensive as hydrogen made by SRM; in other words, on a per-mile basis, renewable hydrogen is approximately five to six times as expensive as diesel.

Fuel cell technology has progressed in certain applications, including forklifts, but it is still in the development stage for heavy-duty trucks and other heavy-duty vehicles. As of 2017, there were 19 fuel cell buses in service in California, and 30 more were planned to be put into service. This compares to hundreds of battery-electric buses. The first demonstration-level fuel cell truck was put into service (also

[4] Fuel cells can come in extremely compact sizes, allowing for placement wherever electricity is needed. This includes residential, commercial, and industrial settings.

in California) in 2017. The SPBP *Clean Air Action Plan Draft Drayage Truck Feasibility Assessment* (2018) states that "…Class 8 tractors incorporating hydrogen fuel cell technology are just beginning to be developed and demonstrated in drayage service at the Ports." That study also concluded that "Perhaps more than any other ZE [zero-emissions] or NZE [near-zero-emissions] fuel technology platform, the rate-determining step for commercializing hydrogen fuel cell trucks appears to be as much (or more) fuel related than vehicle related. Significant cost and logistical challenges will need to be overcome before LMCs [licensed motor carriers] are likely to gain affordable, convenient access to hydrogen fuel." In addition, before hydrogen fuel cells can be considered commercially feasible in clean-energy applications, the cost of generating hydrogen by electrolysis will have to drop significantly. Nonetheless, the *Clean Air Action Plan Draft Drayage Truck Feasibility Assessment* also reports that startup OEM Nikola Motors has received hundreds of preliminary procurement orders from major Class 8 trucking fleets for its two different hydrogen fuel cell tractor models. At the same time, Nikola has not yet provided specifics about production dates, costs, or final specifications, although it has indicated mass production will be well under way by 2025 (SPBP 2018).

Larger fleets (i.e., those owned by large delivery service companies or large manufacturers) have the capital capacity to procure relatively large numbers of new types of equipment. Smaller fleets, such as the ones providing drayage service to Port tenants, lack the financial resources to risk investing in relatively unproven technology. Thus, most drayage truck operators serving the Port are likely to delay procurement of zero-emissions equipment until it has been proven in commercial service for some period of time.

A technology assessment for hydrogen fuel cells needs to address the source(s) of hydrogen, the hydrogen fueling infrastructure, and the fuel cell technology itself.

F-2: Electricity Supply

The Port serves as the electric utility to a large container terminal in the Seaport as well as to several small Seaport support facilities, primarily those located on the Port's portion of the former OAB. Other areas of the Seaport are served by PG&E or East Bay Community Energy (the local energy community choice aggregator serving Alameda County). At portions of the Seaport served by the Port, the Port purchases most of its electricity from the wholesale power market and resells the electricity to its end users. The Port also partners with other electric utilities on power purchase agreements to secure desirable rates. Pursuant to Senate Bill 100 (SB 100), the State-mandated Renewables Portfolio Standard (RPS) program requires investor-owned utilities, publicly owned utilities, electric service providers, and community choice aggregators to increase electricity procurement from eligible renewable energy resources to 60% of their retail sales by 2030 and to procure 100% of the electricity from carbon-free resources by 2045. The Port, PG&E, and East Bay Community Energy will continue to increase the renewable content of the electricity they sell to comply with the RPS. Increases in renewable electricity due to the RPS will reduce GHG emissions from electricity use at the Seaport.

Electricity generation within and near the Seaport area is limited. Aside from the excess electricity generated by the East Bay Municipal Utility District (EBMUD) Wastewater Treatment Plant and the Dynergy Oakland Power Plant (Dynergy) adjacent to Jack London Square, electricity is mainly transmitted from outside the Bay Area into the Seaport area through a network of transmission lines (a transmission system) owned by PG&E. The Dynergy plant is more than 30 years old and is nearing the end of its useful life. If the Dynergy plant is retired, transmission system upgrades or new transmission lines or locally generated renewable energy will be required to meet the electrification needs of the region and provide transmission reliability.

F-3: Local Solar Power Generation

The Port will continue to work with tenants considering or willing to consider installing solar panels on rooftops of large warehouses and other canopy-type structures to generate electricity within the Seaport. While the overall amount of electricity that could be generated within the footprint of the Seaport is likely to be small relative to the total demand (given that there are relatively few large buildings because Seaport uses are land-intensive), doing so would contribute towards moving the Port to a zero-emissions future.

F-4: Renewable Diesel Fuel

Renewable diesel is made by a different process and has a different chemical composition than biodiesel (see the discussion of biodiesel below). Made from a high-percentage renewable content, RD is marketed at many locations by petroleum jobbers[5] throughout California and particularly throughout the Bay Area. RD is a fuel made partially or entirely from waste materials, such as animal fats, slaughterhouse waste, fish oils, and used restaurant vegetable oil. These waste sources are supplemented by virgin raw materials (non-petroleum oils). Renewable diesel can reduce DPM emissions by 30% to 40%, and GHG emissions by 50% to 80% (depending on the feedstock) relative to petroleum diesel (Neste 2018; Mitchell, pers. comm., 2018a). RD shipped to or produced in California (as part of the State's Low Carbon Fuel Standard program) typically provides GHG reductions of 60% or greater, with the average being on the order of 67% to 68%. RD also provides NO_X reduction benefits on the order of 10% to 20% (Mitchell, pers. comm., 2018a). Many OEMs have approved the use of pure RD in their engines (BAAQMD 2017). Renewable diesel is accepted by most engine manufacturers, meaning that there is no loss of warranty coverage with the use of RD.

The criteria air pollutant emissions reductions are for *engine-out* performance, meaning that they do not take into consideration the effects of exhaust after treatment (diesel particulate filters [DPFs], diesel oxidations catalysts, or Selective Catalytic Reduction [SCR]). CARB currently assumes that there is no benefit with regard to NO_X emissions reductions when RD is used in an engine equipped with SCR (such

[5] People or companies that purchase refined fuel from refining companies either for sale to retailers or to sell directly to the users of those products.

as Model Year 2015 or later heavy-duty truck diesel engines). However, CARB indicated that DPM emissions reductions will be seen even when a DPF is in use. The benefit in terms of actual emissions reductions for any one vehicle is small. Diesel particulate filters are installed on virtually all diesel trucks, and reduce exhaust DPM by 90%. When the engine-out DPM is reduced 30% due to the use of RD, the DPF-out DPM reduction increases to 93.5%. Nonetheless, CARB believes that in the aggregate, the use of RD in truck engines is beneficial (Mitchell, pers. comm., 2018b).

In terms of net emissions reductions per vehicle, RD is likely to be most useful in off-road engines. Criteria air pollutant emissions reductions are hard to quantify for modern diesel engines; there are few studies and some of the data conflict. A study of RD in 200 in-use pieces of equipment is currently under way, and expected to be completed in 2019 (BAAQMD 2017). CARB is also conducting a study to assess criteria air pollutant emissions reductions in modern engines (Mitchell, pers. comm., 2018b); the study is expected to be completed in 2019. There are some indications that RD may reduce the overall toxicity of DPM, but more studies are needed before firm conclusions can be drawn (BAAQMD 2017). The effects in marine and heavy off-road engines have not been studied. The GHG benefits are not affected by the type of equipment in which RD is used.

RD fuel is readily available and due to Low-Carbon Fuel Standard (LCFS) subsidies, costs little or no more than regular diesel. It is completely interchangeable with traditional petroleum diesel fuel in engines and in storage tanks. The price for RD in California has routinely matched or been slightly lower than standard petroleum diesel. Renewable diesel is a very low-carbon-intensity fuel, with better combustion performance characteristics than petroleum diesel. Because RD burns very cleanly, experience has shown that it reduces the need to regenerate DPFs. CARB estimates that approximately 500 million gallons per year of RD are currently available to California. That is expected to increase to 1.5 billion gallons per year by 2030 or sooner (Mitchell, pers. comm., 2018a), which can be compared to the total 2015 California diesel use (including off-road diesel) of 4.2 billion gallons (CEC 2018).

Unlike biodiesel, RD does not have a shelf life issue because it is hydrogenated in the refining process (meaning it does not contain any oxygen). This greatly reduces the potential for microbial breakdown and keeps the fuel from gelling in cold temperatures.

Many cities, counties, and local and state agencies throughout California (including the City and County of San Francisco, the City of Oakland, and the City of Walnut Creek) now require RD only for use in their diesel vehicles and equipment. This measure has been made an important part of compliance with GHG emissions reductions requirements across the State. Fleet managers are interested in RD in part because of the reported (anecdotal) reduction in maintenance from reduced DPF regeneration, especially forced regeneration (BAAQMD et al. 2017). The Port is currently investigating the use of RD for its fleet. The Port will also further evaluate the benefits of RD for on-road and off-road use and share the results of that evaluation with its tenants.

Renewable diesel does not appear to pose any operability problems in marine applications. Pure RD and RD mixed with petroleum diesel both appear to be suitable for use in marine environments. A study conducted by the Scripps Institute of Oceanography on its own research vessel found that the vessel operated well on RD (Scripps 2016). No problems were noted during more than 40 research cruises conducted over a period of more than a year (the vessel was at sea for a total of 89 days). The Scripps findings are consistent with laboratory research performed by the United States Navy.

Recently, the Red and White Fleet (ferries) in the Bay Area switched to RD. The company reports near-complete elimination of soot, reduced maintenance problems, as well as reduced fuel odors (Monroy, pers. comm., 2018). A question remains as to whether RD provides criteria pollutant emissions reductions benefits when used in marine applications. The Scripps study found that emissions of DPM actually increased with the use of RD, especially at high engine speeds. During the study, the four engines aboard the research vessel logged a total of 6,985 hours of engine time using 100% RD. The study showed that the total number and total mass of particles increased with the use of RD. The increase in particle emissions was larger at higher engine speeds. At lower engine speeds (700 revolutions per minute [rpm]), particle emissions were similar for both petroleum diesel and RD. However, the engines powering the Scripps vessel are old two-stroke diesel engines that are not representative of the more modern engines found on ocean-going vessels (OGVs) (Monroy, pers. comm., 2018). Further evaluation is required to determine if RD would provide emissions reductions benefits in marine applications. The Port will continue to track information pertaining to the performance of RD in marine applications and share the results with ocean carriers and harbor craft operators.

F-5: Biodiesel

Biodiesel is a renewable fuel typically made by reacting vegetable or animal fat feedstocks (the same types of feedstocks as for RD) with alcohol. Like RD, biodiesel can be made using waste fats or virgin fats. Pure biodiesel provides approximately a 55% reduction in DPM (also on an engine-out basis) and typically, depending on feedstocks, processing efficiency, and other factors, reduces GHG emissions by 80% to 85%, compared to petroleum diesel (Mitchell, pers. comm., 2018a). In California, biodiesel has reached cost parity with petroleum diesel (when accounting for credits under the LCFS) (Lane 2017). Biodiesel is typically used in a blended form (20% biodiesel with petroleum diesel, referred to as B20). However, it is also possible to operate on 100% biodiesel (referred to as B100). Pure biodiesel has proven successful in fleets and some trains (Wikipedia 2018). B20 delivers 20% of the emission reduction benefits of B100.

Biodiesel, sometimes referred to as fatty acid methyl ester (FAME), is made through a process called transesterification. The transesterification process yields a fuel that contains more oxygen and is more polar than petroleum diesel. This results in mild surfactant (lowering surface tension of a liquid, an effect similar to the effect of soap) properties and a substantially higher water uptake capacity than petroleum diesel. As a result, there are three specific operating considerations associated with biodiesel in on-road diesel engines:

- Fuel filter plugging: When biodiesel is first introduced into an engine, its mild surfactant properties often cause it to solubilize existing fuel tank deposits. This can result in plugging of the fuel filter and may require more frequent fuel filter replacements after the initial switch to biodiesel. Operators who switch from petroleum diesel to biodiesel are more likely to experience this problem in older vehicles that have used petroleum diesel for many years, as these are likely to have more deposits in the fuel tank.
- Cold weather gelling: Biodiesel will gel at higher temperatures than petroleum diesel, leading to the potential for cold-weather start-up challenges.
    - The amount of saturated fats in the feedstock determines the gelling point, which can range from a low of 15 degrees Fahrenheit (°F) to a high of 60°F
    - The use of flow-improving additives and winter blends has proven effective at extending the range of operating temperatures for biodiesel fuel (Penn State 2016)
- Water carryover: Most diesel fuel storage tanks have some water in the bottom of the tank. Because biodiesel is hygroscopic, a tank to be used for biodiesel storage needs to be cleaned or a water filter needs to be installed prior to placing biodiesel into the tank.

Warranties may also be a consideration. Using a fuel that that is not approved by an OEM may void the warranty. Most manufacturers approve blends of up to 20% biodiesel (B20) when blended using biodiesel approved by the American Society for Testing and Materials.

All diesel fuel is subject to microbial breakdown in storage. However, because of its structure, biodiesel is more susceptible to biological breakdown than petroleum diesel or RD. If engines are expected to be out of service for a period of time, it may be necessary to drain the engine of all fuel before storage, change back to petroleum diesel before storage, or add a fuel stabilizer.

F-6: Natural Gas

Natural gas is a colorless, odorless gas that is easy to burn; it typically consists mostly of methane (90% or more). Natural gas generated from fossil sources has a lower carbon intensity[6] than diesel fuel, and renewable natural gas (see discussion below) has an extremely low to negative carbon intensity. In addition, engines using natural gas do not generate DPM and may burn cleaner overall than diesel engines. According to the U.S. Department of Energy Alternative Fuels Data Center, due to increasingly stringent emissions regulations, there is less difference between tailpipe emissions benefits from natural

[6] In other words, it results in lower levels of GHG emissions compared to diesel.

gas vehicles and conventional diesel-powered vehicles with modern emissions controls. One advantage to natural gas vehicles is their ability to meet stringent emissions standards with less complicated emissions controls.

Natural gas technology is well established in certain equipment, including forklifts and light- to medium-duty vehicles. At least one 12-liter natural gas engine has been certified to the low-NO_X standard and is available in trucks from a variety of truck manufacturers (see discussion of low-NO_X technology in Appendix B: Background).

Natural gas is typically used in a CNG or LNG form. Compressed natural gas has a lower carbon intensity than LNG, due to the energy required to liquefy the LNG and keep it cooled. The fuel value of CNG is typically measured in diesel-gas-equivalent (DGE). Typical dispensing rates for CNG stations designed for heavy-duty vehicles are in the 5 to 10 DGE per minute range, which allows heavy-duty natural gas trucks to fully refuel in approximately 15 to 30 minutes (SPBP 2018), compared to a typical fueling period of 3 to 6 minutes for diesel trucks.

Natural gas can also be used to power fuel cells. Fuel cells convert the energy in fossil fuels into electricity much more efficiently than the traditional generation of electricity using combustion. (However, as discussed previously, fuel cells powered by fossil natural gas would not be considered a zero-emissions technology.)

F-7: Renewable Natural Gas

Renewable natural gas (RNG) is methane that is captured from landfills, wastewater treatment facilities, meat production, dairies, and other organic sources. It is fully interchangeable with fossil natural gas. The methane is collected, scrubbed to remove impurities, and injected into an available natural gas distribution pipeline. Similar to green electricity, the user contracts for and receives credit for using a certain volume of RNG, but receives the gas that is available at its location. RNG does not provide any particulate matter (PM) reduction benefits compared to conventional natural gas, but does provide substantial GHG reductions, ranging from 85% to 355% (where 100% GHG reduction is equivalent to eliminating the use of diesel or other fossil fuel). In other words, depending on the source of the RNG, use of RNG in one engine may offset the GHG emissions from more than one engine using diesel fuel. EBMUD is currently considering providing RNG at its West Oakland treatment plant.

F-8: Low Sulfur Diesel Fuel in Ocean-Going Vessels

Ships maneuvering within the North American Emission Control Area (ECA), including California, are required to use fuel that contains no more than 0.1% sulfur (USEPA 2010). Sulfur is a significant contributor to PM emissions. Based on fuel emission factors from the Port Authority of New York and New Jersey’s 2016 Emissions Inventory, reducing the sulfur content of fuel used in OGVs could reduce

PM emissions by approximately 10.6% for fuel containing 0.01% sulfur, and by 9.5% for fuel containing 0.02% sulfur (PA NYNJ 2017).

This approach has been proven in practice. The Port Authority of New York and New Jersey Clean Vessel Incentive Program allows vessels to earn incentive payments for reducing emissions by traveling more slowly and using cleaner fuel than required. During 2016, 420 individual vessels making 1,058 calls (69% of vessel calls) earned incentive payments. Participating vessels switched to lower sulfur fuel than the 0.1% sulfur ECA requirement while calling at the Port Authority; sulfur content in fuel used by participating vessels ranged from 0.01% to 0.05% sulfur. The SPBP also have vessel incentive programs that reward shippers for using fuel containing less than 0.1% sulfur. The Port could investigate the feasibility of creating incentives for vessel operators to use ultra-low-sulfur fuels in vessels calling the Port of Oakland.

CATEGORY 3: Equipment

Equipment Implementing Actions are specific technologies applicable to a given type of equipment and have been identified for all six types of equipment in the Port's emissions inventory. A critical factor in the implementation of zero-emissions equipment is its operational performance. Equipment users are taking a risk when investing in equipment that does not have a proven history of reliable operation and/or for which parts and repair services have limited availability. Once equipment has been proven to be operationally feasible by one user, other Seaport businesses are likely to consider implementing similar technology when it makes sense economically and operationally, based on their planning and capital funding cycles.

For each equipment Implementing Action under consideration, the organization leading the Implementing Action will evaluate the need for infrastructure upgrades for both the individual Implementing Action and for the Seaport Area electrical grid as a whole. For example, the Port may be able to install additional electrical infrastructure at a terminal to accommodate new electrically powered equipment, but must also evaluate the impact of the additional load on the broader Port's electrical system capacity and on future terminal operations.

Studies

E-CHE-1: Container Yard Electrification Feasibility Study

The Port commissioned the *Container Yard Electrification Feasibility Study* in 2018 (M&N 2018). The study concluded that some electrically powered equipment is commercially viable, such as rubber-tired gantry (RTG) cranes and automated stacking cranes (ASCs) that connect to the electrical grid through a cable or bus bar. However, grid electric equipment is not compatible with operations at the Seaport (see the discussion regarding operations at West Coast ports in Appendix F: Equipment Operations and Cost

Assessment to Assist with Electric Infrastructure Planning). Full battery-electric solutions for these types of equipment are in the development or prototype stage.

The study also indicated that for CHE operating on the Seaport marine terminals, fully electric solutions are limited and primarily include early commercial technologies for yard tractors (driverless battery-electric Automated Guided Vehicles are in use, but are primarily suitable for fully-automated terminals, which do not exist at the Seaport). The battery power required to operate the types of CHE on the Seaport's marine terminals and the required rapid recharging of the batteries are stretching the limits of current battery technology (see discussion of battery technology in Appendix B: Background). Emerging technologies are providing battery solutions for electrified yard tractors. Battery-electric solutions for RTG cranes and top-picks are in the development or at the prototype stage. These types of electrified CHE still need to be further developed.

E-CHE-2: Equipment Operations and Cost Assessment to Assist with Electric Infrastructure Planning

As a follow-up to the container yard electrification feasibility study, the Port commissioned an equipment operations cost assessment (provided in Appendix F: Equipment Operations Cost Assessment to Assist with Electric Infrastructure Planning). The assessment corroborated the findings of the container yard electrification study. It found that yard tractors were the only type of zero-emissions CHE that was well developed enough to allow long-term cost projections. In addition, the study concluded that hybrid RTG cranes were developed enough for a cost assessment. The remaining hybrid and zero-emissions CHE as well as zero-emissions drayage trucks are not developed enough for a cost assessment. Figure F-2 in Appendix F shows the status of commercialization for various types of CHE and for drayage trucks. As described in Appendix F, fully electric RTG cranes are considered to be commercially available but are not suitable for terminal operations at the Seaport.

Ocean-Going Vessels

Options to reduce DPM and GHG emissions from OGVs are limited. Actions for OGVs focus both on emissions while at berth (hoteling) and emissions while in transit from outside the Outer Buoys. The Port has already achieved substantial reductions in hoteling emissions through the implementation of shore power regulations (constructing the electrical grid and plug-in infrastructure to supply OGV power needs while at berth). Over time, most emissions reductions for OGVs will come from voluntary engine improvements and technological changes implemented by shippers.

For OGVs, this Plan assumes that shippers have a financial incentive to implement more-efficient engines, that the shipping lines calling the Port are complying with the International Maritime

Organization's (IMO's) fuel and engine standards,[7] and that they are adhering to CARB's requirement for lower sulfur fuels.[8] In addition to equipment options, some emissions reductions from OGVs could potentially be achieved through the use of ultra-low sulfur fuel (see the discussion in the fuels subsection above) and through a vessel speed reduction program (see the Category 4: Operations subsection below).

The SPBP are also considering measures to incentivize energy efficiency improvements and the use of cleaner technologies, and the imposition of a differential rate system to incentivize newer, cleaner vessels. The Port of Oakland will track these SPBP initiatives. Because the same vessels call up and down the entire West Coast, the Seaport and its workers and community are likely to experience the emissions reduction benefits from any successful SPBP incentives. If the incentive program proves effective, other West Coast ports, including the Port of Oakland, may consider a joint incentive program.

E-OGV-1: Shore Power Improvements - Achieve 90% Shore Power Use

Use of shore power eliminates criteria air pollutant and GHG emissions from vessels at berth within the Seaport. Although they do not need to run their main engines to power their propellers, ships need to continue to power lighting, ventilation, navigation equipment and other systems while at berth. These systems are typically powered by auxiliary engines while the vessels are at sea. Ships can either continue to run their auxiliary engines while at berth or plug into shore power. Plugging into shore power avoids emissions from the auxiliary engines while the vessel is in port.

The Port and its tenants, and shippers have invested more than $55 million to provide shore power at berths. In addition, shippers have invested up to $1 million per vessel to retrofit vessels to make them shore power capable (CARB 2018b). The CARB regulation, which has been in place since 2014, ramps up the required shore power usage until 2020, when fleets must demonstrate an 80% reduction in at-berth

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[7] MARPOL (The International Convention for the Prevention of Pollution from Ships) Annex VI, which governs pollution control regulations for vessels in international commerce, was amended in 2008 to set more stringent fuel sulfur limits and more stringent NOx emission standards, especially for vessel operation in designated Emission Control Areas (ECAs). The North American ECA for both fuel sulfur and NOx emissions includes most coastal waters up to 200 nautical miles from the coasts of the continental United States. Vessels operating in ECAs must meet the following requirements:

- Fuel sulfur concentrations may not exceed 0.10 weight percent, or vessels may use an approved equivalent method (such as sulfur oxide (SO_{X}) scrubbers, also known as exhaust gas cleaning systems); and
- Engines above 130 kilowatt installed on vessels built (or modified) since 2000 must be certified to meet appropriate emission standards corresponding to a vessel's build date (or modification date). As of January 1, 2016, engines installed on new and modified vessels are subject to the Annex VI Tier III NOx standards while those engines are operating in the ECA.

[8] CARB adopted the regulation, "Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline" on July 24, 2008. The regulation is designed to reduce PM, oxides of nitrogen, and SOX emissions from OGVs.

power generation from auxiliary engines. Through grant commitments, the requirement for the use of shore power at most Port of Oakland berths is 80% through 2019, and 90% for 2020 and beyond.

In 2018, 75% of all vessels used shore power while berthed at the Port—a substantial accomplishment given that 20% of the vessel calls were by vessels that are not equipped for shore power (not shore power capable). Of the 20% of vessel calls from vessels that are not shore power capable, more than half (10.6% of all vessel calls) were from vessels that were either not capable of being equipped for shore power (steamships) or are not required to be shore power capable (infrequent callers). For the ships that are shore power capable, the plug-in rate was 93%. For ocean carrier/vessels subject to the At-Berth rule, 80% of the 15 carriers achieved a 70% or higher plug-in rate (the lowest rate was 63%). One-third of these ocean carriers achieved a greater than 90% or greater vessel plug-in rate; the highest rate was 99% for the year.

For vessels that are shore power capable, vessel equipment issues are the biggest obstacle to using shore power (this was the case for 3.1 % of the vessel calls in 2018). Vessel equipment issues are the responsibility of the ocean carrier operating the vessel; they are not under the control of the Port.

Additional modifications to infrastructure may lead to a higher percentage of shore power utilization. For example, providing extension systems to enable some additional vessels to connect to available shore power, as described in Appendix B: Background, may increase shore power plug-in rates by 1% to 2%. These potential gains are small compared to the substantial number of calls by vessels that are not shore power capable.

The Port is continuing to evaluate the issues that prevent maximum shore power use, and will work with the marine terminal operators and vessel owners to address these issues and improve the plug-in rates. While the current CARB requirement for each fleet is to reduce onboard auxiliary diesel engine power generation by 70% in 2018, meeting the Port's grant requirements to exceed the regulatory requirements by 10% (80% overall) requires additional coordination with the terminal operators and vessel owners.

E-OGV-2: Barge-Based Exhaust Scrubber System (Bonnet)

For vessels that are not able to plug into shore power, it may be possible to control criteria air pollutants by capturing and filtering the emissions from vessel stacks (using a "bonnet" over the stacks). CARB has certified two alternative technologies (AMECS [Advanced Maritime Emission Control System] and METS-I) for container vessels that can be used to comply with the At-Berth rule. Both technologies are barge-based systems. Currently, these technologies are approved only for container vessels meeting certain configurations. However, operators of both systems are working with CARB to expand approval to include other sizes and types of vessels (Starcrest 2018).

A bonnet would only reduce criteria air pollutants; it would not provide any GHG reductions. On an average per-OGV call basis, use of a bonnet system will reduce DPM by 75% while at-berth (Starcrest

2018). Assuming 75% emissions control efficiency of the barge-based system used during the entire at-berth stay for the 10.6% of the total calls[9] not currently required to use shore power,[10] there is the potential to reduce approximately 3.5 to 3.7 tons of DPM in 2020. Total emissions reductions would depend on (1) the type of system, (2) system utilization, (3) the system's emissions capture and control efficiencies, (4) emissions from diesel generators needed to start up and shut down the barge system when the OGV is at berth, and (5) emissions associated with maneuvering the barge that holds the system. Because the bonnet would be barge-based, use of a bonnet would result in increased GHG emissions as well as some DPM. These emissions would be due to fuel use by the barge's engines while maneuvering and while operating the barge when the bonnet is in use as well as fuel use by auxiliary equipment on the barge itself.

A contractor would provide the bonnet system services. The barge operator would need to work with terminal operators and shipping lines and potentially conduct studies to determine how such emissions control devices could be deployed at the Seaport. The studies would have to evaluate possible barriers to implementation, such as berth space for the barges while not in use, piloting hazards, the ability to use a system at multiple terminals, and financing (the estimated cost of one barge is approximately $6 million). Because ships have different stack configurations and more than one vessel may be at berth at any time, several barge-based systems would be required to achieve 100% at-berth control of the vessels that are not currently shore power capable. Grant funding, if available, could partially offset this cost. AEG, the manufacturer and operator of the AMECS barge, has received Proposition 1B funding from BAAQMD to build a new barge for use at the Port of Benicia. The barge is intended to test the feasibility of the technology with auto carriers. Information on projected fees and the operating process is not yet available.

There are several operational feasibility concerns with implementation of a barge-based bonnet system. Berthing the barge when not in use is an operational issue. While the Port does have some berth space, berth space is limited and may not be available when a bonnet barge operator wants to locate at the Port. (The barge operator could also lease or purchase berth space for this use outside the Port area; however, if the barge is located farther away, DPM and GHG emissions associated with the use of the bonnet system would increase.) Transiting vessel traffic may have to slow down while the bonnet barge is being maneuvered alongside to or from the vessel it is servicing. In addition, the bonnet barge operator may have to compete with larger vessels for tug service. The greater the number of bonnets required to address various stack configurations, the more substantial the operational challenges.

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[9] 2017 data

[10] As described above, infrequent callers are currently not required to comply with the shore power regulations, and steamships cannot be made shore power capable.

E-OGV-3: Increased Shore Power Capability on Vessels

As described above, according to Port data, approximately 20% of the vessels calling on the Port are currently not shore power capable, and retrofitting a vessel to make it shore power capable may cost up to $1 million. New vessels are typically put into service on the Asia-Europe routes and are later transferred to the Asia-North America routes. The vessels are retrofitted for shore power when they are transferred to North American routes.

Steamships, which represent approximately 6.5% of the vessel calls at the Port of Oakland, are not required to be shore power capable under the At-Berth rule. Steamships will be phased out by 2020 and will most likely be replaced by shore-power-capable vessels. Amendments to the CARB At-Berth rule will probably require that certain vessels that are infrequent callers must also be shore power capable by 2023, which would be another approximately 4% of the vessels calling at the Port.

E-OGV-4: Enhanced Ship and Engine Design

Overall, GHG emissions on a unit (per ton of cargo) basis have decreased as vessels have gotten larger and more efficient; however, most of those gains have been offset by increased cargo volume. Ship and engine design is driven by economics and international environmental agreements, such as the International Convention for the Prevention of Pollution from Ships, known as MARPOL 73/78. As long as operating characteristics of the vessel are not affected, reducing fuel use provides great economic benefits to shippers. Therefore, economic and environmental drivers are in alignment. With the recent goals for GHG emissions reductions announced by IMO (IMO 2018), it is likely that on a per-unit-cargo basis, future vessels will have substantially lower emissions than current vessels. At this point, it is impossible to predict whether the ambitious targets set by IMO will be met and when more energy-efficient vessels will be put into service in the Asia-North America trade. Nonetheless, at least one shipping company has announced that it intends to be carbon-neutral by 2050 (Maersk 2018), and it is clear that emissions from OGVs while in transit will continue to decline over time. This is critical because vessels in transit represent by far the greatest residual source of DPM in the 2017 Seaport Emissions Inventory.

Harbor Craft

Harbor craft (HC) are the second largest contributor of DPM in the Port’s emissions inventory, behind OGVs. The Port’s emissions inventories consider tugs, work boats, survey boats, and related harbor craft. Ferries are not included because they do not serve the Seaport. Nonetheless, this section describes technological innovations for ferries because it is possible that these innovations will be transferable to tugs. In 2017, HC contributed 6.1% of total DPM emissions. Harbor craft are forecasted to contribute 10% of total DPM in 2020 and 8% to 10% of total DPM in 2030. An estimated 12 to 13 tugs serve the Seaport. Based on normal attrition and CARB’s in-use fleet regulation, close to 50% of the HC engines at the Port will meet Tier 3 or Tier 4 standards in 2020, and most of the remaining fleet will meet the Tier 2 emissions standard (Starcrest 2018). The U.S. Environmental Protection Agency (EPA) maintains emission standards for marine engines, and the higher tier numbers indicate increasingly stricter standards for NO_X, hydrocarbons, PM, and carbon monoxide (CO). The tier standards for commercial HC are not the same as those for CHE or OGVs.

E-HC-1: Provide Harbor Craft Engine Retrofit Incentives

CARB proposes to update the Commercial Harbor Craft regulation by 2020, but new regulatory measures would not be implemented until after 2023 (see Table B-5: CARB Actions to Further Reduce Emissions from Freight Sources and Facilities in Appendix B: Background). Under this Implementing Action, the remaining HC with Tier 2 engines would be repowered with Tier 4 engines, resulting in an 85% reduction in DPM on a per-engine basis. In advance of an updated regulation, engine replacement must rely on incentives and is limited by the amount of incentive funding that can be obtained. For example, Port tenant AMNAV has applied for Carl Moyer Program funding to retrofit two of its tugs with Tier 3 engines.

Repowering costs are estimated at $1.4 million per engine or $2.8 million per tug, as most tugs are equipped with two engines. On average, DPM emissions per engine will be reduced by 85%, which is approximately between 2.7 and 3.2 tons in 2020 for the entire Bay Area HC fleet that services the Port (Starcrest 2018). Due to cost and operational considerations, including the downtime required to retrofit engines, it is very unlikely that all of the tugs serving the Seaport that still use Tier 2 or lower engines could be retrofitted. Therefore, the actual DPM emissions reductions achievable through tug retrofits cannot be predicted.

The only reductions in GHGs by implementing this measure will result from improvements in efficiency. GHG reductions will depend on tug efficiency improvements (Starcrest 2018).

E-HC-2: Hybrid Harbor Craft Retrofit

It is possible to reduce emissions from existing tug engines by retrofitting them to hybrid technology. In 2013, Foss Maritime Company (Foss) received verification from EPA for their XeroPoint Tugboat Hybrid Retrofit system (Starcrest 2018). According to the EPA verification letter, the hybrid technology will reduce DPM emissions by at least 25% and GHGs measured as carbon dioxide equivalents (CO_2e) by at least 30%, based on the duty cycle provided by Foss. The letter states that fuel savings and emission benefits are dependent on reduced operation of the main propulsion engines and operation with the XeroPoint system while in transit, idling, and stopped (i.e., during the times when power demands are relatively low).

Actual emission reductions will vary depending on the engine selection, duty cycle, and battery selection. While the verification letter requires the highest-available-tier engine to be used as the replacement engine, it also states that greater emission reductions could be attained with Tier 3 and Tier 4 engines. The technology is certified for harbor tugboat vessels with auxiliary generator engines (rated horsepower [hp] range between 100 and 750 hp) and main propulsion engines (up to 5,000 hp each). In 2017, Wärtsilä launched new eco-friendly tug designs based on hybrid technology that reduces criteria pollutants as well as GHG emissions (Starcrest 2018). The company's website does not provide any specific emissions reductions performance.

The U.S. has little operating experience with hybrid tugs. Only two hybrid tugs have been built in the U.S. (at the Ports of Los Angeles and Long Beach), although Baydelta Maritime plans to build a hybrid tug that is expected to begin operations in San Francisco Bay in early 2019 (Starcrest 2018). The Port of Long Beach is working with Harley Marine under a Zero- and Near-Zero-Emissions Freight Facilities (ZANZEFF) grant to develop a hybrid tug as well. Unless retrofits or equivalent engine performance are required by future CARB regulations, hybrid tug technology would also have to be implemented through an incentive program.

On average, DPM emissions per vessel would be reduced by 25% (approximately 1 ton per year in 2030 if all 12 to 13 in-use tugs are hybridized by 2030). On average, GHG emissions per vessel would be reduced by 30% (approximately 4,400 to 4,600 metric tons (MT) of CO_2e per year in 2030 if all in-use tugs are hybridized by 2030). However, as for tug engine retrofits, it is highly unlikely that all tugs serving the Seaport would be retrofitted, given the costs and operational considerations associated with retrofitting (Starcrest 2018).

E-HC-3: Plug-in Hybrid Harbor Craft

In September 2018, the Red and White Fleet put a new plug-in hybrid ferry into service. The ferry uses shore power to initially charge the ferry's batteries and then transitions to diesel fuel (the Red and White Fleet uses RD) to supplement the battery. The Red and White Fleet partnered with Cummins Engines to repurpose a hybrid-electric bus motor for use in a maritime environment and worked with BAE Systems to design the propulsion system. Currently, the ferry can run for an hour on one charge; eventually, the battery system is supposed to be capable of recharging in 9 minutes. The ferry was between 10% and 15% more expensive to build than a similar-sized vessel with a diesel engine. Maintenance costs are projected to be lower than typical diesel engines. All the data about the ferry boat's operations will be released publicly (Baldassari 2018b). This type of technology is likely to be transferable to tugs in the future.

E-HC-4: Fuel Cell Harbor Craft

CARB recently awarded Golden Gate Zero Emission Marine a $3 million grant to construct the first U.S. ferry powered solely by hydrogen fuel cells. The grant follows several years of feasibility studies by Sandia National Laboratories in Livermore. When the ferry is built, the Red and White Fleet will operate it. No dock-side fueling stations will be needed; a hydrogen fueling truck will be able to drive onto the dock and refuel the vessel straight from the truck. Maintenance is expected to be less expensive than maintenance for diesel-powered vessels. Construction of the ferry began in November 2018 and is expected to be completed at the end of 2019. After completion, the ferry will undergo a 3-month demonstration and analysis period, and will be tested at various speeds and for various uses. The designers believe that the technology will be adaptable to a wide range of vessels, including tugs (Baldassari 2018a).

E-HC-5: LNG-Powered Tugs

Natural-gas-powered tugs are available to order or in development from several manufacturers. At the current time, a very small number of LNG-powered tugs are in service at various locations around the world. Developing reliable engines and gas storage systems for natural-gas-powered tugs requires meeting several challenges that are unique to tugs. Tugs are specifically designed for high-power performance in assisting, towing, or repositioning a vessel. At the same time, while assisting a vessel, the majority of a tug's time is spent waiting on standby with the engines idling or operating at extremely low power. Tugs must also be able to transition from idling to maximum output in an extremely short time. Finally, space for fuel storage is limited on tugs.

A natural-gas-powered tug can either rely solely on natural gas as fuel for starting, running without a load, and operating continuously at any engine load, or it can be designed or retrofitted to be a dual-fuel vessel. A dual-fuel vessel may be able handle longer trips. In addition, requiring less LNG storage can reduce capital expenditures for retrofit projects and/or preserve the ability to sell the vessel to users who may not have access to LNG. Given the state of the technology for natural-gas-powered tugs, a dual-fuel system can also increase reliability if the natural gas system fails to perform.

E-HC-6: Shore Power for Tugs

Like OGV, tugs could also plug into shore power while at berth. The Port currently provides berthing to one tug company, AMNAV. AMNAV already uses shore power for its tugs, and other tug operators are based outside of the Port of Oakland. Thus, there is little opportunity for reducing local DPM emissions from expanding shore power capability for tugs.

Cargo-Handling Equipment

As discussed previously, the Port has commissioned two studies to evaluate the status of zero-emissions CHE. While the studies showed that a majority of the different types of CHE are available as electrically powered equipment, much of the equipment is still in the demonstration or pilot stages. Some types of electrically powered CHE can only be used in fully automated terminals (M&N 2018). Appendix F: Equipment Operations and Cost Assessment to Assist with Electric Infrastructure Planning contains the study prepared for Implementing Action E-CHE-2; the study also provides an overview of the cargo-handling process at Oakland marine terminals.

E-CHE-3: Expand Use of Hybrid Cargo-Handling Equipment Where Zero-Emissions Equipment is Not Commercially Available or Affordable

Terminal operator SSA Terminals, Inc. (SSAT) secured Carl Moyer program grant funding to repower all its existing RTG cranes in use at the Oakland International Container Terminal with new hybrid-electric engines. The hybrid system uses a small diesel-hybrid engine to power a battery that is used to operate the crane. The hybrid engine is equipped with an energy recovery system that captures energy released when a container is lowered. A small diesel engine provides additional energy to the battery as needed. Due to the smaller engines, energy recovery from lowering containers, and the smoother operation of the smaller engines, converting to these hybrid engines will reduce the criteria air pollutant emissions from the RTG cranes by 90% to 99%. The reduction in fuel consumption will also substantially reduce GHG emissions. Additional GHG emissions reductions could be achieved by using RD instead of petroleum diesel to power the diesel engine. The first hybrid repower system was delivered to SSAT and installed in February 2019. Subsequent repower systems are expected to be delivered and installed approximately every 2 months. If the hybrid cranes demonstrate satisfactory operating performance at the Oakland International Container Terminal, other container terminals at the Seaport may convert their RTG cranes to hybrid cranes over time.

Over time, other types of hybrid CHE may become available. Depending on the availability and cost of suitable zero-emissions equipment, it may be appropriate for tenants to implement hybrid equipment on an interim basis. Tenants would make the determination as to which type of equipment is most suitable to their operations based on their criteria for equipment purchases and regulatory compliance (as future regulations are put in place).

E-CHE-4: Electrically Powered Cargo-Handling Equipment

Progress is being made with development of electrically powered CHE (see Appendix F: Equipment Operations and Cost Assessment to Assist with Electric Infrastructure Planning). In addition, at its March 23, 2017, meeting, CARB directed its staff to amend the CHE regulation to require 100% zero-emissions CHE by 2030 (Starcrest 2018). CARB staff currently proposes to update the CHE regulation by 2022; the new measures for zero-emissions CHE would not be implemented until after 2026 (see Table B-5: CARB Actions to Further Reduce Emissions from Freight Sources and Facilities, in Appendix B: Background). Implementation of a new CHE regulation would help drive innovation in this equipment sector. The 2017 CAAP of the SPBP calls for those ports to replace all CHE with zero-emissions equipment by 2030, if feasible (Starcrest 2018; SPBP 2017). This momentum will encourage the continued development of the technologies needed for this Implementing Action.

If yard operations permit and if the required electrical infrastructure is in place, replacement of existing CHE with electric equipment may become an option in the foreseeable future for most of the CHE in use today. However, none of the equipment currently meets the feasibility criteria for commercial availability, and there is insufficient operating experience (including operating performance over the typical life of the CHE) to demonstrate operational feasibility. As described in Appendix F, yard tractors are the CHE type that is most likely to become commercially available in the near future; however, further pilot-scale testing is still required to refine designs and evaluate operational issues, and costs will remain substantially higher than for comparable diesel-powered equipment for the foreseeable future. Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) funding, which is currently available to help fund the acquisition of battery-electric yard tractors, would be critical to speed purchases of zero-emissions yard tractors. CARB is currently developing a similar program, the Clean Off-Road Equipment Voucher Incentive Program (CORE).

The terminal operators will continue to evaluate operational and infrastructure needs, and then develop a plan to replace CHE with commercially available electric alternatives over time, where feasible. The Port will continue to work with tenants to identify and apply for grants and other incentive funding.

E-CHE-5: Demonstration Testing of Electrically Powered Cargo-Handling Equipment

The Port of Long Beach was recently successful in obtaining a ZANZEFF grant from CARB. The Oakland component of the grant will include deploying five battery-electric yard tractors and one battery-electric top-pick at the Matson Terminal (Berths 60-63) (CARB 2018a). As part of that grant, SSAT will be testing five battery-electric yard tractors and a battery-electric top-pick at Matson Terminal. None of the equipment is commercially available, and therefore all of it will be built specifically for the test.

Drayage Trucks

Approximately 8,750 trucks are registered in the Port's Secure Truck Enrollment Program (STEP), a prerequisite for permission to pick up cargo at any of the Port's terminals, including the rail yards. On any given day, approximately 3,000 registered drayage trucks access the terminals. Any measures intended to reduce emissions from drayage trucks need to consider the social and economic factors associated with Implementing Actions. For example, the 2017 CAAP acknowledges that the move to cleaner trucks resulting from previous versions of the clean truck program led to serious and legitimate concerns about the impact of expensive new technologies on the working conditions of the drivers who haul cargo to and from the ports. The problem arose because the high cost of new technology was beyond what most drivers could afford. At the Port of Oakland, most drayage trucks are owned by independent owner-operators with limited means. In addition, a substantial number of owner-operators have limited English proficiency.

The question of how to fund the billions of dollars required for the replacement of trucks to zero-emissions vehicles poses a significant challenge for the financial viability and long-term economic sustainability of a clean truck fleet. It should not fall solely on the owner-operators to fund the equipment and manage the technological challenges associated with a transition to a new truck fleet to serve the Port. It is critical that all stakeholders work together on solutions to address the challenge of transitioning to a sustainable, cleaner truck fleet and a drayage system that does not place an undue burden on any particular party.

E-T-1: CTMP Implementation/Clean Truck Program

The Comprehensive Truck Management Plan (CTMP) is an element of the MAQIP. The CTMP consists of five primary elements:

- **Truck Ban Ordinance:** The Port adopted a truck ban ordinance (October 2009) for non-compliant drayage trucks seeking access to Port terminals. This ordinance goes "above and beyond" the CARB regulation's reporting requirements and bans non-compliant drayage trucks at all Port of Oakland maritime terminals, including rail yards.
- **Drayage Truck Retrofit Project:** The Port, CARB, BAAQMD, and EPA provided a combined $38 million in grant funds to help truckers purchase diesel particulate filters or a newer truck. The funding provided grants for 1,319 diesel particulate filter retrofits and for 587 replacement trucks.
- **Idling Restrictions:** The Port installed "No Idling" signage along Port roadways.
- **Truck Parking:** The Port provides Seaport land for drayage truck parking on an interim basis. This interim parking areas allow drayage truck drivers to leave their trucks in the Seaport area, lessening the likelihood that truckers will use local streets as parking areas, and allows drayage truck drivers a place to rest during the day while awaiting dispatch. The Port is committed to providing 15-acres of truck parking.
- **CTMP Web Page:** The Port developed a CTMP web page for the Port of Oakland's public website. The web page is dedicated to informing the trucking community about CARB regulatory requirements and provides a CTMP overview, STEP[11] registry requirements, a restroom facility map, webcams, and other trucker resources.

In addition, the Port conducted studies on parking supply and demand, and conducted West Oakland truck parking surveys every year from 2015 through 2017. Although implementation of the CTMP is considered to be complete, the measures described above will continue to remain in effect. The Port is collaborated with the City of Oakland to complete the joint City of Oakland-Port of Oakland West Oakland Truck Management Plan (TMP) (see Related Plans, Programs, and Projects in Appendix B: Background). The TMP is considered a related plan.

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[11] The STEP is designed to ensure that all licensed motor carriers serving the Seaport are complying with the Port's security requirements.

E-T-2: Truck Emissions Control Equipment Repair Facilities

As discussed in Appendix B: Background, according to the 2017 Seaport Emissions Inventory, DPM emissions from trucks have dropped by 98% since 2005. These emissions reductions are attributable in part to the use of DPFs and, increasingly, to the use of SCR. When emissions control equipment fails, especially on older model-year trucks, emissions from those trucks can increase by more than a factor of 10. Consequently, to maintain emissions reductions that have already been achieved, it is critical for truckers to have ready access to qualified repair facilities that can service the emissions control equipment. Furthermore, modern trucks have onboard monitoring equipment that does not allow the engine to run if the emissions control equipment is out of specification range. Emissions control repair facilities are available in Oakland and nearby communities. At least one provider also offers a mobile DPF repair service.

E-T-3: Incentives to Upgrade to Zero-Emissions Drayage Trucks

The truck-related emissions attributed to the Seaport have been greatly reduced and currently only make up 0.6% of the total DPM emissions at the Port (see Appendix B: Background). While upgrading the drayage truck fleet to zero-emissions trucks would effectively eliminate all emissions from this category in the Seaport, it is unlikely that the entire drayage truck fleet would be converted. Furthermore, converting to zero-emissions drayage trucks on a significant scale is not technologically feasible at present. Zero-emissions short-haul drayage trucks[12] are not commercially available yet and are not expected to be commercially available for several years (2022 or later). Long-haul zero-emissions drayage trucks are not expected to be commercially available until 2027 or later. Most truck owners need the flexibility to be able to do short or long hauls, depending on their clients' needs on any given day.

Converting the entire drayage truck fleet would result in very high costs, given the thousands of trucks that would need to be converted and the cost of installing the necessary infrastructure (see below). Nonetheless, the benefits of converting drayage trucks to zero emissions would extend beyond the Seaport when those trucks are engaged in business not related to the Seaport (*halo* effect). The Port anticipates that future grant funding that may be available under AB 617 would be used to convert a number of trucks operating in and around the West Oakland area, including some trucks serving the Seaport area, to zero-emissions vehicles. In addition, HVIP funding is currently available to aid in the purchase of zero-emissions drayage trucks.

Electric drayage trucks have not been proven in commercial service (they are considered to be in the demonstration phase), and the performance of these trucks in port drayage operations is being studied by the National Renewable Energy Laboratory (NREL 2018). Electrical charging time for battery-electric

[12] Short-haul drayage trucks are those that cover less than 100 miles per day.

trucks is currently considerably longer than fueling time for diesel- or hydrogen-fueled equipment. Electrical charging also requires the truck to return to base or dock at a charging station along each route.

The total cost per truck for 10 zero-emissions drayage trucks is estimated to be approximately $470,000 each. This cost includes charging infrastructure costs estimated at $200,000 per truck. This cost can vary depending on location and available power (Starcrest 2018). The incremental cost of replacing the entire drayage fleet of approximately 9,000 trucks would be approximately $2.4 billion. The actual percentage of trucks that might ultimately be converted to electric operation is unknown, given that truck owners will decide whether to convert their trucks.

Replacing all 9,000 (approximately) drayage trucks would eliminate all DPM associated with drayage trucks (approximately 0.07 to 0.11 tons in 2030). Even accounting for the greater exposure associated with emissions located closer to the community, it is highly unlikely that these emissions reductions could be made cost-effective until electric trucks have reached complete cost and range parity with diesel-powered equipment. Replacement of all drayage trucks in the STEP registry with zero-emissions vehicles would also result in 100% reduction of tailpipe GHG emissions. After accounting for PG&E grid emissions, overall GHG emissions would be reduced by 88%, which is equivalent to approximately 15,000 to 24,000 MT of CO_2e per year in 2030. The actual emissions reductions that could be achieved through conversion of a portion of the trucks serving the Seaport to electric operation depends on the engine model year and age of the trucks as well as the total fraction of diesel-powered trucks replaced by electric trucks.

E-T-4: Short-Haul Drayage Truck Demonstration Testing

A Port tenant is currently evaluating a Phase 1 electric drayage truck, and the manufacturer is currently working with several other Port tenants to deploy 10 Phase 2 electric drayage trucks. The ZANZEFF grant discussed above provides funding for an additional 10 electric drayage trucks. These trucks are being built by a different vendor and will be used by Shippers Transport Express. Pursuant to the Memorandum of Understanding (MOU) between the Port and the Port of Long Beach regarding the ZANZEFF grant, dated February 7, 2019, the Port committed to construct the necessary charging infrastructure for the drayage trucks to be deployed at Shippers Transport Express. All of the test trucks are being used in short-haul service (between marine terminals and near-dock rail yards, warehouses, or container storage yards) due to the electric trucks' limited range. The Port will track the results of the testing.

E-T-5: Incentives for Low-NOx Drayage Trucks

Low-NO_x trucks (90% cleaner than current NO_x standards) are currently available, and CARB is working on a regulation to introduce low-NO_x truck standards. However, those standards are targeted only toward NO_x and will not achieve DPM and GHG emissions reductions. There are currently no CNG- or LNG-fueled trucks in the STEP registry. The Port is not proposing any measures to implement low-NO_x trucks.

E-T-6: High-Emitting Truck Detection System

As discussed in Appendix B: Background, studies have shown that a small fraction of trucks with apparent emissions control systems failures emit a greatly disproportionate amount of air pollutants. The studies have also shown that it is possible to identify these high-emitting trucks. For this Implementing Action, permanent emissions sensors would be installed at key entry points to the Port. When a high-emitting truck is detected by a sensor, the sensor's reading along with the identifying truck information, such as a photo of the license plate, would be transmitted to an enforcement agency, such as CARB or the DMV, for follow-up (see the response to comments in Volume II of the Final Plan for further discussion related to this Implementing Action).

Locomotives

The Oakland International Gateway (OIG) rail yard and the Oakland Global Rail Enterprise (OGRE) are on Port land, and the emissions from locomotives operating in these rail yards are included in the 2017 Seaport Emissions Inventory. OIG is a Class 1 railway and as such, CARB can only regulate certain elements of its locomotive operation, such as idle time. OGRE is a Class 3 railway and is subject to CARB rulemaking. The Union Pacific rail yard, a Class 1 facility, is located adjacent to the Seaport but not on Port land, and is therefore not included in the Port's emissions inventory. Although the Port has little influence with the rail yards, CARB requested that the 2020 and Beyond Plan include Implementing Actions for line-haul locomotives. Several Implementing Actions for line-haul locomotives were added, as shown below. Line-haul locomotives generally face some of the same issues as long-haul drayage trucks—development of wide-ranging charging infrastructure and the need to rapidly charge engines versus the potential demand charges associated with rapidly charging a large battery. In addition, rail yards operate 24 hours a day, 7 days a week. Consequently, developing alternatively fueled line-haul locomotives is extremely challenging. All line-haul locomotive test engines are retrofits onto existing locomotive assemblies, changing out only the engine system.

E-L-1: Switcher Locomotive Replacement (Upgrade to Tier 4)

Several switcher locomotives are assigned to the OIG and OGRE rail yards, with the total hours of operation at both rail yards averaging approximately 9.6 hours per day, 7 days a week. Replacing the existing Tier 0 switcher locomotives with Tier 4 switcher locomotives would provide DPM and GHG emissions reductions. Tier 4 engines provide 95% control of PM compared to Tier 0 engines. Because the activity of the switcher locomotives at OIG and OGRE is relatively low, their emissions are relatively low. However, it is worth noting that the total current DPM emissions from locomotives exceed the total current diesel truck DPM emissions. Both rail yards have several switcher locomotives sharing the switching duties. Unless the yard operators can operate the new Tier 4 locomotive exclusively (with a few of the older locomotives as backups or used in cases where more than one locomotive is needed), several of the switchers would need to be replaced. In addition, switchers are not necessarily tied to one rail yard, so upgraded switchers may not stay in the rail yard at all times.

Incentives or grants could be used to encourage replacement of the OIG and OGRE switcher locomotives. In February 2018, OGRE was granted Carl Moyer Program and EPA Diesel Emissions Reduction Act (DERA) funding to replace one diesel switcher locomotive engine. The grant requires that the project be completed by June 14, 2019. Moyer grants have been used by other railroads (e.g., Pacific Harbor Lines) to replace locomotives. A new Tier 4 switcher costs approximately $2 million to $2.5 million (Starcrest 2018). Replacing one switcher engine and using it for the majority (greater than 90%) of the switching would yield a more than 90% reduction of DPM (approximately 0.13 to 0.37 tons per year in 2030). GHG emission reductions are expected to be approximately 40%,[13]resulting in emission reductions of approximately 250 to 750 MT of CO_2e per year in 2030 (Starcrest 2018).

E-L-2: Support CARB Petition for Tier 5 Line-Haul Locomotives

In an effort to reduce emissions from line-haul locomotives, CARB petitioned EPA to issue Tier 5 emissions standards for line-haul locomotives. This Implementing Action consists of having the Port submit a letter in support of CARB's petition to EPA.

E-L-3: Battery-Electric Switcher Engines

The Ports of Los Angeles and Long Beach are collaborating with CARB and the South Coast Air Quality Management District to test a lithium-ion battery-electric switcher engine. The two ports have the heaviest-duty switching operations in the U.S. At 2,100 hp, the engine is unusually large for a switcher. It has a design 12-hour running-time target and is equipped with a 2,800 kilowatt-hour (kWh) battery pack. The locomotive is currently being built, is scheduled for battery installation and testing from January through April of 2019, and is to be delivered to the Ports of Los Angeles and Long Beach in June 2019. Grant conditions require that the switcher complete 900 operating hours by the fourth quarter of 2019.

E-L-4: Battery-Electric Locomotive for Hybrid Consist

BNSF Railway (BNSF) teamed with the San Joaquin Air Quality Management District on a ZANZEFF grant to develop a battery-powered locomotive that would be used in combination with diesel locomotives in what is termed a *hybrid consist*.[14] The concept includes replacing the engine and associated equipment in a locomotive with an approximately 2,400 kWh battery pack and developing software to optimize the operation of the overall consist. The optimization software is essential, as improper use of the engine could increase fuel use. The hybrid consist will be tested on the Stockton to Barstow run as well as on within-yard movements. BNSF is assessing the new technology for safety, operational fit, total cost of ownership, and reliability. BNSF anticipates overall fuel savings of 10% to 15% on the Stockton to Barstow run. However, even on a given run, it is typical for fuel costs to vary up to 10% due to such

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[13] www.nre.com

[14] A "consist" is combination of locomotives used to power a train.

factors as the variability in the specific freight, the aerodynamics of the train, and wind conditions, among others.

E-L-5: Encourage Railroads to Use Cleanest Engines in Oakland

The Class 1 railroads have discretion over the locomotives that are used in their Oakland yards as well as the line-haul locomotives that are used to haul trains into and out of Oakland. Existing locomotives have variable emissions, depending on their emissions tier. Tier 4 engines are the cleanest engines. For this measure, the Port would write a letter to the Class 1 railroads encouraging the railroads use locomotives with Tier 4 engines for both their line-haul locomotive coming through Oakland and in their switcher locomotives at the Oakland rail yards. This action is included in the Near-Term Action Plan.

Miscellaneous Off-Road Equipment

Miscellaneous off-road equipment consists of construction equipment and equipment used at warehouses as well as maintenance and related vehicles in the Port's own fleet. In addition to the specific measures outlined below, diesel-fueled equipment could easily be converted to use RD, which would result in immediate DPM reductions of 30% to 40% and GHG emissions reductions of 60% or more.

E-M-1: Port Fleet Conversion and Charging Infrastructure

The Port is committed to evaluating the conversion of its own vehicles to battery-electric or other zero-emissions technology as the equipment is replaced at the end of its useful life. The evaluation includes an assessment of the feasibility of zero-emissions equipment from a commercial and operational perspective, using the feasibility criteria presented in this Plan. The Port recently evaluated 13 types of fleet equipment for replacement by battery-electric or other alternatively fueled equipment. Of the 13 types of equipment, only one had a positive return on investment compared to equivalent diesel-powered equipment.

Equipment purchase costs for the alternatively fueled vehicles ranged from 136% to 218% of equivalent diesel-powered equipment. In addition, none of the equipment met the Carl Moyer criterion for cost-effectiveness for zero-emissions equipment ($100,000 per ton of emissions reduced, or less). Nonetheless, Port staff recommended, and the Board of Port Commissioners approved, the purchase of six electric vehicles as part of a larger fleet vehicle replacement effort. In Resolution No. 18-117, the Board authorized the purchase of one electric van, one electric flatbed truck, two electric forklifts, and two electric work trucks. These vehicles are specifically being purchased as pilot test vehicles; three of the vehicles are slated for maritime use. The Port previously purchased a battery-electric passenger van.

The van, which was the first of its kind to be produced by the selected manufacturer, has encountered a significant operating challenge. Implementation challenges provide valuable feedback to the manufacturer and will result in improved products in the future. The Port will continue to evaluate the feasibility of replacing diesel-powered equipment with alternatively fueled equipment as each piece of diesel-fueled equipment reaches the end of it useful life.

The Port has available capacity to support up to six electric vehicle charging plugs at its Harbor Facilities building. In the future, the Port will have to evaluate the existing electrical system serving the Harbor Facilities building to determine the additional infrastructure required to support proposed electric vehicle purchases. In addition, the Port may evaluate the feasibility of light-duty vehicle charging stations in Port parking areas to encourage the transition of personal vehicles to zero-emissions or hybrid-electric vehicles.

E-M-2: Highest-Tier Engine Construction Equipment on Port Projects

Lower-tier diesel engines emit considerably more DPM and other pollutants than the highest-tier engines. If construction conducted within the Seaport were to use only the highest-tier equipment, DPM emissions would be reduced and some reductions in GHGs would also occur, as newer engines are typically more efficient. For example, the CenterPoint Oakland project is using Tier 4 construction equipment except for those items for which Tier 4 equipment is unavailable.

E-M-3: Retrofit Older Construction Equipment with Emissions Control Devices

Older construction equipment with lower-tier diesel engines (i.e., not equipped with emissions control devices) could be retrofitted with these devices to reduce emissions. The emissions reductions achieved would depend on the engine model year of the equipment to be retrofit, the operating of that equipment, and the specific type(s) of retrofit equipment.

E-M-4: Zero-Emissions Loading and Unloading Equipment

Mobile equipment used at warehouses, maintenance facilities, and other support services within the Seaport area could be converted from their existing fuel sources (typically diesel, and propane or LNG/CNG) to battery-electric service. Battery-electric forklifts are considered to be commercially available. Also, forklifts powered by hydrogen fuel cells are commercially available. The Cool Port facility will use battery-electric equipment in its operation and provide electrical plug-ins for transport refrigeration units (refrigerated containers). (As noted previously in the Fuels section, hydrogen fuel cell technology only provides reductions in GHG emissions if the electricity used to generate the hydrogen is from renewable sources.)

CATEGORY 4: Operations

Efficiency Measures

Broadly speaking, efficiency measures fall into two subcategories: direct energy efficiency measures and measures designed to improve operational efficiency, thereby reducing fuel consumption and associated air emissions.

O-1: Fixed-Asset Energy Efficiency Measures Studies and Implementation

Buildings and other infrastructure can be made more energy-efficient through energy-efficient lighting, insulation, low-carbon intensity building materials, painting to reduce heat absorption, and related improvements.

O-2: Overall Seaport Operating Efficiency (Studies and Implementation)

Efficiencies at a container terminal and within a seaport are achieved through a more rapid and smoother cargo-loading and unloading process, including the process of moving the containers onto or off the container yard. The more the various elements of a seaport operation are working well together, the more efficient the overall cargo movement process becomes. Higher efficiencies result in a reduction in air pollutant emissions per unit amount of cargo. Terminal velocity is the term used to describe the speed at which containers can be moved in and out of the terminal en-route to their next destination.

Terminal velocity provides an overall measure of the relative efficiency of each terminal within a seaport. While individual elements of the cargo movement process can be optimized, the greatest efficiencies are achieved when the various elements are integrated. For example, accelerating the rate at which containers can be loaded without ensuring that trucks can be processed quickly enough to provide sufficient containers for loading would limit the value of the improved loading process. Truck turn-time data (the amount of time it takes a truck to enter the terminal and load or unload a container) can identify bottlenecks in the system. As described in Appendix B; Background (see Related Plans, Programs, and Projects), FITS will provide turn-time information when it is implemented.

Based on consultation with Port maritime staff and reflecting their close working experience with Seaport tenants, optimal operations would include all the following:

- Arriving vessels receive a pilot, enter the harbor, dock and begin off-loading as soon as they arrive.
- Containers are off-loaded at a steady rate and placed in areas where they are quickly loaded onto and hauled away by trucks.
- Trucks enter the terminal without delays from having to wait for paperwork to be processed or a container to become available.
- Vessels are reloaded rapidly and cleared for departure as soon as they are fully loaded.

Port of Oakland Seaport terminal tenants and operators are constantly working on and investing in increasing efficiency. Ideally, idling by trucks and CHE is avoided because the container loading and unloading operations are synchronized with the rate at which trucks can enter the terminal to unload or retrieve a container. In addition, a truck would both drop off and pick up a container during each trip to the terminal. This is a challenging goal because many factors must be integrated to ensure a smooth operation. Currently, a combined drop-off and pickup occurs for roughly 25% to 35% of truck trips.

Improving marine terminal operating efficiency requires extensive coordination with ocean carriers, shippers, and truckers. For example, a vessel would have to provide the information on the containers that it will be off-loading prior to arriving at the Port, including their ultimate destination. This information, in turn, could then be used by the marine terminal operator to set up truck appointments.

Facilitating coordinated operations requires use of terminal operating systems, which help avoid bottlenecks through proper planning, thereby increasing productivity. While each container terminal has its own terminal operating system, terminals are currently unable to communicate with each other. A secure community network is required to optimize terminal and Seaport operations. The Port Efficiency Task Force (PETF) will continue to meet and identify potential efficiency improvements.

O-3: Evaluate Voluntary Vessel Speed Reduction Program

Under a Voluntary Vessel Speed Reduction (VSR) program, participating OGVs voluntarily reduce their speed while in transit. When OGVs slow down, the load on the main engines decreases considerably compared to the engine load when transiting at higher speeds. This leads to a decrease in the total energy required to move the OGV through the water. The energy reduction in turn reduces emissions for this segment of the transit. Since the load on the main engines affects power demand and fuel consumption, this strategy can significantly reduce all pollutants including PM (including DPM), NO_X, sulfur oxide, and GHG emissions. Experience shows that incentivizing these programs increases participation rates from around 70% to nearly 100% (Starcrest 2018).

In San Francisco Bay, OGVs already transit at a relatively slow speed east of the Sea Buoy, where the bar pilot boards. The Port is consulting with the San Francisco Bar Pilots to identify and discuss issues and concerns associated with a voluntary VSR program within the Precautionary Zone outside San Francisco Bay. The Port would consider a voluntary VSR only with the San Francisco Bar Pilots' consultation and support. A voluntary VSR could provide emissions reduction benefits inside the Precautionary Zone between the Outer Buoys and the Sea Buoy. In its 2018 VSR pilot program, BAAQMD in collaboration with other air districts is incentivizing lower transit voyages through the Precautionary Zone, which is included in the Port's emissions inventory. Initial results show some emissions reduction benefits associated with use of incentives, and BAAQMD is continuing its study to better understand the benefits and drawbacks (Michael Murphy, pers. comm. 2019). One potential concern with VSR programs is the longer transit time for the vessel. In some cases, the ocean carrier may increase speeds once it is past the VSR zone to make up for the time lost to VSR. This would negate the emissions reductions achieved by VSR.

The potential DPM reduction benefits of a voluntary VSR in the outer Precautionary Zone would be approximately 2 tons per year in 2020. The potential GHG benefits in the outer Precautionary Zone would be approximately 4,200 to 4,500 MT of CO_2e per year in 2020 (Starcrest 2018). The Port will evaluate the potential for a voluntary VSR program after the results of the BAAQMD pilot study are available. A voluntary VSR program could be included as part of an overall environmental incentive program.

O-4: Monitor Shore Power Use

Under CARB's At-Berth rule, shipping lines calling the Port are required to reduce onboard auxiliary diesel engine power generation by 70% (2018 requirement) on a fleet-wide basis while at berth. To date, all shipping lines that visit the Port have chosen to plug into shore power, although in the future, some vessels may use a barge-based emissions reduction system (bonnet; see the discussion in the Ocean-Going Vessel section). Port staff have been monitoring the success of shore-power plug-ins to determine the issues preventing the use of plug-ins and to enhance usage. For issues that are identified, the Port works with the shipping lines and marine terminal operators to evaluate potential solutions.

O-5: Combined Environmental Performance Incentive Program for Ocean Carriers

A combined environmental performance incentive program provides an opportunity for ocean carriers to earn incentives for each vessel call, depending on specific types of actions they take to meet performance requirements in two or more categories of incentivized actions. Depending on the type of program implemented, ocean carriers may be incentivized at different levels for achieving certain levels of environmental performance. For example, a program that includes an incentive to use ultra-low-sulfur diesel fuel (see the discussion in the Fuels section) may offer different levels of incentive award points, depending on the specific sulfur content of the fuel, with the lowest-sulfur fuel resulting in the highest incentive points. Other environmental performance measures that could be added to a combined incentive program include VSR, use of vessels with cleaner engines, shore-power plug-in performance, and use of alternative fuels such as RD (if beneficial in marine use) or, longer-term, natural gas. A combined incentive program could be similar to the Environmental Ship Index currently used by the Port of Los Angeles.

O-6: Track Other Incentive-Based Programs

The SPBP are considering measures to incentivize energy efficiency improvements and use of cleaner technologies. These ports are also considering imposing a differential rate system to incentivize newer, cleaner vessels. The Port of Oakland will track the experience of the SPBP with these initiatives along with implementation of the 2017 CAAP in general. The Port of Oakland and other ports along the West Coast are likely to benefit from any successful incentives. It will be important to track the benefits of any such program against the improvements in ship emissions reductions pursuant to the most recent MARPOL guidance (IMO 2018).

The SPBP are also planning to develop a Green Terminal program. The Port of Oakland will continue to track various efficiency and incentive measures tested at the SPBP. Successful programs will be evaluated for their applicability to the Port of Oakland, consistent with the screening and evaluation process for

Implementing Actions described in Appendix D: Screening and Evaluation Criteria for Implementing Actions.

CATEGORY 5: Partnership Actions

As described in Strategy #4, effective partnerships are crucial to the successful implementation of the Plan and to realizing the Plan's vision of a zero-emissions Seaport. Partnership Implementing Actions focus on information exchange and development of joint funding opportunities. The Port is continually working to strengthen its partnerships with tenants, truckers, other Port-related businesses, other Ports, regulatory agencies, and the community.

P-1: Track San Pedro Bay Ports CAAP Progress and Technology Advancement Program

The SPBP currently provide progress updates to their CAAP online (http://www.cleanairactionplan.org/) and specific quarterly reporting. Port staff will continue to track CAAP progress using this online resource as well as the Port of Oakland relationships with SPPB staff. Likewise, SPPB also provide annual reports on their Technology Advancement Program (TAP) online (http: //www.cleanairaction plan.org/technology-advancement-program/) and the Port will continue to check in on the progress of the TAP directly with SPBP staff.

P-2: Participate in Trucker Working Groups

Three primary trucker groups represent the interests and concerns of truckers serving the Seaport: the Port of Oakland-specific Trucker Working Group, the Harbor Trucking Association, and the Western States Trucking Association. The Trucker Working Group meets every other month and is an organized forum for Port staff, marine terminal operators, chassis equipment providers, regulatory agencies, the Oakland Police Department, logistic/drayage software developers, trucking associations, and others to provide updates to each other and those in the trucking community. Port staff will continue coordinating, attending, and using the Trucker Working Group as a forum for sharing updates on Plan implementation as well as receiving feedback on Implementing Actions. In addition, Port of Oakland staff receive regular email updates multiple times a week from the Harbor Trucking Association and weekly newsletters from the Western States Trucking Association. Port staff will continue tracking the information provided and the concerns expressed by each respective trucking association.

P-3: Port Environmental Office Hours for Trucking Companies and Truckers

Port environmental staff have weekly standing environmental office hours at the Maritime Harbor Facilities building. The goal of these weekly office hours is to make staff available to various trucking companies (primary motor carriers and licensed motor carriers) as well as independent owner-operators to assist with truck compliance and potential grant or incentive funding for newer diesel, low-NO_X, and zero-emissions equipment. Port staff also use the Port Environmental Office Hours to distribute information from BAAQMD. The Port will continue environmental office hours and work with

BAAQMD staff on how best to provide information on and assistance with grant opportunities for those in the trucking community.

P-4: ZANZEFF Grant MOU with Port of Long Beach

Pursuant to the MOU with the Port of Long Beach, Port of Oakland staff will manage the Port-of-Oakland-related component of the Port of Long Beach's ZANZEFF grant project. This will include providing project updates and coordinating data collection and monitoring by consultants, as needed, to meet the ZANZEFF grant reporting requirements. The Port will use this partnership opportunity to strengthen its relationship with the ports of Long Beach and Stockton.

P-5: Meet with Port Tenants

As part of the Port's lease agreement with tenants, annual meetings are held between Port environmental staff and tenants to review tenant environmental responsibilities with respect to air quality. Port environmental staff will continue having annual meetings with Port tenants to jointly look for opportunities to improve air quality (e.g., by upgrading equipment, implementing efficiency measures, and pursuing grant project partnering opportunities). These annual meetings are in addition to the ongoing coordination by Port environmental staff with Port tenants.

P-6: Participate in Industry Stakeholder Groups

Port industry stakeholder groups provide an opportunity to share information about port air quality improvement initiatives. Port of Oakland environmental staff will continue to participate, as invited, in the PETF to provide the PETF updates regarding Port air quality initiatives, and they will use the PETF to continue building relationships with the Pacific Merchant Shipping Association and other industry stakeholders. In addition, the Port is in weekly contact with Pacific Merchant Shipping Association staff regarding air quality initiatives and technologies.

P-7: Attend Industry Trade Conferences

Port environmental staff attend and participate in numerous industry trade conferences focused on clean technology. For example, in 2018, the conferences included the Advanced Clean Transportation Expo, the American Association of Port Authorities Green Ports conference, the NorCal Clean Technology Summit, and the West Coast Collaborative. In 2018 Port staff also spoke at VERGE, a conference and expo for accelerating clean energy, and participated on a Clean Truck Panel for an Intermodal Association of North America conference-related event. In addition, Port staff regularly participate in industry trade webinars organized by such agencies as CalStart and the Hydrogen Business Council. Port environmental staff will continue to attend conferences for both learning and connecting with those associated with clean energy and zero-emissions technology.

P-8: Collaborate with Public Agencies

The Port of Oakland can collaborate with other public agencies in identifying opportunities for sharing Implementing Actions and grant opportunities.

P-9: Collaborate with Regulatory Agencies

In 2018, the Port of Oakland, BAAQMD, CalStart, and CARB hosted two grant and incentive funding workshops for truckers and trucking companies to learn about opportunities for cleaner equipment. The Port plans to continue hosting such events and evaluate other outreach events that may be held in the future.

P-10: Outreach Regarding Potentially Applicable Grants and Incentives

In addition to the Port Environmental Office Hours held at the Maritime Harbor Facilities building and the 2018 Grant and Incentive Funding Workshops, the Port will continue to reach out to tenants and marine terminal operators to inform them about potential grant and incentive opportunities. Outreach may be through events or may occur informally during other meetings, such as the annual meetings with tenants. Additionally, Port staff can connect successful grantees with others in the Seaport community seeking the same grants so that the grantees can share grant application information and lessons learned.

P-11: Provide Support during Development of Grant Applications

For marine terminal operators or Port tenants developing grant applications, the Port can provide letters of support and initial evaluation of projects if requested and deemed appropriate.

P-12: Develop a Workforce Development Program

The Port will continue its workforce development program with adjustments to account for zero-emissions technology, as described in Appendix E: Workforce Development Plan.

P-13: Partner with Other Ports on Grant Applications

In 2018, the Port of Oakland signed an MOU with the Port of Long Beach to implement the Oakland components of a ZANZEFF grant to the Port of Long Beach. The Port of Oakland will continue identifying future opportunities for collaborating on applications with other ports as time and resources allow.

P-14: Advocate for Cleaner OGVs and Fuels

Ocean-going vessels are regulated at the international level, and Class 1 railroads are regulated at the federal level. The Port will continue to advocate for cleaner vessels and locomotives with the appropriate agencies.

CATEGORY 6: Stakeholder Engagement

SE-1: Seaport Air Quality 2020 and Beyond Task Force Meetings

The Port intends to continue to hold Seaport Air Quality 2020 and Beyond Task Force (Task Force) meetings during Plan implementation, as described in Appendix G: Public Engagement Plan. The Port will also provide documentation for Steps 1 through 4 of the screening and evaluation process to the Task Force Co-Chairs for review (see Screening and Evaluation Process for Implementing Actions in the Main Text of the Plan). Additionally, Selected Actions will be provided to the Task Force Co-Chairs for their feedback. Where needed or desired, the Task Force Co-Chairs will convene a working session for collaborative problem-solving on specified Selected Actions. Task Force Co-Chairs will present the results of Steps 1 through 4 to the Task Force for its feedback.

SE-2: Community Town Hall Meetings

A Community Town Hall meeting can be a method of reporting to the community regarding the progress of the 2020 and Beyond process, as described in Appendix G: Public Engagement Plan. Community Town Halls would be scheduled at times and on dates when more stakeholders are able to attend, such as during the evening or on weekends.

SE-3: Conduct Directed Outreach

While the Seaport Air Quality 2020 and Beyond Task Force has engaged a wide range of stakeholders, some community members and organizations may not be aware of or may not be engaged in the 2020 and Beyond process. As described in Appendix G: Public Engagement Plan, the Port intends to do directed outreach to these community members and organizations. Directed outreach may be done through social media, by telephone, and through direct contact. It may also be done through announcements and information provided at locations that community members frequent, such as faith groups, grocery stores, and laundromats. Other directed outreach includes public workshops and tours, community and business surveys, questionnaires, and polls, as described in Appendix G.

SE-4: Document Responses to Comments on the 2020 and Beyond Plan

Several commenters requested that the Port provide specific, written responses to all comments received. The Port developed the *Responses to Comments on the June 29, 2018 Draft Seaport Air Quality 2020 and Beyond Plan* document, which provides responses to all comments (emails and comment letters, etc.), as Volume II of the Revised Draft. Similarly, the Port developed the *Volume II Responses to Comments on the Revised Draft Seaport Air Quality 2020 and Beyond Plan, December 14, 2018,* document, which provides responses to all comments received on the Revised Draft.

SE-5: Outreach to Individuals with Limited English Proficiency

Meaningful engagement with the whole community requires outreach to community members with limited English proficiency. Informational materials for those with limited English proficiency will be developed using graphics and minimal text with simple language, and the materials will be produced in appropriate languages.

CATEGORY 7: Funding Actions

FG-1: Estimate Overall Costs Associated with the 2020 and Beyond Plan

The Port requires an overall cost estimate to be able to assess funding needs relative to Plan goals and to develop a conceptual approach to implementation of the overall Plan. The Port has conducted several feasibility studies for infrastructure and equipment to date. The total Plan cost will be highly dependent on the long-term cost of zero-emissions technology and the availability of incentive programs.

FG-2: Financing Mechanisms and Sources

A wide range of potential financing mechanisms could be used to advance the goals of the Plan. In addition to self-funding and external grants and incentives, the Port will consider a variety of potential debt-financing mechanisms for larger-scale infrastructure improvements. These improvements would be planned and constructed in accordance with the Port's project delivery process. Identification of suitable mechanisms will include tracking grant and incentive opportunities. For example, in 2018, Port staff attended the CalStart-sponsored Funders Forum meeting in Sacramento. The Funders Forum gathered representatives of multiple agencies (state agencies, air districts, and utilities) to exchange information and best practices for vehicle and infrastructure incentives.

The 2018 Funders Forum was the second meeting of its kind. The Port hopes that this meeting or a similar type of meeting will continue. In addition, Port staff currently receive email updates from the various funding sources, including the California Energy Commission, CARB, and BAAQMD. Collaborations with OEMs are another potential funding or support mechanism. OEMs can provide equipment for operational testing or demonstration use and can financially support required ancillary equipment, such as chargers and supporting infrastructure (e.g., transformers).

FG-3: Grant and Incentive Funding Program Requirements

Port staff will continue to become educated on established grant and incentive funding programs so that they are better able to strategically pursue the most appropriate opportunities and to provide general guidance and information on opportunities for Port tenants and truckers.

FG-4: Track SPBP Truck Rate Study

In addition to tracking the progress of the SPBP CAAP and TAP, Port staff will track the current SPBP truck rate study to understand the projected benefits and effects of implementing a truck rate as well as the mechanics of implementing such a rate. The results of the SPBP study can help inform the feasibility and suitability of a similar program at the Port of Oakland.

FG-5: Evaluate the Feasibility of Providing Incentives

Provided funding allows, the Port could evaluate incentives for voluntary VSR to increase participation (provided BAAQMD's VSR pilot program shows that VSR would provide net emissions reductions benefits) and/or implement a combined environmental incentive program such as the Environmental Ship Index. A combined environmental incentive program typically awards points to each vessel depending on its performance on certain environmental indicators, such as fuel sulfur content and shore power use. The feasibility evaluation would consider both the costs involved with providing a meaningful level of incentives and the administrative requirements of implementing such a given incentive program.

FG-6: Advocate for New or Expanded State and Federal Grant and Incentive Funding Programs

Through the identification of a full range of financing mechanisms and sources, the Port may identify additional needs for grant and incentive funding programs. Port staff participate in agency working groups to provide feedback on grant programs. Through its stakeholder engagement process, the Port may also become aware of barriers to the use of existing grant or incentive programs and could advocate for changes in these programs to make them more accessible to potential applicants.

REFERENCES

A.P. Moller-Maersk (Maersk). 2018. Maersk sets net zero co2 emission target by 2050. December. Available at: https://www.maersk.com/en/news/2018/12/04/maersk-sets-net-zero-co2-emission-target-by-2050. Accessed February 22, 2019.

Baldassari, Erin. 2018a. Nation's first hydrogen fuel-cell ferry to be built in Bay Area. July 17. *San Jose Mercury News*. Available at: https://www.mercurynews.com/2018/06/25/first-in-the-nation-hydrogen-fuel-cell-ferry-to-be-built-in-bay-area/ . Accessed October 28, 2018.

_____. 2018b. First-of-its-kind hybrid-electric ferry boat to take maiden voyage in San Francisco Bay. September 13. *San Jose Mercury News*. Available at: https://www.mercurynews.com/2018/09/13/first-of-its-kind-hybrid-electric-ferry-boat-to-take-maiden-voyage-in-sf-bay/. Accessed October 28, 2018.

Bay Area Air Quality Management District (BAAQMD). 2017. Renewable Diesel as a Major Transportation Fuel in California: Opportunities, Benefits, and Challenges. Prepared by Gladstein, Neandross & Associates for BAAQMD and SCAQMD. August.

Burns and McDonnell. 2016. Port of Oakland Maritime Electric Strategic Assessment. June.

_____. 2019. *Maritime Power Capacity Study for Terminal Electrification*. In preparation.

California Air Resources Board (CARB). 2018a. CARB announces more than $200 million in new funding for clean freight transportation. September 26, 2018. Available at: https://ww2.arb.ca.gov/news/carb-announces-more-200-million-new-funding-clean-freight-transportation. Accessed December 3, 2018.

_____. 2018b. Draft Technology Assessment: Ocean Going Vessels. May. https://www.arb.ca.gov/msprog/tech/techreport/ogv_tech_report.pdf?_ga=2.45759396.1057527286.1553218730-614534368.1538958514

California Energy Commission (CEC). 2018. Diesel Fuel Data, Facts, and Statistics. Available at: https://www.energy.ca.gov/almanac/transportation_data/diesel.html. Accessed 10/28/18.

California Fuel Cell Partnership. n.d. Cost to refill. Available at: https://cafcp.org/content/cost-refill

International Maritime Organization (IMO). 2018. UN body adopts climate change strategy for shipping. Available at: http://www.imo.org/en/MediaCentre/PressBriefings/ Pages/06GHGinitialstrategy.aspx. Accessed April 14, 2018.

Lane, Jim, in Biofuels Digest. 2017. Ethanol and biodiesel: dropping below the production cost of fossil fuels? May 18. Available at: https://www.biofuelsdigest.com/bdigest/2017/05/18/ethanol-and-biodiesel-dropping-below-the-production-cost-of-fossil-fuels/

Moffatt & Nichol (M&N). 2018. Container Yard Electrification Feasibility Study, Version 2.0. February.

National Renewable Energy Laboratory (NREL). 2018. South Coast Air Quality Management District Truck Evaluation. Available at: https://www.nrel.gov/transportation/fleettest- electric-scaqmd.html. Accessed June 1, 2018.

Neste Corporation (Neste). 2018. Neste MY Renewable Diesel plays a significant role in the implementation of California's Climate Plan. Undated. Available at: https://www.neste.us/customers/products/renewable-products/neste-my-renewable-diesel. Accessed 11/2/2018.

Pennsylvania State University Extension (Penn State). 2016. Using Biodiesel Fuel in Your Engine. June 9. Available at: https://extension.psu.edu/using-biodiesel-fuel-in-your-engine

Port Authority of New York and New Jersey Port Department (PA NYNJ). 2018. 2016 Multi-Facility Emissions Inventory. January. Available at: https://www.panynj.gov/about/pdf/PANYNJ-2016-Multi-Facility-EI-Report.pdfSan Pedro Bay Ports (SPBP). 2017. *Clean Air Action Plan 2017 - Final Clean Air Action Plan Update*. November.

_____. 2018. SPBP *Clean Air Action Plan Draft Drayage Truck Feasibility Assessment*. December.

Scripps Institution of Oceanography (Scripps). 2016. Longitudinal study of the performance characteristics and environmental impacts of renewable diesel fuels in marine engines. March.

Starcrest Consulting Group, LLC. 2018. Technical Memorandum: MAQIP Update - Emissions Forecast and Potential Additional Reduction Strategies. July.

United States Environmental Protection Agency (USEPA). 2010. Designation of North American Emission Control Area to Reduce Emissions from Ships. March. Available at: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100AU0I.PDF?Dockey=P100AU0I.PDF. Accessed May 28, 2018.

Wikipedia. 2018. Biodiesel. Available at: https://en.wikipedia.org/wiki/Biodiesel

Personal Communications

Lex (Alexander) Mitchell, CARB. 2018a. Personal communication with Susanne von Rosenberg (GAIA). May 2.

Lex (Alexander) Mitchell, CARB. 2018b. Personal communication with Susanne von Rosenberg (GAIA). October 30.

Michael Murphy, BAAQMD. 2019. Conversation with Tracy Fidell, Port of Oakland. March 25.

Nick Monroy, Neste. 2018. Personal communication with Susanne von Rosenberg (GAIA). November 2.

TABLE C-2: INITIAL IMPLEMENTING ACTIONS[15]										
No.	Implementing Action	Implementing Action Category	Location	Port's Level of Control (Note 1)	Associated Strategy or Strategies					
					1	2	3	4	5	6
Infrastructure										
I-1	Engineering Feasibility Studies for Increased Cargo Movement Efficiency through Smart Technology	Infrastructure	Seaport	Control	X	X	X			
I-2	Engineering Feasibility Studies for Drayage Truck Charging Infrastructure	Infrastructure	Seaport	Control	X	X	X			
I-3	Maritime Power Capacity Study for Terminal Electrification	Infrastructure	Terminals	Control	X	X	X			
I-4	Roadway and Other Hard Infrastructure Upgrade Studies	Infrastructure	Seaport	Control/ Influence	X	X	X			
I-5	Electric Vehicle Infrastructure Guide for Port Tenants	Infrastructure	Seaport	Control	X	X	X			
I-6	Uniform Charging Standards for Electrically-Powered CHE and Drayage Trucks	Infrastructure	Terminals	Influence	X	X	X			
I-7	Charging Infrastructure to Support Zero-Emissions Equipment	Infrastructure	Seaport	Influence/ Control		X	X			
I-8	Future Infrastructure Modifications	Infrastructure	Seaport	Control	X	X	X			
Fuels										

[15] The actions listed in this table could be implemented at any time during the life of the Seaport Air Quality 2020 and Beyond Plan. The Near-Term Action Plan described in the Main Text of the report, and summarized in Table 2 in the Main Text, provides the actions that are proposed for the next 5 years.

Notes:

1. The Port may have direct control ("control"), be able to influence the likelihood that the initiative or action will occur ("influence") or may have no control over the action, although the action would affect air emissions within the emission inventory area of the Seaport ("concern").
2. Seaport includes the container terminals, warehouses, ancillary maritime services, Port-owned rail yards, and certain roadways.

TABLE C-2: INITIAL IMPLEMENTING ACTIONS[15]										
No.	Implementing Action	Implementing Action Category	Location	Port's Level of Control (Note 1)	Associated Strategy or Strategies					
					1	2	3	4	5	6
F-1	Technology Assessment for Hydrogen and Hydrogen Fuel Cells	Fuel	Seaport	Control	X	X				
F-2	Electricity Supply	Fuel	Seaport	Control	X	X	X			
F-3	Local Solar Power Generation	Fuel	Seaport	Influence/ Control	X	X	X			
F-4	Renewable Diesel Fuel	Fuel	Seaport	Control/ Influence	X					
F-5	Biodiesel	Fuel	Seaport	Control/ Influence	X					
F-6	Natural Gas	Fuel	Seaport	Influence	X					
F-7	Renewable Natural Gas	Fuel	Seaport	Influence	X					
F-8	Low Sulfur Diesel Fuel in Ocean-Going Vessels	Fuel	Waterways	Influence	X					
Equipment										
Studies										
E-CHE-1	Container Yard Electrification Feasibility Study	Equipment	Terminals	Control	X	X	X			
E-CHE-2	Equipment Operations and Cost Assessment to Assist with Electric Infrastructure Planning (Appendix F)	Equipment	Terminals	Control	X	X	X			
Ocean-Going Vessels										
E-OGV-1	Shore Power Improvements - Achieve 90% Shore Power Use	Infrastructure	Terminals	Control	X	X	X			
E-OGV-2	Barge-Based Exhaust Scrubber System (Bonnet)	Equipment	Waterways	Influence	X					

TABLE C-2: INITIAL IMPLEMENTING ACTIONS[15]										
No.	Implementing Action	Implementing Action Category	Location	Port's Level of Control (Note 1)	Associated Strategy or Strategies					
					1	2	3	4	5	6
E-OGV-3	Increased Shore Power Capability on Vessels	Equipment	Waterways	Concern	X	X				
E-OGV-4	Enhanced Ship and Engine Design	Equipment	Waterways	Concern	X	X				
Harbor Craft										
E-HC-1	Provide Harbor Craft Engine Retrofit Incentives	Equipment	Waterways	Influence	X					
E-HC-2	Hybrid Harbor Craft Retrofit	Equipment	Waterways	Influence	X					
E-HC-3	Plug-in Hybrid Harbor Craft	Equipment	Waterways	Influence	X	X				
E-HC-4	Fuel Cell Harbor Craft	Equipment	Waterways	Influence	X	X				
E-HC-5	LNG-Powered Tugs	Equipment	Waterways	Influence	X					
E-HC-6	Shore Power for Tugs	Equipment	Seaport	Influence	X		X			
Container Handling Equipment										
E-CHE-3	Expand Use of Hybrid Cargo-Handling Equipment Where Zero-Emissions Equipment is Not Commercially Available or Affordable	Equipment	Terminals	Influence	X	X	X	X		
E-CHE-4	Electrically Powered Cargo-Handling Equipment	Equipment	Terminals	Influence	X	X	X	X		
E-CHE-5	Demonstration Testing of Electrically Powered Cargo-Handling Equipment	Equipment	Terminals	Influence	X	X	X	X		
Trucks										
E-T-1	CTMP Implementation/Clean Truck Program	Operations	Seaport	Influence/ Control	X					
E-T-2	Truck Emissions Control Equipment Repair Facilities	Equipment	Seaport lands and West Oakland	Influence/ Concern	X					

TABLE C-2: INITIAL IMPLEMENTING ACTIONS[15]

No.	Implementing Action	Implementing Action Category	Location	Port's Level of Control (Note 1)	Associated Strategy or Strategies					
					1	2	3	4	5	6
E-T-3	Incentives to Upgrade to Zero-Emissions Drayage Trucks	Equipment	Seaport	Influence	X	X				
E-T-4	Short-Haul Drayage Truck Demonstration Testing	Equipment	Seaport	Influence/ Control	X	X	X			
E-T-5	Incentives for Low-NO_X Emissions Drayage Trucks	Equipment	Seaport and West Oakland	Control						
E-T-6	High-Emitting Truck Detection System	Equipment	Seaport	Influence/ Concern	X					
Locomotives										
E-L-1	Switch Locomotive Replacement (Upgrade to Tier 4)	Equipment	Rail Yards	Influence	X					
E-L-2	Support CARB Petition for Tier 5 Line-Haul Locomotives	Equipment	Rail Yards	Control	X			X		
E-L-3	Battery-Electric Switcher Engines	Equipment	Rail Yards	Concern	X	X				
E-L-4	Battery-Electric Locomotive for Hybrid Consist	Equipment	Rail Yards	Concern	X	X				
E-L-5	Encourage Railroads to Use Cleanest Engines in Oakland	Equipment, Partnership	Rail Yards	Concern/ Influence	X			X		
Miscellaneous Equipment										
E-M-1	Port Fleet Conversion and Charging Infrastructure	Equipment	Seaport	Control	X	X	X			
E-M-2	Highest-Tier Construction Equipment on Port Projects	Operations	Seaport	Control	X					
E-M-3	Retrofit Older Construction Equipment with Emissions Control Devices	Operations	Seaport	Influence/ Control	X					
E-M-4	Zero-Emissions Loading and Unloading Equipment	Equipment	Warehouses	Influence	X	X				

TABLE C-2: INITIAL IMPLEMENTING ACTIONS[15]

No.	Implementing Action	Implementing Action Category	Location	Port's Level of Control (Note 1)	Associated Strategy or Strategies					
					1	2	3	4	5	6
Operations										
O-1	Fixed Asset Energy Efficiency Measures Studies and Implementation	Operations, Infrastructure	Warehouses	Influence	X	X	X			
O-2	Overall Seaport Operating Efficiency (Studies and Implementation)	Operations	Warehouses	Influence	X		X			
O-3	Evaluate Voluntary Vessel Speed Reduction Program	Operations	Waterways	Influence/ Control	X					
O-4	Monitor Shore Power Use	Operations	Waterways/ Terminals	Control	X					
O-5	Combined Environmental Performance Incentive Program for Ocean Carriers	Operations	Waterways	Influence/ Control	X	X				
O-6	Track Other Incentive-Based Programs	Operations, Equipment	Waterways, Seaport lands	Control/ Influence	X	X				
Partnership										
P-1	Track San Pedro Bay Ports CAAP Progress and Technology Advancement Program	Partnership	NA	Control			X	X		
P-2	Participate in Trucker Working Groups	Partnership	NA	Control				X	X	
P-3	Port Environmental Office Hours for Trucking Companies and Truckers	Partnership	NA	Control	X	X		X	X	X
P-4	ZANZEFF Grant MOU with Port of Long Beach	Partnership	NA	Control		X		X		X
P-5	Meet with Port Tenants	Partnership	NA	Control	X	X	X	X	X	
P-6	Participate in Industry Stakeholder Groups	Partnership	NA	Control				X	X	
P-7	Attend Industry Trade Conferences	Partnership	NA	Control				X		
P-8	Collaborate with Public Agencies	Partnership	NA	Influence				X	X	

TABLE C-2: INITIAL IMPLEMENTING ACTIONS[15]											
No.	**Implementing Action**	**Implementing Action Category**	**Location**	**Port's Level of Control (Note 1)**	**Associated Strategy or Strategies**						
					1	**2**	**3**	**4**	**5**	**6**
P-9	Collaborate with Regulatory Agencies	Partnership	NA	Influence				X	X	
P-10	Outreach Regarding Potentially Applicable Grants and Incentives	Partnership	NA	Control		X		X	X	X
P-11	Provide Support during Development of Grant Applications	Partnership	NA	Control		X		X		X
P-12	Develop a Workforce Development Program	Partnership	NA	Control				X	X	
P-13	Partner with other Ports on Grant Applications	Partnership	NA	Influence				X		X
P-14	Advocate for cleaner OGVs and Fuels	Partnership	NA	Control	X			X		
Stakeholder Engagement										
SE-1	Seaport Air Quality 2020 and Beyond Task Force Meetings	Stakeholder Engagement	NA	Control					X	
SE-2	Community Town Hall Meetings	Stakeholder Engagement	NA	Control					X	
SE-3	Conduct Directed Outreach	Stakeholder Engagement	NA	Control					X	
SE-4	Document Responses to Comments on the 2020 and Beyond Plan	Stakeholder Engagement	NA	Control					X	
SE-5	Outreach to Individuals with Limited English Proficiency	Stakeholder Engagement	NA	Control					X	
Funding and Grants										
FG-1	Estimate Overall Costs Associated with the 2020 and Beyond Plan	Funding and Grants	NA	Control						X
FG-2	Financing Mechanisms and Sources	Funding and Grants	NA	Control						X

TABLE C-2: INITIAL IMPLEMENTING ACTIONS[15]										
No.	Implementing Action	Implementing Action Category	Location	Port's Level of Control (Note 1)	Associated Strategy or Strategies					
					1	2	3	4	5	6
FG-3	Grant and Incentive Funding Program Requirements	Funding and Grants	NA	Control						X
FG-4	Track SPBP Truck Rate Study	Funding and Grants	NA	Control	X	X				X
FG-5	Evaluate the Feasibility of Providing Incentives	Funding and Grants	NA	Control	X					X
FG-6	Advocate for New or Expanded State and Federal Grant and Incentive Funding Programs	Funding and Grants	NA	Control						X

Source: Port of Oakland 2019

Acronyms and Abbreviations:

2020 and Beyond Plan = Seaport Air Quality 2020 and Beyond Plan

CAAP = Clean Air Action Plan

CARB = California Air Resources Board
CTMP = Comprehensive Truck Management Plan

LNG = liquefied natural gas
MOU = Memorandum of Understanding
NA = not applicable
NOx = nitrogen oxides

OGV = ocean-going vessel

Port = Port of Oakland

SPBP = San Pedro Bay Ports

ZANZEFF = Zero- and Near-Zero-Emissions Freight Facilities

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
1		Require Tenant and Contractor Compliance with all Applicable Air Quality Regulations	Require that all tenants and onsite construction contractors comply with and monitor compliance with all applicable air quality regulations for heavy duty- diesel trucks, including the Air Resources Board's (ARB) Tractor-Trailer Greenhouse Gas Reduction Regulation, Period Smoke Inspection Program, Off-Road Regulation, and Statewide Truck and Bus Regulation. To document compliance, require that fleets provide ARB Certificates of Compliance for the equipment regulations and copies of annual smoke test results.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations, Partnerships	Seaport (Note 2)	X			X		
2		Contractual Lease Language for Air Quality Compliance	Incorporate contractual language into tenant lease agreements to ensure that tenants comply with all applicable air quality regulations, are using the cleanest technologies for their equipment (in both construction and operations) and understand their responsibilities of building and maintaining a green facility as well as compliance with diesel regulations.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations, Partnerships	Seaport (Note 2)	X			X		
3	Duplicate of Suggested Action 16	Require Cleanest Possible Construction Equipment and Processes	Require that the cleanest possible construction practices and equipment are utilized. This should include eliminating idling of diesel powered equipment, requiring the use of zero and near-zero emission equipment and tools to the greatest extent feasible, and providing the necessary infrastructure, like electric hookups, to support that equipment.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations	Seaport (Note 2)	X					
4		Plan for the Necessary Infrastructure to Support ZE and NZE Technology	Implement and plan for the necessary infrastructure to support zero-emissions and near-zero-emissions technology vehicles and equipment at the Port. This includes physical, energy, and fueling infrastructure for construction equipment, on-site vehicles, and equipment, and medium-heavy and heavy-heavy duty trucks. ARB's Technology and Fuels Assessments provide information on the current and projected development of mobile source technologies and fuels, including current and anticipated costs at widespread deployment. The assessments can be found at http://www.arb.ca.gov/msprog/tech/tech.htm.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Infrastructure	Seaport (Note 2)			X			
5		Adopt Targets for Electric Raceway Construction	At a minimum, both the Port and City should adopt targets for electric raceway circuit installation as part of initial facility construction. This will ensure sufficient electrical power is available for EV charging at sites under development and minimizes future costs to install infrastructure for zero and near zero emissions vehicles.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Infrastructure	Seaport (Note 2)			X			

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies 1	2	3	4	5	6
6		Develop a Sustainable Leasing Program	Develop a Sustainable Leasing Program whereby the Port and City shall work with tenants to develop and implement a policy incentive-based sustainable leasing program to attract the cleanest ships, ships that utilize shore power, zero and near-zero technologies, and otherwise incorporate technological and operational practices that reduce freight related emissions.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Partnerships	Seaport (Note 2)	X	X		X		
7		Require Tenants to Use Cleaner Technologies Over Time	Require tenants to use cleaner technologies over time as they become available and feasible. If a technology review demonstrates the new technology will be effective in reducing emissions and the Port or City determines that installation or use of the technology is feasible, the tenant shall implement such technology within 12 months of the Port or City's determination.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Partnerships, Equipment	Seaport (Note 2)		X		X		
8		Require Tenants to Develop an Annual Technology Review Program	Require tenants to develop an annual Technology Review Program to identify any new emissions- reduction technologies that may reduce emissions at the Port, including the feasibility of zero and near-zero emissions technologies for heavy-duty trucks, yard equipment, tugs, vessels, and bulk handling equipment.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Partnerships, Operations, Equipment	Seaport (Note 2)	X	X		X		
9		Ensure Tenants Compliance with ARB's Transport Refrigeration Regulation	Ensure existing and future tenants are compliant now and in the future with ARB's Transport Refrigeration Regulation. If not already implemented, incorporate operating practices that eliminate the amount of time that a transport refrigeration system powered by a fossil-fueled internal combustion engine can operate utilizing the combustion system at the Port.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations	Seaport (Note 2)	X			X		
10		Cold Storage Facilities with Clean TRU Technology	Plan and design cold storage facilities that incorporate zero emission all-electric plug-in transport refrigeration systems, hydrogen fuel cell transport refrigeration, and cryogenic transport refrigeration sufficient to meet Port growth.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Infrastructure	Warehouses (Note 2)	X		X			
11		Require the Use of Cleanest Available Cargo Handling Equipment	Require the use of cargo-handling equipment (CHE), including yard trucks, handlers, gantry cranes, fork lifts, that is the cleanest available technology (LPG/LNG, renewable diesel, electric, hydrogen, electric hybrid) and use zero- and near-zero emissions technology for equipment that is commercially available now and in the future, as more zero-emissions equipment becomes commercially available, as committed to in A Bold Vision. ARB's Technology Assessment: Mobile Cargo Handling Equipment, provides information on current and projected development of CHE, including current and anticipated costs at widespread development. This assessment can be found at https://www.arb.ca.gov/msprog/tech/techreport/che_tech_report.pdf.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment, Partnerships	Seaport (Note 2)	X	X		X		

TABLE C-3: NEW SUGGESTED ACTIONS														
No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
12		Require Yard Layout to Maximize Use of Zero-Emissions Equipment	Tenants should be required to demonstrate how their yard layout maximizes their ability to use zero-emissions equipment such as electric rail mounted gantry cranes.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations, Infrastructure, Partnerships	Terminals (Note 2)		X	X	X		
13		Require Use of Commercial Harbor Craft Technologies that Exceed Tier 2 or 3	Require the use of commercial harbor craft (CHC) technologies that exceed the Tier 2 or 3 requirements of CARB's CHC Regulation. There are some zero- and near-zero emissions technologies for equipment that are commercially available now, and additional projects are under way demonstrating the capability of CHC to achieve emission lower than Tier 4 marine and off-road emission standards. Some of these solutions may require retrofit with aftermarket emission control devices. ARB's Technology Assessment: Commercial Harbor Craft, provides information on current and projected development of CHC, including current and anticipated costs at widespread development. This assessment can be found at https://www.arb.ca.gov/msprog/tech/techreport/draft_chc_technology_assessm ent.pdf	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment, Partnerships	Waterways (Note 2)	X	X		X		
14	Duplicate of Suggested Actions 65, 99	Standards for Medium-Heavy and Heavy-Heavy Duty On-Road and Yard Trucks	Require that all medium-heavy and heavy-heavy duty on-road and yard trucks, including any alternative fuel vehicles, meet or exceed the 2010 emission standards. As it becomes available, require that medium-heavy and heavy-heavy duty trucks traveling within 100 miles of the site use zero and near- zero technology and require that yard trucks with similar duty cycles (less than hundred miles daily) convert to zero and near- zero technology. ARB's Technology and Fuels Assessments provide information on the current and projected development of mobile source technologies and fuels, including current and anticipated costs at widespread deployment. The assessments can be found at http://www.arb.ca.gov/msprog/tech/tech.htm.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment, Partnerships	Seaport (Note 2)	X	X		X		
15		Require that all Forklifts Meet a Zero Emissions Standard.	All forklifts should be required to meet a zero emission standard.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment, Partnerships	Warehouses (Note 2)		X		X		

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies 1	2	3	4	5	6
16	Duplicate of Suggested Action 3	Require Highest-Tier Construction Equipment.	During all construction activities, require that off-road construction equipment meet Tier 4 engine standards, if not available, require equipment that meets Tier 3 engine standards. Tenants shall keep a list of available equipment and submit to the Port or City upon request.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)								
17		Require Zero Emissions or Highest Available Engine Tier for Onsite Vehicles	Require that all on-site service vehicles, light-duty vehicles and equipment (operational and during construction activities), and property maintenance equipment use zero- emissions technology and, if zero-emissions technology is unavailable, that all vehicles and equipment meet the cleanest applicable emission standard.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment	Seaport (Note 2)	X	X				
18		Truck Traffic Plan	Require that all projects include a robust traffic plan that moves truck traffic away from residents reducing truck traffic in neighborhoods, reduces and enforces truck speeds to reduce exposure to noise and increase safety, and discourages new development near truck routes. Coordinate and consult with the West Oakland community on site-wide truck traffic circulation.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	NA	NA						
19		Require Integration of Freight Transport Infrastructure for Maximum Efficiency.	Properly integrate truck parking, terminal parking, security systems, electronic gates systems, and other freight transport infrastructure to maximize achievable efficiencies.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations	Seaport (Note 2)	X					
20		Require Operational Support for Zero and Near-Zero Emission Freight Equipment	Require future project design plans include operational support to demonstrate and deploy zero and near-zero emission freight equipment.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment, Partnerships	NA		X				
21		Require Emissions-Based Berthing Fees to Support West Oakland Emissions Reduction Projects	Require ships that enter the Port area pay emissions-based berthing fees or other user fees. The fees shall be used to reduce emissions and exposure in West Oakland.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations	Terminals (Note 2)	X					

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
22		OGV Fuel Requirements Compliance	Require that ocean-going vessels comply with fuel requirements for both the California Ocean-Going Vessel Regulation and the North American Emission Control Area Requirements.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Fuels	Waterways (Note 2)	X					
23		Provide Support for Demonstration Projects	Provide support (logistical and financial) for demonstration projects to encourage the use of alternative and/or advanced technologies. ARB's Technology and Fuels Assessments provide information on the current and projected development of mobile source and port equipment technologies and fuels, including current and anticipated costs at widespread deployment. The assessments can be found at http://www.arb.ca.gov/msprog/tech/tech.htm	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment, Partnerships, Funding and Grants	Seaport (Note 2)	X	X		X		
24		Enhance Community Engagement	Utilize concepts to enhance community engagement as outlined in the U.S. Environmental Protection Agency Draft Environmental Justice Primer for Ports, "The Good Neighbor Guide to Building Partnerships and Social Equity" released in July 2016. This document provides a road map to assess current community engagement and outlines strategies to assist the City and the Port to enhance neighboring community relationships. The document can be found at https://www.epa.gov/ports-initiative/draft-environmental-justice-primer-ports	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Stakeholder Engagement	NA (Note 2)					X	
25		Use Grant Funding	Utilize grant funding from Federal, State and local programs to reduce air pollution emissions and health risk from diesel exhaust. Incorporate a collaborative process between tenants and the Port and/or the City to apply for funding to support zero-emissions freight related diesel equipment technologies.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Funding and Grants	NA (Note 2)						X
26		Require Recycling and Metal Melting Facilities to Meet BAAQMD BACT Standards	Require that all recycling facilities and metal melting facilities that include re-melting furnaces for the melting of alloys, within the Port, the OAB project area, and within 1,000 feet of the West Oakland community meet the best available control technology (BACT) standards as defined by the BAAQMD.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Not Seaport-Related	Seaport (Note 2)						
27		Limit Truck Idling	All trucks shall be prohibited from idling more than two minutes when loading and unloading, staging or when not in active use for extended periods of time. Exemptions from the two-minute idling rule would be allowed when required for safety or when equipment is in use. (Plan Bay Area)	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations	OAB	X					

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
28		Implement an Appointment/ITS System for Drayage Trucks	An appointment/ITS system shall be implemented that minimizes truck idling and queuing for the movement of containers.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations	OAB	X					
29		Require Tier 4 or Cleaner, or ZE Harbor Craft	Prior to implementation of zero-emissions harbor craft: Prior to 2023, all CHC accessing the new OAB port facilities will meet USEPA Tier 4 standards (or cleaner) for both propulsion and auxiliary engines, or zero emissions technologies such as: batteries, shorepower, or hydrogen fuel cell.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment	Port-Owned Portion of OAB	X					
30		Low NOx Retrofit Technology for Tugs	Prior to implementation of zero-emissions harbor craft: NOx emissions can be controlled with selective catalytic reduction systems. For example, implement emission reduction control measures to replace tugboat engines with low NOx technology (for example, through the expansion of the existing cargo handling equipment re-powering and retrofitting program, part of the Berths 55-58 Project air quality mitigation program).	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment	Port-Owned Portion of OAB	X					
31		Broaden Zero-Emissions Cargo-Handling Equipment Category to Include Non-Electric Zero-Emissions and Hybrid Equipment	All the mobile cargo handling equipment will be electric equipment. (MAQIP) The Air District suggest this be broadened to allow for other zero emissions fuels (Hydrogen) and for near zero emissions equipment in the event that full zero emissions equipment in not commercially available.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment	Port-Owned Portion of OAB						
32		LEED Platinum Certification Standards for All Buildings	Buildings shall meet LEED Platinum certification standards.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations	Port-Owned Portion of OAB	X					
33		Energy Generation from All Buildings	All buildings shall provide sources of energy.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Fuels	Port-Owned Portion of OAB			X			
34	Duplicate of Suggested Action 55	Investigate Alternative Energy Generation	Solar, wind, mechanical, tidal or solar generated hydrogen systems will be investigated to determine their feasibility.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Fuels	Port-Owned Portion of OAB			X			

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies 1	2	3	4	5	6
35		Plant Trees in OAB to Trap DPM	The developer shall be required to plant trees and/or vegetation throughout the OAB. Trees that are best suited to trapping PM shall be planted, including one or more of the following: Pine (Pinus nigra var. maritima), Cypress (X Cupressocyparis leylandii), Hybrid popular (Populus deltoids X trichocarpa), and Redwoods (Sequoia sempervirens). (Plan Bay Area)	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	NA	Port-Owned Portion of OAB	X					
36		Provide HEPA Air Filters to Sensitive Receptors, and Contribute to System Maintenance	All existing land uses serving sensitive receptors within 1,000 feet of the Project boundaries shall be equipped with HEPA air filtration systems rated MERV 13 or better. The Port and City will establish a fund and contribute on a fair share basis to the cost of installing and maintaining the MERV 13 systems and provide educational materials to owners and occupants explaining how to maximize the benefits of these systems.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	NA	Port-Owned Portion of OAB						
37		Fund Fair Share of Transportation Control Measures (TCMs)	Consistent with SCA/MM 4.4-5, when redevelopment activity generates more than 20,000 square feet of employment-generating land uses, or generates 100 or more local jobs, the City, Port and developers will fund on a fair share basis Transportation Control Measures (TCMs) for reducing vehicle emissions from commercial, institutional, and industrial operations. See SCA/MM 4.4-5 for a full list of TCMS and include the following for new stationary sources: 2.11.1 On the OAB property, new stationary sources that are added as part of the project must reduce emissions beyond what is required by CARB and BAAQMD, whenever possible. For example, the cleanest available stand- by diesel generators and portable generators will be required. The City and Port shall fund this on a fair share basis.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations, Partnerships	Port-Owned Portion of OAB						

TABLE C-3: NEW SUGGESTED ACTIONS													
No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
38		Develop Commute Benefits Committee and Program	(1) To design and implement a Commute Benefits Program, the City, Port, and private developers need to form a committee and assign a representative to the committee. Committee representatives will include two West Oakland community members, an employee representative, and a representative from the Port and from the City. (Note that all employers with 50 or more full-time employees in the Bay Area are subject to the Bay Area Commuter Benefits Program [BAAQMD regulation 14, Rule 1]. For more information, please see https://commuterbenefits.511.org); (2) 2 Design and locate buildings to facilitate transit access, e.g., locate building entrances near transit stops, and eliminate building setbacks. Construct transit facilities such as bus turnouts/bus bulbs, benches, shelters, and improving transit bus service to the area. Provide on-site services, such as cafeterias, banks, dry cleaners, and convenience market so that employees can walk to these services. Include bicycle and pedestrian facilities in the design; (3) Transit, Bicycle and Pedestrian Access: Include sidewalks, multi-use paths and bike lanes in the project design. Provide secure, weather- protected bicycle parking for employees, Provide showers and lockers for employees bicycling or walking to work. Provide safe, direct access for bicyclists to adjacent bicycle routes. Provide direct, safe, attractive pedestrian access from project to transit stops and adjacent development; and (4) Mange [sic] Travel Demand and Provide Transit Service: Encourage OAB tenants to use carpools, vanpools, and public transit by providing incentives. Provide a shuttle to and from the West Oakland BART station. Establish mid-day shuttle service for worksite to food service establishments/commercial areas. Provide preferential parking for carpool and vanpool vehicles. Implement parking fees for single occupancy vehicle commuters.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations, Partnerships	Port-Owned Portion of OAB						

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies 1	2	3	4	5	6
39		Ensure Tenant Compliance with CARB's Transport Refrigeration Regulation	Ensure existing and future tenants are compliant now and in the future with ARB's Transport Refrigeration Regulation. Incorporate operating practices that eliminate the amount of time that a transport refrigeration system powered by a fossil-fueled internal combustion engine can operate utilizing the combustion system while at the Port. Require the use of zero emission all-electric plug-in transport refrigeration systems and ensure the design plan includes the necessary infrastructure. ARB's Technology Assessment: Transport Refrigerators, provides information on the current and projected development for transport refrigerators, including current and anticipated costs at widespread deployment. This assessment can be found at https://www.arb.ca.gov/msprog/tech/techreport/tru_ 07292015.pdf.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations	Cool Ports Oakland	X					
40	Duplicate of Suggested Action 47	Accelerate the Turnover of Line-Haul Locomotives	Accelerate the turnover of line-haul locomotives servicing the Port to Tier 4, ARB proposed Tier 5, or Zero emissions locomotives as expeditiously as possible, with the goal of 95% of operations to be performed at a minimum Tier 4 standard by 2023. ARB's Technology Assessment: Freight Locomotives, provides information on current and projected development of freight locomotives, including current and anticipated costs at widespread development. This assessment can be found at https://www.arb.ca.gov/msprog/tech/techreport/freight_locomotives _tech_repor t.pdf.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment	Cool Ports Oakland	X					
41	Duplicate of Suggested Action 52	Co-Funding and Other Support for Development of Zero-Emissions Line Haul Locomotives	Furthermore, the Port, Union Pacific (UP) Railroad, and/or BNSF Railway should commit to providing co-funding, facility access, and operational support for the development and demonstration of interstate line-haul locomotive technology with zero-emissions capability. This would include, but is not limited to, a hybrid-electric locomotive with all electric capability. ARB's Technology Assessment: Freight Locomotives, provides information on current and projected development of freight locomotives, including current and anticipated costs at widespread development. This assessment can be found at https://www.arb.ca.gov/msprog/tech/techreport/ freight_locomotives_tech_repor t.pdf.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment, Partnerships, Funding and Grants	Cool Ports Oakland		X		X		
42		Lease Agreements for Minimum Tier 4 Locomotives by 2023	Incorporate conditions into lease agreements with BNSF and/or UP to ensure that switch locomotives meet a minimum Tier 4 emissions level by 2023.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment, Partnerships	Cool Ports Oakland	X					

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
43	Duplicate of Suggested Action 48	Replacement of Diesel-Powered Switcher Locomotives on Port- or City-owned Rail Properties	Phase in the replacement of diesel powered switcher locomotives with electric rail car movers, within the Port or City owned rail properties.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment	Cool Ports Oakland		X				
44		Infrastructure for 100% Plug-in of TRUs	Plan and design for the necessary infrastructure to ensure 100%, plug-in equipped, to accommodate future growth volumes of TRU's or expansion of this area.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Infrastructure	Cool Ports Oakland			X			
45		Limits on TRU Operation without Plugging In	Implement a policy that limits the amount of time that a transport refrigeration system powered by a fossil-fueled internal combustion engine can operate utilizing the combustion system while on Site.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations	Cool Ports Oakland	X					
46		Encourage Use of Zero-Emissions Refrigeration Systems	Encourage the use of zero emission all-electric plug-in refrigeration systems, hydrogen fuel cell and cryogenic transport refrigeration systems.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment, Partnerships	Cool Ports Oakland		X				
47	Duplicate of Suggested Action 40	Accelerate the Turnover of Line-Haul Locomotives	Accelerate the turnover of line-haul locomotives servicing the Port to Tier 4, ARB proposed Tier 5, or zero-emissions locomotives as expeditiously as possible, with the goal of 95% of operations to be performed at a minimum Tier 4 standard by 2023. Furthermore, the Port, Union Pacific (UP) Railroad, and/or BNSF Railway should commit to providing co-funding, facility access, and operational support for the development and demonstration of interstate line-haul locomotive technology with zero-emissions capability. This would include, but is not limited to, a hybrid-electric locomotive with all electric capability. Incorporate conditions into lease agreements with BNSF and/or UP to ensure that switch locomotives meet a minimum Tier 4 emissions level by 2023. ARB's Technology Assessment: Freight Locomotives, provides information on current and projected development of freight locomotives, including current and anticipated costs at widespread development. This assessment can be found at https://www.arb.ca.gov/msprog/tech/techreport/ freight_locomotives_tech_repor t.pdf.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)								

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies 1	2	3	4	5	6
48	Duplicate of Suggested Action 43	Replace Diesel-Powered Switcher Locomotives with Electric Rail Car Movers	Phase in the replacement of diesel-powered switcher locomotives with electric rail car movers, within the Port- or City-owned rail properties.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)								
49		Require Flexible Shore Power Configurations	Require that berths providing shore power now or in the future, can accommodate changes to vessel sizes and various berthing configurations. The ARB At-Berth Regulation currently requires 80% compliance of ocean-going vessels by 2020. Vessel operations should meet 100% shore power compliance rate for all vessels or incorporate other technologies, such as emissions capture and control systems, to maximize emission reductions from all vessels in advance of the regulation. ARB's Sustainable Freight: Pathways to Zero and Near-Zero Emissions Discussion Document has identified the development and proposal of amendments to the At-Berth Regulation that could expand the regulation to include smaller fleets and/or additional vessel types to the current At Berth Regulation.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Infrastructure	Terminals (Note 2)	X					
50		Incorporate Hybrid Technologies into Tug Operations	Additionally, hybrid technologies have shown success at achieving emission reductions in certain tugs based on duty, engine size, and location and should be incorporated into operations, where possible.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment	Waterways (Note 2)	X					
51		Demonstration Project of Zero and Near-Zero Emission Truck Technology	The City and Port should administer a minimum of a one year demonstration project, prior to 2020, of zero and near-zero emission truck technology. This demonstration project shall be conducted in cooperation with regional and state agencies and stakeholders.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment	Seaport		X				
52	Partial Duplicate of Suggested Action 41	Identify and Test Hybrid Diesel Electric Locomotives	Research and funds shall be used to identify and test hybrid diesel electric locomotives	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment	Railyards	X					
53		Conduct a Demonstration of Locomotive DOC or DPF Retrofits.	Research and funds shall be used to conduct a demonstration of locomotive DOC or DPF retrofits.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment	Railyards	X					

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
54		Conduct Feasibility Studies of Electrification of Freight/Passenger Rail	Feasibility studies of electrification of freight/passenger rail from Port intermodal yards to the Bay Area Air Quality Management District's boundaries conducted in conjunction with the Metropolitan Transportation Commission, Capital Corridor JPA, Union Pacific, and Burlington Northern Santa Fe railroads.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment, Partnerships	Railyards, Bay Area Air Basin		X	X	X		
55	Partial Duplicate of Suggested Action 34	Renewable Energy Generation from Trucks	Investigation of renewable energy generation via mechanical systems that utilize truck weight to generate electricity.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Equipment	Seaport						
56		Study of a "Virtual Container Yard" System	Study of a "virtual container yard" system that integrates truck movements with container moves to minimize emissions and maximize efficient use of trucking fleets.	BAAQMD	BAAQMD Emissions Reductions Actions (Note 1)	Operations	NA	X					
57	Duplicate of Suggested Action 110	Create a Mayor's Sustainable Freight Advisory Committee	Create a Mayor's Sustainable Freight Advisory Committee to provide input and oversight on Port and City planning efforts. The Committee should include designated seats for community members.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Partnerships, Stakeholder Engagement	OAB				X	X	
58	Duplicate of Suggested Actions 111, 112	Shared Vision of the Future of West Oakland	Engage in a community-based effort that brings stakeholders together to create a shared vision of the future of West Oakland. Establish standing, facilitated meetings with all stakeholders including representatives from the City, Port, other local, state and federal agencies, businesses, unions, and impacted residents, and connect with broader planning efforts under way with the Alameda County Transportation Commission.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Partnerships, Stakeholder Engagement	West Oakland				X	X	
59	Duplicate of Suggested Action 101	Coordinate Mitigation Planning between Construction and Operation Air Quality Reviews	End practice of piecemealing mitigation planning between construction and operations air quality reviews.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	NA	NA	X			X		
60	Duplicate of Suggested Action 113	Provide Notice and Public Comment Period on Relevant Planning or Land-Use Decisions	Provide notice and at least 30 days of comment period on all relevant planning or land-use decisions.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Stakeholder Engagement, Partnership	NA					X	

TABLE C-3: NEW SUGGESTED ACTIONS													
								Associated Strategy or Strategies					
No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	1	2	3	4	5	6
61	Duplicate of Suggested Action 105	End Practice of Conditional Use Permitting	End practice of conditional use permitting to allow incompatible freight operations in the community.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	NA	Seaport						
62	Duplicate of Suggested Actions 70, 104, 106	Move Freight and Supporting Service Activities away from Disadvantaged Communities	Use zoning authority and incentives such as small business loans and subsidies to move freight and supporting service activities away from disadvantaged communities and to appropriate locales.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	NA	Seaport						
63	Duplicate of Suggested Action 108	Enforce Truck Parking, Route, and Idling Restrictions	Enforce truck parking, route, and idling restrictions. This includes training enforcement personnel, taking enforcement delegation as necessary to enforce specific requirements, and providing funding for enforcement personnel.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	NA	Seaport						
64	Duplicate of Suggested Action 98	Continue ARB Spot Inspection Program	Continue ARB spot inspection program by collecting and reporting information on trucks with excess smoke, improper emissions control labels, evidence of tampering, and noncompliance with regulations requiring soot filters on trucks and transport refrigeration units.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	NA	Seaport	X					
65	Duplicate of Suggested Actions 14, 99	Ban or Report Trucks not in Compliance with ARB Regulations	Deny Port access to, or report, any truck not in compliance with ARB regulations.	Earth Justice	Title VI Suggested Actions, Table (Note 3)								
66	Duplicate of Suggested Action 97	Regular Reporting on Progress with Emission Reduction Requirements	Provide regular reporting on progress and compliance with emission reduction requirements.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Stakeholder Engagement, Partnership	NA					X	
67	Duplicate of Suggested Action 100	Conduct New EIR for Current Proposed Development of Oakland Army Base	Conduct new environmental review (EIR) for current proposed development of Oakland Army Base. Include alternatives that support moving freight activities and services out of the surrounding communities onto Port and OAB properties.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	NA	NA						

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
68	Duplicate of Suggested Action 86	Prepare Clean Air Action Plan	Prepare Clean Air Action Plan with interim targets for replacing all port equipment and drayage trucks with zero-emissions vehicles and equipment.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	NA	NA	X	X		X	X	
69	Duplicate of Suggested Action 103	Prepare New Traffic and Transportation Plan	Prepare new traffic and transportation plan to route truck traffic away from disadvantaged communities.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	NA	NA						
70	Duplicate of Suggested Actions 62, 104, 106	Move Incompatible Freight Activities out of the Community	Use parking, route, and idling restrictions to move incompatible freight activities out of the community.	Earth Justice	Title VI Suggested Actions, Table (Note 3)		West Oakland						
71	Duplicate of Suggested Actions 107, 120	Improve Signage	Improve signage to avoid any confusion over such parking, route, and idling restrictions.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	NA	Seaport and West Oakland						
72	Duplicate of Suggested Action 95	Provide Supportive Services within Port Properties	Provide supportive services within Port properties.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Operations	Seaport	X			X		
73	Duplicate of Suggested Action 109	Install Network of Air Monitoring Sensors	Work with community to design and install network of air monitoring sensors, and commit to using data to design and assess impacts of mitigation measures.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Partnerships	Seaport, West Oakland				X	X	
74	Duplicate of Suggested Action 90	Develop Electrical Infrastructure Plans in Conjunction with Utilities	Work with utilities to develop electrical infrastructure plans to support port electrification by 2018.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Infrastructure, Partnership	NA			X	X		
75	Duplicate of Suggested Action 91	Maximize Use of Distributed Renewable and Storage Resources at the Port	Maximize use of distributed renewable and storage resources at the Port.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Fuels, Infrastructure	Seaport			X			

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies 1	2	3	4	5	6
76	Duplicate of Suggested Action 102	Commit to Renewable Energy Projects	Commit to renewable energy projects to mitigate impacts and facilitate transition of trucks and other equipment to zero-emissions technologies.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Fuels, Infrastructure	Seaport			X			
77	Duplicate of Suggested Actions 96, 154	Land for Green Infrastructure and Truck Charging Stations	Set aside land for green infrastructure and truck charging stations.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Infrastructure	Seaport			X			
78	Duplicate of Suggested Action 87	Zero-Emissions Truck Commercialization Pilot Program	Implement a 100 zero-emissions truck commercialization pilot program by 2023.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Equipment, Partnership	Seaport		X		X		
79	Duplicate of Suggested Action 88	At-Berth Emission Reduction	Require all ships to use shore power or at-berth emission reduction technology by 2023.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Equipment, Operations, Partnership	Terminals	X					
80	Duplicate of Suggested Action 92	Electrification of Resident Locomotives	Require electrification of locomotives that do not leave oort facilities.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Equipment	Railyards		X				
81	Duplicate of Suggested Action 93	Emission Capture Technologies for Non-Resident Locomotives	Require emission capture technologies for other locomotives while at port facilities.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Equipment	Railyards	X					
82	Duplicate of Suggested Action 94	Encourage Turnover of all Tier 3 and Older Locomotives	Adopt strategies for encouraging turnover of all Tier 3 and older locomotives by 2020.	Earth Justice	Title VI Suggested Actions, Table (Note 3)	Partnership, Equipment	Railyards	X	X				
83	Duplicate of Suggested Actions 89, 115	Indirect Source Emission Caps	Adopt indirect source emission caps by 2020 to encourage efficiency and emission reductions within the port.	Earth Justice	Title VI Suggested Actions, Table (Note 3)								

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies 1	2	3	4	5	6
84		Replace All CHE with Zero-Emissions Equipment	Commit to replace all cargo handling equipment with zero-emissions equipment by 2030.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)	Equipment	Seaport	X	X				
85		Require Zero-Emissions Drayage Trucks	Commit to allow only zero-emissions drayage trucks to service the port by 2035.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)	Equipment	Seaport	X	X				
86	Duplicate of Suggested Action 68	Prepare Clean Air Action Plan	Prepare a Clean Air Action Plan with interim targets for achieving these 2030 and 2035 commitments.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
87	Duplicate of Suggested Action 78	Zero-Emissions Truck Commercialization Pilot Program	Implement a 100 zero-emissions truck commercialization pilot program by 2023.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
88	Duplicate of Suggested Action 79	At-Berth Emission Reduction	Require all ships to use shore power or an at-berth emissions reduction technology by 2023.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
89	Duplicate of Suggested Actions 83, 115	Indirect Source Emission Caps	Adopt indirect source emission caps by 2020 to encourage efficiency and emission reductions within the port.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
90	Duplicate of Suggested Action 74	Develop Electrical Infrastructure Plans in Conjunction with Utilities	Work with the relevant utilities to develop electrical infrastructure plans to support port electrification. Initial plans should be presented for Board consideration in 2018.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies 1	2	3	4	5	6
91	Duplicate of Suggested Action 75	Maximize Use of Distributed Renewable and Storage Resources at the Port	Such plans should maximize the use distributed renewable and storage resources at the Port. Initial plans should be presented for Board consideration in 2018.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
92	Duplicate of Suggested Action 80	Electrification of Resident Locomotives	Require electrification of locomotives that do not leave port facilities	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
93	Duplicate of Suggested Action 81	Emission Capture Technologies for Non-Resident Locomotives	Require emission capture technologies for other locomotives while at port facilities.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
94	Duplicate of Suggested Action 82	Encourage Turnover of all Tier 3 and Older Locomotives	Adopt strategies for encouraging turnover of all Tier 3 and older locomotives by 2020.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
95	Duplicate of Suggested Action 72	Provide Supportive Services within Port Properties	Provide space for truck supportive services within Port properties.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
96	Duplicate of Suggested Action 77	Land for Green Infrastructure and Truck Charging Stations	Set aside land for green infrastructure and truck charging stations.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
97	Duplicate of Suggested Action 66	Regular Reporting on Progress with Emission Reduction Requirements.	Provide regular reporting on progress and compliance with emission reduction requirements.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
98	Duplicate of Suggested Action 64	Continue ARB Spot Inspection Program	Continue ARB spot inspection program by collecting and reporting information on trucks with excess smoke, improper emissions control labels, evidence of tampering, and noncompliance with regulations requiring soot filters on trucks and transport refrigeration units.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
99	Duplicate of Suggested Action 14, 65	Ban Trucks not in Compliance with ARB Regulations	Report or deny access to any truck not in compliance with ARB regulations.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
100	Duplicate of Suggested Action 67	Conduct New EIR for Current Proposed Development of Oakland Army Base	Conduct new Environmental Impact Review for current proposed development of Oakland Army Base. Include alternatives that support moving freight activities and services out of the surrounding communities onto Port and OAB properties.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
101	Duplicate of Suggested Action 59	Coordinate Mitigation Planning between Construction and Operation Air Quality Reviews	End practice of piecemealing mitigation planning between construction and operation air quality reviews.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
102	Duplicate of Suggested Action 76	Commit to Renewable Energy Projects	Commit to renewable energy projects to mitigate impacts and to facilitate transition of trucks and other equipment to zero-emissions technologies.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
103	Duplicate of Suggested Action 69	Prepare New Traffic and Transportation Plan	Prepare new traffic and transportation plan to route truck traffic away from disadvantaged communities.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								

TABLE C-3: NEW SUGGESTED ACTIONS														
No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies						
								1	2	3	4	5	6
104	Duplicate of Suggested Action 62	Move Freight and Supporting Service Activities away from Disadvantaged Communities	Use zoning authority and incentives such as small business loans and subsidies to move freight and supporting service activities away from disadvantaged communities and to appropriate locales.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
105	Duplicate of Suggested Action 61	End Practice of Conditional Use Permitting	End practice of conditional use permitting to allow incompatible freight operations in the community.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
106	Duplicate of Suggested Action 62, 70	Move Incompatible Freight Activities out of the Community	Use parking, route, and idling restrictions to move incompatible freight activities out of the community.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
107	Duplicate of Suggested Actions 71, 120	Improve Signage	Improve signage to avoid any confusion over such parking, route, and idling restrictions.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
108	Duplicate of Suggested Action 63	Enforce Truck Parking, Route, and Idling Restrictions	Enforce truck parking, route, and idling restrictions. This includes training enforcement personnel, taking enforcement delegation as necessary to enforce specific requirements, and providing funding for enforcement personnel.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
109	Duplicate of Suggested Action 73	Install Network of Air Monitoring Sensors	Work with community to design and install network of air monitoring sensors, and commit to using data to design and assess impacts of mitigation measures.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
110	Duplicate of Suggested Action 57	Create a Mayor's Sustainable Freight Advisory Committee	The Mayor should create a Sustainable Freight Advisory Committee to provide input and oversight on Port and City planning efforts. The Committee should include designated seats for community members.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								

TABLE C-3: NEW SUGGESTED ACTIONS														
No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies						
								1	2	3	4	5	6
111	Duplicate of Suggested Action 58	Shared Vision of the Future of West Oakland	The City should engage in a community-based effort that brings stakeholders together to create a shared vision of the future of West Oakland. The process should include standing, facilitated meetings with all stakeholders including representatives from the City, Port, other local, state and federal agencies, businesses, unions, and impacted residents.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
112	Duplicate of Suggested Action 58	(3) Planning should connect with broader planning efforts under way with the Alameda County Transportation Commission.	Planning should connect with broader planning efforts under way with the Alameda County Transportation Commission.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
113	Duplicate of Suggested Action 60	Provide Notice and Public Comment Period on Relevant Planning or Land-Use Decisions	The City should provide notice and at least 30 days of comment period on all relevant planning or land-use decisions.	Earth Justice	Title VI Suggested Actions, Attachment (Note 3)								
114		Phase-in of Zero-Emissions Drayage Trucks	Commit to allow only zero-emissions drayage trucks to service the Port by 2035. *BAAQMD Response*: ***This requirement should be phased in with 20% by 2025, 60% by 2030 and 100% by 2033***	BAAQMD	BAAQMD Response to EARTHJUSTICE List of Actions	Equipment	Seaport	X	X				
115	Duplicate of Suggested Actions 83, 89	Include Indirect Source Emission Caps and Local Emission Offset Fund in the Clean Air Action Plan	Adopt indirect source emission caps by 2020 to encourage efficiency and emission reductions within the port. *BAAQMD Response*: ***Indirect source emission caps should be included in the Clean Air Action Plan identified in recommendation# 3 above. Projects above the emission caps should pay into a local emission offset fund.***	BAAQMD	BAAQMD Response to EARTHJUSTICE List of Actions	NA	NA	X					

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies 1	2	3	4	5	6
116		Complete OAB Mitigation Measures that Require Development of Emissions Reductions Plans and Funding of Strategies to Reduce Truck Emissions be in a Public Process Prior to Additional Development Plans or Tenant Improvements Approvals	End practice of piecemealing mitigation planning between construction and operation air quality reviews. *BAAQMD Response*: ***Air District staff recommends that the OAB mitigation measures requiring development of emission reduction plans and the funding of strategies to reduce truck emissions should be completed in a public process before any additional development plans or tenant improvements are approved.***	BAAQMD	BAAQMD Response to EARTHJUSTICE List of Actions	Operations, Funding and Grants, Stakeholder Engagement	OAB	X				X	
117		Initiate New OAB Stakeholder Process and Integrate with AB 617 Process	The City should engage in a community-based effort that brings stakeholders together to create a shared vision of the future of West Oakland. The process should include standing, facilitated meetings with all stakeholders including representatives from the City, Port, other local, state and federal agencies, businesses, unions, and impacted residents. *BAAQMD Response*: ***Air District staff supports this recommendation. The current OAB stakeholder process does not accommodate meaningful input from the community stakeholders on proposed development within the OAB. A new stakeholder process should be initiated and integrated with the stakeholder process currently being developed for the AB 617 Community Health Protection Action Plan under way for the West Oakland Community.***	BAAQMD	BAAQMD Response to EARTHJUSTICE List of Actions	Stakeholder Engagement	West Oakland					X	
118		Zero-Emissions Trucks for Short-Haul Drayage	By 2021, the Port should require zero-emissions truck operation for transport of containers on-site and between terminals, as well as to nearby rail yards or other freight facilities.	CARB	Comments on Draft 2020 and Beyond Plan	Equipment	Seaport		X				
119		Develop a Trucking Concession Program	This could be achieved by developing a concession program, where companies have responsibility and oversight for short-haul operations between terminals, and between local rail yards such as the adjacent Union Pacific intermodal rail yard that handles a large amount of port cargo through its facility.	CARB	Comments on Draft 2020 and Beyond Plan	Operations, Equipment	Seaport		X		X		

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
120	Duplicate of Suggested Actions 71, 107	Work with City of Oakland to Install Signage	We encourage the Port continue to work with the City to install adequate signage in neighborhoods and along truck routes, and to enforce local ordinances when violated.	CARB	Comments on Draft 2020 and Beyond Plan								
121		Partner with Community Groups to Apply for Supplemental Environmental Projects (SEP) Grants	The Port should also partner with community groups to apply for Supplemental Environmental Projects (SEP) grants to receive funding for local initiatives. CARB can provide further information on this potential funding source. These funds originate from settlement dollars of violators of environmental regulations. The community of Bayview Hunters Point near the Port of San Francisco has achieved success in reducing illegal truck idling after receiving funding through an approved SEP to install signage and conduct other outreach in that community.	CARB	Comments on Draft 2020 and Beyond Plan	Partnership, Funding and Grants	NA				X		X
122		Pre-Model Year 2010 Truck Ban	By 2023, the Port should use the Drayage Truck Registry to begin banning trucks not equipped with MY 2010 or newer engines pursuant to CARB's Truck and Bus regulation.	CARB	Comments on Draft 2020 and Beyond Plan	Equipment	Seaport	X					
123		Implement Rate Structure to Promote Use of Zero-Emissions Trucks	By 2023, the Port should implement a rate (i.e. fee) structure, where cargo owners would pay more for each gate move if the trucks carrying their goods are not using the cleanest commercially available technologies.	CARB	Comments on Draft 2020 and Beyond Plan	Operations, Funding and Grants	Seaport	X					X
124		Join International Vessel Environmental Performance Incentive Programs	By 2020, the Port should join one of the international vessel environmental performance incentive programs, such as the Environmental Ship Index (ESI) Incentive Program used by the Port of Los Angeles. Providing lower docking fees or other financial incentives to attract cleaner vessels and reward vessel measures that go beyond requirements will increase emission reductions within the Bay Area and other surrounding West Coast ports.	CARB	Comments on Draft 2020 and Beyond Plan	Operations	Waterways, Terminals	X					
125		Design and Implement a VSR Program	By 2020, design and implement a VSR program that would reduce emissions from vessels in transit to the greatest extent possible. CARB recommends that a VSR zone that begins outside the Golden Gate Bridge.	CARB	Comments on Draft 2020 and Beyond Plan	Operations	Waterways	X					

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies 1	2	3	4	5	6
126		100% Shore Power Use for Vessels Equipped with Shore Power	By 2020, require, where feasible, use of shore power for 100% of visits by vessels equipped with shore power. CARB's existing regulation already requires an equipped vessel at an equipped berth to connect. This recommended measure should include responsibility for the marine terminal operators to provide access to shore power connections for each vessel equipped to plug in, accelerating the anticipated CARB requirements.	CARB	Comments on Draft 2020 and Beyond Plan	Equipment	Terminals	X					
127		Demonstrate and Deploy Alternative Systems to Control Vessels When Shore Power is not Available.	By 2020, set interim goals for demonstrating and deploying alternative systems to control vessels when shore power is not available.	CARB	Comments on Draft 2020 and Beyond Plan	Equipment	Terminals	X					
128		Accelerate Turnover to the Cleanest Available Rail Yard and Locomotive Technologies	At a local level, the Port needs to use its control of or its influence over rail operations to take more aggressive action to accelerate turnover to the cleanest available technologies.	CARB	Comments on Draft 2020 and Beyond Plan	Partnership, Equipment	Railyards	X			X		
129		Support CARB's Tier 5 Petition to U.S. EPA	The Port should support CARB's Tier 5 petition to U.S. EPA with a written letter (other support letters are posted on CARB's rail activities website).	CARB	Comments on Draft 2020 and Beyond Plan	Partnership, Equipment	NA	X			X		
130		Seek Partners to Demonstrate the Use of Tier 5 Equivalent Locomotives in the Three Rail Facilities	Seek partners to demonstrate the use of Tier 5 equivalent locomotives in the three rail facilities.	CARB	Comments on Draft 2020 and Beyond Plan	Partnership, Equipment	Railyards	X			X		
131		Replace Switchers with Zero-Emissions Railcar Movers or Zero-Emissions Locomotives at OIG and OGRE Rail Yards	For the OIG and OGRE rail yards, which are on port property, the Port should set specific targets to cut emissions by replacing switchers with zero-emissions railcar movers, or zero-emissions locomotives. These types of projects are eligible for several local, State, and federal incentive programs.	CARB	Comments on Draft 2020 and Beyond Plan	Equipment	Railyards		X				

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
132		Establish Target of 100% Zero-Emissions Yard Trucks by 2023	In the Revised Plan, the Port should establish a target to achieve 100% zero-emissions yard trucks by 2023. Today, there are commercially available technologies manufactured by several companies such as OrangeEV and BYD that should be able to meet the demands of a seaport within the next five years.	CARB	Comments on Draft 2020 and Beyond Plan	Equipment	Terminals	X	X				
133		Achieve 100% zero-emissions RTG cranes by 2026	In the Revised Plan, the Port should establish a goal of 100% zero-emissions RTG cranes by 2026. In this particular sector, repower or conversion kits are available for a fraction of the cost of replacing the entire RTG crane. Further, zero-emissions technologies do not need batteries to power all of their operations; instead, they can operate using direct power technologies using cable reels or conductor rails when lifting and lowering containers. A number of ports around the world have been retrofit to electrify RTG crane operations and reduce emissions, save money on maintenance and fuel, and improve efficiencies.	CARB	Comments on Draft 2020 and Beyond Plan	Equipment, Infrastructure	Terminals	X	X	X			
134		Establish Target of 100% Zero-Emissions Cargo-Handling Equipment by 2030	In the Revised Plan, the Port should consider a goal of 100% zero-emissions cargo-handling equipment by 2030. Establishing targets earlier than statewide regulations will ensure the Port and its tenants remain eligible for a wider range of incentive funding opportunities when repowering or replacing older equipment.	CARB	Comments on Draft 2020 and Beyond Plan	Equipment	Terminals	X	X				
135		Upgrade Specific Infrastructure Components in the Near-Term (2018-2023)	The Port should commit to upgrading specific components of infrastructure within the Near-Term (2018-2023) phase, which will help the Port and its tenants to remain eligible for incentive dollars that require projects to be completed in advance of statewide requirements.	CARB	Comments on Draft 2020 and Beyond Plan	Infrastructure	Seaport			X			
136		Annual Meetings for Stakeholders	We recommend holding at least annual meetings for stakeholders to provide input and receive updates on progress, annual emissions inventory updates, and health risk assessment updates annually until health risks are resolved.	EDF	Comments on Draft 2020 and Beyond Plan	Stakeholder Engagement	NA					X	
137		Annual Review of the Plan	We recommend that there be annual review of the plan in the first few years so that additional actions can be added to the Near-Term plan as new technologies and funding become available.	EDF	Comments on Draft 2020 and Beyond Plan	Stakeholder Engagement, Partnership	NA				X	X	

TABLE C-3: NEW SUGGESTED ACTIONS													
								Associated Strategy or Strategies					
No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	1	2	3	4	5	6
138		Refine Emissions Inventory Methodology	Refining Emissions Inventory Methodology: (a) Automated data collection that can capture detailed activity data is available across most vehicle and equipment types and should be leveraged to improve the accuracy of emission estimates. (b) Expand the geographic scope of each emission source mode to the first intermodal transfer point and in a way that reflect the mode footprint. (c) Apply sensitivity analysis to account for uncertainty and improve accuracy.	EDF	Comments on Draft 2020 and Beyond Plan	NA	NA	X					
139		Develop a Real and Tangible Plan to Fund AQ Mitigations	Develop a Real and Tangible Plan to Fund AQ Mitigations - Under the current draft, the original problem of insufficient commitment to funding mitigations persists. As per comments of interagency stakeholders in the original process, EPA, local air district, and local health agencies wrote, "it is very important for the Port Commission to take some additional concrete steps to make the MAQIP a plan that clearly demonstrates the Port's strong commitment to improving air quality and the health of Oakland residents who live near the Port." The missing component is a realistic strategy to fund emissions mitigations adequately. Unfortunately, the prior MAQIP suffered from the same limitation, and thus leads EDF to ask if the Port is truly committed to seeing thru improved air quality and associated health. This broad concern leads to several additional questions pertaining to the current proposal:	EDF	Comments on Draft 2020 and Beyond Plan	Funding and Grants	NA						X
140		Technology Advancement Program Investment Plan	To demonstrate commitment to actions, we also recommend that the Port include an investment plan similar to the Technology Advancement Program adopted by the Port of LA to accelerate cleaner technologies at the Port.	EDF	Comments on Draft 2020 and Beyond Plan	Equipment	NA		X		X		
141		Apply for All Available Grant Opportunities	Demonstrate Commitment to Winning Grants – As part of the funding and investment plan, we suggest that the Port commit to not leave any grant funding opportunities unapplied for. This would include having dedicated and adequate staff capacity to develop and submit grant applications, as well as building sufficient matching funds for grants into the budget.	EDF	Comments on Draft 2020 and Beyond Plan	Funding and Grants	NA						X
142		Port Loan Program for Zero-Emissions Equipment	Explore Innovative Funding Mechanisms - We urge the Port to consider designing a loan program for electric drayage trucks, CHE and other off-road equipment to make it easier for operators to transition to zero-emissions technologies.	EDF	Comments on Draft 2020 and Beyond Plan	Partnership, Funding and Grants	NA				X		X

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies 1	2	3	4	5	6
143		Evaluate Establishment of an Air Quality Finance Authority	We also recommend that the Port explore the establishment of an Air Quality Finance Authority, recommended by the U.S. EPA's National Environmental Justice Advisory Council. This authority could serve as a mechanism to assist small fleet owners and other goods movement related businesses to receive low cost financing.	EDF	Comments on Draft 2020 and Beyond Plan	Funding and Grants	NA						X
144		Clarify the Scope of Drayage Truck Charging Infrastructure Study	Clarifying the Scope of Drayage Truck Charging Infrastructure- The proposed needs assessment and feasibility study (Table 2) should reflect how drayage trucks are operated beyond the gates of the Port, including an assessment of the daily cycle of the trucks. It should map out optimal charging strategies while minimize the overall emission footprint, for instance, taking into consideration the potential impact on peak load. Importantly, planning and committing real estate for infrastructure requirements for these technologies will also be critical and should be built into the assessment. Additionally, recognizing that most drayage drivers are independent with limited resources, the assessment should also take into account the cost impact on drivers. We request that the Port share the scope of the proposed study as it becomes ready.	EDF	Comments on Draft 2020 and Beyond Plan	Infrastructure	NA			X			
145		Electrification and Resilience Plan for Mobile Equipment	Electrification and Resilience Plan for Mobile Elements of Operations – Beyond the charging infrastructure for drayage trucks, we recommend that the Port develop a clear roadmap for infrastructure that will be needed to electrify other mobile components of its operations - including a resiliency assessment. EV systems have the potential to be more resilient that fossil-fueled systems for several reasons, notably shorter supply lines and potential for in situ generation. On the point of generation, as the Port is itself a municipal utility, it has the opportunity to lead the development of renewable generation in situ and nearby solar (and wind) generation. The Port should look to the electrified fleet as both a new load and a new capability to store energy. This latter capability creates the full set of capabilities needed to implement island microgrids, which is a good resiliency strategy. One of Port's tenants demonstrates an example of this strategy, FedEx, which is showing the way to resiliency, reliability and zero-emissions with its fuel cells and solar PV array.	EDF	Comments on Draft 2020 and Beyond Plan	Equipment, Infrastructure	NA		X	X			

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
146		Track Harbor Craft Repowering Options	Strategy for harbor crafts – The Port's 2015 emissions inventory shows that harbor crafts are the second largest contributor of DPM, and the third largest contributor of total NOx emissions associated with port's operations. We urge the Port to continually assess the readiness of different repowering options as part of their annual review of actions and proactively seek cost-effective and technology-ready solutions that go beyond the expected regulatory updates in 2020.	EDF	Comments on Draft 2020 and Beyond Plan	Equipment	NA	X					
147		Transition to Cleaner Harbor Craft	In the meantime, the Port should also seek commitments from its tenants to transition to cleaner harbor crafts.	EDF	Comments on Draft 2020 and Beyond Plan	Equipment	Waterways	X			X		
148		Seek New Funding Sources to Upgrade Tug and Switcher Engines	For near-term solutions, the Port may also consider tapping into new funding sources such as the Volkswagen fund to upgrade tug and switcher engines to the latest clean diesel technology. A recent study[3] by Diesel Technology Forum and Environmental Defense Fund confirms that these upgrades offer one of the most cost-effective options for reducing diesel emissions, particularly NOx emissions.	EDF	Comments on Draft 2020 and Beyond Plan	Funding and Grants, Equipment	NA						X
149		Mandatory Use of Shore Power or Emission Control Systems	At-berth emissions: we recommend that over time use of shore power or emission control systems become mandatory, and that the Port should set a timeline for capturing 100% of vessel at-berth emissions similar to the Ports of LA/Long Beach.	EDF	Comments on Draft 2020 and Beyond Plan	Equipment, Operations	Terminals	X					
150		Evaluate Overall Effectiveness of Vessel Speed Reduction	Vessel speed reduction: the draft plan identifies this as a near-term action. Vessel speed reduction is a routine emission reduction strategy and we agree should be explored; however, this practice can also lead to ships speeding up once outside the channel, thereby cancelling out the benefits. We encourage the Port to consider taking into account the impact of any potential unintended consequences in assessing the effectiveness of this strategy. Automatic information systems can also be used to evaluate how frequently this occurs.	EDF	Comments on Draft 2020 and Beyond Plan	Operations	NA	X					

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
151	Duplicate of Suggested Action 158	Collaborate on High-Emitting Truck Detection System (Work Group)	High-Emitting Truck Detection System (E-T-6). CARB funded the University of California, Berkeley evaluation of in-use trucks serving the Port, and has since developed its own advanced detection system, the Portable Emissions Acquisition System (PEAQS). This provides CARB the ability to detect automatically, and in real-time, trucks with high emissions. In 2018, CARB amended its statewide inspection programs to lower opacity limits for trucks equipped with diesel particulate filters. Lowered opacity limits support our ability to identify and require repair of the subset of high polluting drayage trucks affecting West Oakland. We are asking the Port to collaborate with CARB to determine how PEAQS or other advanced detection systems can be used to identify trucks with high emissions for citation and repair. The Center for Environmental Public Policy at the University of California, Berkeley submitted recommendations on this issue and may be interested as well.	CARB	Comments on Revised Draft 2020 and Beyond Plan	Equipment, Operations, Partnership, Stakeholder Engagement	NA	X			X	X	
152		Implement Voluntary Vessel Speed Reduction Program Now	A Port commitment for a voluntary VSR does not need to wait until the completion of the Bay Area Air Quality Management District pilot study.	CARB	Comments on Revised Draft 2020 and Beyond Plan	Operations	Waterways	X					
153		Accelerate Electrical Infrastructure Deployment and Upgrades	Infrastructure Planning and Investment. We previously suggested that [the] Port begin infrastructure investments in the Near-Term Phase (2019-2023) instead of waiting until the Intermediate-Term Phase (2023-2030). We are supportive of the additional equipment and infrastructure actions in the Revised Plan, but urge the Port to begin deploying more widespread electrical infrastructure and modifying electrical substations now. The Maritime Power Capacity Study for Terminal Electrification is expected in Spring 2019, and early upgrades will begin laying the groundwork for zero-emissions maritime operations. Earlier investments in infrastructure will accelerate the adoption of zero-emissions equipment instead of next-best alternatives, and will also allow infrastructure projects to remain competitive for local, State, and/or federal incentive opportunities.	CARB	Comments on Revised Draft 2020 and Beyond Plan	Infrastructure	Seaport			X			

TABLE C-3: NEW SUGGESTED ACTIONS														
								Associated Strategy or Strategies						
No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	1	2	3	4	5	6
154	Duplicate of Suggested Actions 77, 107	Identify Truck Charging Space at the OAB	To address the lack of space for truck charging infrastructure that is cited in the response to comments on the Draft Plan, we strongly encourage the Port to work with the City of Oakland to identify space within the entire former Oakland Army Base property for this need. This action is to help mitigate the impacts of the expanded on- and off-port freight activities occurring in response to development of that property by both the Port and the City.	CARB	Comments on Revised Draft 2020 and Beyond Plan								
155		Track Cost/Availability of Electric Drives	Track Cost/Availability of Electric Drives. Costs of electric drive, battery and charging technology are declining very rapidly. Availability of electric powered trucking and cargo handling equipment is expected to expand quickly in 2019-2021. Sound decisions by the Port, its tenants and supporting service industries, about infrastructure and fleets investment require up-to-date information on equipment price and availability with which to compare to conventional, fossil-fuel powered trucking options. Our general sense is that the Port's assessment of cost and availability of electric-drive and charging technology is somewhat conservative and understates the opportunities that will be presented in the market in the near-term. For example, the Revised draft states, '…if HVIP funding continues to be available under the current terms, battery-electric yard tractors could reach cost parity with diesel-fueled equipment by 2027; if no incentive funding is available, cost parity may not be achieved until 2038 or later." Other sources suggest parity could occur sooner than 2027, and that in the interim, state financial incentives will create an artificial parity and opportunities to integrate substantial numbers of yard trucks and other diesel equipment into Port, tenant and service industry operations. We acknowledge that reasonable minds may differ on how quickly electric drives will be available in such quality, quantity and price to cost effectively replace other diesel equipment. But trends in battery technology costs suggest that electric drive technology may become competitive with new diesel equipment relatively soon for certain types of equipment, especially if oil prices rise again. The Port, its tenants, and its service industries need access to current and reasonably accurate data on cost and availability. The Port could contract for regular delivery and dissemination of such data, or could generate information from periodic, aggregated, requests for proposals (RFPs) developed collaboratively with other entities operating at the Port.	GSPP	Comments on Revised Draft 2020 and Beyond Plan	Equipment, Partnership	NA		X		X		

TABLE C-3: NEW SUGGESTED ACTIONS														
No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
156		Group Buying System	Group Buying System. We also encourage the Port to collaborate with other West Coast ports on RFPs, and develop a group buying system to help lower upfront costs of zero-emissions equipment.	GSPP	Comments on Revised Draft 2020 and Beyond Plan	Equipment, Funding and Grants, Partnership	NA		X		X		X
157		Dedicated Zero-Emissions Vehicle Lane into Marine Terminals	A dedicated EV lane into the terminals will speed adoption of EV's more so than the HOV lane on the Bay Bridge.	DockTime	Comments on Revised Draft 2020 and Beyond Plan	Infrastructure, Operations	Seaport		X	X			
158	Duplicate of Suggested Action 151	High-Emitting Truck Detection System Working Group	Find and Fix High-Polluting Trucks**.** We included a broad initial comment on the creation of a Find and Fix plan in our September comments (pg. 9), but have added greater detail on the program implementation in Appendix A. We recognize that the Port does not directly regulate trucks, but we believe that the Port would be within its rights to refuse access to vehicles that are likely in violation of air quality standards. The Center would welcome the opportunity to help convene and manage a work group this subject and to coordinate with BAAQMD and CARB on related monitoring studies. Recent studies by UC Berkeley researchers show that a significant percentage of trucks entering the Port have faulty air pollution control systems. A system to "find and fix" these vehicles, coupled with information on state financial assistance for vehicle upgrades and repairs could produce short-term air quality benefits to people of West Oakland.	GSPP	Comments on Revised Draft 2020 and Beyond Plan								

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies 1	2	3	4	5	6
159		Collect Trucking Duty-Cycle Data and Identify Trucks Suitable for Electrification	Collect Trucking Duty-Cycle Data and Identify Trucks Suitable for Electrification. The Port's commitment to zero emission operations would be aided by collection of data on Trucking Duty-Cycles. Currently there does not appear to be an inventory of the full range of diesel equipment operating within, and around the Port. Such data is needed to help target financial incentives, forecast need for supporting infrastructure and identify those segments of the transport sector that are most ripe for electric drive technology. This data is potentially available from Port Tenants, trucking companies serving Port functions or from private services. The Port, perhaps in cooperation with state agencies or University of California Centers, could collect the data in a form that protects confidentiality, but helps identify trucks that: (1) are approaching retirement; (2) have predictable duty cycles that could be served by electric drives. Our guess is that this data could identify dozens or even hundreds of trucks per year that would be amenable, practically and economically, to electrification. This information will likely be critical as new electric truck models become more available and allow the Port to prepare charging infrastructure and procedures.	GSPP	Comments on Revised Draft 2020 and Beyond Plan	Equipment	NA		X		X		
160		Electric Supply/Charging Infrastructure Work Group	Electric Supply/Charging Infrastructure Work Group. The Revised Plan includes several improvements concerning electrification infrastructure, but we believe the process needs to accelerate into order to take full advantage of state funding. A formal work group dedicated to learning, planning and outreach on this subject would help ensure a transparent, inclusive and effective response to rapid changes in technology, funding, and markets. This could include planning for locations where trucks could charge, how charging fees would be assessed, and forecasted energy demand.	GSPP	Comments on Revised Draft 2020 and Beyond Plan	Infrastructure, Stakeholder Engagement, Partnership	NA			X	X	X	

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
161		Distributed Clean Energy Potential Study	Distributed Clean Energy Potential Study. Even from a BART train is it apparent that there is a large amount of roof space at the Port that could potentially host solar generation. Similarly, there are likely to be many locations where demand response, targeted energy efficiency retrofits, and batteries would help lower costs of electric supply infrastructure needed for vehicle electrification and help avoid energy demand peaks due to growing vehicle energy charging demand. Wind turbines take up very little surface area and can operate above other port operations (just as they do above agricultural activity in other locations). In anticipation of demand from charging infrastructure, a study of distributed clean energy potential at the Port is necessary to ensure that the Port is able meet increased demand in a sustainable, and economic fashion.	GSPP	Comments on Revised Draft 2020 and Beyond Plan	Infrastructure	NA	X	X	X			
162		Differential Ship Berthing and Truck Access Rates Study	Differential Ship Berthing and Truck Access Rates Study. This comment is repeated from CEPP's September 25, 2018 comment letter (See page 4). The Response to Comments addressed our original comment, we still believe that offering differential rates is a feasible and appropriate measure to phase in over time. Other California Ports, such as Los Angeles and Long Beach have developed a plan to charge differential access rates. At a minimum we request that the Port to commit to evaluating the feasibility of an entrance fee structure to be instituted by 2026 (three years after the entry fees for non-near zero trucks will become effective in Los Angeles). The Port needs a source of revenue to support infrastructure and other expenses of the transition to zero emission operations. It also needs to establish incentives to encourage ship and truck owners to shift equipment to zero carbon technology. The Port should commit to study and establish a set of access charges or preferential access rules that will gradually create revenues and incentives for investment in low carbon vessels and vehicles.	GSPP	Comments on Revised Draft 2020 and Beyond Plan	Operations	NA	X					
163		Yard Hostler Transition Plan	Yard Hostler Transition Plan. Establish a plan to gradually move yard hostler equipment from diesel to electric drive technology, with a goal to replace half of the yard hostler fleet with electric drives by 2025 and complete replacement by 2030.	GSPP	Comments on Revised Draft 2020 and Beyond Plan	Equipment	NA	X	X		X		
164		Yard Hostler Electric Supply Infrastructure	Yard Hostler Electric Supply Infrastructure. Modify port electric supply infrastructure to accommodate a complete yard hostler transition to electric drives by 2030.	GSPP	Comments on Revised Draft 2020 and Beyond Plan	Infrastructure	Terminals			X			

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6
165		Power Supply Transition for Drayage Trucks	Power Supply Transition for Drayage Trucks. Achieve a gradual/sustained increase in power supply and charging equipment for drayage trucks that bring containers to and from the Port.	GSPP	Comments on Revised Draft 2020 and Beyond Plan	Infrastructure	Seaport			X			
166		Long-Range Planning for Zero-Emissions Fuels for OGV, HC, and Long-Haul Trucks	ZE Fuels for OGV, HC, and Long-Haul Trucks. We recognize that some forms of propulsion are not amenable to electrification, including long- haul trucks, transoceanic ships and some harbor-craft. The Port will, sooner or later need to assess how to meet fossil-free fuel requirements for these important elements of shipping. The International Maritime Organization (IMO) has already acted to reduce sulfur content of bunker fuel, a move that is causing changes in fuel markets and ship design. It has also set a greenhouse gas emission reduction target that strongly suggests a move, over the long term, away from fossil fuels for ships. The Oakland Port will eventually face market demand for non-fossil fueling infrastructure for ships and long haul trucks. Now is a good time to begin long range planning to assess how to meet renewable hydrogen, or hydrogen/ammonia demand for ship and long haul trucking. Hydrogen ferries are, or will soon be operating in the San Francisco Bay.	GSPP	Comments on Revised Draft 2020 and Beyond Plan	Infrastructure, Fuels	NA			X			
167		Establish Local Supplies of Renewable Hydrogen Feedstocks	The long term competitiveness of the Port of Oakland may depend on early planning to assess how to fuel ships with near zero-carbon fuels, and take advantage of local supplies of renewable hydrogen feedstocks (e.g. EBMUD Wastewater facility, food-agriculture-forestry bio-waste diversion).	GSPP	Comments on Revised Draft 2020 and Beyond Plan	Fuels	Seaport			X			
168		Enable Yard Hostlers to Operate on Public Streets	The Port should work together with the City, industry, regulatory agencies, and the community to change local ordinances and determine how electric hostlers can travel to off-site yards near the Port.	EJ/WOEIP	Comments on Revised Draft 2020 and Beyond Plan	Operations, Partnership, Stakeholder Engagement	Seaport	X			X	X	
169		Host Private Financing Workshop	The Port of Long Beach is hosting a workshop on private financing options. The Port of Oakland should do the same.	EJ/WOEIP	Comments on Revised Draft 2020 and Beyond Plan	Funding and Grants	NA						X
170		Provide Incentives to Rail Operators to Use Cleaner Equipment	We recognize that the Port has no direct control over these railyards, but the Port can work with railyard operators to create incentives to use available cleaner equipment.	EJ/WOEIP	Comments on Revised Draft 2020 and Beyond Plan	Equipment, Partnership	Railyards	X			X		X

TABLE C-3: NEW SUGGESTED ACTIONS														
No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies						
								1	2	3	4	5	6
171		Conduct Truck Rate Study	The Port should commit to study and establish a set of access charges or preferential access rules that will gradually create revenues and incentives for investment in low carbon vessels and vehicles.	GSPP	Comments on Revised Draft 2020 and Beyond Plan	Operations, Funding and Grants	NA	X					X
172		Technology Demonstrations and Vendor Fairs	Pilot demonstrations will assist in this effort, but more could be included in the Plan. For example, the Port could organize technology fairs and opportunities for vendors to demonstrate their technologies and answer questions, financing workshops as noted above, and briefings from other operators that have adopted zero-emissions technologies.	EJ/WOEIP	Comments on Revised Draft 2020 and Beyond Plan	Equipment, Partnership, Engage Stakeholders, Funding and Grants	NA	X	X		X	X	
173		Develop Feasibility Analysis for Requiring Zero-Emissions Drayage Trucks	The Plan declines to provide a detailed analysis of the feasibility of requiring drayage trucks servicing the Port to be zero-emissions. The Plan should be updated to include such an analysis.	EJ/WOEIP	Comments on Revised Draft 2020 and Beyond Plan	Equipment	NA		X				
174		Pursue Low-Carbon Fuel Standard Credits	The Low Carbon Fuel Standard was recently amended to allow for credits from fuel use by heavy-duty mobile equipment. The Port will pursue credits for the electrical power it supplies to support this equipment.	Port	NTAP	Funding and Grants	NA						X
175		Replace Electrical Infrastructure that is Beyond its Serviceable Life	Certain components of the Seaport electrical grid are nearing the end of their serviceable life and need to be replaced and potentially upgraded. The Port will identify high-priority components and integrate the replacement of these components into its budget planning cycle. During the Near-Term, high priority replacement actions are identified in the Maritime Power Capacity Study for Terminal Electrification	Port	NTAP	Infrastructure	Seaport			X			
176		Port Electrical Grid Reliability and Capacity Upgrades	In addition to replacing electrical grid components that have reached the end of their serviceable life, the Port will also undertake specific actions to increase the resilience and capacity of the Seaport electrical grid. High priority upgrade and resilience projects are identified in the Maritime Power Capacity Study for Terminal Electrification (Burns & Mc Donnell 2019). The Port will integrate the high priority actions into its budget planning cycle.	Port	NTAP	Infrastructure	Seaport			X			

TABLE C-3: NEW SUGGESTED ACTIONS													
								Associated Strategy or Strategies					
No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	1	2	3	4	5	6
177		Analysis of Financing Options	A thorough analysis of these financing options should be conducted.	EJ/WOEIP	Comments on Revised Draft 2020 and Beyond Plan	Funding and Grants	NA						X
178		Identify Range Requirement for Trucks Serving the Port	The revised analysis should identify the range requirements for trucks serving the Port, including the number of "short-haul" and "long-haul" trucks, and their operational requirements.	EJ/WOEIP	Comments on Revised Draft 2020 and Beyond Plan	Equipment	NA		X				
179		Identify and Repair High-Emitting Trucks	Recent studies by UC Berkeley researchers show that a significant percentage of trucks entering the Port have faulty air pollution control systems. A system to "find and fix" these vehicles, coupled with information on state financial assistance for vehicle upgrades and repairs could produce short-term air quality benefits to people of West Oakland.	GSPP	Comments on Revised Draft 2020 and Beyond Plan	Equipment	Seaport	X					
180		Provide Truck Parking	To address the lack of space for truck charging infrastructure that is cited in the response to comments on the Draft Plan, we strongly encourage the Port to work with the City of Oakland to identify space within the entire former Oakland Army Base property for this need. This action is to help mitigate the impacts of the expanded on- and off-port freight activities occurring in response to development of that property by both the Port and the City.	CARB	Comments on Revised Draft 2020 and Beyond Plan	Partnership, Stakeholder Engagement	Seaport	X		X		X	
181		Financing Plan for Transition to Zero-Emissions Seaport	More fundamentally, the Plan should identify the investment needs over time for achieving its vision for becoming a zero-emissions Seaport and propose a plan for financing those needs. Instead, the Plan raises the uncertainty of financing to justify avoiding strong commitments – that approach will virtually ensure failure.	EJ/WOEIP	Comments on Revised Draft 2020 and Beyond Plan	Funding and Grants	NA						X
182		Incentives for College or Job Training	Workforce Development - incentives for West Oakland residents to enter job training at community colleges are important. They might take the form of the Port holding a certain number of jobs for local workers, providing scholarships, or helping to find waivers for college fees.	EJ/WOEIP	Comments on Revised Draft 2020 and Beyond Plan	Partnerships, Engage Stakeholders	NA				X	X	

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies 1	2	3	4	5	6
183		Provide Public Drayage Truck Charging Infrastructure	The Port, working with the City of Oakland, could promote off-terminal charging and servicing locations within the Port's land, as part of the ongoing Truck Management Plan effort or within the Oakland Army Base development process. The Plan notes that the Port will be responsible for providing power to trucks domiciled at the Port-provided parking areas (Plan at p. F-24), but does not explain why similar charging infrastructure could not be used by other drayage trucks serving the Port.	EJ/WOEIP	Comments on Revised Draft 2020 and Beyond Plan	Infrastructure	Seaport	X		X			
184		Include Near-Zero Emissions Truck Technologies Certified to CARB's Optional Low-NOx Standard	Include near-zero truck technologies that are certified to the California Air Resources Board's (CARB) most stringent optional low-NOx standard of 0.02 g/bhp-hr as an immediate strategy to reduce harmful port-related emissions from heavy duty trucks. The comparative benefits that near-zero technologies provide compared to zero-tailpipe emission strategies include: • An optional low NOx CARB certification that delivers 90% less NOx emissions than the current EPA and CARB heavy duty engine standard and an in-use performance according to UC Riverside that found NOx emission reductions at 95% or 0.01 g/bhp-hr; • A strategy that is 99% cleaner than the diesel trucks currently operating in and around the Port based on the fleet's average model year; • 70% to well over 100% lower greenhouse gas emissions compared to conventional diesel when powering a near-zero truck with renewable natural gas (RNG) - a fuel that can deliver up to a negative 250 carbon intensity score; • 90% quieter than diesel engines; • Commercially available now to deliver reliable emissions relief today; • Fueling infrastructure already in place with plans to further increase statewide fueling network as the market grows; and, • Far lower cost and more cost effective than any other competing technology with comparable performance.	CE	Comments on Revised Draft 2020 and Beyond Plan	Equipment	Seaport	X					

TABLE C-3: NEW SUGGESTED ACTIONS

No.	Duplicate?	Suggested Action Name	Suggested Implementing Action Description	Source	Document	Implementing Action Category	Location	Associated Strategy or Strategies					
								1	2	3	4	5	6

Source: Port of Oakland 2019

Acronyms and Abbreviations:

BAAQMD = Bay Area Air Quality Management District

CARB = California Air Resources Board

CE = Clean Energy

EDF = Environmental Defense Fund

EJ/WOEIP = Earth Justice/West Oakland Environmental Indicators Project

GSPP: U.C. Berkeley Goldman School of Public Policy Center for Environmental Public Policy

HC = Harbor Craft

NOx = Oxides of Nitrogen

OAB = Oakland Army Base

OGV = Ocean-Going Vessel

Port = Port of Oakland

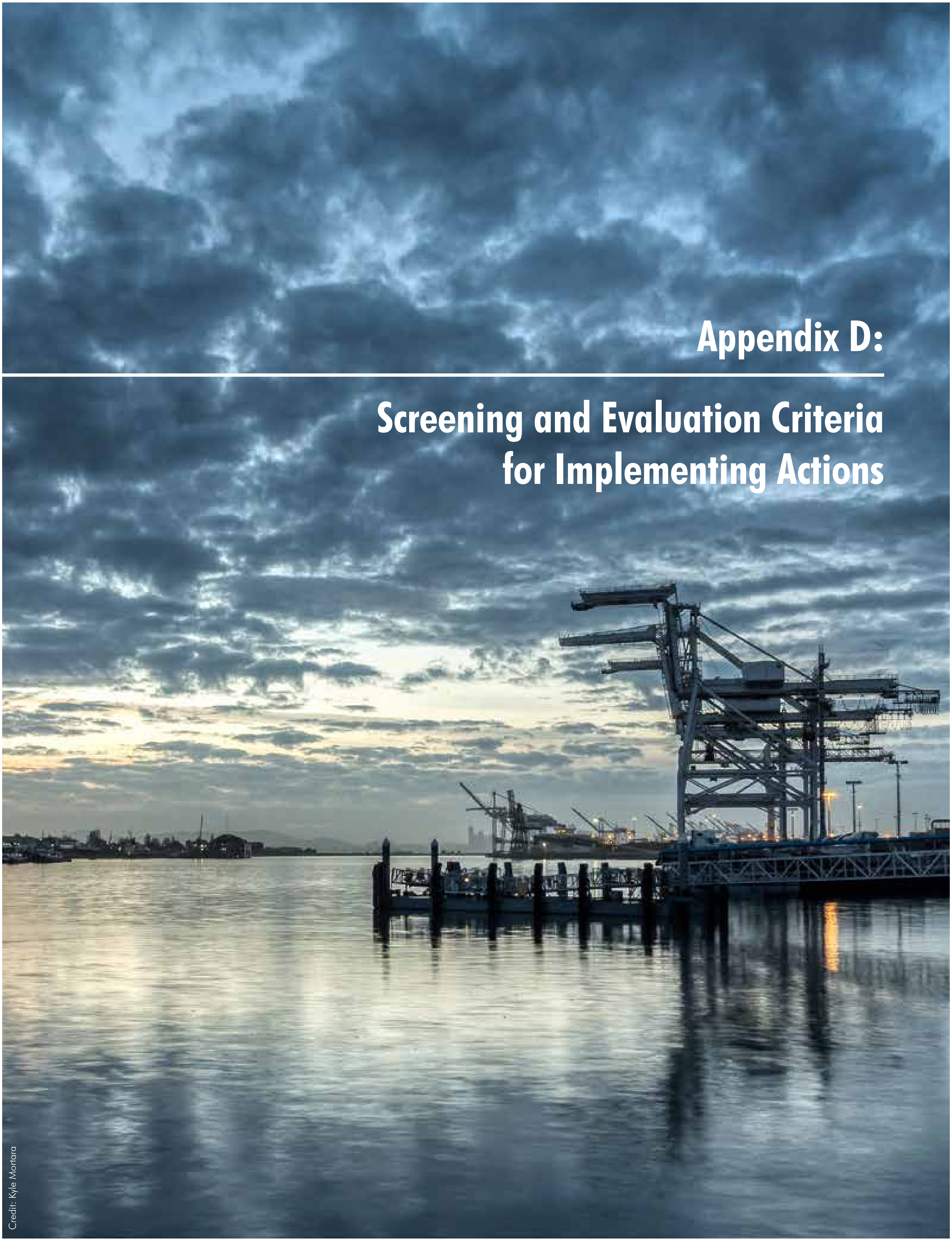
ZE = Zero Emissions

Notes

1. *BAAQMD Emissions Reductions Actions for the Port of Oakland/Former Oakland Army Base* (August 2017); attached to Nov 3, 2017 letter to the Board of Port Commissioners entitled *Re: Ordinance and Resolution to approve Lease with CenterPoint-Oakland Development I, LLC for a Transload and Distribution Facility on the Former Oakland Army Base*. The Nov 3, 2017 letter and the attachment were in turn attached to the August 31, 2018 BAAQMD comments on the Draft Seaport Air Quality 2020 and Beyond Plan. The summary of suggested actions excludes those specifically designated for the City-owned portion of the OAB.
2. The attachment refers to this as "Port-Wide" although what is likely meant is the Port's maritime area including the OAB (Port-owned and City-owned)
3. Earth Justice attached a December 8, 2017 letter, entitled *Re: Investigation of West Oakland Title VI Administrative Complaint (DOT # 2017-0093, EPA File Nos. 13R-17-R9 (City of Oakland) and 14R-17-R9 (Board of Port Commissioners and Port of Oakland)* to the comments it submitted on behalf of WOEIP on the Draft Seaport Air Quality 2020 and Beyond Plan. The letter contains a table of suggested actions and an attachment of suggested actions (the table and attachment contain the same list of actions). The letter also included a letter dated April 10, 2018, entitled: EARTHJUSTICE Letter of December 8, 2017 Regarding the West Oakland Title VI Administrative Complaint and Subsequent Meeting on February 7, 2018. That letter contains an attachment providing BAAQMD's response to the series of actions proposed in the Dec 8, 2017 EARTHJUSTICE letter. The EARTHJUSTICE actions are shown as being from EARTHJUSTICE; where the BAAQMD response suggests a different action, it is listed as BAAQMD.

Appendix D:

Screening and Evaluation Criteria for Implementing Actions



Credit: Kyle Mortara

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Acronyms and Abbreviations

2020 and Beyond Plan	Seaport Air Quality 2020 and Beyond Plan
BAAQMD	Bay Area Air Quality Management District
Board	Board of Port Commissioners
CARB	California Air Resources Board
CEC	California Energy Commission
Final Plan	*Final Seaport Air Quality 2020 and Beyond Plan*
NGO	non-governmental organization
Plan	Seaport Air Quality 2020 and Beyond Plan
PM	Particulate Matter
Port	Port of Oakland
TRL	Technological Readiness Level

SCREENING AND EVALUATION CRITERIA FOR IMPLEMENTING ACTIONS

As discussed in the Main Text of this *Final Seaport Air Quality 2020 and Beyond Plan* (Final Plan), the Port of Oakland (Port) will implement a five-step screening and evaluation process for Implementing Actions. The five-step process (see Figure D-1) is summarized below. The Port will document the screening and evaluation process.

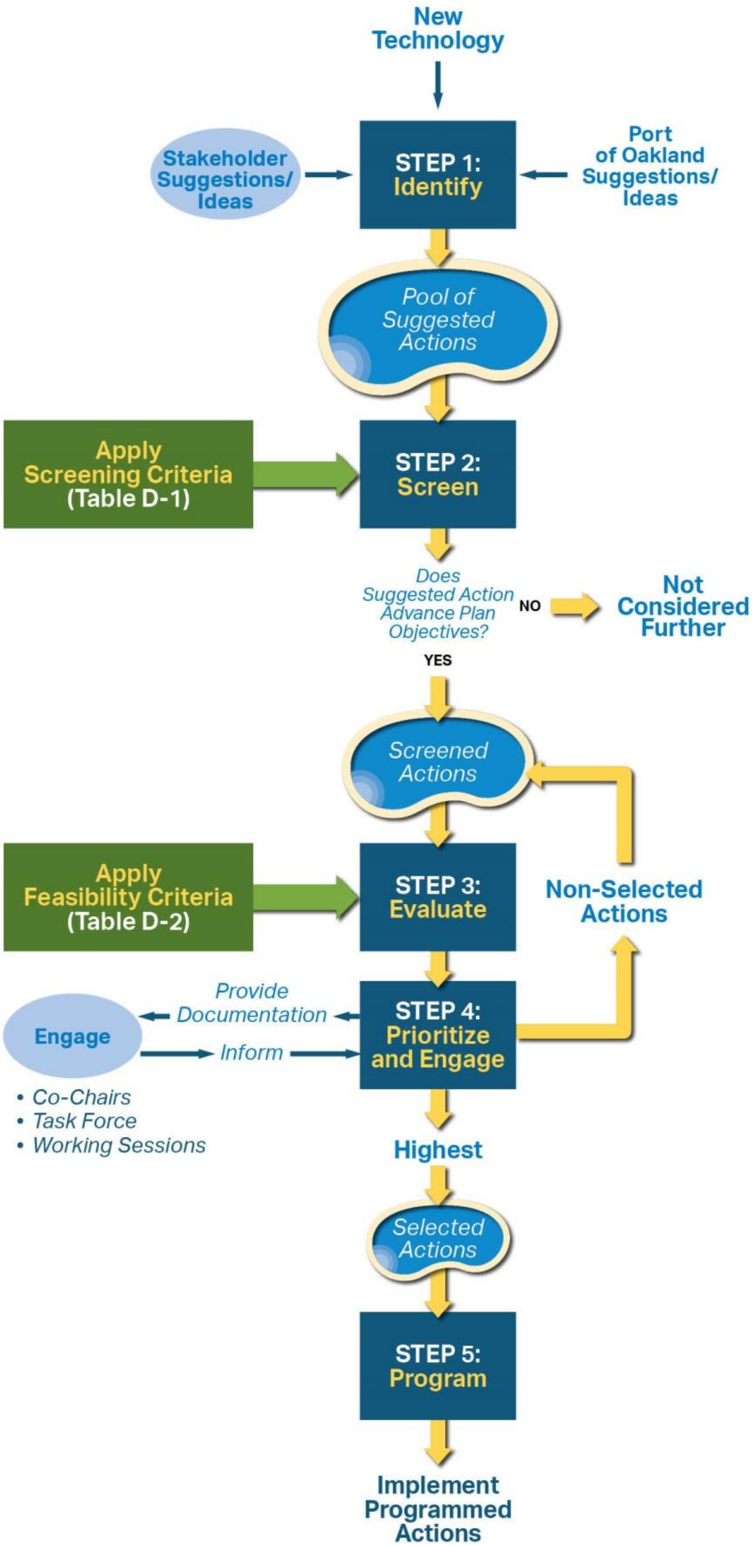
WHICH SOURCES OF INFORMATION CAN BE USED FOR THE SCREENING AND EVALUATION PROCESS?

To conduct the screening and evaluation process, the Port will rely on a range of information and data sources. Some information and data sources provide clear, quantitative metrics and guidance; other sources may be more qualitative. The Port may commission its own studies and may also rely on outside sources of information. The preferred sources of information include reports and studies published by agencies with subject matter expertise in a specific regulatory or resource area, such as the California Air Resources Board (CARB), the California Energy Commission (CEC), and the Bay Area Air Quality Management District (BAAQMD). Research conducted by universities, policy think tanks, and non-governmental organizations (NGOs) will also be sources of data and information. The Final Plan provides for ongoing tracking of information developed by relevant demonstration and pilot projects, such as those undertaken by the San Pedro Bay Ports to support their Clean Air Action Plan. In using published information sources, the Port's aim is to promote consistency with previous studies that have already been publicly reviewed and verified by technical experts.

SCREENING AND EVALUATION PROCESS

Figure D-1 illustrates the five-step screening and evaluation process. These five steps are concisely described following Figure D-1; the Main Text of the Final Plan provides a more detailed description of the steps.

FIGURE D-1: SCREENING AND EVALUATION PROCESS FOR IMPLEMENTING ACTIONS



Source: Port of Oakland 2019

Step 1: Identify

Port staff and stakeholders suggest concepts, ideas, and actions that might contribute to the Seaport Air Quality 2020 and Beyond Plan (2020 and Beyond Plan or Plan) goals. The screening and evaluation process characterizes these concepts, ideas, and actions as “Suggested Actions.” Port staff will compile the Suggested Actions into a pool (Pool #1) for screening in Step 2 (see Appendix C: Suggested Actions).

Step 2: Screen

In Step 2, Port staff screen each Suggested Action against the screening criteria in Table D-1 to determine whether the Suggested Action supports the Plan’s goals. This is a pass/fail screen. To pass, a Suggested Action has to satisfy all applicable screening criteria.

Not all screening criteria are applicable to all Suggested Actions. Suggested Actions that pass Step 2 are classified as “Screened Actions.” The Port will compile the Screened Actions into a second pool (Pool #2). Suggested Actions that fail one or more of the applicable screening criteria in Step 2 are removed from further consideration. Port staff will screen the pool of Suggested Actions on a periodic basis. However, should a new Suggested Action be sufficiently compelling, or if the available time to respond is limited, Port staff may screen a new Suggested Action on an individual basis.

Step 3: Evaluate

In Step 3, Port staff evaluate Screened Actions according to the seven feasibility criteria shown in Table D-2. In contrast to the screening in Step #2, the feasibility assessment is not a pass/fail evaluation; it is an assessment of relative performance against the feasibility criteria.

Step 4: Prioritize and Engage

Following the feasibility evaluation, Port staff conduct a qualitative assessment of each Screened Action to select the highest-priority actions (these actions are classified as “Selected Actions) for implementation. Selected Actions comprise Pool #3. Non-selected Screened Actions will remain in Pool #2 (Screened Actions). Selected Actions that are to be implemented by another organization (e.g., a licensed motor carrier or an ocean carrier) or that require the participation of another organization in addition to the Port are considered guidance. Port staff may remove a specific Screened Action from Pool #2 if it continues to perform poorly against the feasibility criteria.

Port staff then provide the 2020 and Beyond Task Force Co-Chairs documentation for Steps 1 through 4 for their review and feedback. Where needed or desired, the Co-Chairs may convene a Working Session, which will include Task Force members, for collaborative problem-solving on specified Selected Actions. The Co-Chairs will document the Working Sessions to inform the qualitative assessment of specified Selected Actions. Task Force Co-Chairs will present the results of Steps 1 through 4 to the Task Force.

Step 5: Program

Port staff analyze and recommend specific Selected Actions for approval by the Board of Port Commissioners (Board). This recommendation is informed by the Co-Chairs and Task Force engagement undertaken in Step 4. The Board retains sole and absolute discretion to decide whether to approve or disapprove the recommendation. Following Board approval, an action is classified as a Programmed Action and implementation can begin. If the Board does not approve the recommendation, Port staff will respond to the Board's direction. Other organizations may choose to fund and schedule an Implementing Action; Port staff will also classify such non-Port-sponsored actions as Programmed Actions.

SCREENING CRITERIA FOR STEP 2

The screening criteria presented in Table D-1 determine whether a Suggested Action in Pool #1 contributes to the Plan's goals and will be added to Pool #2 (Screened Actions). Suggested Actions that fail one or more criteria will be eliminated from further consideration. (Note: Not all criteria are applicable to all actions. For example, a study would not provide emissions reductions, and therefore Criterion 3 would not be applicable.)

Table D-1: Screening Criteria

Screening Criterion	Description
1. Air Quality Action by the Port or a Port-related business	Is the Suggested Action an action that the Port or a Port-related business would undertake as part of the Seaport Air Quality 2020 and Beyond Plan (2020 and Beyond Plan or Plan), or is this action included in or under the purview of another program (such as the West Oakland Truck Management Plan)?
2. Surplus Emissions Reductions (Avoid Regulatory Duplication)	Does the Suggested Action achieve "surplus" emissions reductions, which are defined as emissions reductions in advance of new proposed regulations or emissions reductions above and beyond an existing regulation??
3. Community Health Risk Reduction and Emission Reductions	Does the Suggested Action reduce Seaport-related diesel particulate matter (DPM) emissions, and thereby reduce community exposure to pollutants that are harmful to public health? Does the Suggested Action reduce nitrogen oxides (NO_X), sulfur oxides (SO_X) and/or greenhouse gas (GHG) emissions?
4. Contribution to Zero-Emissions Pathway	Does the Suggested Action contribute to the Plan's pathway to a zero-emissions Seaport by (as applicable): • Developing designs or collecting data in support of infrastructure improvements and/or deployment of zero-emissions or hybrid equipment; and/or • Delivering infrastructure in support of zero-emissions equipment; and/or • Deploying zero-emissions equipment; and/or • Deploying hybrid equipment that substantially reduces criteria air

Table D-1: Screening Criteria	
Screening Criterion	**Description**
	pollutants, DPM, and/or GHGs; and/or • Creating the fiber-optic communications systems infrastructure required to operate some zero-emissions equipment; and/or • Increasing the availability of zero-emissions fuels or other fuels that contribute to emissions reductions?
5. Side Effects	Does the Suggested Action avoid or minimize foreseeable negative environmental, economic, or social side effects?

Source: Port of Oakland 2019

COST-EFFECTIVENESS AND TECHNOLOGICAL READINESS CRITERIA FOR STEP 3

In Step 3, each Screened Action in Pool #2 is evaluated against seven feasibility criteria: (1) exposure reduction, (2) affordability, (3) cost-effectiveness, (4) commercial availability, (5) operational feasibility, (6) acceptability and (7) need (see Table D-2).

Table D-2: Feasibility Criteria	
Criterion	**Description**
Exposure Reduction	Does the Screened Action contribute to efforts to reduce community exposure to pollutants that are harmful to public health?
Affordability	Has the Board of Port Commissioners approved Port of Oakland (Port) funds for the Screened Action or do the Port's budget projections indicate that sufficient funding is likely to be available given all other budget considerations? How does the cost of any zero-emissions equipment compare to its diesel-powered counterpart? Do projected Port net revenues support any longer-term associated costs? If the Screened Action will be implemented by an organization other than the Port, has that organization decided that the Screened Action is affordable according to its criteria? Is grant or other incentive funding available, and what is the level of effort required to apply for the funding? Would the Screened Action potentially result in stranded equipment or infrastructure, or jeopardize usage requirements for any grant-funded equipment already in place? Would the Screened Action impose an additional expense on the Port or Port-related business which would result in job losses, slowed job growth or other unacceptable, significant economic impacts?
Cost-Effectiveness	Does the Screened Action provide cost-effective emissions reductions? (See detailed description below.)
Commercial Availability[1]	Has the proposed technology or system associated with the Screened Action reached commercial availability (Technological Readiness Level [TRL] 9) or, at a minimum, the pre-production stage (TRL 7)? (See Table D-3 for Technological Readiness Levels.) Is the equipment readily available from multiple vendors, and is there

[1] This is the Port's working definition used in this Plan.

Table D-2: Feasibility Criteria	
Criterion	**Description**
	adequate competition in the marketplace?
Operational Feasibility	Is there sufficient experience with the technology or equipment to determine that its operational performance is acceptable? Are parts readily available and are repair and maintenance services available nearby? Does the existing workforce have sufficient training and experience to operate the new technology or equipment? Can routine maintenance be performed in-house?
Acceptability	Is there a party or entity willing to undertake the Screened Action, given the range of other considerations, such as availability of land, constraints on current or future operations, or financial capability? Does the Screened Action allow for continued reliable and satisfactory service delivery to customer(s)?
Need	To support the qualitative assessment: • Is the Screened Action needed to keep the Port operational, or has a Port tenant or Port-related business determined that the Screened Action is required to keep it operational? • Does the Screened Action complement other initiatives or programs that aim to reduce emissions-related health risk in the local community? • How urgent is the Screened Action (e.g., is lack of electrical infrastructure preventing further deployment of battery-electric equipment)? • Is the Screened Action part of a planned program, such as ongoing investment in capital equipment? • Will the Screened Action result in a delay or cancellation of other (non-air-quality-focused) priority projects? • Will the Screened Action substantially advance experience with a certain type or class of equipment? • If the Screened Action provides emissions reductions benefits, do the associated emissions reductions benefits accrue near the local community? • Will the Screened Action build capacity (such as expanding maintenance and repair services for battery-electric equipment or providing training for electric vehicle mechanics)?

Source: Port of Oakland 2019

Note: Table D-2 is identical to Table 1 in the Main Text of the *Final Seaport Air Quality 2020 and Beyond Plan*; it is provided in this appendix for the convenience of the reader.

Quantitative metrics are available to support the evaluation of cost-effectiveness and commercial availability, as described below. The other criteria will be evaluated using qualitative factors.

Cost-Effectiveness

Cost-effectiveness is calculated as the incremental cost of the project over "business as usual" divided by the annual emission reductions from the project. The targeted emission reductions will be decided on a case-by-case basis. The incremental cost of the project will be annualized over the useful life of the project. Project costs could include operational costs (fuel, maintenance, repair, and labor, among others) as well as capital costs.

Technological Readiness Criteria to Assess Commercial Availability

Commercial availability, the fourth feasibility criterion, will be evaluated in part using the U.S. Department of Energy's nine-level scale (DOE 2011), which has been adapted by the Port to equipment rather than processes. The nine levels, as adapted for application in this Plan, are summarized in Table D-3: Technological Readiness Levels (TRLs). The Port expanded the scale to consider availability of parts and maintenance services. Full commercial availability requires achievement of TRL 9.

Table D-3: Technological Readiness Levels (TRLs)

Relative Level of Technology Development	TRL	TRL Definition	Description
Technology Operations	TRL 9	Actual technology or equipment operated over the full range of expected operating conditions	The technology or equipment is in its final form and has operated under the full range of operating conditions. Parts and maintenance are readily available.
Technology Commissioning	TRL 8	Actual equipment completed and qualified through test and demonstration	The technology or equipment has been proven to work in its final form and under expected operating conditions. In almost all cases, this TRL represents the end of true equipment development. Parts and maintenance are available on a limited basis.
	TRL 7	Full-scale, similar (prototypical) equipment demonstrated in a relevant environment	This represents a major step up from TRL 6, requiring demonstration of an actual equipment or technology prototype in a relevant environment. Examples include testing equipment in the field under a range of operating conditions. Final design is virtually complete. Parts are custom-made or adapted, and maintenance is available only from the equipment developer or a very limited group of providers.
Technology Demonstration	TRL 6	Engineering-scale/ pilot-scale, similar (prototypical) equipment or technology validation in relevant environment	Engineering-scale prototypes are tested in a relevant environment. This represents a major step up in a technology's demonstrated readiness. Examples include testing an engineering-scale prototype with a range of potential operating conditions. TRL 6 begins true engineering development of the technology as operational equipment. The major difference between TRL 5 and TRL 6 is the step up from laboratory scale to engineering scale. The prototype should perform all the functions that will be required of the operational equipment. The operating environment for the testing should closely represent the actual operating environment. Parts and maintenance are not available because each piece of

Table D-3: Technological Readiness Levels (TRLs)			
Relative Level of Technology Development	**TRL**	**TRL Definition**	**Description**
			equipment is custom-built.
Technology Development	TRL 5	Laboratory-scale, similar system validation in relevant environment	The basic technological components are integrated, so that the equipment configuration is like (matches) the final application in almost all respects. The major difference between TRL 4 and TRL 5 is the increase in the fidelity of the equipment and test environment to the actual application. The system tested is almost prototypical.
Technology Development	TRL 4	Component and/or system validation in a laboratory environment	The basic technological components are integrated to establish that the pieces will work together. This is relatively *low fidelity* compared with the eventual complete equipment. TRL 4 through TRL 6 represent the bridge from scientific research to engineering. TRL 4 is the first step in determining whether the individual components will work together as a system.
Research to Prove Feasibility	TRL 3	Analytical and experimental critical function and/or characteristic proof of concept	Active research and development is initiated. This includes analytical studies and laboratory-scale studies to physically validate the analytical predictions of separate elements of the technology. Components of the technology are validated, but there is no attempt to integrate the components into a complete system. Modeling and simulation may be used to complement physical experiments.
Basic Technology Research	TRL 2	Technology concept and/or application formulated	Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions.
	TRL 1	Basic principles observed and reported	This is the lowest level of technological readiness. Scientific research begins to be translated into applied research and development.

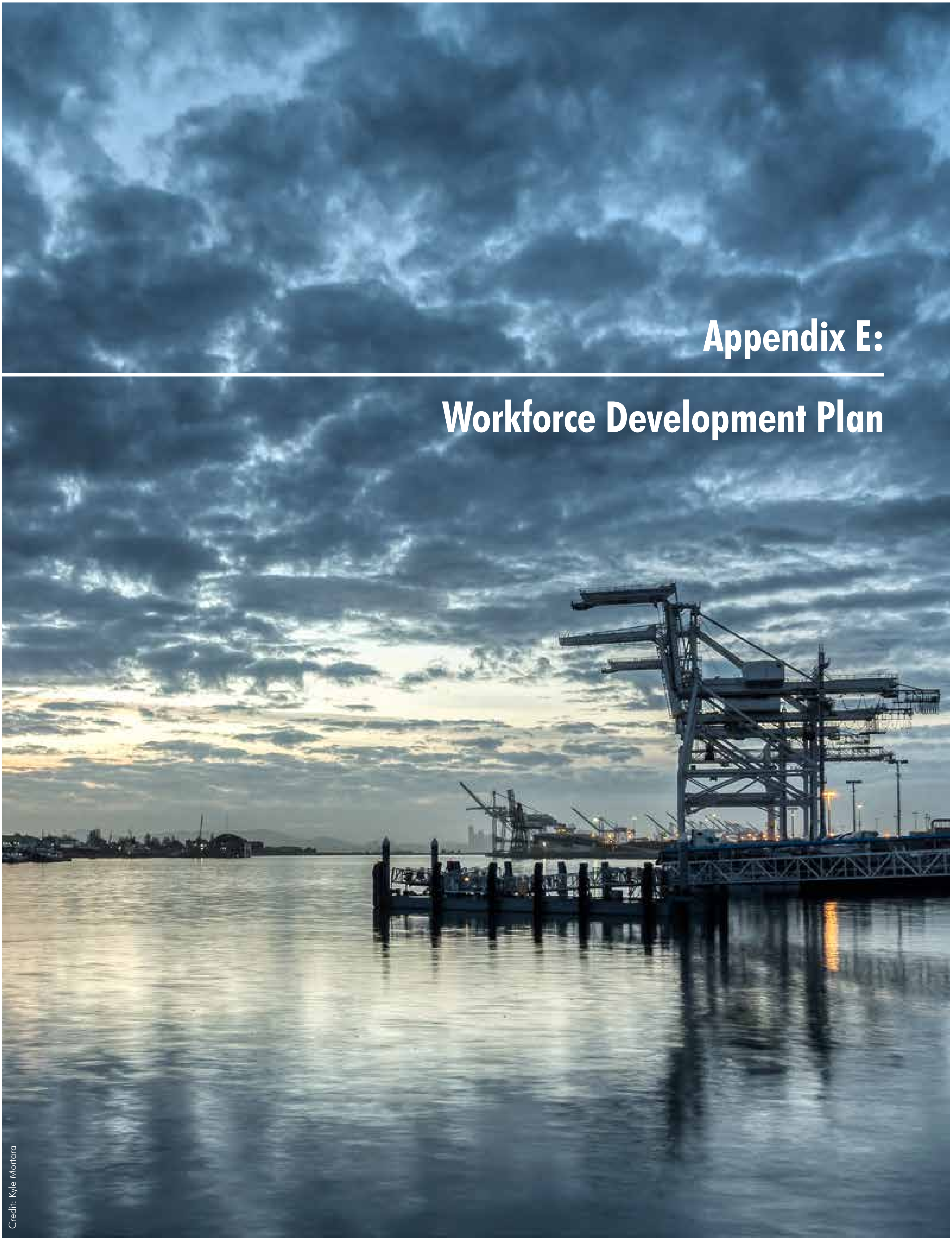
Source: Port of Oakland 2019

REFERENCES

United States Department of Energy (DOE). 2011. Technology Readiness Assessment Guide. DOE G 413.3-4A. September 15.

Appendix E:

Workforce Development Plan



Credit: Kyle Mortara

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ACRONYMS AND ABBREVIATIONS

2020 and Beyond Plan	Seaport Air Quality 2020 and Beyond Plan
ATL	advanced transportation and logistics
CCCCO	California Community College Chancellor's Office
CHE	cargo-handling equipment
DPM	diesel particulate matter
ETP	State of California Employment Training Panel
ETT	Employment Training Tax
GHG	greenhouse gas
ILWU	International Longshore and Warehouse Union
LIA	local impact area (cities of Oakland, San Leandro, Emeryville and Alameda)
MAPLA	Maritime and Aviation Project Labor Agreement
NTAP	Near-Term Action Plan
Plan	Seaport Air Quality 2020 and Beyond Plan
PMA	Pacific Maritime Association
WG	Port Jobs and Workforce Development Stakeholders Group
WOJRC	West Oakland Job Resource Center
ZANZEFF	Zero- and Near-Zero-Emissions Freight Facility

WORKFORCE DEVELOPMENT PLAN

INTRODUCTION

The Seaport Air Quality 2020 and Beyond Plan (the 2020 and Beyond Plan or Plan) positions the Port to expand upon its years of community and education commitment to identify, analyze, and assess potential workforce needs in collaboration with community stakeholders, including training partners and industry leaders. This Workforce Development Plan, which is aligned with the Port of Oakland 5-year Strategic Business Plan 2018 – 2022, will complement and strengthen the overall objectives of community engagement; improve Port access for the community; minimize adverse community impacts; and ensure that as the Port thrives, the community thrives. To ensure job growth and provide economic opportunity, the Port's commitment to Oakland and the East Bay is central to this Workforce Development Plan.

As a critical economic partner in the region generating more than $2.2 billion annually in trade through the Seaport, the Port will continue to promote training programs that prepare candidates for careers in transportation, logistics, or the building and construction trades. With more than 11,000 jobs generated by cargo handled at the Port's maritime terminals (Martin 2019), coupled with record-high throughput through the Seaport, the future of jobs growth is promising. In addition, strong community partnerships are a key element of the Port's commitment to strengthening community support.

Community outreach, employer engagement, educational partnerships with local schools, summer internships, and local training and apprenticeship programs are all part of the Port's long history in community and economic development. The Port remains committed to promoting programs that train local candidates for careers in transportation, logistics, or the building and construction trades and will continue to provide resources to support job training and skills development to ensure Oaklanders and Californians are prepared for Port and Port-related industries. As a strong workforce partner, the Port plays a vital role as an economic engine for Northern California, supporting more than 84,000 jobs throughout the region from the Port's maritime, aviation and real estate activities (Martin 2019).

Background

As the Port continues to manage programs, policies, and initiatives that promote access to Port and Port-related careers, ensuring a viable and skilled workforce is of great importance. With the advancement of smart technology, electrification, and hybrid equipment, upgrading of skills for new and current workers is a critical priority. Supporting a pathway to a zero-emissions Seaport and new clean air technologies will affect the workforce in various sectors of the Seaport's operations and goods movement.

Partnership development with industry leaders, training partners, and other community stakeholders will continue to be central to the development of a comprehensive Workforce Development Plan that will promote a better understanding of the effects of clean air technologies and meet workforce demands. Ultimately, an expansive Workforce Development Plan is part of the Port's vision of economic growth and financial stability. Equally important, this Workforce Development Plan is directly aligned with the stated goals of the 2020 and Beyond Plan:

- Keep the Port competitive and financially sustainable, and a catalyst for jobs and economic development.
- Minimize emissions of criteria air pollutants and toxic air contaminants (TACs) —with a focus on reducing diesel particulate matter (DPM) emissions.
- Reduce greenhouse gas (GHG) emissions.
- Build and strengthen partnerships among the Port, tenants, equipment manufacturers, owners and operators, community organizations, regulatory agencies, and the public.
- Provide opportunities for meaningful stakeholder engagement.

Aligned with the Near-Term Action Plan (NTAP) (Years 2019-2023), the Port will continue to expand upon existing Port workforce policies and initiatives that serve as a foundation for building deeper partnerships with existing stakeholders and for increasing those partnerships to ensure the Port's Workforce Development Plan is part of a collective effort. Key examples of existing workforce policies, initiatives, and funded incentives that support job growth and local hire commitments are highlighted below:

- **Port's Maritime and Aviation Project Labor Agreement (MAPLA):** The Port's and Building Trades' agreement for construction projects, the MAPLA provides economic opportunities to local small businesses, contributes workforce training dollars to community training programs, and supports local hire careers in construction. As of 2018, MAPLA employer contributions funded more than $140,000 of the grants awarded to the Cypress Mandela Training Center and Rising Sun Center for Opportunity. Both community-based organizations serve local populations with barriers to employment and placed a total of 25 local job seekers into construction training programs in 2018.

  The Port is also working directly with the Peralta Community College District, Oakland Unified School District, and other East Bay public agencies and cities to develop a broader strategy that facilitates preparation and entry into high-paying, skilled construction jobs. The intent of this strategy is to focus on reaching a targeted population in West Oakland (McClymond High School) in addition to other local impact area (LIA) areas (the cities of Oakland, San Leandro, Alameda, and Emeryville). With continued fundraising from the Port and Port employers, the Port expects an increase in job placements for West Oakland and LIA residents in 2019 and beyond.

- **Operations Jobs Policy:** The Operations Jobs Policy (which is specific to the lease with CenterPoint-Oakland Development I, LLC) incorporates a Community Benefits Agreement that creates construction jobs and future permanent living-wage warehouse positions that will enable long-time residents to remain in Oakland. The CenterPoint project will construct the largest state-of-the-art warehouse facility at the Port of Oakland and will offer the following community benefits: preference for hiring local residents with priority for West Oakland neighborhoods; "Ban-the-Box" prohibiting employers from asking about prior criminal offenses; special consideration for disadvantaged residents; living wages and benefits for workers, with limits on the use of temporary agencies; initial funding commitment of $250,000 to the West Oakland Job Resource Center (WOJRC), a local community-based workforce partner; and the establishment of an advisory body called the Port Jobs and Workforce Development Stakeholders Group (WG). The WG is a 13-member committee representing community-based organizations in West Oakland, Oakland, and Alameda County. It will be responsible for monitoring, tracking and submitting workforce recommendations to the Board of Port Commissioners. In addition to its intentional design as a jobs-generating program that will positively affect local residents, the Operational Jobs Policy also commits to working with the WOJRC to conduct outreach, recruitment, job training, and job placement.

- The Port is also playing a pivotal role as an advisor to the WOJRC on the development of a warehouse-to-California commercial driver license state-registered apprenticeship training program, funded by the California State Workforce Development Board – High Road Training Partnership. This partnership is directly connected to the Port's Operational Jobs Policy as part of a broader strategy to ensure local hire commitments are realized by West Oakland job seekers.

  The training program is an "earn as you learn" model that provides access to entry-level warehouse jobs with training certifications that lead to a commercial driver license. Such a program offers a high level of oversight, tracking and monitoring of skills, upskilling, and a career pathway leading to high wages. Partners include WOJRC, Teamster's Joint Council 7, ATLAS – College of Alameda, two major employer groups, the Department of Apprenticeship Standards, and the California Federation of Labor. The site of the warehouse-to-California commercial driver license program will be in the heart of West Oakland at the WOJRC, and the anticipated start date for the warehouse apprenticeship training program is Fall 2019. The program's skills attainment element may prepare warehouse workers for future jobs at a zero-emissions Seaport, as transferable skills will be an integral component of the training curriculum in the transportation, distribution, and logistics industries.

As the Port continues to enhance its current workforce policies and initiatives to align with the pathway to a zero-emissions Seaport, it will reassess and revise the Workforce Development Plan. Outlined below are further considerations for a comprehensive Workforce Development Plan that includes a broader scope of planned training for a near-zero-emissions and zero-emissions Seaport.

Purpose

As part of a larger framework aligned with Strategy #4: Build and Strengthen Partnerships, this Workforce Development Plan will guide the Port's workforce development to support the NTAP (years 2019-2023). The Plan will be updated as new technologies emerge. In developing and expanding partnerships with industry leaders, training partners, and other community stakeholders, the Port will collaborate on efforts to better understand workforce needs, to upgrade skills, and to provide training for new and/or current workers to support the pathway to a zero-emissions Seaport. Building on the Port's historical partnership with the local community, the Workforce Development Plan will review the Port's workforce and education initiatives and programs, including the zero-emissions and near-zero-emissions demonstration projects currently under way and/or pending implementation. Moreover, the Workforce Development Plan will be a framework that allows for growth, change, and innovation to support the pathway to a zero-emissions Seaport. To prepare the current and future workforce for a zero-emissions Seaport as well as take interim technological steps along the way, the Port will play a central role in the convening of partners, including state, local, and educational institutions.

Finally, this Workforce Development Plan will engage industry leaders and community stakeholders in a discovery process. The goal of this process is twofold: to support workforce needs and to identify the skills needed by incumbent workers as well as the education and training programs that will open up new career pathways for the future workforce of a zero-emissions Seaport.

Workforce Methodology

To support the pathway towards a zero-emissions Seaport, this Workforce Development Plan offers a framework for conducting a workforce analysis in partnership with industry stakeholders as part of the planning process to understand current and future workforce needs. Industry partners and labor organizations may already have tools to measure current workforce needs, training, and or skills development, so this workforce methodology is meant to complement and/or enhance current models of workforce needs assessments. For example, the Port is keenly aware that the Pacific Maritime Association (PMA) is the premiere trainer for one of the Seaport's largest workforce groups, the International Longshore and Warehouse Union (ILWU). By creating a workforce analysis methodology, the Port is underscoring its vested interest in supporting industry needs and demonstrating its commitment to ensuring local education and training providers are preparing Oaklanders for Port and Port-related jobs.

This Workforce Development Plan will also provide a framework that will mitigate unnecessary workplace disruptions and maintain a steady workforce. One of the major components of the Port's development and expanding partnership with industry leaders is to establish clear baseline data on their current workforce. The data obtained will be analyzed through a workforce methodology framework to align with future organizational goals and objectives.

The primary elements of a workforce analysis methodology involve the gathering of organizational human resource data to address the following:

- **Identification of** mission-critical occupations and competencies.
- **Supply** evaluation, i.e., the current workforce, including anticipated retirements and separations, as well as current skills and competencies.

- **Demand** forecast, i.e., the optimal number of workers and competencies needed in mission-critical occupations for the future workforce.
- **Gap analysis** – an evaluation of the gap between supply and demand to identify the current number of workers, the competency surplus and deficiencies, and the following gaps:
  - Future workforce gap
  - Future competency gap

Based on the workforce methodology presented, it is critical that the Port work directly with its industry leaders and training partners in developing training programs that include a sector-specific labor market analysis to better understand industry trends, workforce projections, and competencies that are adaptable to new and emerging technologies for a pathway to a zero-emissions Seaport. The workforce gap analysis will serve as the basis for the development and implementation of a workforce transition plan.

Workforce Transition Plan

As part of managing the transition of its workforce over time, the Port will track and monitor the performance outcomes of workforce development demonstration projects in partnership with industry leaders to ensure that the workforce:

- Is able to adapt to the changes in the working environment
- Understands the new processes, programs, equipment, and technology associated with the transformation of the Seaport
- Demonstrates high levels of efficiency and effectiveness in new roles
- Meets needs and requirements of employers and customers
- Is able to work with new colleagues as a high-performing team

The performance outcomes of each workforce development demonstration project play a critical role in understanding scalability, the required resources for the upgrading of skills, new equipment, and potential occupational changes. Workforce development projects may be included with:

- Carl Moyer Grants – Retrofit of two tugs with Tier 3 engines and the replacement of 13 existing rubber-tired gantry cranes with hybrid cranes

- Zero- and Near-Zero-Emissions Freight Facility (ZANZEFF) grant to support 10 electrical Class 8 drayage trucks at Shippers Transport Express (a Port off-dock tenant) and up to six pieces of electric cargo-handling equipment (CHE) at the Matson Terminal

Tracking and monitoring of these workforce demonstration projects are critical to understanding future workforce needs and the required competencies for implementation and operations and maintenance of equipment. Each project workforce can be analyzed using the workforce methodology.

Example: Workforce Gap Analysis

- Identification: Identify equipment needs for mission-critical occupations and competencies.

- Supply: Identify the current number of workers and their current skill level:
  - Number of workers (Each worker must be assigned to critical equipment.)
  - Number of workers by skill set/competencies (industry and or labor may train, track, and monitor skill level by worker.)
  - Number of workers expected to retire and or separate (based on industry and/or labor human resource data projections.)
- Demand: Identify the number of workers and competencies required to support future jobs:
  - Number of workers required to support the future workforce
  - Number of workers with skill set required for the future workforce
- Workforce Gap Analysis: After completion of the supply and demand analyses, a workforce analysis will emerge that will identify a surplus or deficiency of required workers as well as a skills surplus or deficiency.

The Workforce Plan is based on three major recommendations:

1. Partner with industry leaders on a sector labor market analysis to complete a Workforce Gap Analysis.
2. Identify resources to offset employer investment in the upgrading of skills and certifications for hybrid and zero-emissions equipment. An example of an available resource is the Employment Training Panel—the State of California provides funding to employers to assist them in upgrading the skills of their workforce.
3. Coordinate and seek continuous feedback from stakeholders through the Public Engagement Plan (see Appendix G), and ensure communications reach the intended audience.

Initial Workforce Analysis

To understand the workforce needs and impacts of a zero-emissions Seaport, a Workforce Gap Analysis of the jobs related to anticipated changes in technology, equipment, fuel, infrastructure, and operations must be cross-referenced with the actual job categories shown in Table E-1. This table was developed by Martin Associates as an update to their 2011 report, "The Economic Impact of the Port of Oakland" (Martin 2019), through interviews with hundreds of firms, representing the universe of firms that provide services at the Port of Oakland Seaport and Oakland International Airport as well as the tenants of the Port's Commercial Real Estate Division. As the table indicates, truckers serving the Port's marine terminals constitute the largest number of jobs, followed by employees in warehousing and distribution center/cross dock operations, ILWU members, and freight forwarders.

As an initial workforce assessment of the Port's pathway to a zero-emissions Seaport, it is premature to predict whether the current workforce will experience a reduction and/or an increase in the number of jobs, changes to job functions, and changes in the types of training and certifications required. This level of workforce detail will need to be developed in partnership with all employer and industry stakeholders as part of the Workforce Gap Analysis referenced above. However, a deeper review of the job classifications provides some initial insight into the number of workers potentially affected by the new technologies associated with creating a zero-emissions Seaport.

Workforce Job Classifications

Of the 11,393 Seaport-related job classifications, truckers constituted the largest number of workers (3,912) servicing the Port. Steven Viscelli suggests in his research report, “Driverless? Autonomous Trucks and the Future of the American Trucker,” that the most vulnerable truckers to be affected by automation are long-haul drivers and that 294,000 trucking jobs nationwide could be eliminated (Viscelli 2018). At the same time, it is expected that more freight-moving jobs will be created than are lost in trucking. These new freight-moving jobs are likely to emerge as the number of local drivers increases and as last-mile delivery demands increase. Given that the Port is continuing to develop its Seaport warehouse and distribution centers, this scenario seems plausible.

The second largest workforce is made up of warehouse workers (1,980). With the development of warehouse and distribution centers, the number of warehouse workers at the Seaport is expected to grow. Development of the technology to support warehouse equipment and logistics data management systems is a key element that should be considered as part of the Workforce Gap Analysis. With the adoption of new technology, training and retraining for current workers will be essential. The Port will work directly with industry partners to help prepare current and future warehouse workers.

The third-largest workforce at the Seaport is made up of ILWU workers (1,808), who may be active participants in the Port’s demonstration projects. All demonstration projects could benefit significantly from a Workforce Gap Analysis, which would clearly identify current levels of workers, job classifications, and competencies.

The PMA’s training center at the Port is a current example of the use of workforce assessment. According to its 2017 Annual Report (PMA 2018), the ILWU and PMA established a comprehensive training center at the Port in 2017, which included a crane training simulator, classrooms, and clerk testing areas. The monitoring, tracking, and evaluation of competencies managed by PMA at this training center will provide much needed data to complete the Workforce Gap Analysis.

Table E-1 below provides a more complete picture of the Seaport’s workforce, which provides a strong baseline for a workforce gap analysis.

TABLE E-1: DIRECT JOBS BY DETAIL CATEGORY

Impact Category	Direct Jobs
Surface Transportation	
Rail	203
Truck	3,912

Subtotal	**4,115**
Maritime Services	
Terminal	216
ILWU	1,808
Tug Assists	114
Pilots	48
Steamship Lines/Agents	90
Maritime Services/Surveyors	532
Freight Forwarders	1,613
Warehouse/Distribution Centers	1,980
Government	441
Marine Construction/Ship Repair	287
Barge	0
Subtotal	**7,130**
Dependent Shippers/Consignees	88
Port Authority	60
TOTAL	**11,393**

Source: Martin 2019

RECOMMENDATIONS AND STRATEGIES

As part of the transition to a zero-emissions Seaport, the Port in partnership with stakeholders will support a series of strategies, including a workforce gap analysis, to better understand the changing conditions that will be brought about by new technologies and the resources required to support a pathway to a zero-emissions Seaport.

Recommendation I: Conduct Workforce Gap Analysis: Partnerships and Advisory Roles

The Port's Workforce Development Plan will be informed by a comprehensive workforce analysis guided by a strategic workforce methodology. Industry leaders along with education and training partners are critical stakeholders in developing competencies that will be needed in the future.

The strategy categories described below are meant to serve as an initial framework to help start and guide a deeper discussion and analysis. The strategies include actionable plans that can be incorporated in a robust workforce plan to support employer's needs for their current workforce as well as long-term plans for future workforce needs.

Strategy I. Training

- Develop current worker training for cargo-handling equipment (CHE) to support zero-emissions equipment, operations, and maintenance.
- Provide training on new clean air technologies (i.e., hybrid and electric vehicles) to local workforce preparedness programs.

- Develop curriculum with industry partners to address identified workforce needs.
- Develop maritime career pathways in partnership with research institutions, community colleges, the University of California and California State Universities, and K-12 Linked Learning pathways to connect high school students with meaningful internships as part of their career exploration.

Strategy II. Meeting Sector and Regional Workforce Needs

- Develop and implement actionable plans in partnership with regional employers, labor unions, workforce development boards, and other economic and community partners to align with the 2020 and Beyond Plan.
- Create education programs for emerging, high-growth and hard-to-fill occupations in partnership with local education and training providers.
- Implement interlinked K-12, adult education, and apprenticeship pathways.
- Partner with programs and services to address employer workforce development priorities.
- Translate national standards and certifications into model competency-based curricula.
- Construct and disseminate shareable workforce development resources.

Strategy III. Revitalize Communities and Connect Residents to Meaningful Career Opportunities

- Partner with intermediary workforce agencies, community colleges, workforce development boards, chambers of commerce, and others to support regional and state zero-emissions projects, policies, and initiatives.
- Ensure the developing zero-emissions Seaport workforce represents the community it serves via outreach and recruitment of LIA residents into workforce development programs.
- Build gateway programs that include pre-education and pre-employment preparation, support services, and work-based learning experiences to increase education and employment success.

Recommendation II: Resources to Support Equipment, Infrastructure, and Training

Through demonstration projects such as the ZANZEFF grant completion of a workforce gap analysis, educational partners will gain a deeper understanding of how to identify new areas of skills and learning. As part of the letter of commitment from the Oakland Unified School District and the Peralta Community College District, the Port will receive technical assistance from the Port of Long Beach, Long Beach Community College, and Long Beach Center for International Trade and Transportation. An initial framework for this partnership with high schools and postsecondary partnerships is shown below:

- Oakland Unified School District
    - ZANZEFF Letter of Commitment
    - Oakland Unified School District – Linked Learning
    - Revamping Linked Learning Pathway aligned to community college career pathway
        - Advanced Transportation and Logistics
        - Global Trade

        - Energy, Construction, and Utilities

- Peralta Community College District
    - ZANZEFF letter of commitment to support workforce assessment and alignment to current and future education and training priorities
    - Community College Sector Priorities
        - Advanced Transportation and Logistics
        - Global Trade
        - Energy, Construction, and Utilities
    - Community College Strong Workforce Initiative (a resource to enhance career technical education in partnership with industry)

Collaboration with local training partners as mentioned above could result in stronger partnerships with local schools and community colleges to support career pathways and continued education in the maritime sector.

In addition to collaborating with other ports to secure grants, the State of California Employment Training Panel (ETP) serves as a funding agency to support job creation through upgrading skills of workers. This type of funding is specifically used to reimburse the cost of employer-driven training for current workers and could prove beneficial in offsetting training costs associated with any of the jobs at the Seaport that call for retraining. Seaport employers eligible for ETP funding must meet the requirements mandated by a special Employment Training Tax (ETT) paid by California employers, and only employers subject to this tax directly benefit from the program. These training funds are underutilized by employers and could deepen relationships with employers, strengthen training standards, increase worker productivity, and promote a safe and healthy workplace.

TABLE E-2: STATE OF CALIFORNIA EMPLOYMENT TRAINING PANEL OVERVIEW

State of California Employment Training Panel (ETP) Program Overview	How ETP Funding Works
ETP targets firms threatened by out-of-state competition or that compete in the global economy.	Employers make decisions about their training needs.
For incumbent worker training, employers contribute to the cost of training.	Training investments help companies become more profitable locally and globally.
Additional incentives are provided to assist small businesses and employers in high unemployment areas of the state.	Employers are encouraged to assume greater responsibility for training.
Partnerships allow ETP to provide funds from alternative sources for industry-specific training programs.	Performance-based contracting helps to ensure success.

Source: Port of Oakland 2019.

ETP funding opportunities are a great resource for employers, enabling them to offset or supplement investments in anticipated training needs for their current workforce. ETP also offers employer incentives to support new workers, which could prove beneficial as emerging technologies for alternative fuels and hybrid and zero-emissions equipment continue to be developed.

Recommendation III: Coordinated Efforts with Education and Business Community

As part of California's strategy for reducing its climate change impact and its dependence on foreign energy, and for supporting its growing of a green economy, the California Community College Chancellor's Office (CCCCO) identified 10 top sector priorities. Two of these priorities, advanced transportation and logistics (ATL) and global trade sector programs, are in alignment with the need to identify a curriculum and programs that support DPM and GHG reductions at seaports. Through the CCCCO system, state-level sector navigators work with regional deputy sector navigators who assist with research, curriculum development, employer outreach, and sector-based coordination with the business community. Formalizing a relationship with state-level sector navigators could provide significant support to Seaport employers, local education partners (including high schools and community colleges), and other key stakeholders, and help coordinate their efforts to establish an advisory group.

The role of the advisory group could be to identify business needs, assist with securing state funding, (such as ETP funds for worker training), and further develop education partnerships leading to career pathways in the maritime area. The ATL sector developed the following programs, which align with the 2020 and Beyond Plan:

- Electric Hybrid and Hydrogen Fuel Cell Program
- Gaseous Fuel Programs for Heavy-Duty Vehicles
- Gaseous Fuel Programs for Light-Duty Vehicles
- Intelligent Transportation Systems Programs
- Railroad Operation Programs
- Automotive Clean Air Car Emissions Programs

Through strengthening partnerships with education leaders, community colleges, and local school districts, the Port can develop a robust workforce plan that will continue to complement the 2020 and Beyond Plan over time. The Port will continue to work closely with industry partners and local education and training programs to prepare workers for future jobs at the Seaport. More specifically, the Port will continue to partner with our largest employers to ensure upskilling, and job training skills are aligned to meet the needs of our growing Seaport.

The Oakland Unified School District is interested in exploring career pathways in global trade and logistics and collaborating with local community colleges on offering relevant continuing education opportunities that could ultimately lead to 4-year degrees. At present, the Port provides more than 25 college students and 5 high school students with summer internships through its college internship program. This program can be strengthened through the coordination efforts discussed above, and by aligning it to the degree programs at the California Maritime Academy, which include the following 4-year undergraduate majors and minors:

- Business Administration (International Business and Logistics)
- Global Studies and Maritime Affairs
- Marine Transportation
- Mechanical Engineering
- Facilities Engineering Technology
- Marine Engineering Technology
- Power Generation

CONCLUSION

To identify changes in workforce skills and occupation shifts and/or new occupations arising from technology developments, and to set standards for new and existing occupations, the Port will develop a broad alliance with key stakeholders in industry, the community, local education and training agencies, and labor. New zero-emissions technologies continue to emerge, and the more informed all stakeholders become, the better prepared all will be to support a stronger workforce for the future.

The Port is strategically positioned to lead a collaboration between industry, training institutions, and community stakeholders to gather and assess the data needed to better understand workforce development, training and retraining needs, certifications, and anticipated costs.

New hybrid and zero-emissions technologies continue to emerge for maritime applications. To achieve a near-zero and zero-emissions operational environment at the Seaport, the Port's Workforce Development Plan must be flexible and responsive to the emergence of these new technologies and any initiatives, regulations, and or policies that result in industry changes that could impact the Seaport's workforce needs.

REFERENCES

Martin Associates (Martin). 2019. The Economic Impact of the Port of Oakland. April.

Viscelli, Steve. 2018. Driverless? Autonomous Trucks and the Future of the American Trucker. Center for Labor Research and Education, University of California, Berkeley, and Working Partnerships USA. September. http://laborcenter.berkeley.edu/driverless/.

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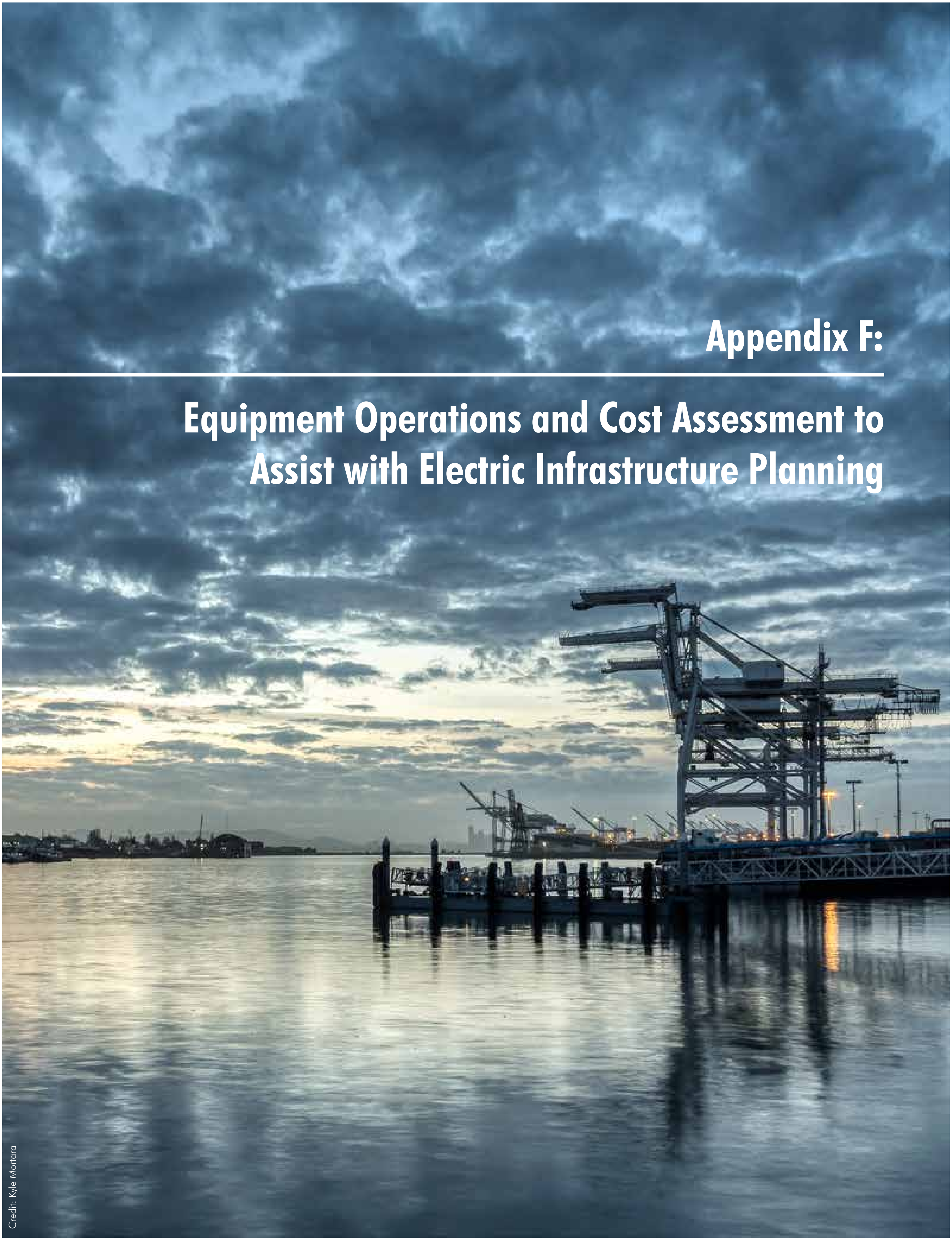
Appendix F:

Equipment Operations and Cost Assessment to Assist with Electric Infrastructure Planning



Credit: Kyle Mortara

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ACRONYMS

CARB	California Air Resources Board
CHE	Cargo-Handling Equipment
CO_2	Carbon Dioxide
DAC	Disadvantaged Community
DPM	Diesel Particulate Matter
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
IAM	International Association of Machinists and Aerospace Workers Union
ILWU	International Longshore and Warehouse Union
kWh	Kilowatt-Hour
kV	Kilovolt
LCFS	Low Carbon Fuel Standard
MTO	Marine Terminal Operator
NOx	Nitrogen Oxides
NZE	Near-Zero-Emissions
OEM	Original Equipment Manufacturer
OICT	Oakland International Container Terminal
PG&E	Pacific Gas and Electric Company
PM_{10}	Particulate matter less than 10 micrometers in diameter
RPS	Renewables Portfolio Standard
RTG	Rubber-Tired Gantry
STS	Ship to Shore
TEU	Twenty-Foot Equivalent Units
ZANZEFF	Zero- and Near-Zero-Emissions Freight Facilities
ZE	Zero-Emissions

OBJECTIVES

Appendix F has the following objectives:

- Identify near-term (2019-2023) commercially available equipment for a high-level (planning level) analysis of costs needed to transform current land-side sources of petroleum-based emissions (cargo-handling equipment [CHE] and drayage trucks) at the Seaport to near-zero-emissions[1] and zero-emissions (NZE and ZE) goods movement.
- Estimate timing of initial efforts for each land-side equipment type based on cost, incentive funding, charging patterns, and other relevant factors.

Rather than estimate the capital costs to replace the entire inventory of land-side equipment at the Seaport, this appendix analyses capital and operating costs of battery-electric yard tractors and hybrid rubber-tired gantry (RTG) cranes that have achieved or are nearing commercial availability. This analysis is intended to demonstrate the potential capital and operating costs associated with these more widely available near-term NZE and ZE equipment technologies compared to traditional pure petroleum-fueled equipment, and how costs may trend over time.

EXECUTIVE SUMMARY

Key planning assumptions for this study include:

- No change will occur in status quo Seaport operations (i.e., operations remain primarily manual, in contrast to automated operations, which are not used at the Port).
- No equipment is discarded before the end of its typical life span (no *stranded assets*).
- Costs of electric vehicles decline over time due to falling battery costs and increasing production scale.
- Existing voucher programs remain in place indefinitely.
- No infrastructure costs are included (equipment costs only, not including charging equipment).

This appendix focuses on the analysis of the near-term equipment technologies with sufficiently developed commercial availability to allow for cost analysis, which primarily are electric yard tractors and hybrid lift equipment. Intermediate-term technologies that do not yet have substantial cost information available are discussed qualitatively, including electric top-picks and electric drayage trucks. Overall results show that voucher programs to offset higher ZE and NZE equipment purchase prices (in contrast to conventional diesel equipment) will be critical to facilitating their adoption, particularly in the

[1] Near-zero equipment as defined in this appendix includes certified low nitrogen oxide (NOx) engines and hybrid engines.

near term, while vehicle purchase costs remain much higher than those of traditional petroleum-based equipment. Hybrid lift equipment, such as RTG cranes, reach stackers, and sides-picks, is commercially available and may save 40% in fuel compared to conventional diesel lift equipment.

BACKGROUND

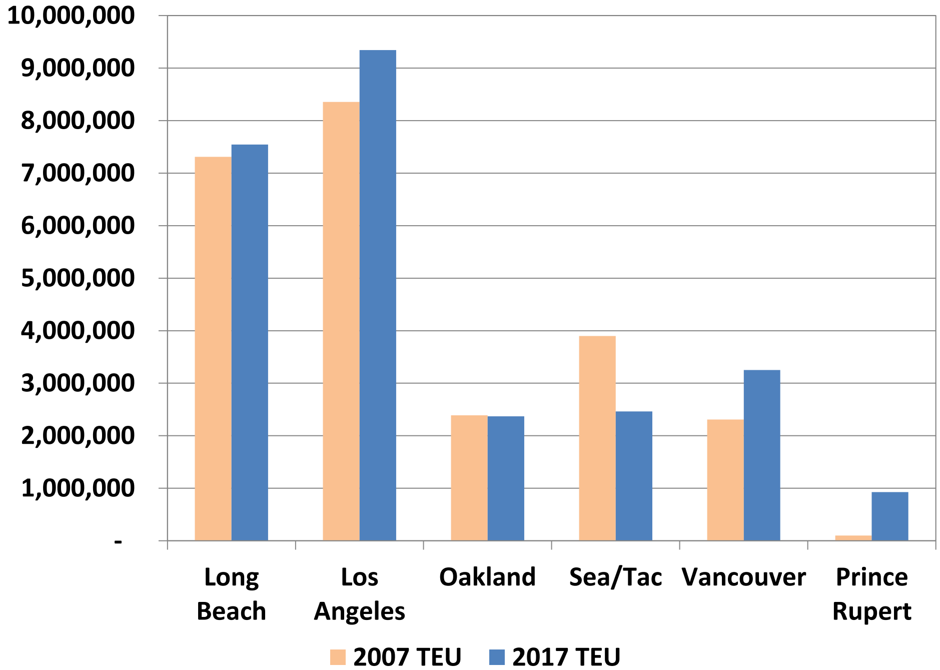
The Port, which is a container-only cargo port, is a second port-of-call (second-tier) seaport compared with the ports of Los Angeles and Long Beach in Southern California, which handled nearly half of all United States (U.S.) containerized imports from Asia during the first half of 2018 (Mongelluzzo 2018). Oakland also competes for rail cargo destined for the interior of the United States with other ports along the North American West Coast, up to and including the Port of Prince Rupert, British Columbia (BC). All of these ports are landlord ports (as opposed to operating ports); all CHE is owned by terminal operators rather than the individual ports. All West Coast U.S. ports use International Longshore and Warehouse Union (ILWU) labor to operate equipment at marine terminals. The International Association of Machinists and Aerospace Workers (IAM) Union also provides longshore labor to marine terminals at the Port.

Figure F-1 (on the following page) shows the volume in twenty-foot equivalent units (TEU) at West Coast container ports for 2007 and 2017. This chart shows the dominant market position of the ports of Los Angeles and Long Beach, which are adjacent to each other in San Pedro Bay. It also demonstrates market trends in the last decade, both before and after the Great Recession.

The Port of Oakland handled almost the same amount of container cargo in 2017 as it did a decade earlier. The ports of Los Angeles and Long Beach showed modest growth during this period, while East Coast ports grew substantially in terms of both actual volume and market share. In the Pacific Northwest, there was a strong shift of cargo from the ports of Seattle and Tacoma (Sea/Tac in Figure F-1) across the U.S. border to the Port of Vancouver, BC, and to the new container terminal at the Port of Prince Rupert, BC, which opened in 2007.

The first port-of-call volumes and correspondingly high revenues at the San Pedro Bay Ports (SPBP [Ports of Los Angeles and Long Beach]) allow more access to capital for investment relative to the Port of Oakland, and the higher volumes result in higher levels of utilization per vehicle for CHE. Higher per-unit equipment usage at the SPBP, in terms of both hours of operation and container moves, results in a more favorable business case for switching to ZE and NZE equipment that costs the same to buy as in Oakland, since higher utilization results in more operating cost savings. Because the ports of Oakland, Los Angeles, and Long Beach are in California, they are subject to the same California Air Resources Board (CARB) regulations.

FIGURE F-1: CONTAINER VOLUME (TEU) FOR NORTH AMERICAN WEST COAST PORTS



Notes:
Sea/Tac = Seattle and Tacoma
TEU = Twenty-Foot Equivalent Units

Source: AAPA 2018

Seaport activities at the Port of Oakland include transfer of cargo between vessels and container yards at marine terminals, where cargo is also delivered and taken to its destination by drayage trucks. The Seaport Area at the Port is served by two Class I railroads, one operating on Port-owned property (BNSF Railway), and one on private property adjacent to the Seaport (Union Pacific Railroad). Furthermore, the Seaport includes off-dock tenants, such as transloading and distribution businesses.

SEAPORT AIR QUALITY 2020 AND BEYOND PLAN

The Seaport Air Quality 2020 and Beyond Plan (2020 and Beyond Plan or Plan*)* includes three phases: Near-Term (2019-2023), Intermediate-Term (2023-2030), and Long-Term (2030-2050). The Seaport is moving forward in the context of anticipated new CARB regulations, currently under development, that are expected to have a substantial effect on the Plan going forward (see the following section, Regulatory Setting).

Due to regulatory uncertainty and limited availability of current ZE equipment, an overall cost to convert all landside equipment and drayage trucks to ZE has not been predicted in this study, as there is insufficient information available to develop a meaningful cost estimate. For example, current electric drayage truck prototypes are priced at around $300,000 each, so complete replacement of the about 8,750 trucks in the Port's Drayage Truck Registry could have an estimated total cost of about $2.6 billion. However, this figure has very little meaning for a variety of reasons, including: (1) current electric drayage truck models are not developed enough to be capable of replacing all duty cycles performed by the current diesel drayage truck fleet; (2) when the technology is fully developed, it should be somewhat closer to the costs of conventional equipment with potential operational savings factored in; and (3) ZE truck production capabilities are not yet sufficient to replace the entire drayage truck fleet in any reasonable amount of time.

Overall equipment replacement costs were not analyzed in detail, as this was also not expected to yield a meaningful result due to a variety of technical, commercial, and regulatory uncertainties. For example, there are 386 pieces of diesel-powered CHE on-site at the Port of Oakland. If Tier 4 diesel replacements were ordered tomorrow, the total replacement cost would be on the order of $125 million, plus tax and freight. If terminal operators instead ordered whichever demonstration ZE equipment is available today, it would amount to perhaps $350 million plus tax and freight (about three times higher). This is not a feasible or reasonable cost for operators, so this analysis focused instead on individual case studies for the equipment most likely to be feasible within the next 5 years. Although the Seaport awaits new regulations that will drive investment in zero-emissions equipment, investments in large amounts of new equipment (either clean diesel or ZE models), given the stranded assets concern (i.e., getting rid of equipment that still has some useful life remaining), are not expected. Furthermore, while demonstration equipment models are available for purchase in small quantities, current ZE equipment vendors do not have the production capability to replace petroleum-powered equipment serving the Seaport with ZE models.

Infrastructure costs, such as transmission system upgrades and electric vehicle charging stations, are also not included in this Appendix. The Port is developing a separate cost estimate for these costs, independent of this report.

REGULATORY SETTING

CARB regulates mobile sources of emissions. The relevant regulations include the Mobile Cargo-Handling Equipment Regulation (CHE Regulation) at Ports and Intermodal Rail Yards, amended in October 2012, and the Drayage Truck Regulation, dated November 2011. The CHE Regulation requires new equipment to have either a Tier 4 Final off-road engine or a model year 2010 or newer on-road engine. Yard tractors were required to be fully compliant with the CHE Regulation by December 31, 2017, and other types of yard equipment (top-picks, RTG cranes, etc.) were required to be fully compliant by December 31, 2013. In March 2017, the CARB Governing Board directed CARB staff to develop new regulations for CHE that will require up to 100% ZE equipment by 2030. New CHE regulations may be adopted as soon as 2022, with implementation starting as early as 2026.

The feasibility of the proposed 2030 ZE regulations will depend heavily on how the rule is structured and how stranded assets are treated. A rule that requires all equipment in operation to be fully ZE by 2030 is unlikely to be feasible, as this will require terminal operators to get rid of substantial quantities of equipment with some useful life remaining. However, if the rule is structured such that all new purchases from 2030 onward are required to be ZE, the feasibility of meeting this schedule will improve, although the schedule may still present substantial technical challenges. See Figure F-2: CHE and Truck Technology Maturity Status for a summary of the technical and commercial status of various ZE and NZE equipment types.

Under the Drayage Truck Regulation, since January 2014, drayage trucks (which are Class 8 trucks) must have a 2007 or newer model year engine; by January 2023, drayage trucks must have a 2010 or newer model year engine. Senate Bill 1 prohibits CARB from implementing new requirements that would be applicable before a truck has reached 800,000 vehicle miles or 18 years from the engine model year, whichever comes first. CARB has published an update indicating that it will consider new drayage truck regulations in 2022, with implementation in the period from 2026 to 2028 (CARB 2018).

INCENTIVE FUNDING

The most readily accessible incentive funding is CARB's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP), which is administered by CALSTART on a first-come, first-served basis. The program provides incentives (up to 80% of the capital cost differential between diesel and NZE/ZE equipment) for Class 8 (down to Class 2B) on-road non-passenger vehicles. Yard tractors, although generally used off-road, can be purchased via HVIP with a $150,000 voucher (with an additional $15,000 if the buyer is from a disadvantaged community [DAC]). Currently, one off-dock City of Oakland tenant operates an electric yard tractor at the former Oakland Army Base.

Yard tractors operating within marine terminals must be designed to support heavier loads than those that have been purchased for off-dock use. A yard tractor suitable for serving vessels at a marine terminal (on-dock) is in the demonstration phase. CARB plans to unveil its off-road equivalent to HVIP, the Clean Off-Road Equipment incentive program, in mid-2019. One ZE electric drayage truck available for purchase via HVIP is also in the demonstration phase at the Port of Oakland.

EQUIPMENT AND VEHICLE TECHNOLOGIES CONSIDERED

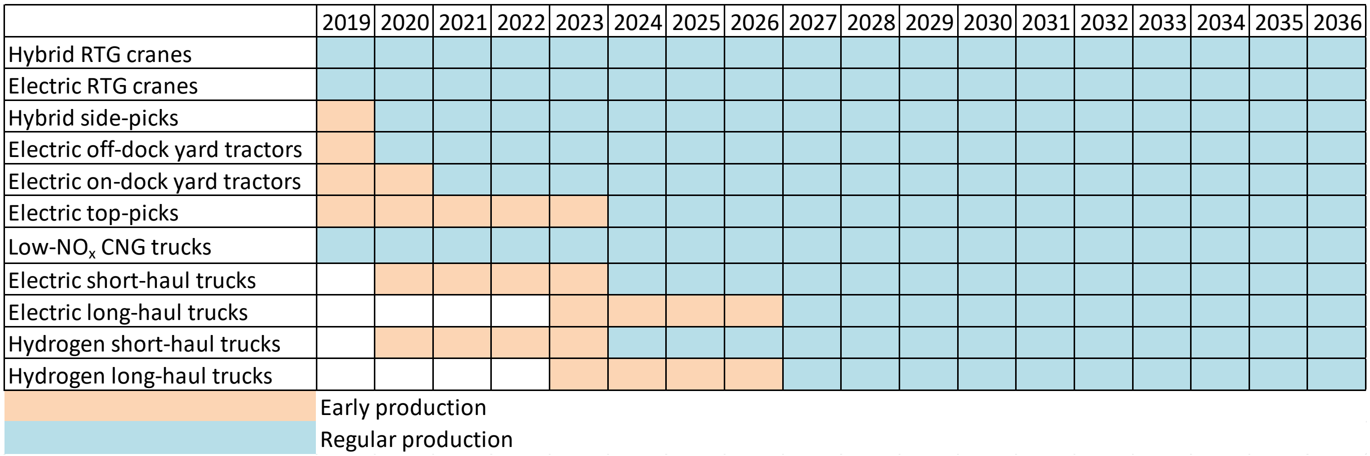
This analysis considered two categories of land-side equipment: CHE and drayage trucks. CHE consists primarily of yard tractors, RTG cranes, and top-picks. Locomotives operating at near-dock rail yards were not analyzed, as they only generate a small fraction of total Seaport emissions and not all locomotives can be regulated by CARB (Class I rail is not regulated by CARB).

Drayage trucks were divided into two categories: short-haul and long-haul. Short-haul trucks stay within a seaport for lower-speed moves such as rail yard trips and therefore need less range to be viable. These lower-speed moves are often referred to as "shuttle" or "land-bridge" moves. Long-haul trucks are often domiciled (i.e., stored when not in use) away from the Port and travel longer distances at highway speeds. Any non-petroleum replacement therefore requires long-range capability and fast recharging to be operationally feasible. Currently, about 10% to 15% of all containers moving through the marine terminals go to and come from the rail yards (Tioga 2016).

Advanced technologies to replace conventional equipment vary considerably in their current state of development. Current options for replacement include hybrid NZE equipment, alternative fuel engines that allow NZE operation (e.g., natural gas engines using renewable natural gas), battery-electric vehicles, hydrogen fuel cell vehicles, and terminal equipment that can be connected to the electricity grid through cables or bus bars. For example, hybrid RTG cranes, which use a battery with a small engine for repowering when energy recovery is insufficient to keep the battery charged, are part of the regular offering list from multiple large equipment vendors (e.g., Kalmar, Kone, and Paceco). On the other end of the spectrum, battery-electric top-picks or long-haul drayage trucks are a few years away from even early production. The necessary charging infrastructure for long-haul trucks is also unknown at this point. Furthermore, there are potential issues associated with the electrical vehicle charging equipment, including city electrical permit and inspector safety certification requirements, standardization of electric plug design among manufacturers, and the technological advancement of master controllers (power management) to charge vehicles sequentially and reduce peak demand.

Figure F-2: CHE and Truck Technology Maturity Status shows a conceptual view of the availability of each type of equipment analyzed in this appendix. Although early production indicates prototypes exist and individual units may be available for purchase and testing by interested parties, large-scale production and purchases are not available. These early units will also generally be effectively custom-made as ordered and thus have much higher purchase costs and lead times than fully commercially available vehicles, as full commercial production requires much more robust manufacturing infrastructure and speed of delivery. Regular production means vehicles are fully commercially available and fleets of vehicles can be purchased as needed from equipment manufacturers. With the exception of battery hybrid RTG cranes and side-picks, all of these refer to fully electric vehicles. Other technologies, such as hydrogen fuel cell drayage trucks, are in the demonstration phase and have not yet reached early commercialization.

FIGURE F-2: CHE AND DRAYAGE TRUCK TECHNOLOGY MATURITY STATUS



Notes:

CHE = cargo-handling equipment
CNG = compressed natural gas
NOx = nitrogen oxides
RTG = rubber-tired gantry

Source: Port of Oakland

Yard tractors offer the most detailed data, as there are four worldwide manufacturers (Orange EV, BYD, Kalmar, and Terberg) with battery-electric models as of late 2018. However, the total number of units produced to date is low, and most units are lighter-specification machines suitable for off-dock use only, not for heavier marine terminal applications, which comprise 90% of the Port's yard tractor fleet. A comprehensive cost analysis of these machines shows that they may save money compared to diesel today, and cost savings likely improve over time, as the price of electric vehicles is expected to drop due to decreases in battery prices and increasing production economies of scale. High capital costs, however, are a barrier to widespread adoption, and the availability of HVIP vouchers to offset the higher purchase price of electric yard tractors is critical and will remain critical to users' widespread adoption.

Although the overall amount of electric power needed for CHE charging will be low in the near term compared to the current power used at the Port due to the relatively small number of units that will be deployed, the peak power delivery capacity required for charging on busy days may become substantial in the intermediate term. This can potentially be mitigated by pairing chargers with a battery buffer to limit the draw on the electric grid. Any such buffer (or other energy storage system) would increase infrastructure costs related to implementing battery-electric equipment.

Hurdles to initial adoption of battery-electric yard tractors include operator concerns about either battery range or maximum allowed cargo-handling weight (ability to move up to 170,000 pounds) and uncertainty about the role of ILWU and IAM labor in plugging and unplugging vehicles. As these issues are better understood, electric yard tractors may become a more appealing option in the intermediate term.

This Appendix focuses on battery-electric yard tractors as the most appealing zero-emissions CHE at marine terminals because the state of battery-electric yard tractor development is advanced enough to allow a preliminary cost analysis. Other options exist, including hydrogen fuel cell vehicles or internal combustion vehicles using alternative and renewable fuels, but these vehicles have downsides in terms of current development status, cost, fuel availability, local emissions, or upstream emissions compared to battery-electric vehicles. An ongoing effort to increase renewable power to the California electric grid may eventually allow electric equipment to be paired with zero-emissions electricity for true zero-emissions operations. No matter whether or when the California electric grid becomes 100% renewable, the fraction of renewable power is expected to increase every year for the foreseeable future.

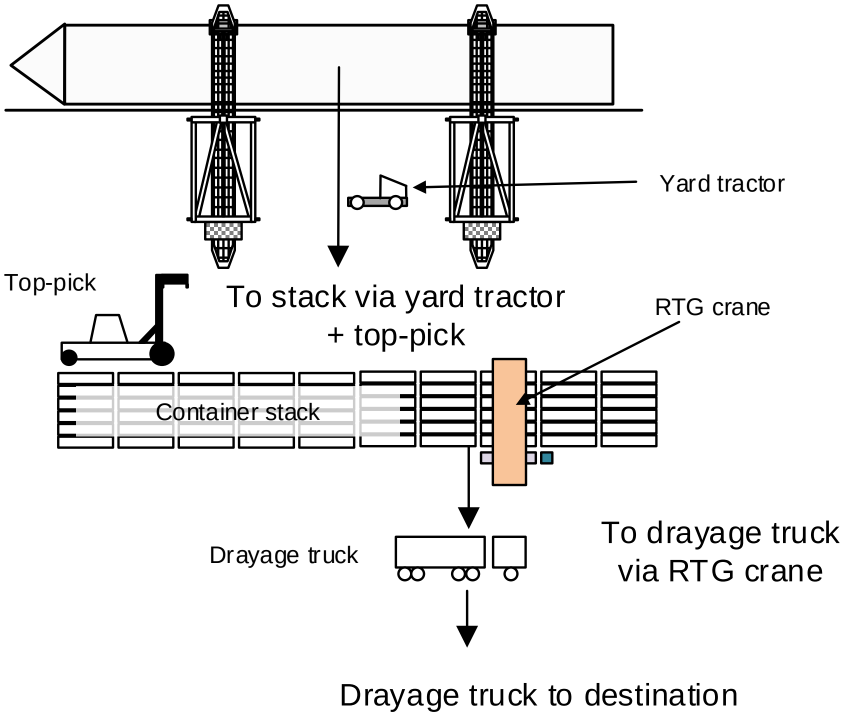
CONTAINER TERMINAL OPERATIONS

Four primary types of CHE are used at the Seaport to handle containers within the marine terminals:

- Ship-to-shore (STS) cranes
- RTG cranes
- Top-picks (and side-picks)
- Yard tractors

Figure F-3: Import Container Move Schematic Example shows a schematic of how this equipment is used for a typical import container move (i.e., taking a container from a ship to the marine terminal to a drayage truck). For imports, an STS crane removes the container from the vessel and places it on a yard tractor. A top-pick moves the container from the yard tractor to the stacked containers in the yard. When a drayage truck is ready to receive a container, an RTG crane moves the container from the stack onto the truck. When a container is brought to a marine terminal for loading onto a ship (an *export move*) only top-picks are used. The top-pick moves the container from the drayage truck to the stack, and then from the stack to a yard tractor. The yard tractor then brings the container to the STS crane for loading onto the vessel. This practice is why top- and side-picks are far more numerous than RTG cranes at U.S. West Coast container terminals and why commercial availability of ZE top-pick models is crucial to transitioning the U.S. West Coast to fully zero-emissions terminal operations.

FIGURE F-3: IMPORT CONTAINER MOVE SCHEMATIC EXAMPLE



Note:
RTG = rubber-tired gantry
Source: Port of Oakland.

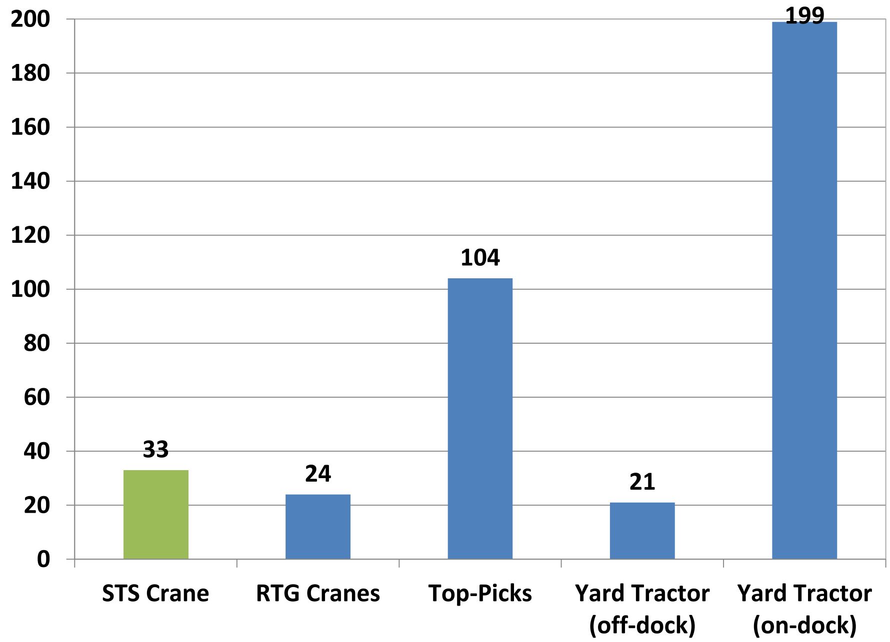
Figure F-4 shows example images of top-picks and RTG cranes.

FIGURE F-4: TOP-PICK (LEFT) AND RTG CRANES (RIGHT)

Note:
RTG = rubber-tired gantry
Source: Port of Oakland, 2019.

Figure F-5 shows the 2017 inventory of each piece of CHE at the Port.

FIGURE F-5: PORT-WIDE CARGO-HANDLING EQUIPMENT (CHE) INVENTORY



Notes:

RTG = rubber-tired gantry
STS = ship-to-shore

Source: Port of Oakland, 2019.

CURRENT STATE OF ZERO-EMISSIONS VEHICLE TECHNOLOGY

The STS cranes in Oakland are powered by electricity delivered via high-voltage cables. All the STS cranes are 100% electric and no batteries are involved with their operation.

Although approximately 25% of the global fleet of RTG cranes also runs on electric power delivered by cable or bus bar, this type of landside infrastructure is incompatible with the standard stevedoring practice on the U.S. West Coast, which is to use top-picks to place import containers into a stack and RTG cranes to extract containers for drayage trucks (see Figure F-3: Import Container Move Schematic Example). For this reason, hybrid-electric RTG cranes appear to be the most appealing option to reduce emissions from this class of CHE in the near to intermediate term. Hybrid RTG cranes are currently available from multiple equipment vendors (e.g., Kalmar, Kone, and Paceco), and existing diesel RTG cranes can also be repowered as hybrids. SSA Terminals, which operates Oakland International Container Terminal (OICT) and Matson Terminal, is in the process of replacing thirteen 1,000-horsepower engines with 142-horsepower engines via the hybrid-electric RTG project at OICT (refer to Appendix C, Implementing Actions).

As described above, and as Figure F-5: Port-Wide Cargo-Handling Equipment (CHE) Inventory shows, top-picks are a much more common type of CHE than RTG cranes in Oakland. At present, there are no commercially available battery-electric top-picks. A few top-picks have been developed as custom conversions for demonstration purposes, but the cost of these machines will probably not indicate what original equipment manufacturers (OEMs) will offer in the future. Fully battery-electric top-picks are under development. Hybrid-electric side-picks exist but are only suitable for lighter applications (empty containers). No hybrid top-picks are commercially available. Development of fully battery-electric top-picks is driven largely by interest in transitioning to full zero-emissions operations in California. Therefore, developing a fully electric top-pick is of greater interest than the interim step of hybridizing. Because hybrid top-picks are not currently commercially available or under development, hybrid top-picks costs were not analyzed in detail.

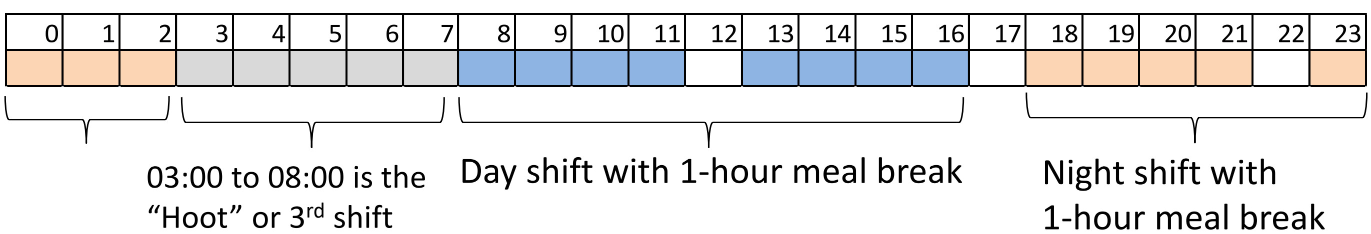
There are indications that fully electric top-picks will be available in the intermediate term (2023-2030). Through a variety of grant funding sources, the Port of Long Beach plans to test five electric top-picks at three separate facilities in the near term. One of these same grants will fund demonstration of an electric top-pick at the Port's Matson Terminal in 2020. In addition, the Kalmar website states:

> "Kalmar announced that our full offering will be available as electrically powered versions by 2021. Why have we taken such a leap with our entire product portfolio? Because the industry demand is there, and it's growing much faster than anyone could have anticipated only a few years ago" (Kalmar Global 2018).

As previously mentioned, operating hours per charge and labor rules regarding plugging in equipment are major issues limiting the enthusiasm of marine terminal operators for electric yard tractors.

Figure F-6 shows the standard working hours for the ILWU, the union responsible for stevedoring operations (loading and unloading of ships) on all U.S. West Coast marine terminals (IAM also operates at OICT and Matson Terminal but is not directly involved in stevedoring).

FIGURE F-6: ILWU WORK HOURS



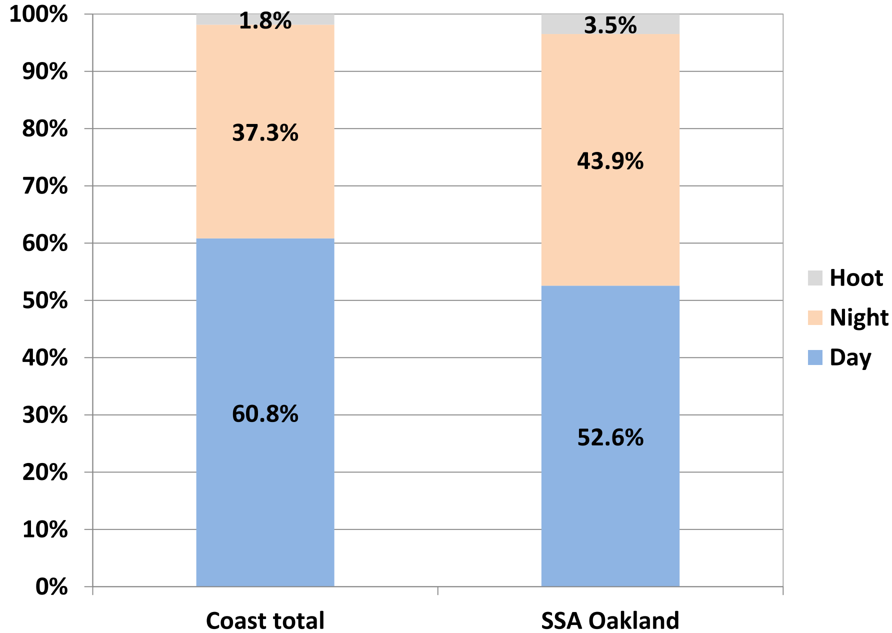
Note:

ILWU = International Longshore and Warehouse Union

Sources: AECOM and Port of Oakland interview with Michael Andrews, Terminal Manager, Everport Terminal Services, September 14, 2018; AECOM and Port of Oakland interview with Brian Bauer, Vice President, Operations, TraPac, September 4, 2018; AECOM and Port of Oakland interview with Paul Gagnon, Vice President, SSA Terminals, August 29, 2018, and conversation with Port staff October 2, 2018.

Figure F-7 shows a breakdown of the total shifts worked in 2017 at the terminals on the entire U.S. West Coast versus the total shifts worked at OICT in Oakland, showing that hoot shifts are worked occasionally, but vessel operations are dominated by day and night shift activity.

FIGURE F-7: SHIFTS WORKED IN 2017 AT OICT VERSUS U.S. WEST COAST CONTAINER TERMINALS



Notes:

OICT = Oakland International Container Terminal
SSA = SSA Terminals

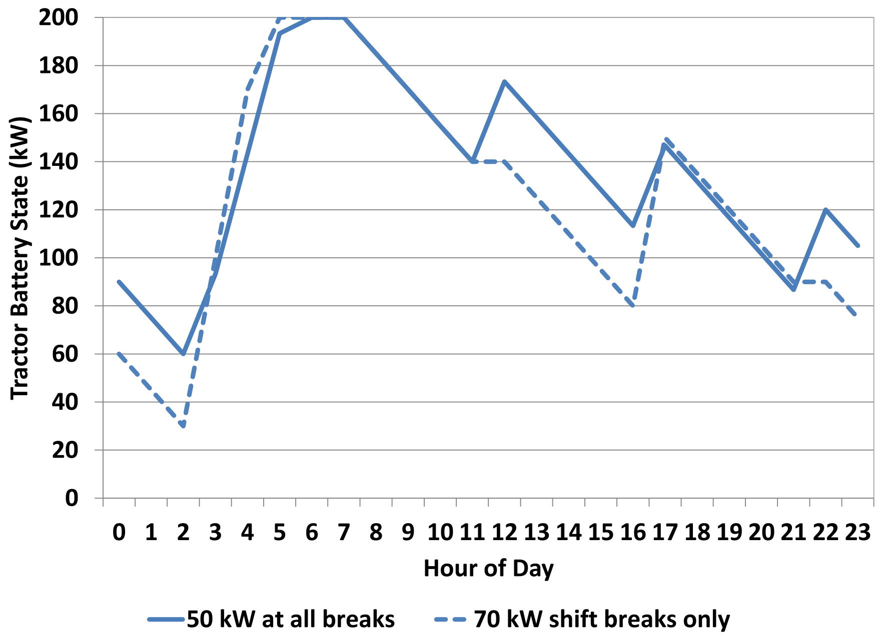
Sources: *Pacific Maritime Association 2017 Annual Report* (PMA 2018)*;* Susan Ransom, Customer Support Manager, SSA Terminals, and Jim Rice, General Manager of OICT, SSA Terminals, email to Port of Oakland staff, October 16, 2018.

The primary opportunity for electric vehicle charging is the 5-hour *hoot* shift between 3:00 a.m. and 8:00 a.m. An ideal equipment specification for the Oakland market would have a battery large enough to last 20 operating hours. If a marine terminal yard tractor uses perhaps 15 kilowatt-hours (kWh) per hour, roughly three times more than a non-Port yard tractor (Bill Aboudi, AB Trucking, conversation with Port of Oakland staff, 2018), a battery of about 220 kW would be sufficient if the vehicle could be charged between the day and night shift breaks. This is approximately equal to the maximum battery sizes currently offered from manufacturers. There are days when all three shifts are worked—this analysis considers an average day, recognizing that in reality, electric yard tractor charging solutions may sometimes need to accommodate the maximum three-shift usage scenario. The two-shift scenario is based on being able to fully recharge tractors overnight during the third (hoot) shift.

Figure F-8 shows two potential battery uses and recharge patterns during a two-shift workday for a nominal 200 kWh battery. A 200 kWh battery was selected as a value near the top end of current electric yard tractor models for sale. For 16 hours of work at 15 kWh per hour, an electric yard tractor will require a total of 240 kWh per day if required for a full two shifts. With a 200 kWh battery size, this means some recharging over an hour-long shift, and lunch breaks may be required during peak operating conditions.

Both cases in Figure F-8 assume the battery drains at a rate of 15 kWh per hour of operation, and any hour break would result in a net 40 minutes of actual recharge time. The solid bar shows a recharge rate of 50 kW over each shift break, meal break, and the hoot shift. The dashed line shows a recharge rate of 70 kW during shift breaks and the hoot shift only. Meal breaks are excluded due to uncertainty about whether vehicles can effectively be recharged during meal breaks; this uncertainty is based on the fact that in current operations, yard tractors may not be parked in locations with charging stations over meal breaks. Either pattern shows that electric yard tractors have the potential to operate through a typical two-shift workday, with recharging as needed over shift changes and/or breaks.

FIGURE F-8: YARD TRACTOR BATTERY STATE DURING A TWO-SHIFT WORKDAY



Note:
kW = kilowatt
Source: Port of Oakland

ELECTRICAL SYSTEM STATUS

UTILITY OPERATIONS AND TERRITORY

The Port of Oakland has been serving as a municipal utility since 1985, at a portion of the Seaport and the Oakland International Airport. The TraPac Terminal, the Ben E. Nutter Terminal, the Outer Harbor Terminal, Matson Terminal, and Howard Terminal all have Pacific Gas and Electric Company (PG&E) or East Bay Community Energy as their utility. The main Port utility customers include tenants at the former Oakland Army Base, OICT, Cool Port, and BNSF Railway. In addition, shore power (cold ironing) is also served by the Port utility, with the exceptions of Matson Terminal and Howard Terminal.

The Port and PG&E are on target to meet the requirements of the Renewable Portfolio Standards (RPS) and California legislative mandates, such as Senate Bill 100 (September, 2018), which updates the RPS requirements to 60% eligible renewable by 2030 and 100% carbon-free electric supply to end-use customers by 2045.

TRANSMISSION AND DISTRIBUTION

As the Seaport moves towards zero-emissions operations, unless there is a breakthrough with hydrogen or currently unknown zero-emissions sources of energy, it will likely become necessary to upgrade the transmission infrastructure, although the exact tactics and timing are difficult to predict. All Port power is delivered through the main PG&E Substation C at 115 Martin Luther King Jr. Way in Oakland. The main line (115 kilovolts [kV]) is fed into two substations (which convert power from 115 kV to 12 kV) operated and maintained by the Port. The electrical distribution infrastructure downstream of these substations is also maintained by the Port.

A substantial new load from the Port will likely require additional upgrades both at Substation C and all downstream infrastructures owned and maintained by the Port. These upgrades may also include a completely new transmission line and substation. The cost of these upgrades is not developed here because it was not part of AECOM's scope. The Port is currently conducting a seaport electrical infrastructure study to assess infrastructure needs and costs to upgrade the electrical infrastructure in the Port area to support charging for future zero-emissions equipment as well as increased loads from shore power compliance, cold storage, and other projected future demands.

CARGO-HANDLING EQUIPMENT COST AND EMISSIONS ANALYSIS

AECOM analyzed the two cost-recovery scenarios presented below for equipment types that have early commercial advanced technology replacement options. Evaluations are also included for drayage trucks and renewable diesel as a replacement fuel. This analysis includes equipment only, not infrastructure.

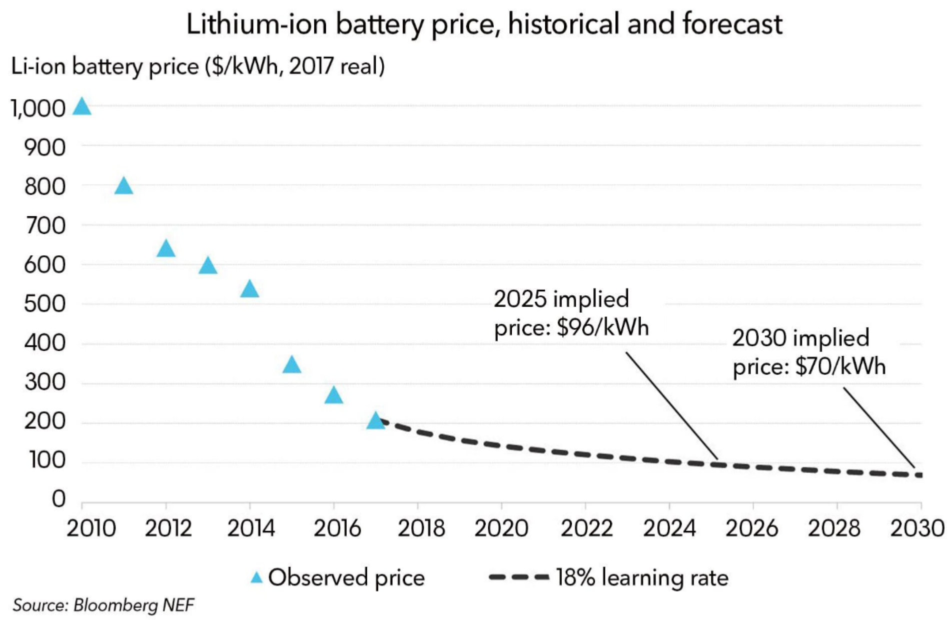
ELECTRIC VERSUS DIESEL YARD TRACTORS

In the near to intermediate term, electric vehicles will cost more to buy than diesel equivalents, but will likely save on maintenance and fuel costs. Subsidy programs in California can defray most of the difference in the purchase price between diesel and electric vehicles. The HVIP Program, for example, has $78 million in funds for this purpose from California's cap-and-trade revenue, and the HVIP Program's stated goal is to reduce the purchase cost difference in zero-emissions and conventional equipment by 80%.

An electric yard tractor may cost more than double what a comparable new diesel yard tractor costs in 2018. This is due to the relatively high cost of batteries and the very low production volume that increases the design and manufacturing cost per unit. In addition to the higher upfront costs, these yard tractors have a longer delivery time than their diesel counterparts and are not available from the lot. However, it is expected that the price of the lithium-ion batteries powering the electric yard tractors will continue to decline for the foreseeable future.

Figure F-9 is a chart of the future predicted price of lithium-ion batteries, generated by Bloomberg New Energy Finance.

FIGURE F-9: PREDICTED LITHIUM-ION BATTERY PRICE



Notes:

kWh = kilowatt-hour
Li-ion = lithium-ion

Source: BloombergNEF 2018.

According to Figure F-9 above, a 200 kWh battery that costs $40,000 or more in 2018 may cost as little as $14,000 (in 2017 dollars) in 2030. This trend, along with increasing scales of commercial production over time, will drive down the prices and price premium of electric yard tractors versus diesel machines over time.

As an example of this, consider the comparison of costs in 2018 versus 2025 for yard tractors. A new diesel yard tractor will cost $115,000 (in 2018 dollars) for both years. With 12% tax and fees included, a new diesel yard tractor will cost approximately $129,000 to purchase. An electric yard tractor currently costs $300,000, but includes an HVIP voucher of $150,000 (+$15,000 if the buyer is in a DAC), for a net retail price of $150,000 (or $135,000 if in a DAC). The buyer will pay 12% tax and fees on the original price of $300,000 ($36,000), which brings the total purchase price to $171,000, for a difference of $42,000 in the capital cost if the buyer is in a DAC.

By 2025, the retail price of an electric yard tractor is expected to decline to approximately $217,000 due to lower battery costs and a lower commercialization scale. The rebates available will decline along with the difference in price between diesel and electric, so the 2025 voucher is expected to be $82,000, for a net price of $135,000 and an all-in price including tax of $161,000, which is about $33,000 higher than a diesel yard tractor. If the buyer is in a DAC with an additional $15,000 voucher, this $33,000 difference may reduce to $18,000. Whether HVIP vouchers will be available after 2023 is unknown and this may have a substantial impact on cost trends; without them, the 2025 example case will cost equipment buyers $82,000 more per yard tractor.

Electric yard tractors will generate savings in both maintenance and energy compared with diesel yard tractors, based on preliminary operating data from existing in-use electric yard tractors as well as current diesel fuel and electricity costs. However, these tractors are likely to incur some operating costs for the labor to plug and unplug the vehicles, as drivers of electric yard tractors are not likely to plug and unplug their own vehicles. The potential labor cost has not been accounted for in this study due to uncertainty about future equipment charging strategies, including the potential for future automated charging systems such as pantographs (an apparatus mounted on the roof of a piece of equipment that collects electricity through a connection to overhead wires).

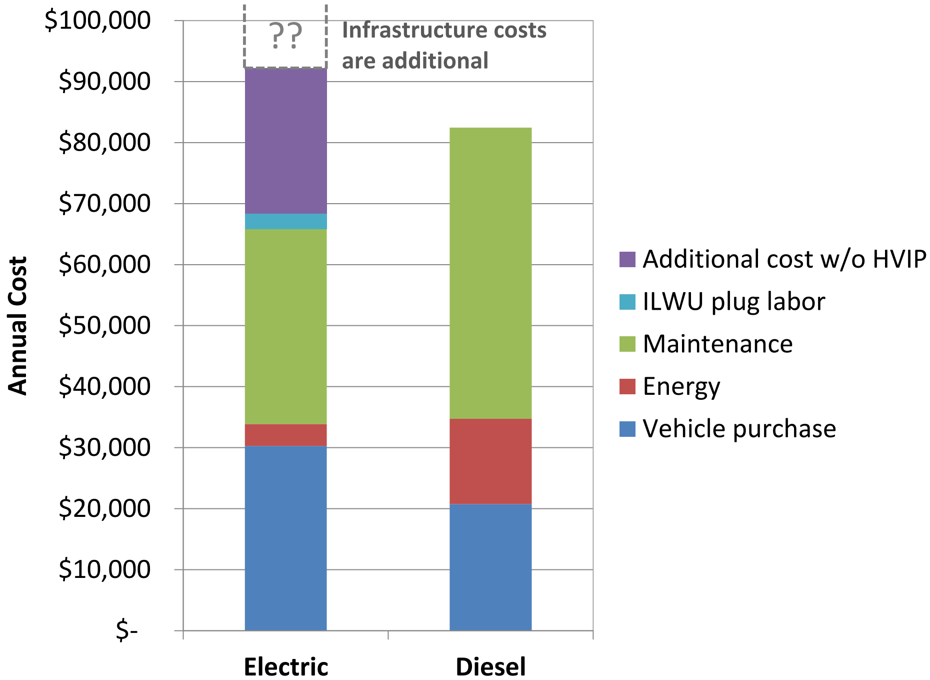
The following assumptions were used to derive the operating expense savings for electric yard tractors:

- 1,600 yard tractor operating hours per year, growing at 1.2% per year
- $30 maintenance cost per operating hour for diesel yard tractors
- $20 maintenance cost per operating hour for electric yard tractors
- 2.5 gallons of diesel burned at $3.50 cost per gallon = $8.75 per hour fuel cost
- 15 kW electricity used at a mean rate of $0.15/ kWh = $2.25 per hour electricity cost

Beginning in 2019, additional electric yard tractor savings may be realized from Low Carbon Fuel Standard (LCFS) credits. Depending on the sale price of the LCFS credits and the costs to administer the LCFS program and monetize LCFS credits, LCFS credits could be used to offset the cost of electric yard tractors. Due to uncertainty about when these credits will be available, the cost to administer these programs, and the long-term sales price (value) of the credits, none of the charts in Appendix F includes LCFS credits.

Figure F-10 shows a comparison of the total annual cost of an electric versus a diesel yard tractor based on 2018 values. With HVIP vouchers, the all-in annual cost to purchase and operate an electric vehicle may already be less than that of a diesel yard tractor, considering vehicle costs only. As the chart notes however, infrastructure costs are not included and will add to the total cost of owning and operating an electric yard tractor. It should also be noted that this cost estimate assumes relatively problem-free operations.

FIGURE F-10: ANNUALIZED YARD TRACTOR COST COMPARISON (2018)



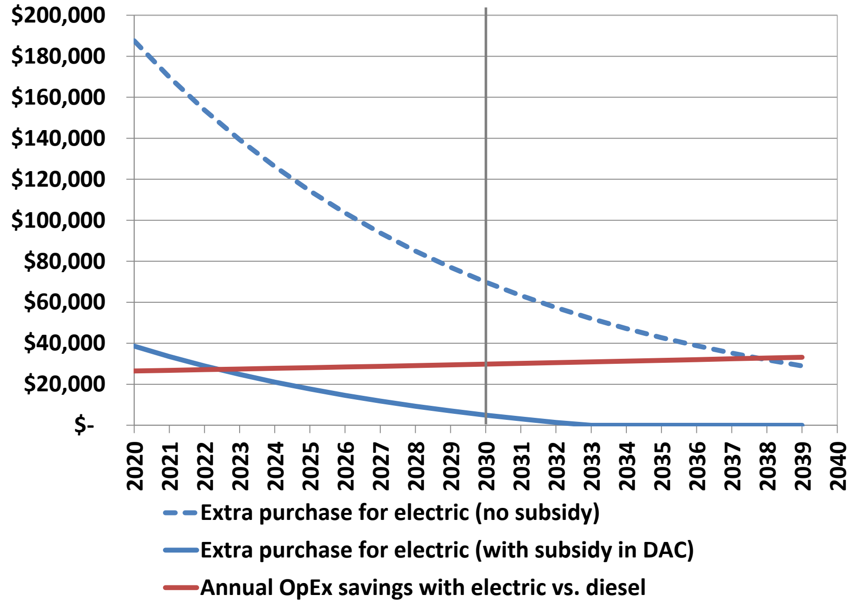
Notes:

HVIP = Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
ILWU = International Longshore and Warehouse Union
w/o = without

Source: Port of Oakland

Figure F-11 shows the projected difference in purchase price between electric and diesel yard tractors through 2040 as well as the expected annual savings in operating costs with electric yard tractors. When the red and blue lines cross, it means the additional upfront capital required to purchase an electric yard tractor will be recouped in 1 year through operating expense savings (i.e., less fuel and maintenance); this is noted merely to provide context and to compare the two potential cost trends. Note that Figure F-11 presents two purchase cost trends: a) with and b) without subsidies. (Note that the *with subsidy* case includes an additional amount up to $15,000 for being in a DAC.) In the case in which subsidies are available indefinitely, the lines cross around 2022. Without any subsidies, the lines do not cross until about 2038. This underscores how crucial vouchers will be to encouraging adoption of electric yard tractors, not only in the near term but for many years. Yard tractors need to be financially appealing to terminal operators to be adopted on a large scale. Note that Figure F-11 addresses vehicle cost trends only; there will be additional costs for charging infrastructure and potentially additional labor costs to plug in and unplug yard tractors, as also noted in Figure F-10: Annualized Yard Tractor Cost Comparison (2018).

FIGURE F-11: YARD TRACTOR COST TRENDS OVER TIME



Notes:

DAC = disadvantaged community
OpEx = operating expense

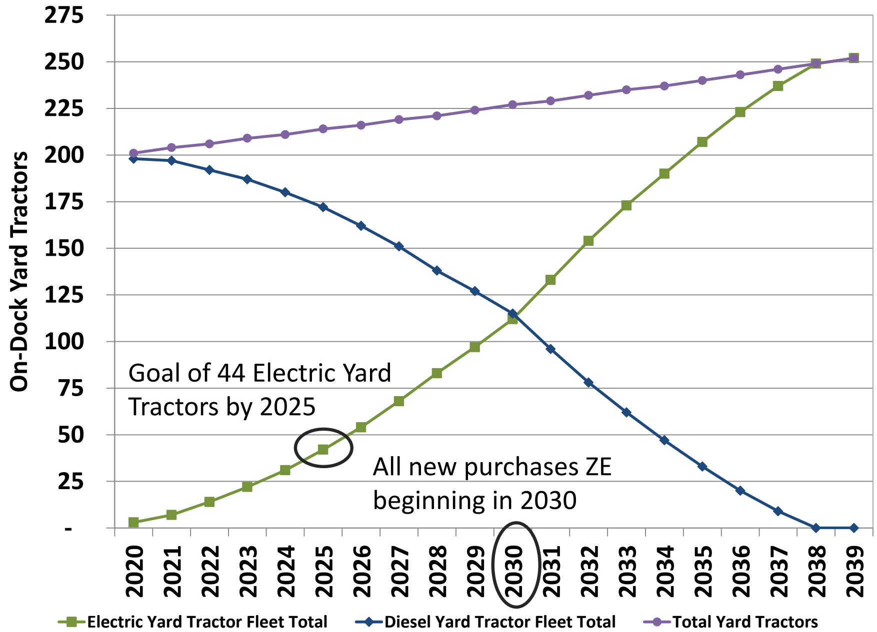
Source: Port of Oakland

On a purely financial basis, electric yard tractors seem appealing at present with subsidies, and this equipment will get more appealing over time. Despite this, it is difficult to predict the rate at which operators will adopt this equipment. Operators are concerned about the lack of real-world data in marine terminals with regard to battery range, load capacity, and durability (how long the vehicle will actually last), as well as the uncertainty regarding plug-in and un-plug labor protocols and the availability of parts and repair service. For businesses that typically purchase used equipment, the higher capital expenses may be more of a deterrent even if the operating expenses are lower, and current equipment may not be fully amortized yet. Smaller operators may not be able to afford the equipment and/or banks may be unwilling to provide financing for equipment that does not have a proven track record.

The makeup of the overall fleet of vehicles at the Port will change gradually because a typical diesel yard tractor has a useful life of approximately 8 years, according to interviews with each of the marine terminal operators. It is unlikely that operators will replace equipment before the end of its useful life, so it is assumed that one-eighth of the Port fleet of 199 yard tractors will be replaced each year on average.

Figure F-12 shows the assumed electric (versus diesel or gasoline) yard tractor fleet sizes at the Port over the next 20 years. This analysis assumed that beginning in 2030, all new yard tractors purchased will be electric. Prior to that, the fraction of electric yard tractors bought ranges from about 10% to 60%. New purchases to accommodate volume growth are also included, and a larger total yard tractor fleet size is therefore expected in 2039 rather than 2020.

FIGURE F-12: ASSUMED FRACTION OF PORT YARD TRACTORS USING ELECTRIC POWER VERSUS DIESEL OR GASOLINE



Note:

ZE = zero emissions

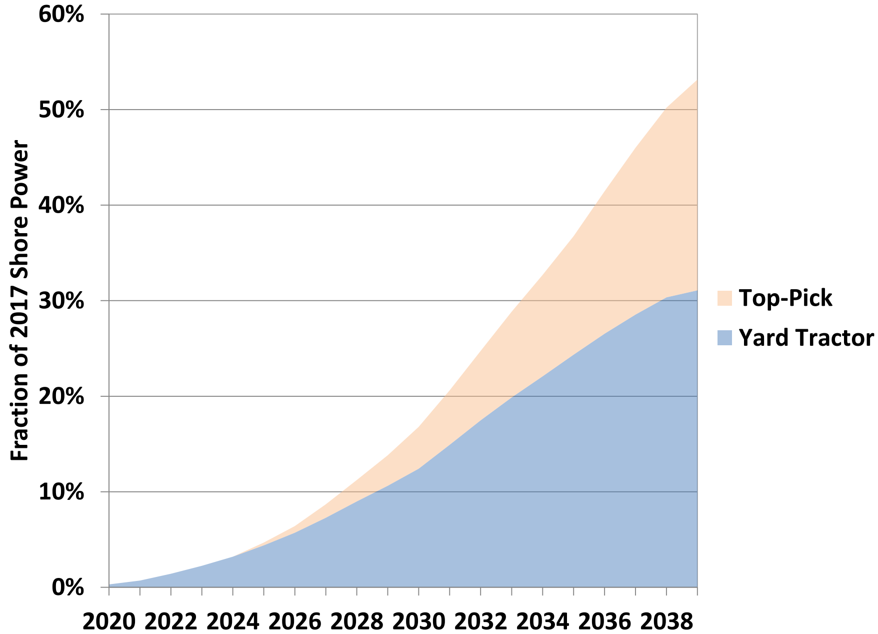
Source: Port of Oakland

POWER USE FOR NEAR-TERM ELECTRIC YARD TRACTORS AND INTERMEDIATE-TERM ELECTRIC TOP-PICKS

Figure F-13 shows a projected annual power used by both yard tractors and top-picks, the two equipment types expected to have electrically powered models requiring charging from the grid. Top-pick adoption was assumed to lag yard tractor adoption by 5 years. For a rough comparison, AECOM assumed that electric top-picks use approximately twice as much electricity per operating hour as electric yard tractors. As there are also about twice as many yard tractors as top-picks (see Figure F-5: Port-Wide Cargo-Handling Equipment Inventory) operating at the Port today, electric yard tractors and electric top-picks will use approximately the same amount of energy as a total fleet.

As Figure F-13 shows, the total power demand for CHE charging in 2040 is expected to be about 53% of what the Port currently uses annually for vessel shore power (about 24,000 megawatt hours in 2017 per Port of Oakland staff) or about 12,000 megawatt hours. Shore power is used as a baseline to compare to existing Seaport electricity usage because, in the near-term, some electrical capacity may be available from recent shore power infrastructure upgrade projects. Based on this gradual rate of increase, it is not expected that the adoption of battery-electric CHE will require substantial infrastructure upgrades within the next decade. However, further site-specific study is required to confirm this. Eventually, a transition to fully electric terminal equipment may require costly electrical capacity upgrades, but the exact timing and cost of these upgrades are unknown, and upgrades for different parcels of Port property may vary in timing and cost.

FIGURE F-13: TOTAL CHE POWER VERSUS CURRENT VESSEL SHORE POWER



Note:
CHE = cargo-handling equipment
Source: Port of Oakland

Emissions Reductions for Electric Yard Tractors at Marine Terminals

Table F-1 summarizes the total tons of emissions reductions expected per yard tractor at existing average tractor utilization (i.e., annual hours of operation) and fuel burn rates, based on information provided by marine terminal operators. As there are currently 199 diesel or gasoline yard tractors operating at the marine terminals, use of electric tractors can lead to Seaport emissions reductions, particularly if paired with zero-emissions electricity sources. No grid emissions are accounted for in Table F-1, as the trend in California is toward an increasingly zero-emissions grid over time. Total reductions may trend upward over time as yard tractor fleet sizes grow and as volumes increase and enable more annual operating hours per yard tractor.

TABLE F-1: ANNUAL EMISSIONS REDUCTIONS PER ELECTRIC YARD TRACTOR

	PM_{10}	NO_x	CO_2
Annual Short Tons of Emissions Reduced (Eliminated) per Electric Yard Tractor versus Diesel	0.002	0.12	45.3
Annual Short Tons of Emissions Reduced (Eliminated) with all Existing 199 Yard Tractors Replaced by Electric Yard Tractors	0.45	23.10	9,022

Notes:
CO_2 = carbon dioxide
NO_x = nitrogen oxides
PM_{10} = particulate matter less than 10 micrometers in diameter
Source: Port of Oakland

ELECTRIC TOP-PICKS

Electric top-picks are a potentially promising new technology under development that could lead to substantial CHE-related emissions reductions, if proven feasible. After yard tractors, top-picks are the most common type of on-terminal CHE at the Port, and they contributed 45% of diesel particulate matter (DPM) from CHE in 2017 (Ramboll 2018: Table 4-3).

Although the feasibility of electric top-picks is not yet established, there are at least two pending demonstration projects in the near term:

- SSA Marine at Port of Long Beach Pier J is testing two battery-electric top-picks; equipment is expected to be deployed in 2019, and the demonstration phase is expected to be complete by 2020.

- The Matson (SSA) Terminal at the Port of Oakland will test one electric top-pick, and the demonstration project should be completed in 2020.

If these demonstrations perform favorably, it is possible for electric side-picks and top-picks to be considered feasible within the Plan's near-term time frame.

HYBRID VERSUS PURE DIESEL EQUIPMENT

RTG Cranes

AECOM developed a cost analysis for hybrid RTG cranes, which is presented below. Hybrid RTG cranes (as opposed to fully electric cranes) were included because they are both commercially available and compatible with existing operations at the Seaport.

Note that RTG cranes are a very different type of equipment than the yard tractors analyzed in previous sections (see the example shown in the photo in Figure F-4). RTG cranes lift containers out of stacks and place them onto yard tractors, which results in very high power loads, thus requiring a grid-connected system for fully electric operations (typically a cable-reel or bus bar). Although fully electric RTG cranes are also available worldwide, they are not compatible with the U.S. West Coast practice of placing imports coming off a vessel into stacks with a top-pick and retrieving them with an RTG crane (see the Container Terminal Operations subsection in the Equipment and Vehicle Technologies Considered section).

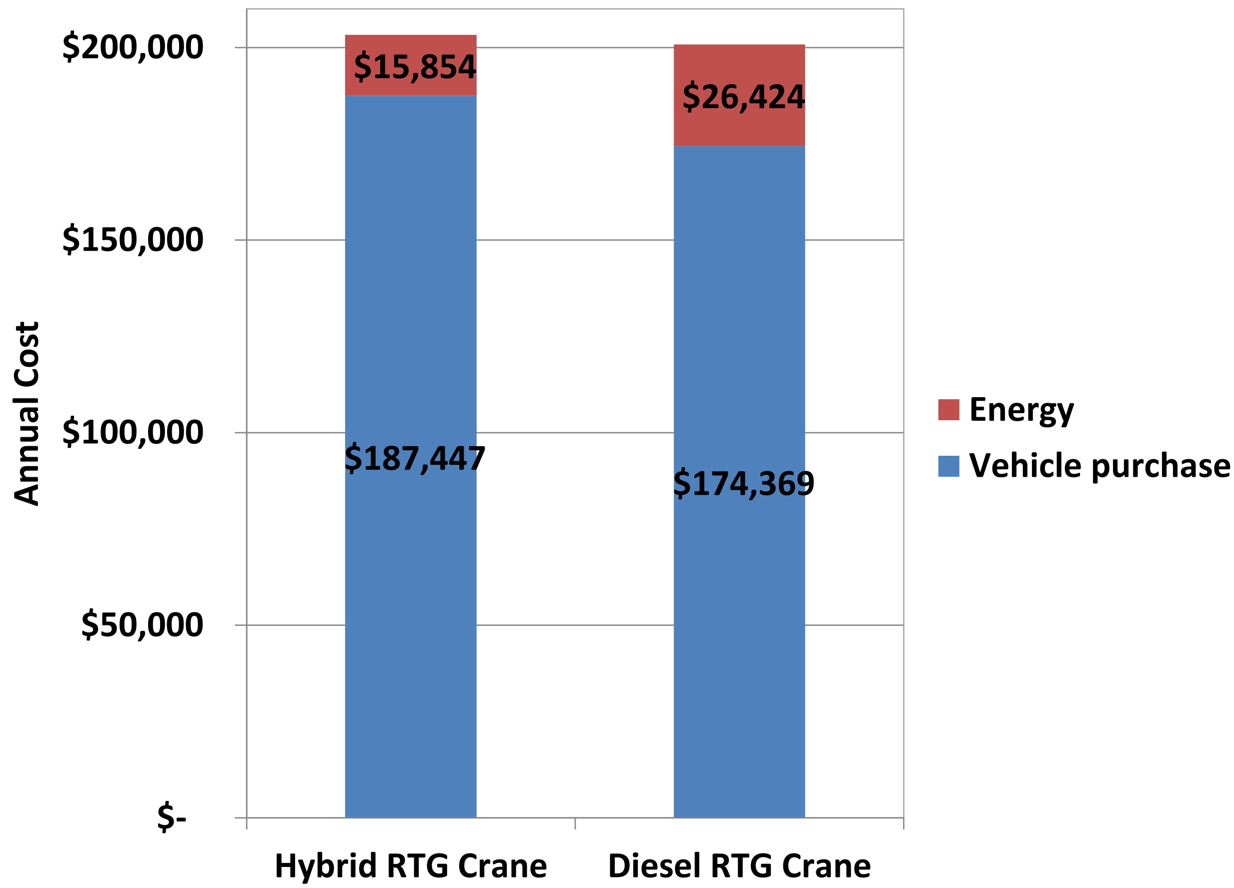
The key assumptions used to analyze the cost of hybrid versus pure diesel RTG cranes were the following:

- A new hybrid RTG crane costs $150,000 more than a pure diesel RTG crane ($2.15 million versus $2.00 million, respectively).
- Both diesel and hybrid RTG cranes have a 20-year machine life.
- Diesel RTG cranes burn on average 6 gallons of diesel per operating hour.
- Hybrid RTG cranes reduce fuel consumption by 40%, to 3.6 gallons per hour.
- The cost per gallon of diesel and associated diesel exhaust fluid is $3.50.
- The mean current RTG crane utilization is 1,200 hours per year.
- There is no difference in annual hybrid versus pure diesel maintenance costs.

Note this analysis is based on purchasing new hybrid RTG cranes, not retrofitting existing equipment, as the latter is a much more costly tactic at roughly $500,000 per retrofit. Retrofits would only be feasible if supported by grant funding, as is underway by SSA Terminals at OICT, but additional grant funding for hybridizing may not be available. Hybridizing RTG cranes through regular ongoing equipment replacement schedules would take on the order of 2 decades to complete, as some of the remaining 11 pure diesel RTG cranes at the Seaport are relatively new and will likely not be replaced for many years. The typical life of an RTG crane is about 20 years, more than twice the average life of a yard tractor.

Figure F-14 compares total annualized RTG crane purchase and fuel costs for hybrid versus pure diesel machines at 1,200 operating hours per year. The chart shows little difference in annual cost between the two cases. Note that RTG cranes at the Seaport are currently operated at a fairly low level of utilization, which limits the potential cost savings that can be generated by reduced hourly fuel usage. Over time volumes are expected to increase, so additional savings with hybrid RTG cranes may be recouped through increased utilization and thus more annual fuel savings. Figure F-14 does not include newly available LCFS credits, which can potentially be used to offset hybrid equipment costs.

FIGURE F-14: COST COMPARISON OF HYBRID VERSUS PURE DIESEL RTG CRANES



Note:
RTG = rubber-tired gantry
Source: Port of Oakland

Table F-2 summarizes the total annual emission reductions per hybrid RTG crane versus pure diesel RTG crane, based on existing equipment and operating conditions. Note this applies to the 11 RTG cranes at the TraPac and Everport terminals only, as SSA Terminals is already in the process of completing the repowering of its existing RTG cranes to hybrid RTG cranes at OICT in 2020; there are no RTG cranes at Matson Terminal. These figures are also based on 2018 utilization rates. Total reductions may trend upward over time as volumes increase and enable more annual operating hours per RTG crane.

TABLE F-2: ANNUAL EMISSIONS REDUCTIONS WITH HYBRID RTG CRANES VERSUS DIESEL-ONLY RTG CRANES

	PM_{10}	NO_x	CO_2
Annual Short Tons of Emissions Saved per Hybrid RTG Crane versus Pure Diesel RTG Crane	0.01	0.99	33.8
Annual Short Tons of Emissions Saved with All Remaining 11 RTG Cranes Hybridized	0.06	10.9	372

Notes:
CO_2 = carbon dioxide
NO_x = nitrogen oxides
PM_{10} = particulate matter less than 10 micrometers in diameter
Source: Port of Oakland

Other Hybrid Lift Equipment

Other commercially available hybrid lift equipment includes reach stackers from Kone cranes and side-picks manufactured by CVS Ferrari. Reach stackers are like top-picks with rotation and multiple row-stacking capability, while side-picks lift only empty containers. Reach stackers are not used in regular operation at any Seaport container terminal, so hybrid reach stackers were not analyzed as part of this study. No hybrid top-picks (which have heavier duty cycles than side-picks, as they handle loaded containers) are currently commercially available.

Due to the expected regulatory push toward requiring ZE equipment in California, several tests of fully electric top-picks, supported by grant funding, are planned in the State in the near-term. There has been comparatively little interest in development of hybrid top-picks, as hybrid models may not meet the ZE regulations that are under development. Hybrids top-picks and side-picks may also be less financially appealing, as they will not generate the same level of operating expense savings to offset increased purchase costs as fully electric models.

DRAYAGE TRUCKS

Drayage trucks have a much more demanding duty cycle than yard tractors because they must reach higher operating speeds. Long-haul trucks may have to climb typical highway gradients. They may also need to cover long distances in order to be viable. For these reasons, development of feasible long-range battery-electric trucks is expected to lag yard tractor development by several years (see Figure F-2: CHE and Truck Technology Maturity Status).

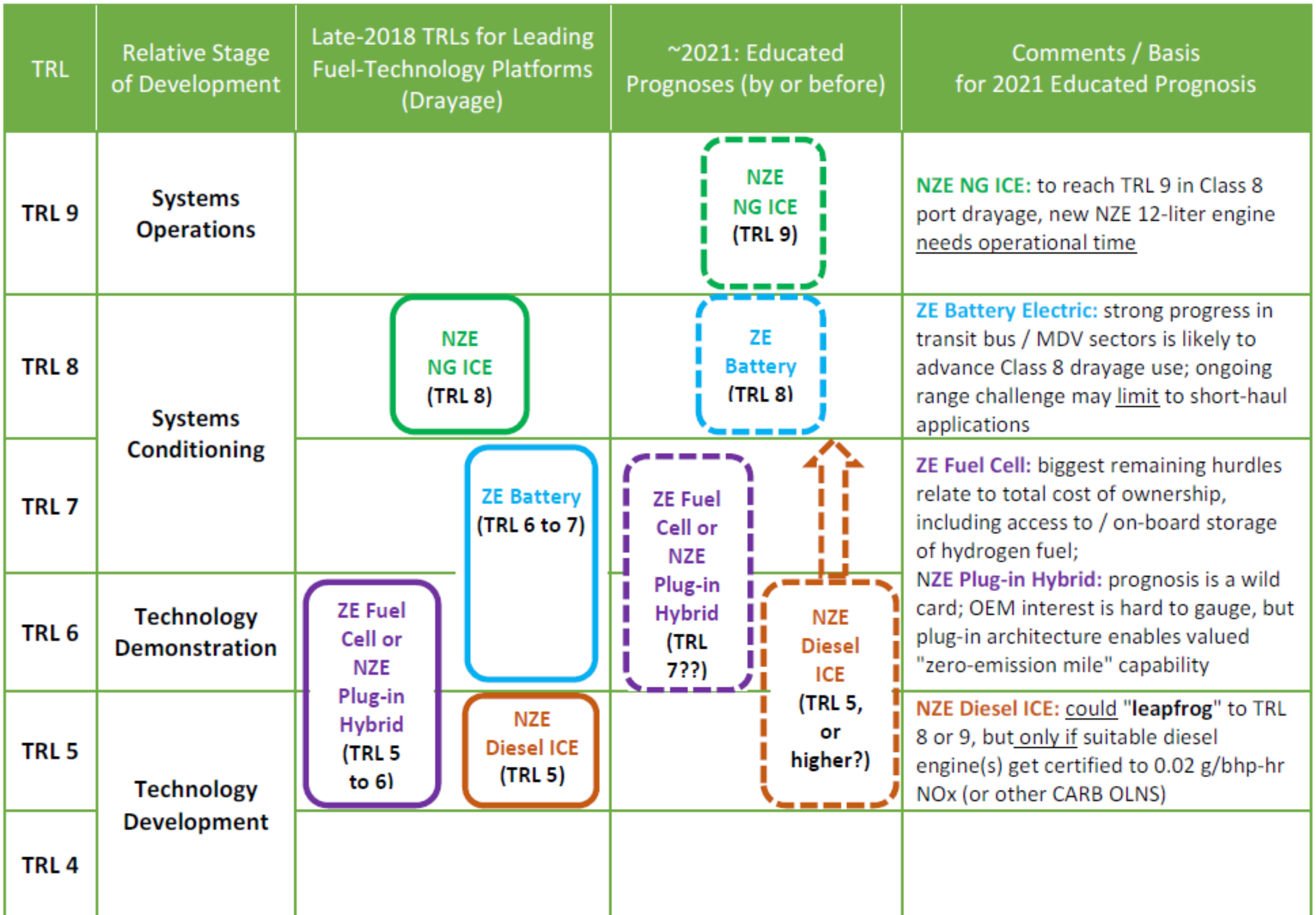
The Port's Drayage Truck Registry includes approximately 8,750 drayage trucks, a majority of which are domiciled off Port property. Even assuming that existing incompatibilities in charging equipment between different manufacturers are resolved, marine terminal operators will not be able to accommodate external trucks charging on-site due to a combination of space constraints and labor rules regarding plugging and unplugging activity. External drayage trucks will charge at their home base, at client warehouses, or at public charging stations. The cost and utility impact of external truck charging are largely beyond the control and responsibility of the Port.

Another difference between yard tractors and drayage trucks is that external drayage truck companies often purchase used trucks, whereas terminal operators nearly always buy new yard tractors. It will be some time before there is an effective secondhand market for electric drayage trucks, so in the near to intermediate term, the relevant up-front cost comparison is between a new electric truck and a used diesel truck. This will result in a substantially larger cost difference for drayage trucks than for yard tractors. Although at least one OEM provides private financing for its electric trucks, drayage trucking companies are often small businesses with less ability to finance large purchases compared with marine terminal operators. This cost differential may therefore prove a substantial hurdle to adoption of electric drayage trucks.

The overall cost picture for drayage trucks is similar to yard tractors. The business case revolves around investing more capital to save on operating costs. As battery prices fall over time, the cost comparisons for electric trucks will become increasingly favorable compared to diesel trucks.

In December 2018, San Pedro Bay Ports released a much more detailed study solely on the subject of ZE and NZE emissions drayage trucks, which largely reached the same conclusions (SPBP 2018).
Figure F-15 summarizes the key findings from the executive summary section of this study, showing the status of major ZE and NZE truck types in terms of Technology Readiness Level (TRL) ratings.

FIGURE F-15: SUMMARY OF FINDINGS FOR 2018 TECHNICAL VIABILITY, SAN PEDRO BAY PORTS DRAFT 2018 FEASIBILITY ASSESSMENT FOR DRAYAGE TRUCKS



Source: TRL methodology adapted from U.S. DOE, "Technology Readiness Assessment Guide, Table 1: Technology Readiness Levels, September 2011 (see footnote). TRL ratings estimated based on input from 1) OEM surveys, 2) various technical reports, 3) demonstration activities, and 4) meetings with agency technical personnel (CARB, CEC, SCAQMD).

Notes:

CARB = California Air Resources Board
CEC = California Energy Commission
ICE = internal combustion engine
NG = natural gas
NZE = near-zero-emissions
SCAQMD = South Coast Air Quality Management District
TRL = Technology Readiness Level
ZE = zero-emissions

Source: *Clean Air Action Plan Draft 2018 Feasibility Assessment for Drayage Trucks* (SPBP 2018)

In terms of ZE truck types, according to Figure F-15 and the SPBP study, electric drayage trucks are the most developed and are currently in the demonstration/initial systems conditioning phase (TRL 6 to TRL 7, per the study notation). Electric drayage trucks are expected to move to TRL 8 by 2021, which will indicate that they are in the final systems conditioning phase but are not yet ready for full-scale systems operation and commercial production levels. As AECOM has also indicated, the study concludes that range issues may limit these truck types to short-haul applications during this early time frame (SPBP 2018).

RENEWABLE DIESEL COST AND EMISSIONS IMPACT

One potential near-term emissions-reduction strategy in advance of electrification or other ZE and NZE technology implementation is to fuel existing diesel yard tractors, RTG cranes, and top-picks/side-picks with renewable diesel rather than traditional diesel. Renewable diesel is made from organic biomasses and requires no special infrastructure to be utilized; it can be used directly in existing traditional diesel engines.

For example, the City of Oakland has implemented a program to fuel all City vehicles with renewable diesel and reports that the switch has been effectively cost-neutral, due to California's LCFS, which provides credits equalizing the price difference between renewable and petroleum diesel (Piellisch 2018).

However, it is important to note that global supplies of renewable diesel are limited, so the switch could have minimal impact globally if supplies cannot be increased (i.e., if increased usage in Oakland comes at the expense of another existing renewable diesel use).

Overall emissions reductions with renewable diesel could be substantial. Greenhouse gas reductions will depend on the production and shipping methods of whichever fuel provider is selected. Renewable diesel shipped to or produced in California (as part of the LCFS program) typically provides greenhouse gas reductions of 60% or greater compared to traditional petroleum diesel (Mitchell, pers. comm., 2018). Renewable diesel may also eliminate 30% to 40% of DPM and 10% to 20% of NOx (Neste n.d.).

TIMING OF IMPLEMENTING ACTIONS

Table F-3 summarizes the current expectations for the timing of new vehicles and the potential role of the Port of Oakland.

TABLE F-3: EXPECTED TIMING OF ZE AND NZE VEHICLES AND EQUIPMENT		
Vehicle or Strategy Type	**Target Time Frame**	**Port of Oakland Role**
Renewable diesel	2018 onward	Investigate renewable diesel fuel purchasing program for the Port fleet.
Electric yard tractors	2018 onward	Conduct tenant outreach; encourage the purchase of electric tractors using HVIP vouchers and stacking grants; track power usage, customer satisfaction, etc. Develop Electric Vehicle Infrastructure Guide for tenants.
RTG (hybrid) cranes	2019 -2020	Track SSA Terminal's repowering of 13 RTG cranes at OICT funded by BAAQMD's Carl Moyer grant; no infrastructure required.
Yard tractors (electric)	2019-2021 2021+	Track SSA Terminal's project at Matson Terminal as part of CARB's grant. Facilitate grants and install charging infrastructure based on tenant demand and Port capacity.
Top-picks (hybrid)	2019-2021	Track commercial development of hybrid top-picks, if any, and consider the deployment of near-term hybrid picks if they become commercially available prior to fully electric models.
Top-picks (electric)	2019-2023	Track SSA Terminal's project at Matson Terminal as part of CARB's ZANZEFF grant.
Local (short-haul) drayage trucks (electric)	2019-2020 2019-2021	Encourage BYD deployment of 10 Phase II trucks at the Seaport. Install charging infrastructure at Shippers Transport Express for 10 trucks as part of CARB's ZANZEFF grant.
RTG (electric) cranes	2020-2023	Track the Port of Long Beach test of 9 electric RTG cranes through CEC grant funding. If tests demonstrate U.S. West Coast electric RTG crane feasibility, facilitate grants and install charging infrastructure if tenants choose to implement an electric RTG crane. Local Oakland ILWU work rules are not exactly the same as those in Long Beach, and this will affect the feasibility of the electric RTG crane operating model in Oakland.
Long-haul drayage trucks (electric)	2023-2026	Track ongoing commercial development of electric drayage trucks; facilitate grants; and coordinate utility upgrades with any third-party charging companies leasing space from the Port.

Notes:

BAAQMD = Bay Area Air Quality Management District

CARB = California Air Resources Board
CEC = California Energy Commission
HVIP = Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
ILWU = International Longshore and Warehouse Union
NZE = near-zero-emissions
OICT = Oakland International Container Terminal
RTG = rubber-tired gantry
ZANZEFF = Zero and Near Zero Freight Facilities (Grant)
ZE = zero-emissions

Source: Port of Oakland

REFERENCES

Alexander Mitchell, California Air Resources Board (CARB). 2018. Personal communication with Susanne von Rosenberg. May 2.

American Association of Port Authorities (AAPA). 2018. Available at: https://www.aapa-ports.org/unifying/content.aspx?ItemNumber=21048#Statistics

Bill Aboudi, owner, AB Trucking. 2018. Conversation with Port of Oakland staff.

Brian Bauer, Vice President, Operations, TraPac. 2018. In-person interview with AECOM and Port of Oakland. September 4.

BloombergNEF. 2018. New Energy Outlook (NEO). Bloomberg New Energy Finance. June. Available at: https://about.bnef.com/new-energy-outlook/.

California Air Resources Board (CARB). 2018. Diesel Particulate Matter Health Risk Assessment for the West Oakland Community. December.

Kalmar Global. 2018. "Are you ready to be fully electric by 2021?" May 22. Available at: https://www.kalmarglobal.com/news--insights/2018/20180522_are-you-ready-to-be-fully-electric-by-2021/.

Michael Andrews, Terminal Manager, Everport Terminal Services. 2018. In-person interview with AECOM and Port of Oakland. September 14.

Mongelluzzo, Bill. 2018. "Gates Open for Imports." *Journal of Commerce*, October.

Neste. n.d. Neste MY Renewable Diesel: High-performing low carbon biofuel. Available at: https://www.neste.us/customers/products/renewable-products/neste-my-renewable-diesel.

Pacific Maritime Association (PMA). 2018. *Pacific Maritime Association 2017 Annual Report*. Available at: http://www.pmanet.org/annual-report.

Paul Gagnon, Vice President, SSA Terminals. 2018. In-person interview with AECOM and Port of Oakland. August 29.

Paul Gagnon, Vice President, SSA Terminals. 2018. Conversation with Port of Oakland staff. October 2.

Piellisch, Rich. 2018. "Oakland and Renewable Diesel: 'Not a Single Downside'." *NGT News*, March. Available at: https://ngtnews.com/oakland-and-renewable-diesel-not-a-single-downside.

Ramboll Environ (Ramboll). 2018. *Port of Oakland 2017 Seaport Air Emissions Inventory Final Report*. August. Available at: http://www.portofoakland.com/files/PDF/Port_Oakland_2017_Emissions_Inventory.pdf.

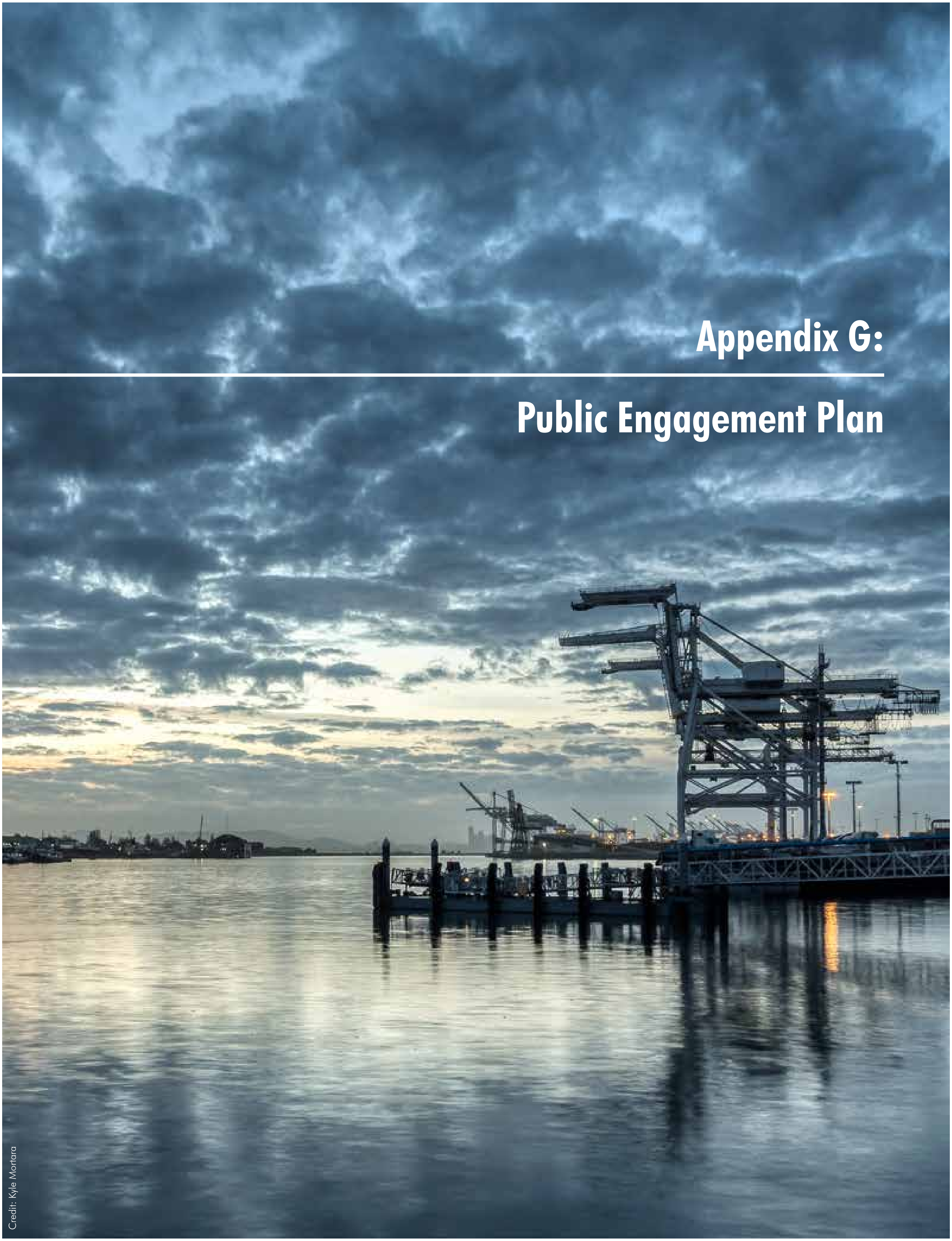
Susan Ransom, Customer Support Manager, SSA Terminals, and Jim Rice, General Manager of OICT, SSA Terminals. 2018. Email to Port staff, October 16.

San Pedro Bay Ports (SPBP). 2018. *Clean Air Action Plan Draft 2018 Feasibility Assessment for Drayage Trucks*. December. Available at: http://www.cleanairactionplan.org/documents/draft-drayage-truck-feasibility-assesment.pdf/.

The Tioga Group, Inc. (Tioga). 2016. Port of Oakland Truck Parking Report. February.

Appendix G:

Public Engagement Plan



Credit: Kyle Mortara

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ACRONYMS

2020 and Beyond Plan	Seaport Air Quality 2020 and Beyond Plan
AB 617	Assembly Bill 617
BAAQMD	Bay Area Air Quality Management District
BMP	Best Management Practice
Board	Board of Port Commissioners
Caltrans	California Department Of Transportation
CARB	California Air Resources Board
CBO	Community-Based Organizations
DPM	Diesel Particulate Matter
Draft Plan	Draft Seaport Air Quality 2020 and Beyond Plan
Envirocom	Envirocom Communications Strategies
Final Plan	Final Seaport Air Quality 2020 and Beyond Plan
GHG	Greenhouse Gas
I-580	Interstate 580
I-880	Interstate 880
I-980	Interstate 980
LEP	Limited-English Proficient
MAQIP	Maritime Air Quality Improvement Plan
NCPC	Neighborhood Crime Prevention Council
OAB	Oakland Army Base
OUSD	Oakland Unified School District
PEP	Public Engagement Plan
Plan	Seaport Air Quality 2020 and Beyond Plan
Port	Port of Oakland
NTAP	Near-Term Action Plan
Revised Draft	Revised Draft Seaport Air Quality 2020 and Beyond Plan
SONIC	South of the Nimitz Improvement Council
Task Force	Seaport Air Quality 2020 and Beyond Task Force
WOEIP	West Oakland Environmental Indicators Project

Public Engagement Plan

Prepared by: Surlene Grant, Principal
Envirocom Communications Strategies, LLC

May 2019

1.0 INTRODUCTION AND PURPOSE

The Seaport Air Quality 2020 and Beyond Plan (2020 and Beyond Plan or Plan) focuses on reducing emissions from seaport operations. This focus necessarily impacts several local stakeholders, including business operators and residents from the surrounding community. This Public Engagement Plan (PEP) was used to guide the Port in involving stakeholders and the public in the development of the Plan and will be used to implement the 2020 and Beyond Plan, including their engagement in the implementation of the Near-Term Action Plan (NTAP) (Years 2019-2023) and the development of the Plan Update in 2023. The PEP recommendations will further enhance the Port's communications and community relations with local community and neighborhood groups, community-based organizations (CBOs) and residents, as well as Port-related business interests and tenants, and regulatory agencies. This PEP was prepared by Envirocom Communications Strategies, LLC (Envirocom) on behalf of the Port of Oakland (Port) to present strategies and best management practices (BMPs) to inform, consult, collaborate, and empower stakeholders in the development and implementation of the NTAP of the 2020 and Beyond Plan.

This PEP outlines the Port's strategies and actions to engage ethnic minority and traditionally underserved and limited-English proficient (LEP) populations and all others who live or work in West Oakland so that they have active, fair, and meaningful access to authentically participate in the implementation and update of the 2020 and Beyond Plan. Authentic participation means that the engagement is two-way and meaningful. The PEP outlines the various opportunities for stakeholders to be involved in the implementation and update of the 2020 and Beyond Plan, including the implementation of the NTAP. The PEP details how information about the Plan may be shared with the public and describes the points of engagement for evaluating and weighing in on the Plan's Implementing Actions.

Additionally, the 2020 and Beyond PEP is consistent with the best practices of related (and concurrent) initiatives, and their respective Public Engagement Plans (PEPs). These include the West Oakland Truck Management Plan Public Engagement Plan (City of Oakland 2018); and the Public Engagement Plan for the Oakland Army Base (OAB), which addresses both specific projects and overall OAB activity. These

PEPs provide a common list of best practices to foster and build public engagement processes. Each PEP however, describes and provides an appropriate level of public participation for its respective project.

In developing the PEP, Envirocom consulted with representatives of local environmental groups, government agencies, local business operators, members of the Seaport Air Quality 2020 and Beyond Task Force (Task Force), and staff from the Port of Oakland. The primary departments of the Port that were consulted for this PEP are the Executive Office, the Social Responsibility Division, Government Affairs, Environmental Programs and Planning, and the Office of the Port Attorney. Much of the information that is foundational to the PEP was gathered and aggregated from one-on-one interviews and assessments; in addition, input was gleaned through interactive Task Force meetings hosted by the Port on June 21, 2018, September 26, 2018, and January 10, 2019, and from comments submitted in response to the initial release of the *Draft Seaport Air Quality 2020 and Beyond Plan* (Draft Plan) released on June 29, 2018, (see Section 9.0) and in response to the *Revised Draft Seaport Air Quality 2020 and Beyond Plan* (Revised Draft), released to the public for review on December 14, 2018. The information culled from these sources is reflected in the project background, community profile, and recommendations of the PEP.

2.0 DOCUMENT ORGANIZATION

This document is organized as follows:

- Background of the Seaport Air Quality 2020 and Beyond Plan
  - From the Maritime Air Quality Improvement Plan (MAQIP) to the 2020 and Beyond Plan
  - Vision
  - Timeline for 2020 and Beyond Plan Implementation
- Community Profile
  - West Oakland Demographics
  - Community Benefits Arising from the PEP
- Approach for Development of the Public Engagement Plan
  - Guiding Principles
  - Stakeholders
  - Summary of Stakeholder Comments
  - Best Practices for Public Engagement
- Public Outreach Activities for this Plan
- Meeting Components and Logistics
- Schedule of Public Engagement Activities
- Performance Measures and Evaluation of Public Engagement
- Summary and Resources

3.0 BACKGROUND OF THE SEAPORT AIR QUALITY 2020 AND BEYOND PLAN

3.1 FROM THE MAQIP TO THE 2020 AND BEYOND PLAN

The Port of Oakland operates aviation, maritime, and real estate divisions in Oakland. The Port is responsible for Oakland International Airport, the Oakland Seaport (which is among the top 10 container ports in the United States, handling 99% of all containerized goods in Northern California), and approximately 19 linear miles of waterfront. Besides the airport, the most public-facing part of the Port's operations is the entertainment, retail, residential, and commercial area of Jack London Square. In addition to the public airport and real estate areas, the Port manages the properties of the Oakland Seaport. These properties are home to the freight, warehousing and other maritime-related business operations that most people casually refer to as "the Port." These operations are seldom seen by the public, yet they have a great beneficial economic impact on the Northern California Region as well as unintended consequences from environmental impacts. The Port of Oakland's maritime operations are located less than 2 miles from the mixed-use residential/industrial community referred to as West Oakland.

To help reduce emissions from Seaport sources, the Board of Port Commissioners (Board) approved the MAQIP in April 2009 (Port 2009). The MAQIP provided a comprehensive plan with goals, strategies, and targets to reduce air emissions from maritime operations, with a goal of reducing excess community cancer risk attributable to Seaport-related diesel particulate matter (DPM) emissions by 85% (the MAQIP expressed this goal as an 85% reduction in DPM emissions). Implementation of the MAQIP is from 2009 to 2020 and reflects the Port of Oakland's long-term commitment to (1) reducing emissions that impact air quality and to (2) contributing to the abatement of the elevated cancer health risks in West Oakland. The main goal of the MAQIP was to reduce DPM from ships, trucks, and freight operations, as well as from other Seaport-related sources.

The guiding principles of the MAQIP were to:

- Seek economic growth.
- Promote environmental stewardship.
- Apply the concept of fair share.
- Exercise the Port's authority.
- Engage stakeholders.
- Promote environmental justice.
- Build knowledge.

A robust outreach process resulted in the formation of a 35-member MAQIP Task Force. The MAQIP Task Force was a key player in developing and monitoring the implementation of the MAQIP. Over the years, the Port worked with the Task Force and the four-member de facto Steering Committee appointed by the Board as the Co-Chairs, tenants, freight operators, and others to develop an action plan that would reduce the level of emissions released in the air from Seaport operations. Based upon its most recent Seaport Emissions Inventory (Ramboll 2017), the Port calculated an 81% reduction in DPM emissions.

The MAQIP has been fully launched by the Port, and most of its programs and projects have been implemented. New information and policies began shaping environmental planning for air quality improvements and greenhouse gas (GHG) reductions. By January 1, 2014, government agencies such as the California Air Resources Board (CARB) and the United States Environmental Protection Agency began announcing proposed changes in regulations. The focus on improving air quality began to shift from that of reducing ambient emissions to that of preventing human exposure to localized air pollutants. Because of the proposed regulatory changes and emerging technologies, and other new developments, the focus of the goals and actions of MAQIP was re-evaluated. In spring 2018, the Port responded to the changes by announcing that it would continue to pursue the actions and goals of MAQIP while launching a new effort to create a new plan—the Seaport Air Quality 2020 and Beyond Plan.

The MAQIP focused on reducing emissions from existing equipment, as demonstrated by one of its most referenced implementation actions— the Port clean trucks program. The 2020 and Beyond Plan is a broader planning effort than the MAQIP, as it includes more categories, such as fuels, equipment, operations, and infrastructure. Using the MAQIP as its foundation, the Seaport Air Quality 2020 and Beyond Plan proposes a pathway to zero emissions for maritime operations.

3.2 VISION STATEMENT

The Plan proposes the following vision:

"The vision of the 2020 and Beyond Plan is a pathway to zero-emissions Seaport operations through changes in equipment, operations, fuels, and infrastructure."

Because of the broad reach of the 2020 and Beyond Plan into areas such as infrastructure, fuels, operations, and technologies, and because of the Plan's focus on localized exposure of impacted communities, the stakeholder interests encompassed by the 2020 and Beyond Plan are more far-reaching than those of the MAQIP. The 2020 and Beyond Plan maintains the Port's focus on emissions reductions while aligning with the State of California's GHG reduction targets for 2030 and 2050 as well as providing a framework for the Port and its stakeholders to position themselves for State grant and incentive funding programs.

The purpose of the Plan is to provide a common structure and guidance for all stakeholders involved in moving to a zero-emissions Seaport. The Plan proposes three phases from 2019 to 2050. The Port anticipates that the plan will be a "living document" and will need to be updated in 5 years (2023) based on projected State regulations and technology development. The three phases and the update will allow changing conditions, especially regarding technology, financial resources, emissions reductions, and stakeholder input, to be incorporated in the Plan.

3.3 TIMELINE FOR 2020 AND BEYOND IMPLEMENTATION

The timing and schedule of the update also directly affect this PEP, which will be updated as part of the Plan's annual progress report to the Board. Section 7.0, Schedule for Public Engagement Activities, compares the development and evaluation of the Plan over the years with the PEP and identifies the level of public engagement.

4.0 COMMUNITY PROFILE – GEOGRAPHIC AREA AND AFFECTED COMMUNITIES

The geographic area for the 2020 and Beyond Plan consists of the location of the Port of Oakland's Seaport operations, including its shipping terminals, freight yards, warehouses, and the Port-owned areas of the OAB.

Close to the Seaport is the area defined as West Oakland, which is located between Interstate 880 (I-880) and Interstate 980 (I-980) to the west and east, respectively, and between Interstate 580 (I-580) and I-880 to the north and south. As the focus for air quality planning shifted from regional emissions reductions to the abatement of local exposure to toxic air contaminants, on September 27, 2018, West Oakland was designated by CARB, under Assembly Bill 617 (AB 617), as a community bearing a disproportionate air quality burden (CARB 2018).

Table 1 provides demographic data for West Oakland as well as for the City of Oakland and Alameda County. The data are from the 2017 American Community Survey for Alameda County, Oakland, and West Oakland (U.S. Census n.d.). The West Oakland data comes from 13 census tracts: 4014, 4015, 4016, 4017, 4018, 4022, 4024, 4025, 4026, 4027, 4105, 9819, and 9820.

TABLE G-1: DEMOGRAPHIC DATA FOR WEST OAKLAND (13 CENSUS TRACTS) AND SURROUNDING AREAS			
2017 Census Estimates	West Oakland 2017 Estimates	Oakland 2017 Estimates	Alameda County 2017 Estimates
Population	**25,993**	**417,442**	**1,629,615**
Race/Ethnic Origin			
Caucasian	23.6%	27.3%	32.2%
African American	41.7%	23.6%	10.7%
Asian	11.1%	15.8%	28.7%
Hispanic	17.6%	27.0%	22.5%
Pacific Islander	0.5%	0.6%	0.8%
Native American	0.5%	0.4%	0.3%
Two or more races	4.8%	5.0%	4.4%
Housing Units	**11,283**	**169,303**	**596,898**
Owner-occupied	23.4%	37.5%	50.5%
Renter-occupied	68.5%	56.7%	44.8%
Vacant	8.1%	5.8%	4.7%
Median Income	**$43,711**	**$63,251**	**$85,743**
% of families below poverty	**27.2%**	**14.5%**	**7.4%**
Educational Attainment for residents age 25+			
Less than High School	15.5%	19.3%	12.5%
High School	16.7%	15.6%	17.9%
College w/o degree	24.3%	18.7%	18.4%
College with degree	43.5%	46.4%	51.2%
Language Spoken[1]			
English only	70.2%	59.4%	55.4%
Spanish only	6.9%	11.1%	7.0%
Chinese	5.8%2	4.9%	5.5%

[1] Primary language spoken at home

Source: U.S. Census Bureau n.d.

4.1 WEST OAKLAND DEMOGRAPHICS

- The census data for West Oakland show that approximately 76% of the population of West Oakland consists of people of color, including African Americans, Hispanics, and Asians, compared to approximately 72% in Oakland and 67% in Alameda County.
- The census data show that approximately 69% of West Oakland residents are renters, which is a notably higher percentage than throughout the City of Oakland and Alameda County.
- The census data show that approximately 27% of the residents live below the federal poverty levels. The median income of residents of West Oakland is about two-thirds of the median income for City of Oakland residents and about half of the median income for Alameda County residents.
- Based on these census data, the public outreach for far-reaching activities will be designed to prioritize reaching the African American, Hispanic, and Asian residents of West Oakland. It will also be focused on effectively reaching low-income residents and renters.
- An Alameda County Public Health Department report ("Asthma & Cumulative Health Risks in West Oakland") to the MAQIP Task Force in February 2018 revealed health disparity data that showed that the life expectancy of West Oakland residents is 6 years less than the rest of the county and that African American residents of West Oakland have a 14-year shorter life expectancy than that of white residents of the Oakland Hills neighborhoods.
- According to the Alameda County Public Health Department report "Asthma & Cumulative Health Risks in West Oakland," West Oakland residents are exposed to higher concentrations of DPM than the average background levels in the Bay Area.

4.2 COMMUNITY BENEFITS ARISING FROM THE PUBLIC ENGAGEMENT PLAN

- The public engagement process will help strengthen relationships, understanding, and respect between the Port, its tenants, and business partners and the communities of West Oakland.
- The public engagement process will provide opportunities for public education and awareness of the effects of pollution, health, and other equity impacts on West Oakland, and of new and developing technologies and science.
- Implementation of the 2020 and Beyond Plan will further reduce DPM emissions affecting the neighborhoods near the Port. The Port and many of the stakeholders in this process acknowledge that there are other mobile and stationery sources that emit constituents that affect the air quality of West Oakland; however, the Plan's emissions reduction measures are expected to contribute to an abatement of health impacts on residents.
- The public engagement process will inform and involve West Oakland residents, especially long-term residents. This will reduce impacts from the Port on West Oakland, whose residents are predominantly African American, Hispanic, and Asian.

5.0 APPROACH FOR DEVELOPMENT OF THE PUBLIC ENGAGEMENT PLAN

The MAQIP was developed in conjunction with a public engagement process based on the recommendations and actions of the Co-Chairs and a Task Force. As the Port of Oakland transitioned from the MAQIP to the planning process for the 2020 and Beyond Plan, the Co-Chairs and the Task Force agreed to transition in their role to support the public engagement efforts of the planning and implementation effort of the Plan. With completion of the planning effort in this *Final Seaport Air Quality 2020 and Beyond Plan* (Final Plan), the Co-Chairs and the Task Force are key stakeholders for the implementation of public involvement and public engagement activities.

Each Co-Chair represents a significant stakeholder affiliation:

- Community Based Organization/Environment: West Oakland Environmental Indicators Project (WOEIP)
- Regulator/Government Agency: Bay Area Air Quality Management District (BAAQMD)
- Industry/Port-related Business and Tenants: GSC Logistics
- Port of Oakland

The Task Force has representatives from the following stakeholder groups:

- Industry and Freight (including shipping, trucks and freight)
- Regulatory Agencies
- Government Agencies
- Environmental and Land Use CBOs and Non-Governmental Organizations
- Community Health Organizations
- Residents/Elected Officials
- Organized Labor
- Maritime Project Developers
- Port of Oakland
- City of Oakland

Section 5.2 addresses the participation of new stakeholders on the Task Force.

Many of the Plan's policies and Implementing Actions will directly impact those stakeholders with interests in the maritime industry and the businesses and operations that they support as well as the Port's tenants. In addition, any change to Port operations will also impact the quality of life of West Oakland residents.

The overall approach for public engagement is based on a series of public education and consultation activities that engage the stakeholder groups. This PEP and the recommendations presented were based on:

- One-on-one interviews with the Co-chairs and key participants from the Task Force representing the Alameda County Public County Health Department, the trucking industry, and the environmental community (interviews were conducted from July through October 2018)
- Broad-based West Oakland resident, worker, and other stakeholder roundtable discussions on September 26, 2018, and January 10, 2019
- Comments submitted to the Port as part of the solicitation of comments on the Draft Plan and the Revised Draft

The PEP is designed to involve stakeholders in a consultative manner at every key juncture throughout the process. Public engagement will:

- Promote equity and bring representation of underrepresented communities into the process
- Help with the design of agenda and process before and during public interfacing workshops, meetings and events
- Provide avenues for the stakeholders to advise on revising the public engagement process, if needed during the process, and to develop draft recommendations STOP

5.1 GUIDING PRINCIPLES

Guiding principles are the values that apply throughout the Plan process, including Plan development, public participation, and implementation. These guiding principles were accepted by the Co-Chairs and the Task Force in spring 2018:

- Planning is a joint fact-finding and co-learning process.
- All stakeholders share the desire to develop knowledge and the capacity to promote informed decision-making.
- The pursuit of near-term "wins" delivers verifiable air quality benefits and adds value to long-term planning.
- Pragmatic and cost-effective solutions advance Plan progress.
- Strong partnerships among stakeholders are a critical element of Plan implementation.

5.2 STAKEHOLDERS IN THIS PROCESS/TARGET AUDIENCE

During the one-on-one interviews and other discussions, participants were asked: "Who is missing and who should be at the table?" The following entities and individuals were suggested:

- Local utilities, including Pacific Gas and Electric Company and alternative energy providers such as MCE (My Choice Energy)
- Alameda County Transportation Commission
- City of Oakland Department of Transportation
- Mayor of Oakland
- Oakland City Administrator's office
- Oakland Planning Department
- Prologis (a City of Oakland developer)
- CenterPoint terminal operators
- Railroads
- East Bay Municipal Utility District
- U.S. Postal Service (for West Oakland operations)
- U.S. Customs and Border Protection
- California Department of Transportation (Caltrans)
- BART (Bay Area Rapid Transit) West Oakland Station

The following is a list of some of the known stakeholders and groups that would be interested in the broader outcomes of the Plan process. These are the groups that may be invited to a larger, annual Town Hall type event on the 2020 and Beyond Plan and its implementation. Because of the Seaport's proximity to West Oakland, it is critical to have representatives from the racial and ethnic minority groups who live or work in the project area. Community-based organizations include neighborhood groups, business groups, advocacy groups, and non-profit agencies. To date, the list[1] of identified CBOs includes the following.

- West Oakland Business Alert (WOBA)
- **West Oakland Community Advisory Group (WOCAG)**
  (Generally meets on the 4th Thursday of each month, 6-8 p.m., West Oakland Senior Center; group has a specific charge regarding the Oakland Army Base (OAB) project.)
- **West Oakland Commerce Association**
- **West Oakland Environmental Indicators Project**
- West Oakland Economic Development Working Group
- Jack London Improvement District
- **Jack London District Association**

[1] Names highlighted in bold are participating members of the Task Force.

- West Oakland Merchants
- **West Oakland Neighbors**
- Prescott Neighborhood Council
- Lower Bottoms Neighborhood Association
- Village Bottoms Neighborhood Association
- South of the Nimitz Improvement Council (SONIC)
- East Bay Asian Local Development Corporation (EBALDC/Mandela Gateway Tenants, California Hotel, and San Pablo Area Revitalization Collaborative
- Oakland Unified School District (OUSD) Community Liaison
- OUSD: West Oakland Middle School, Hoover School, Martin Luther King Jr. School, PLACE at Prescott School, Lafayette Elementary
- Student Program for Academic and Athletic Transitioning at McClymond's High School
- Ralph Bunche Academy (High School)
- **Oak Center Neighborhood Association**
- Hoover Foster Resident Action Council
- Acorn Tenants Association
- City Towers Tenants Association
- Sylvester Rutledge Tenant Association
- Neighborhood Crime Prevention Council (NCPC) Five on the West Side Beat 2X/5X Lowell/Acorn
- NCPC Beat 7X and West Oakland Neighbors
- NCPC Beat 2Y/5Y Prescott
- Acorn Safety Meeting
- West Oakland Core Team
- **Oakland Housing Authority**
- St. Mary's Center
- **Port of Oakland Trucker Work Group**
- West Oakland Senior Center
- Center for Independent Living of Oakland
- West Oakland Green Initiative
- Green for All
- Ella Baker Center
- Attitudinal Healing Connection
- **Prescott Joseph Center**
- West Oakland Community Collaborative

- **Office of Alameda County Supervisor Keith Carson, D5**
- West Oakland Teen Center
- St. Vincent de Paul
- West Oakland Urban Farm and Park (City Slicker Farms)
- Civicorps
- People's Community Market
- Vincent Academy
- **West Oakland Jobs Resource Center**
- **Rose Foundation for Communities and the Environment**
- Oakland Climate Action Coalition

Private sector businesses in the affected area include:

- **Equipment owners, such as marine terminal operators, trucking entities, and logistics companies**
- **Businesses in the area that serve the Port, serve customers of the Port, or serve residents of the area**
- Railroads and rail services, such as BNSF Railway and Amtrak
- **Trucking businesses that operate in West Oakland and Jack London Square**
- Lease holders and current and future tenants at the Port-owned and City-owned portions of the former OAB, including Prologis, CCIG, Oakland Maritime Support Services, Custom Alloy Scrap Sales, California Waste Solutions, Lineage/Dreisbach and CenterPoint
  (Only some are participating.)
- Employers in the area
  (Only some are participating).

5.3 SUMMARY OF STAKEHOLDER COMMENTS

In the process of developing this PEP, various stakeholders stated the following concerns or desires regarding stakeholder engagement and the Draft Plan.

5.3.1 Public Involvement

- Co-Chairs should work collaboratively with the facilitator to plan meetings and agendas.
- The Task Force should include representatives from the different affiliations and stakeholder interest groups, primarily tenants and business partners of the Port; those who have a role with emerging technologies, such as utility companies; and residents.
- Establish an advisory group that follows the process and ensures that the plan(s) are being followed. Tie the 2020 and Beyond Plan into some of the other planning efforts under way in the area.

- Support a working group that includes a marine terminal and/or shipping line representative to assess the feasibility of the Implementing Actions.
- To the key question of expanding the Task Force to include as many individuals as possible, opinions were split. The majority stated that if all the interests are represented, the current size of the Task Force seems to work well. It was suggested that periodic larger Community Town Hall meetings could be held to keep everyone informed.
- As the Plan develops, the Port needs to communicate clear goals to operators.
- Other sources that contribute to impacts, including weather and wind, should be considered.
- There should be public recognition and awards for entities that are doing something.
- Stakeholders must be educated about what the Port is trying to accomplish and empowered with that information to participate in the ongoing monitoring of progress.
- Some type of town hall meeting(s) should be held to include a broader audience that may not be able to make the daytime meetings. Include elected officials across Oakland in this process, and even consider having the elected officials host this discussion with their constituents. The Port's Good Neighbor Breakfast concept would be a good model.
- Develop a timeline with annual meetings, and check in for input and to receive updates on the process, annual emissions inventory of updates, and health risk assessment updates.
- Be transparent. Acknowledge what has happened to the input received. Post all comments and the response to the comments on the website.
- Engage and provide feedback for the implementation phase and feedback on the feasibility criteria and decision-making.

5.3.2 Equity

- Job training and education should keep abreast of new technology. Support training, education, and awareness, especially for jobs that the new Implementation Actions may bring.
- Ports are in equity-sensitive areas.
- The process should provide an opportunity to advise the Port of what can and cannot be done.
- Manage the process so that it is not so Port-centric; the process seems like a Port-driven process rather than a collaborative process.

5.3.3 Planning and Implementation/Monitoring

- There are concerns about how the 2020 and Beyond Plan efforts overlap with, and are complementary to, the State (and West Oakland community) AB 617 process and recommendations.
- Identify the metrics and the modeling assumptions that are being used in the report.
- As clean technologies are advancing, determine if there are emissions reduction measures that could be implemented in the immediate term rather than over a 5-year period; review this annually.

5.3.4 Grants and Funding Assistance

- Given a concern that the process will get ahead of new technology, what will inform the Port's Plan - the promise of a new technology or the availability of that technology?

Comments on the Draft Plan were included in the Response to Comments section of the Revised Draft (Volume II) and comments on the Revised Draft are included in Volume II of this Final Plan (Responses to Comments). The Response to Comments sections document all comments received and provide a response to each comment.

6.0 PUBLIC OUTREACH ACTIVITIES FOR THIS PLAN

The goals of the PEP, which are derived directly from the guiding principles, are:

- **Fact-finding and co-learning process.** Inform, educate and build a common baseline of knowledge among the community and policy makers about air quality concerns and environmental planning.
- **Informed decision-making**. Through consultation and collaboration, all stakeholders will work jointly to build capacity, share knowledge and discuss options, and identify solutions.
- **Near-term wins and value added**. Use public input in a collaborative way to create the best options and recommendations for the 2020 and Beyond Plan.
- **Pragmatic and cost-effective solutions:** Be responsive to ideas and suggestions, and evaluate and weigh options through collaboration on prioritization and joint problem-solving.
- **Strong partnerships**. Be inclusive and actively facilitate the involvement of the West Oakland community, especially racial and ethnic groups and individuals that are traditionally hard to reach, yet are the most impacted.

The desired outcome of public engagement is to have a more educated and informed community base and a Plan that reflects meaningful and authentic participation from stakeholders. There is no simple solution or one-size-fits-all approach to identifying an effective engagement method. To be most effective, the Port will employ a wide range of complementary methods to engage all stakeholders and make the planning and implementation efforts as accessible as possible.

Public awareness and education are critical to effectively addressing all stakeholder interests. Public participation for direct input into decision-making requires a high degree of stakeholder involvement in the planning and implementation efforts. Stakeholders will have multiple opportunities to access decision makers and provide input into the decision-making process, including opportunities for commenting on the final document and the implementation of the NTAP. Stakeholders will receive direct feedback on how their input helped to influence final decisions and the rationale behind those decisions.

Public participation in the development and implementation of the 2020 and Beyond Plan, including implementation of the NTAP, will involve the Co-Chairs, the Task Force, town halls, and other ongoing opportunities for input, including:

- Co-Chair meetings
- Task Force meetings
- Town hall information meetings
- Community and business surveys, questionnaires, and polls
- Internet-based engagement
  - Dedicated web page for the air quality planning process (already exists), including a schedule of meetings and the materials to be presented at each meeting
  - Use of social media and email to announce events and other news items, and to encourage people to go to the Port's website, attend public meetings, and provide their input
  - Online community surveys and polls

6.1 BEST PRACTICES TO BE USED IN THIS PUBLIC ENGAGEMENT PROCESS

Throughout the development of the 2020 and Beyond Plan and during implementation of the three phases (near-term, intermediate-term, and long-term), the Port's public engagement activities followed and will continue to follow the BMPs identified below.

- Clearly communicate the decision-making processes and the role of the public in those processes.
- Provide transparency and communicate to the public the outcomes and decisions, including the rationale behind them.
- Clearly identify the problems and issues the stakeholders are attempting to solve. Based on early input and feedback, this could initially involve targets and goals as well as funding.
- Clearly identify the decisions that stakeholder knowledge and insight can influence.
- Consult with the Co-Chairs and the Task Force on a regular basis for refinement and adjustment of the public engagement process.
- Evaluate the PEP annually for effectiveness and adapt it to meet the potentially changing audience, demographics, Port operations, and technology.
- Use outreach strategies that are varied and tailored to meet the needs of the West Oakland area. Meet people where they are and when they are available. Provide information and materials that are easy to understand, in the appropriate languages and format. Use outreach staff who can communicate effectively with the various communities in the area.
- Based on where the effort is on the timeline, public engagement may require a large town hall meeting to share information or a small, focused conversation in an industry sector. For each type of meeting, select from a variety of potential methods for reaching stakeholders and the public to

invite them to participate. Among these methods are online/social media; public repositories (e.g., libraries and community centers); CBOs and their outreach methods; attendance at CBO meetings; and government agency meetings, such as those related to AB 617.

- Use public television, radio, newspapers, and other media outlets that are specific to cultural groups and LEP populations in the affected area.
- Use a variety of engagement methods: public meetings and events, individual meetings with community leaders and groups, targeted interviews, and surveys.
- Start the broad range of engagement methods early, and build relationships with stakeholders between meetings. Start early with multiple methods for communicating and providing input.
- Use a variety of methods to accept input, such as online media, email, telephone, letters, and meetings.
- Remove barriers to participating in the engagement process, and create a welcoming environment. This includes accommodating the languages of the stakeholders and removing such barriers as location, time, lack of transportation, lack of childcare, inaccessibility, and power dynamics.
- Use graphics and simple, minimal text to create informational materials in the appropriate languages for the communities in the area. Consider LEP, disabled, and hard-to-reach populations when preparing these materials.
- Informational materials should be distributed at locations frequented by residents and businesses.
- Use technology (email, social media, applications, and websites) appropriately to supplement other outreach efforts.
    - Do not rely too heavily on technology. It is often *not* effective at reaching low-income, elderly, and LEP populations.
    - Send public meeting/workshop announcements via email to each CBO’s standard email address, to representatives of each CBO, and to all others who request such notification.
    - Use email as an educational tool and to encourage attendance at public meetings and other events.
- Ensure that outreach to CBOs includes a broad range of groups representing diverse participants and viewpoints.
- Throughout the process, evaluate whether public engagement is working by assessing both the number of participants and their demographic diversity (e.g., ethnicity, socioeconomic status, homeowner, renter or business owner, etc.). If a public engagement method is not working, make changes to the engagement strategies.
- Summarize input and key themes and share them with decision makers.
- Respond to stakeholders. Acknowledge receipt of input and comments, ask follow-up questions, give input serious consideration and follow-up, and respond to suggestions by showing how input and comments were incorporated or explaining why they were not.

- Build relationships and maintain contact with the community. Report back throughout the process. For example, maintain a list of stakeholders who have made comments or expressed interest and ensure that they receive information on an ongoing basis.
- Make sure printed materials are user-friendly.
- Send targeted mailings/flyers to residents.
- Use maps and photographs of the project area to solicit input on issues, concerns, and improvements people would like to see. Post these maps and graphics online.
- Develop short surveys or questionnaires that can be completed by attendees at festivals and tenant meetings or outside grocery stores and at places of worship.
- Post notices of public meetings that include information on other ways to participate and project information at community centers and public buildings in West Oakland, shops and stores, public transit stations and vehicles, and key locations frequented by residents and businesses, such as the West Oakland Branch of the Oakland Public Library, West Oakland Senior Center, DeFremery Park, West Oakland BART, and places of worship.
- Distribute materials to CBOs to encourage them to announce meetings at their upcoming meetings and post the meeting notices and informational materials on their websites.
- Reach out to managers of apartments; attend monthly homeowners or residential association meetings; distribute materials at the entrances to large housing complexes.
- Notify City Council, specifically District 3, newsletters, electronic outlets, and list servers.
- Use local newspapers and KTOP public television and public radio to announce public meetings, provide background information, and spread the word on ways to participate.
- Make it easy to provide input by including an email address, a phone number with voicemail, and a mailing address in all communications.

6.2 MEETING COMPONENTS AND LOGISTICS

6.2.1 Task Force Meetings

Task Force meetings are open to the public. The public can attend Task Force meetings to learn more about the 2020 and Beyond Plan process. The Task Force meets on a schedule that is set by the Co-Chairs and the Port of Oakland. The Task Force plays an advisory role and provides information on industry sectors, government updates, and technology that may benefit and inform the Plan.

Based on public input from Task Force members and the Co-Chairs in recent months, it was decided that Task Force meetings should have an educational component. Six task force meetings took place between February 2018 through April 2019. At the meeting on September 26, 2018, the issues of race and equity were discussed and how they intersect with the 2020 and Beyond Plan. In a future meeting, Task Force members and members of the public will be able to learn about some of the latest and emerging clean air technologies.

Task Force meetings are planned by the Port's neutral facilitator, who works with both the Port and the Co-chairs to determine the subject of the meeting, develop the agenda, and collaborate with all on roles, responsibilities, and presenters. The meetings are set up to present something new, such as the equity presentation, as well as to review progress on the 2020 and Beyond Plan. Time is also scheduled for small group and/or roundtable discussions among the Task Force members.

Port staff and the facilitation consultant both maintain a distribution list to distribute meeting agendas, notes and other information.

The Co-Chairs will lead the engagement of the Task Force during NTAP implementation. The Task Force will convene every 6 months for updates on the Plan's progress and general information on related plans, programs, and projects. (Appendix B: Background provides information about related plans, programs, and projects.) Feedback from Task Force meetings will be documented and inform the Plan's annual progress report. The Port's response to the feedback will be reported at the subsequent Task Force meetings.

As described in the Main Text of the Plan, the Co-Chairs will convene Working Sessions for collaborative problem-solving as needed (see Step 4 of the five-step screening and evaluation process). The Task Force Co-Chairs will be charged with developing agendas for these Working Sessions. The Co-Chairs will also consider feedback from the Task Force and comments received in planning the working sessions, which will be open to the Task Force and other new stakeholders and members of the public.

6.2.2 Town Halls

Town halls can be used to report annually to the community on the progress of the 2020 and Beyond Plan implementation process, to receive input regarding new technologies, and to ensure that the larger West Oakland community and other stakeholders are aware of the Plan. Additionally, the Port and the Task Force will provide an annual summary of the community and stakeholder engagement process and report card at this forum, using best practices for public participation.

6.2.3 Participation in Existing Meetings

There will be times when project team members may attend meetings of other organizations on related topics, such as AB 617 efforts or a community health initiative, and provide Plan updates.

To reach people and viewpoints that reflect the local impacted community, existing community forums will be included in outreach efforts, with particular focus on creating opportunities for joint forums with (but not limited to) the AB 617 Steering Committee, the Truck Management Plan stakeholders, Alameda County Transportation Commission's GoPort Program, and Plan Bay Area.

6.2.4 Public Workshop and Town Hall Logistics

The planning, designing, and hosting of workshops will reflect these best practices:

- Hold workshops on weekday evenings or Saturday mornings; Sunday afternoons can be considered. CBOs and key stakeholders will help pick dates and times convenient for as many people as possible.
- Coordinate dates with other key events: Council meetings, Board meetings, major public events (holidays, public school calendar dates, and large sporting events).
- Ensure Americans with Disabilities Act accessibility; convenience to public transportation so that residents and businesses can attend; language accessibility, including interpreters if needed and translation of key documents if requested. Select languages for the announcement of public meetings and interpreters based on community demographics. Translate information, based on requests. If material is not printed in a particular language, add a statement such as this in the selected languages: "If you would like this information in (language XX) please contact (510) ###-####."
- In meeting announcements, notify participants about the availability of disability and language services. Such notifications could include, for example:

"The Port and the City of Oakland comply with Title VI of the Civil Rights Act of 1964 and related statutes and regulations in all programs and activities. Key workshop materials can be made available in alternative languages or accessible formats for people with disabilities, if requested. Interpretation of meetings in Spanish and Chinese, sign language, or other languages can be provided on request 72 hours in advance, with contact information provided to request this service. The project webpage contains Port contact information for staff directly related to the Seaport Air Quality 2020 and Beyond Plan" (EPA 2006).

6.2.5 Possible Locations for Workshops and Town Halls

The Port will choose locations that are accessible to people with disabilities, are close to stakeholders and easy to get to, are convenient to public transportation, are large enough for the expected turnout, have good acoustics, and have an appropriate layout and equipment to meet as one large group and in smaller breakout groups. Potential locations include:

- West Oakland Branch of the Oakland Public Library
- West Oakland Teen Center
- West Oakland Senior Center
- Oakland Housing Authority meeting room
- DeFremery Center
- Taylor Memorial United Methodist Church
- West Oakland Urban Farm and Park
- Lincoln Family Center
- Oakland City Hall

- Waterfront Hotel
- Port of Oakland Administrative Building Meeting facilities

6.2.6 Increasing Participation and Noticing

The Port will use multiple strategies to advertise the workshops and encourage participation, including the following:

- Email meeting announcements and flyers to CBOs, other stakeholders, anyone who requests such announcements.
- Attend the recurring meetings of the CBOs.
- Conduct direct outreach to CBOs to encourage their attendance at the workshops.
- Post workshop notices on City and Port websites.
- Post notices on approved social media outlets.
- Use KTOP, Oakland's public TV channel, to announce meetings and how to participate.
- Place newspaper announcements, including announcements in minority-language papers.
- Distribute materials at locations in the area that residents and businesses frequent, including shops and stores, libraries, senior centers, housing offices, and other key locations.
- Announce the workshops in the City Administrator's weekly announcement, if possible.

7.0 SCHEDULE FOR PUBLIC ENGAGEMENT ACTIVITIES

TABLE G-2: SCHEDULE FOR PUBLIC ENGAGEMENT ACTIVITIES

Time Frame	Air Quality Plan Development	Public Engagement Plan (PEP) Development	Level of Engagement
2018-Spring 2019	*Revised Draft Seaport Air Quality 2020 and Beyond Plan* (Revised Draft) comments reviewed and incorporated in the *Final Seaport Air Quality 2020 and Beyond Plan* (Final Plan), where applicable. Final Plan presented to the Board of Port Commissioners for consideration and recommendation for approval.	Development of the PEP, initiation and implementation of public engagement. Outreach focused on development of and feedback on the *Revised Draft Seaport Air Quality 2020 and Beyond Plan* (Revised Draft) and preparation of the Final Plan.	Consult/Review and comments on Draft Plan and Revised Draft Plan/ Information-sharing/Knowledge and Capacity-Building/Citizen-Based Science Presentations/Participation in concurrent Assembly Bill 617 and West Oakland Truck Management Plan planning processes.
Spring 2019	*Final Seaport Air Quality 2020 and Beyond Plan* (Final Plan) developed. Final Plan recommended for approval.	Development and initiation of public engagement. Outreach is focused on initial implementa-tion of and feedback on the Seaport Air Quality 2020 and Beyond Plan (2020 and Beyond Plan or Plan)	Consult/review on Final Plan
June 2018 – July 2019	Plan adopted First year monitoring of work on this effort	Co-Chairs meetings (6-8) Task Force meetings (6) Town hall to report to the	Inform/consult on prioritization and collaborate on joint problem-solving

TABLE G-2: SCHEDULE FOR PUBLIC ENGAGEMENT ACTIVITIES			
		broader community	
Near-Term Phase 2019-2023	Near-term implementation 5-year update	Public engagement to review and evaluate progress on the Plan; inform and educate regarding new policies and technologies; and evaluate use of working sessions to deliver input on Implementing Actions. Plan evaluation is focused on Implementing Actions, availability of funding, monitoring, etc.	Inform/consult on prioritization and collaborate on joint problem-solving
Intermediate-Term Phase 2023-2030	Intermediate-term revision and updates. Review of new technologies, new Port developments	Public engagement to update and evaluate the Plan, inform and educate regarding new policies and technologies. Plan evaluation focused on Implementing Actions, availability of funding, monitoring, etc.	Inform/consult on prioritization and collaborate on joint problem-solving
Long-Term Phase 2030-2050	Evaluation of success in meeting State of California policy targets and regulations	Public engagement to evaluate the Plan, inform and educate regarding new policies and technologies. Plan for next phases and the future.	Inform/consult on prioritization and collaborate on joint problem-solving

8.0 PERFORMANCE MEASURES AND EVALUATION OF PUBLIC ENGAGEMENT

The Port will evaluate public engagement to assess the effectiveness of outreach in terms of the number of people attending and the geographic areas they represent; diversity, including race and ethnicity; languages of attendees; number of attendees with disabilities; and other factors. After each public engagement event, whether it is a small group meeting or a large community meeting, the Port team will evaluate what went well and what needs improvement (if anything) and adjust accordingly. The Port will also assess the effectiveness of the engagement process and methods when reports are accepted, grants are announced or issued, related programs are completed, and so forth.

As part of the Plan's annual progress report to the Board, the Port will provide a summary of the community and stakeholder engagement process and activities to facilitate feedback from stakeholders and improve public engagement methods.

Specific performance evaluation techniques may include one or more of the following.

- Outputs (e.g., number of meetings held; number of advertisements placed; number of publications in which notices are distributed; number of visits to the 2020 and Beyond Plan website; number of language and disability access requests honored; number of comments acknowledged; number of comments summarized and raised with decision makers; number of comments incorporated)

- Inputs (e.g., number of comments; quality of comments; number of new commenters/attendees)
- Number of participants (e.g., workshop attendees, commenters)
- Representativeness (e.g., participation from residents, business owners, workers, community organizations, public sector organizations)
- Diversity of participants (e.g., age, race, language, disability, income, geography)
- Which types of outreach reached people and encouraged them to attend (how they heard about it; which venue they attended; how they submitted input)
- Which methods people used to submit input (in person, email, online, phone, individual meeting)
- Whether community input corresponded to, and was coordinated with, key milestones and phases in the planning process
- Whether potential stakeholders were fully identified and whether their interests became known and were acted upon
- Participant satisfaction (e.g., with convenience [location, time, accessibility, etc.] of meetings/communications; effectiveness [clarity, adequacy, timeliness] of communications; variety of communications; ease of input; respect for input demonstrated; level of consideration of and responses to input; fairness), evaluated potentially through paper and/or online surveys
- Whether the results of public participation are communicated to people who were involved in public planning process and to relevant decision makers, to demonstrate how public input is used

9.0 SUMMARY AND RESOURCES

The overall approach for public engagement for the 2020 and Beyond Plan process is based on a series of Task Force meetings and the work of the Co-Chairs as Steering Committee members. An annual town hall meeting will supplement these efforts. In addition, as the Plan rolls out and Implementing Actions are launched, there may be small group meetings with sector-specific individuals, regulators, special interests, and others to explore or find solutions with respect to regulatory requirements, health assessments, funding, technical developments, or other matters.

Individuals who contributed to the development of this PEP:

- Bill Aboudi, AB Trucking
- Brian Beveridge, West Oakland Environmental Indicators Project
- John Driscoll, Port of Oakland
- Andy Garcia, GSC Logistics
- Margaret Gordon, West Oakland Environmental Indicators Project
- Anna Lee, Alameda County Public Health Department

- Chris Lytle, Port of Oakland
- Greg Nudd, Bay Area Air Quality Management District

Participants in the roundtable discussions on September 26, 2018 – a partial list

- Bill Aboudi, AB Trucking
- John Berge, Pacific Merchant Shipping Association
- Kevin Bulger, Apex Maritime Co, Inc.
- John Coleman, Bay Planning Coalition
- Paul Cort, Earthjustice
- Anthony Fournier, BAAQMD
- Michelle Ghafar, Earthjustice
- Margaret Gordon, Co-Chair and WOEIP
- Andy Katz, Sierra Club
- Ray Kidd, West Oakland Neighbors
- Ken Larson, SSA Terminals
- Anna Lee, Alameda County Public Health Department
- Steve Lowe, West Oakland Commerce Association,
- Ben Machol, U.S. Environmental Protection Agency
- (Ms.) Alex McBride, City of Oakland
- David Quiros, CARB
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Additional resource staff and documents:

Port of Oakland Staff:

- Laura Arreola: Community Engagement Liaison, Social Responsibility Division; Port community engagement lead
- Richard Sinkoff: Director, Environmental Programs and Planning; 2020 and Beyond Plan design and development; management and oversight of plan implementation
- Amy Tharpe: Director, Social Responsibility

Documents:

- City of Oakland, Department of Race and Equity. 2017. Inclusive Public Engagement Plan Guide. May 16.

- City of Oakland, Planning and Building. n.d. General plan. Available at: http://www2.oaklandnet.com/government/o/PBN/OurServices/GeneralPlan/DOWD008821.
- City of Oakland, Planning and Zoning. 2014. West Oakland Specific Plan - Final Plan. June. Available at: http://www2.oaklandnet.com/Government/o/PBN/OurOrganization/PlanningZoning/OAK028334.
- Institute for Local Government, TIERS (Think, Initiate, Engage, Review, Shift) Framework for Public Engagement. Available at: https://www.ca-ilg.org/tiers-public-engagement-framework.

10.0 REFERENCES

California Air Resources Board (CARB). 2018. CARB adopts blueprint for statewide community air protection in areas most impacted by pollution. *Board also selects first 10 communities for additional focused actions under AB 617.* News release dated September 27, 2018. Available at https://ww2.arb.ca.gov/news/carb-adopts-blueprint-statewide-community-air-protection-areas-most-impacted-pollution.

City of Oakland. n.d. Oakland Army Base Redevelopment Plan. Available at http://www2.oaklandnet.com/government/o/PBN/OurServices/Application/DOWD009157.

_____. 2018. Draft West Oakland Truck Management Plan. November 16. Available at: https://www.oaklandca.gov/topics/west-oakland-truck-management-plan.

Port of Oakland (Port). 2009. Final Maritime Air Quality Improvement Plan. April.

Ramboll Environ (Ramboll). 2018. *Port of Oakland 2017 Seaport Air Emissions Inventory Final Report*. August. Available at: https://www.portofoakland.com/files/PDF/Port_Oakland_2017_Emissions_Inventory.pdf.

United States Census Bureau (U.S. Census). n.d. American Community Survey for Alameda County, Oakland, and West Oakland. 2017. Available at https://www.census.gov/programs-surveys/acs

U.S. Environmental Protection Agency (EPA), Office of Civil Rights (OCR). 2006. Federal Register. Title VI Public Involvement Guidance for EPA Assistance Recipients Administering Environmental Permitting Programs (Recipient Guidance).

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