CALIFORNIA
AIR RESOURCES BOARD

December 1, 2022

Interim Evaluation Report

Control Measure For Ocean-Going Vessels At Berth

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Acronyms and Abbreviations

AB	Assembly Bill
ABS	American Bureau of Shipping
AMP	Alternative Maritime Power
APCD	Air Pollution Control Districts
AQMD	Air Quality Management District
BAU	Business-As-Usual
CAECS	CARB Approved Emission Control Strategy
CAEM	Clean Air Engineering Maritime
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resources Board
CDC	Centers for Disease Control and Prevention
CEC	California Energy Commission
CEPAM	California Emissions Projection Analysis Model
CEQA	California Environmental Quality Act
CERP	Community Emissions Reduction Program
CEU	Car Equivalent Units
CHE	Cargo Handling Equipment
CO_2e	Carbon Dioxide Equivalent
CSL	Canada Steamship Line
CSLC	California State Lands Commission
DNV	Det Norske Veritas
DPM	Diesel Particulate Matter
EPA	Environmental Protection Agency
ER	Emergency Room
EU	European Union
FAQ	Frequently Asked Question
FY	Fiscal Year
GHG	Greenhouse Gas
HAZID	Hazard Identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ILWU	International Longshore and Warehouse Union

IMO	International Maritime Organization
ISO	International Organization for Standardization
ISOR	Initial Statement of Reasons
kV	Kilovolt
kW	Kilowatt
LADWP	Los Angeles Department of Water and Power
LNG	Liquified Natural Gas
METS-1	Maritime Emissions Treatment System
MOTEMS	Marine Oil Terminal Engineering & Maintenance Standards
MOU	Memorandum of Understanding
NAAQS	National Ambient Air Quality Standards
nm	Nautical Miles
NO_x	Oxides of Nitrogen
OAL	Office of Administrative Law
OGV	Ocean-Going Vessel
PacMMS	Pacific Maritime Management Services
PG&E	Pacific Gas & Electric
PM	Particulate Matter
PMA	Pacific Maritime Association
PMSA	Pacific Merchant Shipping Association
RCW	Regulated California Waters
Reefer	Refrigerated Cargo
ROG	Reactive Organic Gas
Ro-ro	Roll-on/Roll-off
SFPB	San Francisco Bar Pilots
SCE	Southern California Edison
SPBP	San Pedro Bay Ports (Ports of Los Angeles and Long Beach)
TEU	Twenty-foot Equivalent Unit
TIE	Terminal Incident Event
TTD	Transportation and Toxics Division
U.S.	United States
VIE	Vessel Incident Event
WSPA	Western States Petroleum Association
ZANZEFF	Zero- and Near-Zero Emissions Freight Facilities

Executive Summary

The At Berth Interim Evaluation Report ("Report") is designed to provide an implementation status update for the Control Measure for Ocean-Going Vessels At Berth[1] ("At Berth Regulation" or "Regulation"), which was adopted by the California Air Resources Board (CARB) in August 2020 via Resolution 20-22.[2] This Interim Evaluation Report ("Report") assesses the current state of at berth emissions control technologies for ocean-going vessels (OGV) and the status of any landside infrastructure improvements needed to strengthen underlying wharf structures to support emissions control technologies at berth; evaluates the progress being made towards complying with the emissions control requirements of the Regulation; examines the impacts of the global COVID-19 pandemic on the shipping industry; and serves as a tool to help guide potential future CARB actions for reducing emissions from OGVs (including the feasibility of potential control requirements for bulk/general cargo vessels and vessels at anchor). Additionally, this Report includes recommendations for CARB Board consideration about future amendments or rulemakings based on staff's findings.

Staff Recommendation: Based on the scope of the information provided to CARB for this Interim Evaluation Report, staff does not recommend any changes to the At Berth Regulation at this time.

While CARB staff note that there are challenges facing the shipping industry in complying with the upcoming emissions reductions deadlines for the At Berth Regulation, there are no new significant technological feasibility or timeline concerns brought to CARB staff's attention while drafting this Report that are not resolvable within the boundaries of the current Regulation. CARB staff are confident that the Regulation as it is written accommodates the concerns shared by regulated entities as part of this Report, and that regulated entities should be able to comply by the required emissions reductions deadlines or otherwise qualify for the compliance flexibilities already built into the Regulation in the event that there is a delay in equipment installation.

While the Regulation is expected to achieve considerable reductions from vessels at berth, CARB also recognizes that there are a significant emission reductions also needed from the transiting, maneuvering, and anchoring of OGVs in and around California's ports and marine terminals or they will continue to impact the health of portside communities. Tackling in-transit emissions from vessels will be necessary to see a significant reduction in NO_x and PM emissions, especially for the South Coast Air Basin. CARB will continue to push for federal action to reduce emissions from OGVs, as outlined in CARB's *2022 State Strategy for the State Implementation Plan;* however, some additional state-led efforts should be considered to achieve necessary NO_x and PM reductions from OGVs.

Staff Recommendation: In addition to continuing to pursue federal action, CARB staff recommend that CARB's Board direct staff to prioritize exploration of measures to achieve additional reductions from OGVs while in-transit, maneuvering, and at anchor in California waters.

1 Title 17, division 3, Introduction, subConclusion.5, sections 93130-93130.22 of the California Code of Regulations
2 Control Measure for Ocean-Going Vessels At Berth, *Resolution 20-22*. August 27, 2020.

Background

Mobile sources, including OGVs and the fossil fuels that power them, are the largest contributors to the formation of ozone in California, accounting for approximately 80 percent of smog-forming oxides of nitrogen (NO_x) emissions, 90 percent of diesel particulate matter (DPM) emissions, and nearly 50 percent of greenhouse gas (GHG) emissions.[3] Marine-related emissions, including OGVs, constitute a significant portion of the total off-road NO_x emissions. Specifically, without additional emissions reductions requirements beyond the 2007 Airborne Toxic Control Measures for Auxiliary Diesel Engines Operated on Ocean-Going Vessels AtBerth in a California Port ("2007 At-Berth Regulation" or "2007 Regulation")[4], OGVs are projected to account for nearly 50 percent of statewide off-road mobile source NO_x emissions by 2037,[5] an increase from approximately 35 percent as of 2017.[6]

Emissions reductions achieved by the 2007 Regulation play a key role in helping California air basins meet the National Ambient Air Quality Standards (NAAQS) as required by the Federal Clean Air Act. The At Berth Regulation is one of the control measures that is included in California's 2022 State SIP Strategy to assist with achieving the reductions necessary to help the South Coast reach attainment with the 2037 ozone standard.[7] The DPM reductions from the At Berth Regulation is also critical to reducing exposure to toxic air contaminants in port communities that are severely impacted by air pollution as required under Assembly Bill (AB) 617 (Garcia, Statutes of 2017).[8]

The At Berth Regulation builds upon the benefits achieved by the 2007 Regulation, which applied only to container, refrigerated cargo ("reefer"), and cruise vessels visiting six California ports: Hueneme, Los Angeles, Long Beach, Oakland, San Diego, and San Francisco. The 2007 Regulation required container and reefer vessel fleets making 25 or more visits to any of the six regulated ports and cruise vessel fleets making 5 or more visits to those same ports to either plug into shore power[9] while docked ("at berth") or use an equally effective CARB approved emissions control technology (such as a capture and control system) to reduce emissions of NO_x and DPM at berth. The 2007 Regulation phased in with a requirement to reduce their auxiliary engine power generation while at berth by at least 50 percent beginning in 2014, with that requirement increasing to 70 percent in 2017 and 80 percent in 2020.

3 CARB's *Mobile Source Strategy*. May 2016.

4 The 2007 At-Berth Regulation is codified as title 13, Cal. Code Regs., sections 2299.3 and title 17, section 93118.3.

5 2037 is the attainment deadline for areas classified extreme under the National Ambient Air Quality Standard (NAAQS) 70 ppb 8-hour ozone. Both the San Joaquin and South Coast air basins are classified as extreme nonattainment areas.

6 These emissions estimates reflect updated numbers from the At Berth rulemaking based on CARB's latest emissions inventory model (as of August 2022). *CARB CEPAM 2019 Summer emissions (version 1.03)*; the emissions estimates for OGVs under this model include emissions up to 100 nm from shore. Note: these estimates may differ from those values cited in CARB documents during rulemaking as a result of updates made to CARB's emissions inventory since the time the Regulation was drafted.

7 California Air Resources Board, *Draft 2022 State Strategy for the State Implementation Plan*. January 31, 2022.

8 AB 617, which was enacted by California in 2017, requires CARB to pursue new community-focused and community-driven actions to reduce air pollution and improve public health in communities that experience disproportionate burdens from exposure to air pollutants.

9 "Shore power" is defined in the regulation as "electrical power being provided by either the local utility or by distributed generation to a vessel at berth." Title 17, Cal. Code Regs., section 93130.2(b)(72).

Despite the emissions reductions achieved from vessels at berth through the 2007 Regulation, communities around California's port complexes continue to bear a disproportionate health burden due to their close proximity to the emissions generated from freight activity associated with the seaports. CARB anticipates an increase in cargo shipping activity in upcoming years, which would result in an increase in emissions at California's ports for the foreseeable future, even at full implementation of the 2007 Regulation.[10] To further protect communities most heavily impacted by California's freight sector, additional emissions reductions are necessary at seaports, including emissions from vessels at berth.

To help achieve these necessary emissions reductions, the At Berth Regulation expands auxiliary engine emissions reduction requirements to additional categories of vessels (auto carrier and roll-on/roll-off - referred to in this Report as "ro-ro" vessels - and tankers), adds emissions reduction requirements for tanker vessel auxiliary boilers, and extends the applicability of the Regulation to new ports and terminals. The Regulation is expected to add a total of 30 new tanker and ro-ro terminals (14 in Northern California and 16 in Southern California). While these are the terminals that staff currently anticipate having emissions control obligations under the Regulation, any terminal that receives 20 or more visits from a regulated vessel category (container, reefer, cruise, ro-ro, and tanker) will be automatically subject to the emissions control requirements of the Regulation.

The At Berth Regulation is projected to reduce emissions from 2,300+ additional vessel visits (in addition to the 4,000+ visits controlled under the 2007 At-Berth Regulation), achieving the following approximate cumulative total reductions from 2021 to 2032:[11,12]

- 17,500 tons of NO_x
- 370 tons of particulate matter 2.5 (PM2.5)
- 870 tons of reactive organic gas (ROG)
- 356,000 metric tons of carbon dioxide equivalent (CO_2e)

Ultimately, the emissions reductions resulting from the Regulation are projected to result in a reduction in potential cancer risk of 55 percent from OGVs at the Ports of Los Angeles, Long Beach, and Richmond.[13] These reductions are necessary to improve the health of those living and working near California's ports, as well as help California meet the attainment of the NAAQS for ozone and PM in all regions of California as required by the Federal Clean Air Act. Additionally, because the largest portion of emissions from OGVs comes from the vessels' large main engines while they are in-transit, further actions to reduce emissions from OGVs in-transit should be considered to further reduce the impacts of shipping on California's port communities.

10 See *ISOR Appendix H*, pp. H-26 to H-36.
11 California Air Resources Board. *New At Berth Fact Sheet*.
12 *Updated Informative Digest – Control Measure for Ocean-Going Vessels At Berth*, p. 5.
13 See *ISOR Appendix G*, pp. G-40 and G-50.

Overview of the At Berth Regulation

The At Berth Regulation establishes in-use emissions requirements that apply on or after January 1, 2023, with limited exceptions,[14] to any person who owns, operates, charters, or leases any United States (U.S.) or foreign-flag vessel that visits a California port, terminal, or berth; any person who owns, operates, or leases a port, terminal, or berth located where vessels visit; or any person who owns, operates, or leases a CARB approved emissions control strategy (CAECS) for vessel auxiliary engines or tanker auxiliary boilers. Operators of container, reefer, cruise, ro-ro, and tanker vessels docked at regulated California ports, terminals, or berths must reduce emissions from their auxiliary engines during a visit through use of a CAECS that meets the performance standards specified in section 93130.5(d)(1) of the Regulation. Tanker vessels with steam driven pumps must meet the performance standards for auxiliary boilers at berth as specified in section 93130.5(d)(2) of the Regulation unless that vessel is connecting to shore power to reduce auxiliary engine emissions. Additionally, tanker vessels with steam driven pumps that utilize shore power to reduce emissions from their auxiliary engines do not have requirements to control auxiliary boiler emissions. Because boilers cannot be powered by electricity (i.e., cannot be shore powered), this requirement is designed to encourage tanker vessels to use shore power to reduce their auxiliary engine emissions, achieving additional reductions of GHG and DPM while not being required to implement a duplicate emissions control strategy to also control boiler emissions.

The Regulation uses a terminal-based visit threshold to determine which ports and independent marine terminals[15] ("terminals") have emissions control requirements at their berths. Any terminal receiving 20 or more visits from container, reefer, cruise, roro, and/or tanker vessels has a requirement to reduce at berth emissions from those vessel types. Low activity terminals, meaning those terminals receiving fewer than 20 visits from a regulated vessel category, and the vessels calling these low activity terminals are exempt from emissions control requirements of the Regulation, but are not exempt from reporting and opacity requirements.[16] Bulk and general cargo vessels are also exempt from emissions control requirements of the Regulation but are not exempt from reporting and opacity requirements.

Emissions control requirements of the Regulation will phase in on the following schedule:[17]

- Container/Reefer/Cruise – January 1, 2023
- Ro-ro/auto carrier – January 1, 2025
- Tankers (Southern California) – January 1, 2025
- Tankers (Northern California) – January 1, 2027

Container, reefer, and cruise vessels terminals have the earliest compliance deadline, with emissions reductions beginning on January 1, 2023. Container, reefer, and cruise ports and terminal operators and vessel operators put forth great efforts to install the necessary equipment and supporting infrastructure at their berths and on board their vessels, respectively, to comply with the 2007 Regulation. As such, minimal additional equipment or infrastructure development is needed at most container, reefer, and cruise berths to meet their January 1, 2023, compliance date, which is generally reflected in the port and terminal plans that CARB received.

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14 The At Berth Regulation exempts ocean-going vessel voyages that do not stop at a California port, terminal, or berth; OGV stops that are necessitated by force majeure or distress or stopping to assist persons, vessels, or aircraft in danger or distress; OGVs owned or operated by local, state, federal, or foreign governments in government non-commercial service, and emergency/safety events and anchoring or berthing as required by a federal agency. Exemptions also exist for emergency/safety events and anchoring or berthing as required by a federal agency. Title 17, Cal. Code Regs., section 93130.4.

15 An "independent marine terminal" means a terminal that operates independently from a port or port authority.

16 See title 17, Cal. Code Regs., Sec. 93130.8(e) and 93130.10(a).

17 See title 17, Cal. Code Regs., Sec. 93130.7(b).

For the newly regulated vessel categories, ro-ro vessels will phase into the emission control requirements of the Regulation beginning on January 1, 2025, providing ro-ro vessels and terminals with over four years of lead time since the adoption of the Regulation. Separately, tanker implementation dates are staggered, with tanker terminals in Southern California phasing in first in 2025 and Northern California tanker terminals following in 2027. This staggered implementation schedule for tankers reflects the fact that fewer infrastructure upgrade challenges are expected at Southern California tanker terminals when compared to Northern California terminals. In general, tanker berths and terminals differ structurally from container, reefer, cruise, and ro-ro berths and terminals due to the nature of the cargo they transport (for example, to minimize spill and combustion risk).

The At Berth Regulation required all regulated terminal operators and ports with regulated terminals to submit Terminal and Port Plans, respectively, to CARB's Executive Officer by December 1, 2021. The Regulation required Terminal and Port Plans to detail how each entity intends to comply with the emissions reduction requirements of the Regulation by the compliance date specified for the vessel types each entity receives.[18] The Terminal and Port Plans were required to contain all of the elements specified in section 93130.14(a)(3) and 93130.14(b)(3) of the Regulation, respectively, including describing the division of responsibilities between the port and terminal operators, which is necessary to assist CARB staff in more easily identifying who is responsible for noncompliance incidents. In total, CARB received nine Port Plans, 19 container/reefer Terminal Plans, four cruise Terminal Plans, eight ro-ro Terminal Plans, and 22 tanker Terminal Plans, all of which are available for viewing on CARB's website: *Terminal and Port Plan Submissions*. CARB's responses to each Plan submittal are also available on the website, including a letter confirming Plan completeness or advising operators of Plan deficiencies where applicable.[19] The information shared as part of these Terminal and Port Plans helped shape this Interim Evaluation and will be discussed in further detail in *Assessment of Compliance Readiness* of this Report.

Because ro-ro and tanker vessels have implementation dates several years in the future, updated terminal plans will be required for terminals receiving these new vessel categories. Updated Terminal Plans should note any changes since the submittal of the original plan and are due by February 1 the calendar year prior to the first implementation date (February 1, 2024 for ro-ro terminals and Southern California tanker terminals; and February 1, 2026, for Northern California tanker terminals).

The Regulation was designed with flexibility in mind. CARB staff realizes that every vessel, terminal, and port operation is unique, and there may not be a "one-size-fits-all" solution to reducing emissions from vessels at berth. As such, the Regulation allows regulated entities to select the emissions control solution that works best for their particular operations. Additionally, CARB understands that some projects and equipment installations may require extended construction, installation, and/or permitting timelines, particularly as a result of the global COVID-19 pandemic which resulted in global lockdowns, travel restrictions, and snarled supply chains. The Regulation provides flexible compliance options for regulated entities, including Terminal Incident Events and Vessel Incident Events (TIEs and VIEs, respectively), the remediation fund, and Innovative Concepts.[20] These options, explained below, provide regulated entities a potential compliance pathway when emissions at berth are not reduced as required due to various circumstances, such as delays in installing emissions control equipment or an inability to connect to already installed equipment.

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18 See title 17, Cal. Code Regs., Sec. 93130.14.

19 Within that 90-day period, CARB issued letters or emails to all plan submitters letting them know if their plan was complete or not, and for any plans deemed incomplete, identified the specific deficiencies noted by CARB staff. For incomplete plans, CARB staff requested port or terminal operators to re-submit a revised plan that addresses the identified deficiencies. All port and terminal plans were posted to *CARB's website* for public review, along with CARB's responses to each plan submittal and any revised plans that were submitted addressing CARB staff's request for revisions.

20 See title 17, Cal. Code Regs., Sec. 93130.11 (Vessel Incident Events (VIE) and Terminal Incident Events (TIE)), 93130.15 (Remediation Fund Use), and 93130.17 (Innovative Concept Compliance Option).

VIEs and TIEs are exceptions that are granted to vessel fleet and terminal operators each calendar and are based on a percentage of the total visits a vessel fleet made to a port in a given calendar year.[21] VIEs and TIEs are designed to provide regulated vessel fleets and terminal operators, respectively, with a limited amount of operational flexibility while ensuring that emissions reductions from vessels at berth remain high. VIEs and TIEs are port specific to prevent excess emissions from occurring and having an inequitable impact on other California port communities. CARB will provide each vessel fleet or terminal with a specific number of VIEs or TIEs, based on a percentage of the amount of vessel visit activity occurring in a preceding calendar year.[22] VIEs/TIEs are strictly limited in number under the Regulation and more cannot be requested once CARB grants a fleet's or terminal's VIEs/TIEs for a given calendar year, but they may be used by a regulated entity in any situation with no qualifying circumstances needed. Separately, the remediation fund is an optional compliance pathway that may only be used in specific limited circumstances where vessel operators, terminal operators, CAECS operators, and/or ports have attempted to comply with the Regulation.[23] These circumstances include equipment repairs, equipment maintenance, delays in connecting to a control strategy, construction related activities at the terminal that prevent connection to a CAECS, or an unavoidable physical and/or operation constraint that was identified in a terminal plan that was submitted to and approved by CARB. The remediation fund allows regulated entities to pay a specified amount of funds to a third-party fund administrator, if available, that will then be used to fund projects that reduce equivalent emissions in the same port communities impacted by the uncontrolled emissions.[24] The amount paid per hour for remediation is based on vessel type and engine classification.[25]

Lastly, the Innovative Concepts Compliance Option is a voluntary compliance pathway allowing regulated vessel fleets, terminal operators, and/or ports to comply with the Regulation using a project that achieves equivalent emissions reductions near where vessels visit. This compliance option was requested by stakeholders prior to the final adoption of the Regulation and was noticed to the public in the March 2020 15-day notice. The Regulation provided a one-time opportunity for entities to submit all applications for Innovative Concepts projects to CARB by December 1, 2021.[26]

Preparation of the Interim Evaluation Report

In preparation to draft this Report, CARB staff solicited members of the public and industry stakeholders starting in the Fall of 2021 and through 2022 to submit comments to inform this analysis. In total, CARB received 11 comment letters from a variety of shipping lines, terminal operators, ports, industry associations, and environmental advocates. Several of these comment letters contained information regarding progress and challenges seen with adapting and procuring emissions reductions technologies for use by the compliance dates set forth in the Regulation. In addition to stakeholder comment letters, CARB staff also used the port and terminal plans, Innovative Concept applications, a tanker grant solicitation project, community and industry stakeholder meetings, and port tours as part of this evaluation.

21 See title 17, Cal. Code Regs., Sec. 93130.11.

22 Five percent of a vessel's activity and 15 percent of a terminal's activity in 2023-2024, then decreasing to five percent beginning in 2025. See title 17, Cal. Code Regs., Sec. 93130.11(b). Additional VIEs/TIEs can be requested by December 1 of each calendar year to accommodate an anticipated growth in vessel visits. See title 17, Cal. Code Regs., Sec. 93130.11(c) for the process to request additional VIEs/TIEs.

23 See title 17, Cal. Code Regs., Sec. 93130.15(d).

24 See title 17, Cal. Code Regs., sec. 93130.15.

25 See title 17, Cal. Code Regs., sec. 93130.15(f).

26 See title 17, Cal. Code Regs., sec. 93130.17(a)(1).

CARB endeavored to maintain an open and transparent information sharing process leading up to the preparation of this Interim Evaluation Report and the first emissions reduction implementation date (January 1, 2023) of the Regulation. CARB staff developed and published an *At Berth FAQ document* in November 2021, published all port and terminal Plans (original and revisions) along with CARB responses to the Plans on the *At Berth Regulation* webpage in May 2022, and supported and promoted the formal public review process for Innovative Concept applications as set forth by section 93130.17(b) of the Regulation. Public outreach for At Berth Regulation implementation that also informed this Report includes:

- Innovative Concepts application comment period
- Remediation fund administrator process
- Vessel reporting system development
- CAECS approvals
- Public meetings and workshops, including community meetings, industry stakeholder meetings, and site visits

Findings

A thorough review of stakeholder comment letters, port and terminal plans, Innovative Concept applications, and third-party Feasibility Studies submitted to CARB shows that most vessel and terminal operators are actively pursuing a compliance pathway that will enable them to comply with the emissions reductions deadlines (referred to in this Report as "compliance deadlines") established in the Regulation. The majority of terminal operators and ports intend to pursue shore power (grid-based or distributed generation) or capture and control technology, with a small percentage of vessel/terminal operators considering alternative fuels or Innovative Concepts as an emissions reduction strategy. These compliance options selected by regulated terminal operators and ports generally reflect CARB staff's *Berth Analysis* that was prepared and presented during the rulemaking efforts for the At Berth Regulation.[27]

The information analyzed as part of this Report indicates that many regulated entities share concerns regarding the ability of vessels and terminals to design, procure, and/or install emissions reduction technologies in time to meet the compliance deadlines of the Regulation, as well as the technical feasibility and safety of using shore power and capture and control systems on tanker vessels. While CARB staff note that there are challenges facing the shipping industry and terminals/ports in complying with the At Berth Regulation and recognizes there is no single compliance solution for every terminal throughout California, it is also important to note that there were no new significant technological feasibility or timeline concerns brought to CARB staff's attention during the drafting of this Report that are not addressable within the boundaries of the Regulation as it is currently written.

Given that the comments received by CARB during the drafting of this Report highlight the same circumstances and raise the same substantive concerns as considered during the development of the Regulation, CARB staff are confident that the Regulation as it is written accommodates the concerns shared by regulated entities and that the majority of regulated entities should be able to comply with the Regulation by the required emissions reductions deadlines. In some cases, CARB staff have not seen sufficient site-specific information to indicate that compliance with the emissions reductions deadlines are not achievable, such as with many of the tanker terminals who provided only general, non-site-specific studies indicating an inability to comply with the emissions reductions deadlines in the Regulation but offered little evidence of attempts to explore compliance pathways. Additionally, it is worth noting that some tanker terminals indicated to CARB that they were not pursing a compliance pathway until after the publication of this Report. However, nothing in the Regulation or this Report precluded the ports or terminals from acting to ensure compliance with the Regulation requirements after the adoption of the Regulation in 2020.

27 See *ISOR Appendix E*

It is important to note that while there are concerns from some vessel and terminal operators regarding the feasibility and safety of using emissions control technologies such as shore power and capture and control to comply with the Regulation, failure by regulated entities to select potential control technologies and perform site-specific Feasibility Studies does not excuse regulated entities from their compliance obligations. All methods of achieving the required emissions reductions should be explored by regulated entities prior to the compliance deadlines, and CARB recommends that vessel/terminal operators and ports continue to communicate with CARB regarding any challenges they may experience with design, procurement, and installation of emissions control equipment.

Conclusion

Based on the scope of the information provided to CARB for this Interim Evaluation Report, staff does not recommend any changes to the emissions reduction deadlines for the Regulation. While CARB staff note that there are challenges facing the shipping industry in complying with the At Berth Regulation, it is also important to note that there were no new significant technological feasibility or timeline concerns brought to CARB staff's attention while drafting this Report that are not resolvable within the boundaries of the current Regulation.

As mentioned in the *Introduction* of this Report, the Regulation provides several pathways toward compliance when direct emissions reductions are not possible during a vessel's visit to a regulated California port or marine terminal: VIEs/TIEs, the remediation fund, and Innovative Concepts. Vessel and terminal operators can use VIEs and TIEs, respectively, to exempt any visit(s) they choose (up to 20 percent of total visits in 2023/2024 and up to 10 percent of total visits from 2025 onward). Additionally, regulated entities can use the remediation fund to remain in compliance if they qualify for one or more of the criteria outlined in section 93130.15(b) of the Regulation. As long as an entity can show CARB documentation proving that the equipment was ordered in a timely fashion and there was an unpreventable delay (such as COVID-related equipment shortages, labor delays or lack of available engineering staff to install the equipment, etc.), then a vessel/terminal operator or port can pay into the remediation fund to ensure their visits to regulated California berths remain in compliance with the Regulation. This mechanism was written into the Regulation to allow for flexibility during extraordinary circumstances and will fund projects that achieve emissions reductions in port communities that are directly impacted by excess emissions from vessels at berth. Lastly, if a regulated entity has an Innovative Concept approved for use by CARB, they may also use that Innovative Concept to comply with the Regulation. Innovative Concepts could be used by vessel fleets to request the continued use of fleet averaging (similar to the 2007 Regulation); at least one application was received requesting the use of fleet averaging and that application is pending CARB approval.

Regarding the inclusion of bulk/general cargo vessels and vessels at anchor, while CARB staff did not find that technologies or vessel operations have significantly changed such that controlling emissions from these vessel categories would be any more cost effective than what was shown with the rulemaking documents published for the At Berth Regulation in 2019 and 2020. However, CARB does recognize the potential impacts these vessels may have on both air quality and public health. As noted in *Feasibility of Control Requirements for Bulk and General Cargo Vessels* of this Report, emissions from bulk vessels are projected to grow from increased activity, confirming the need to further explore emission reduction strategies for bulk vessels. Additionally, vessels at anchor have shown to be a significant source of pollution over the past two years, particularly during the peak of port congestion in 2021. Although much of the anchorage activity has been reduced as a result of a new vessel queuing system (as described in *COVID-19 Pandemic Impacts* of this Report), CARB staff do not yet have a full understanding of the impacts from emissions associated with vessels drifting farther (50 to 150 nm) offshore. While business-as-usual anchorage emissions are relatively low in comparison to at berth and in-transit modes of operation (as shown in *Figures 27 and 28)*, further investigation is needed to determine if further regulation may be necessary for vessels at anchor to protect public health.

While the Regulation is expected to achieve considerable reductions from vessels at berth, significant additional emission reductions are needed from the transiting, maneuvering, and anchoring of OGVs in and around California's ports and marine terminals and along the California coast that continue to impact the health of portside communities. Tackling in-transit emissions from vessels will be necessary to see a significant reduction in NO_x and PM emissions, especially for the South Coast Air Basin. CARB will continue to push for federal action to reduce emissions from OGVs, as outlined in CARB's *2022 State Strategy for the State Implementation Plan*; however, some additional state-led efforts may need to be considered to achieve necessary NO_x and PM reductions from OGVs. In addition to federal action, CARB staff recommend that CARB's Board direct staff to prioritize exploration of measures to achieve additional reductions from OGVs while in-transit, maneuvering, and at anchor in California waters. Addressing in-transit emissions would move California in line with other progressive efforts to mitigate the impact of shipping pollution. Given the air quality challenges facing California, a more robust approach addressing NO_x, PM2.5, DPM, and ROG, in addition to GHGs, may be necessary in California to meet NAAQS and reduce the health burdens posed by the shipping industry on California's port and coastal communities.

In order to prioritize achieving additional emissions reductions from OGVs, CARB will need to shift course from promulgating a zero-emission cargo handling equipment (CHE) rulemaking to the exploration of measures to achieve additional reductions from OGVs. While this shift would potentially delay a rulemaking to advance efforts to require zero-emissions CHE at California ports and railyards, additional reductions from CHE could be achieved through incentives and other early zero-emissions efforts at these facilities.


PILOT
NO TUG
DANGER
HIGH
VOLTAGE

Introduction

Purpose of the Interim Evaluation Report

This Interim Evaluation Report ("Report") provides an implementation status update for the Control Measure for Ocean-Going Vessels At Berth[28] ("At Berth Regulation" or "Regulation"), which was adopted by the California Air Resources Board (CARB) in August 2020 via Resolution 20-22.[29] The Report includes a high-level summary of CARB staff's findings regarding the following:

1. Assessment of the compliance readiness, including the progress being made in adopting control technologies for use with tanker and roll-on/roll-off ("ro-ro" or "auto carrier") ocean-going vessels ("vessels" or "OGVs"), as well as the status of landside infrastructure improvements that may be needed to support emission reductions at ro-ro and tanker terminals.
2. Review of the control technologies for use with bulk and general cargo vessels and vessels at anchor, and the feasibility of potential control requirements for these vessel types.
3. Summary of Innovative Concepts applications received by CARB for potential use as an alternative compliance pathway to the At Berth Regulation.
4. Evaluation of COVID impacts to the shipping industry and California's ports and marine terminals.
5. Discussion of the public process during implementation of the Regulation and the construction of this Report.

This Interim Evaluation Report assesses the state of at berth emissions control technologies for OGVs and the status of any landside infrastructure improvements needed to strengthen underlying wharf structures to support emissions control technologies at berth; evaluates the progress being made towards complying with the emissions control requirements of the Regulation; examines the impacts of the global COVID-19 pandemic on the shipping industry; and serves as a tool to help guide potential future CARB actions for reducing emissions from OGVs, including the feasibility of potential control requirements for bulk/general cargo vessels and vessels at anchor.

CARB staff initially solicited for comments from stakeholders through the publication of the *At Berth Frequently Asked Questions* (FAQ) document, which was published on CARB's website in November 2021. Staff requested information to be considered for this Interim Evaluation Report be submitted to CARB staff by June 2022 to allow time for staff to review and consider the information in the drafting of the Report. Staff again solicited stakeholders for information during an implementation webinar hosted by CARB on May 17, 2022, and again reminded participants of the need to receive information by June 2022 for timely consideration. Because this Interim Evaluation Report is not part of a formal rulemaking process, stakeholder comments were accepted at any point in time during the drafting of this Report; however, a timeframe for comment submittal was necessary for staff's timely review in order to meet the Report's required publication date of December 1, 2022, as set forth in section 93130.14(d) of the Regulation. In total, CARB received 11 comment letters from stakeholders and these comment letters were reviewed by staff and incorporated into this Report where appropriate.

28 Title 17, division 3, Introduction, subConclusion.5, sections 9313093130.22 of the California Code of Regulations
29 Control Measure for Ocean-Going Vessels At Berth, *Resolution 20-22*. August 27, 2020.

Findings from this Report are intended to update both stakeholders and CARB's Board as to the progress being made toward implementation of the At Berth Regulation. A summary of this Report will be provided to CARB's Board following the publication of this document, as required by section 93130.14(d) of the Regulation. It is important to note that this Report is an implementation status update, not a technical feasibility assessment, and the findings of the Report will not change or alter the compliance obligations for regulated entities, including those entities with compliance deadlines beginning January 1, 2023. Additionally, this Report is not a new rulemaking and findings in this Report do not change or alter any elements of the At Berth Regulation; changes to the Regulation can only be made through a formal rulemaking process at the direction of CARB's Board. Based on the findings of the Report, CARB's Board may direct staff to develop amendments to the At Berth Regulation through the formal, public rulemaking process or pursue additional measures for reducing emissions from ocean-going vessels.

Background

Mobile sources, such as cars, trucks, off-road engines and equipment, including OGVs, and the fossil fuels that power them, are the largest contributors to the formation of ozone, particulate matter (PM2.5), diesel particulate matter (DPM), and greenhouse gas (GHG) emissions in California. Such sources are responsible for approximately 80 percent of smog-forming oxides of nitrogen (NO_x) emissions, 90 percent of DPM emissions, and nearly 50 percent of GHG emissions.[30] Marine-related emissions, including OGVs, constitute a significant portion of the total off-road NO_x emissions. Specifically, without additional emissions reductions requirements beyond the 2007 Regulation, OGVs are projected to account for nearly 50 percent of statewide off-road mobile source NO_x emissions by 2037, [31] an increase from approximately 35 percent as of 2017.[32]

While the largest portion of the emissions from OGVs comes from the vessels' large main engines while they are in-transit, the reductions from the At Berth Regulation are key in helping California air basins meet the National Ambient Air Quality Standards (NAAQS) as required by the Federal Clean Air Act. The At Berth Regulation is one of the control measures that is committed in California's 2022 State SIP Strategy to assisting with achieving the reductions necessary to help the South Coast reach attainment with the 2037 ozone standard.[33] The DPM reductions from the At Berth Regulation is also critical to reducing exposure to toxic air contaminants in port communities that are severely impacted by air pollution as required under Assembly Bill (AB) 617 (Garcia, Statutes of 2017).[34]

30 CARB's *Mobile Source Strategy*. May 2016.

31 2037 is the attainment deadline for areas classified extreme under the National Ambient Air Quality Standard (NAAQS) 70 ppb 8-hour ozone. Both the San Joaquin and South Coast air basins are classified as extreme nonattainment areas.

32 These emissions estimates reflect updated numbers from the At Berth rulemaking based on CARB's latest emissions inventory model (as of August 2022). *CARB CEPAM 2019 Summer emissions (version 1.03)*; the emissions estimates for OGVs under this model include emissions up to 100 nm from shore. Note: these estimates may differ from those values cited in CARB documents during rulemaking because of updates made to CARB's emissions inventory since the time the Regulation was drafted.

33 CARB's *Draft 2022 State Strategy for the State Implementation Plan*. January 31, 2022.

34 AB 617, which was enacted by California in 2017, requires CARB to pursue new community-focused and community-driven actions to reduce air pollution and improve public health in communities that experience disproportionate burdens from exposure to air pollutants.

The At Berth Regulation builds upon the benefits achieved by the Airborne Toxic Control Measures for Auxiliary Diesel Engines Operated on Ocean-Going Vessels At-Berth in a California Port ("2007 At-Berth Regulation" or "2007 Regulation").[35] The 2007 Regulation applied only to container, refrigerated cargo ("reefer"), and cruise vessels visiting six California ports: Hueneme, Los Angeles, Long Beach, Oakland, San Diego, and San Francisco. The 2007 Regulation required container and reefer vessel fleets making 25 or more visits to any of the six regulated ports and cruise vessel fleets making 5 or more visits to those same ports to either plug into shore power[36] while docked ("at berth") or use an equally effective CARB approved emissions control technology (such as a capture and control system) to reduce emissions of NO_x and DPM at berth. The 2007 Regulation phased in with a requirement to reduce their auxiliary engine power generation while at berth by at least 50 percent beginning in 2014, with that requirement increasing to 70 percent in 2017 and 80 percent in 2020.

Despite the emissions reductions achieved from vessels at berth through the 2007 AtBerth Regulation, communities around California's port complexes continue to bear a disproportionate health burden due to their close proximity to the emissions generated from freight activity associated with the seaports. CARB anticipates an increase in cargo shipping activity in upcoming years, which would result in an increase in emissions at California's ports for the foreseeable future, even at full implementation of the 2007 Regulation.[37] To further protect communities most heavily impacted by California's freight sector, additional emissions reductions are necessary at seaports, including emissions from vessels at berth.

To help achieve these necessary emissions reductions, the At Berth Regulation expands auxiliary engine emissions reduction requirements to additional categories of vessels (ro-ro and tanker), adds emissions reduction requirements for tanker vessel auxiliary boilers, and extends the applicability of the regulation to additional ports and terminals. Figure 1 below shows the ports and marine terminals previously regulated under the 2007 Regulation and those now subject to the expanded Regulations. The Regulation applies emission reduction requirements to 14 additional terminals in Northern California:

- Carquinez/Benicia: six independent tanker terminals and one independent ro-ro terminal
- Richmond: five tanker independent terminals and one independent ro-ro terminal
- Port of Stockton: one tanker terminal

Additionally, there are also 16 additional tanker and ro-ro terminals at ports previously subject to the 2007 Regulation (for container, reefer, and cruise vessels) that will be subject to the Regulation emissions reduction requirements for the first time:

- Port of Los Angeles: seven tanker terminals and one ro-ro terminal
- Port of Long Beach: three tanker terminals and two ro-ro terminals
- Hueneme: one ro-ro terminal
- San Diego: one ro-ro terminal
- San Francisco: one ro-ro terminal

While these are the terminals that staff currently anticipate having emissions control obligations under the Regulation, any terminal that receives 20 or more visits from a regulated vessel category (container, reefer, cruise, ro-ro, and tanker) will be automatically subject to the emissions control requirements of the Regulation.[38]

35 The 2007 At-Berth Regulation is codified at title 13, Cal. Code Regs., sections 2299.3 and title 17, section 93118.3.

36 "Shore power" is defined in the regulation as "electrical power being provided by either the local utility or by distributed generation to a vessel at berth." Title 17, Cal. Code Regs., section 93130.2(b)(72).

37 See *ISOR Appendix H*, p. H-26 to H-36.

38 See title 17, Cal. Code Regs., Sec. 93130.9 and 93130.10(a) of the Regulation.

Figure 1: Regulated California Ports and Marine Terminals

The At Berth Regulation is projected to reduce emissions from 2,300+ additional vessel visits (in addition to the 4,000+ visits controlled under the 2007 At-Berth Regulation), achieving the following approximate cumulative total reductions from 2021 to 2032:[39,40]

- 17,500 tons of NO_x
- 270 tons of diesel particulate matter (PM)
- 370 tons of PM2.5
- 356,000 metric tons of carbon dioxide equivalent (CO_2e)
- 870 tons of reactive organic gas (ROG)

Ultimately, the emissions reductions resulting from the Regulation are projected to result in a reduction in potential cancer risk of 55 percent at the Ports of Los Angeles, Long Beach, and Richmond (as shown in Figures 2 and 3 below). These reductions are necessary to improve the health of those living and working near California's ports, as well as help California meet the attainment of the NAAQS for ozone and PM in all regions of California as required by the Federal Clean Air Act.

39 CARB's *New At Berth Fact Sheet*.
40 *Updated Informative Digest – Control Measure for Ocean-Going Vessels At Berth*, p. 5.

Figure 2: Reduction in Potential Cancer Risk from the At Berth Regulation at the Ports of Los Angeles and Long Beach

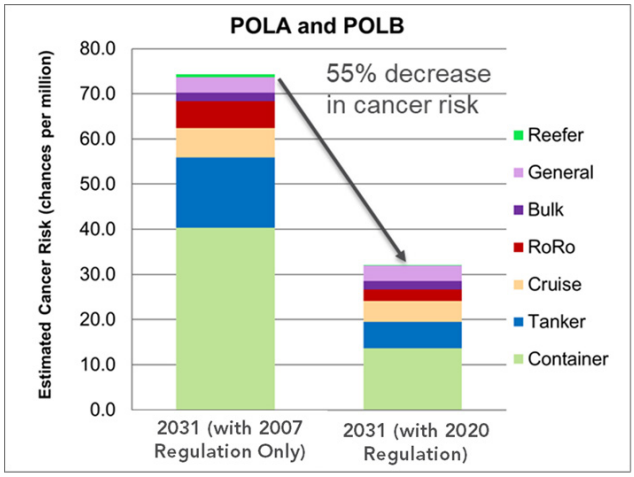
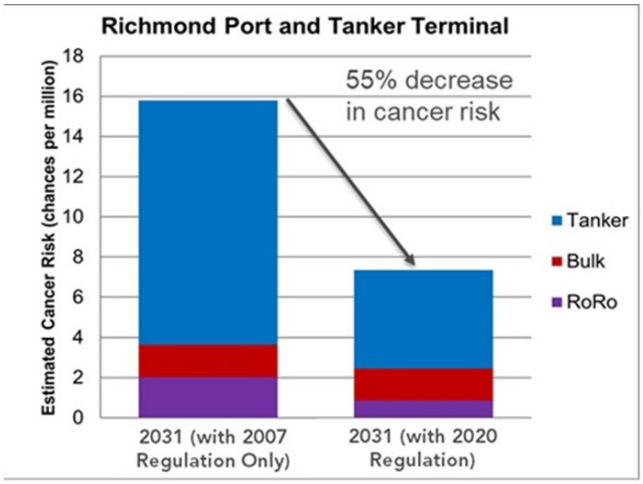


Figure 3: Reduction in Potential Cancer Risk from the At Berth Regulation at the Port of Richmond and Richmond Long Wharf



Overview of the At Berth Regulation

The At Berth Regulation establishes in-use emissions requirements that apply on or after January 1, 2023, with limited exceptions,[41] to any person who owns, operates, charters, or leases any United States (U.S.) or foreign-flag vessel that visits a California port, terminal, or berth; any person who owns, operates, or leases a port, terminal, or berth located where vessels visit; or any person who owns, operates, or leases a CARB approved emissions control strategy (CAECS) for vessel auxiliary engines or tanker auxiliary boilers.

The Regulation uses a terminal-based visit threshold to determine which ports and independent marine terminals[42] ("terminals") have emissions control requirements at their berths. Any terminal receiving 20 or more visits from container, reefer, cruise, roro, and/or tanker vessels has a requirement to reduce at berth emissions from those vessel types.[43] Low activity terminals, meaning those terminals receiving fewer than 20 visits from a regulated vessel category, and the vessels calling these low activity terminals are exempt from emissions control requirements of the Regulation, but are not exempt from reporting and opacity requirements.[44]

Bulk and general cargo vessels are also exempt from emissions control requirements of the Regulation but are not exempt from reporting and opacity requirements.

Implementation Timeline

Emissions control requirements of the Regulation will phase in on the following schedule:[45]

- Container/Reefer/Cruise – January 1, 2023
- Ro-ro – January 1, 2025
- Tankers (Southern California) – January 1, 2025
- Tankers (Northern California) – January 1, 2027

Container, reefer, and cruise vessels/terminals have the earliest compliance deadline, with emissions reductions beginning on January 1, 2023. Container, reefer, and cruise ports/terminal operators and vessel operators put forth great efforts to install the necessary equipment and supporting infrastructure at their berths and on board their vessels, respectively, to ensure they could comply with the 2007 Regulation. As such, minimal additional equipment or infrastructure development is needed at most container, reefer, and cruise berths to meet their January 1, 2023, compliance date, which is generally reflected in the port and terminal plans that CARB received.

For the newly regulated vessel categories, ro-ro vessels will phase into the Regulation beginning on January 1, 2025, providing ro-ro vessels with over four years of lead time since the adoption of the Regulation. Separately, tanker implementation dates are staggered, with tanker terminals in Southern California phasing in first in 2025 and Northern California tanker terminals following in 2027. This staggered implementation schedule for tankers is largely due to the fact that fewer infrastructure upgrade challenges are expected at Southern California tanker terminals when compared to Northern California terminals. In general, tanker berths and terminals differ structurally from container, reefer, cruise, and ro-ro berths and terminals as a direct result of safety issues that stem from the hazardous cargo they often transport.

41 The At Berth Regulation exempts ocean-going vessel voyages that do not stop at a California port, terminal, or berth; OGV stops that are necessitated by force majeure or distress or stopping to assist persons, vessels, or aircraft in danger or distress; OGVs owned or operated by local, state, federal, or foreign governments in government non-commercial service, and emergency/safety events and anchoring or berthing as required by a federal agency. Exemptions also exist for emergency/safety events and anchoring or berthing as required by a federal agency. Title 17, Cal. Code Regs., section 93130.4.

42 An "independent marine terminal" means a terminal that operates independently from a port or port authority.

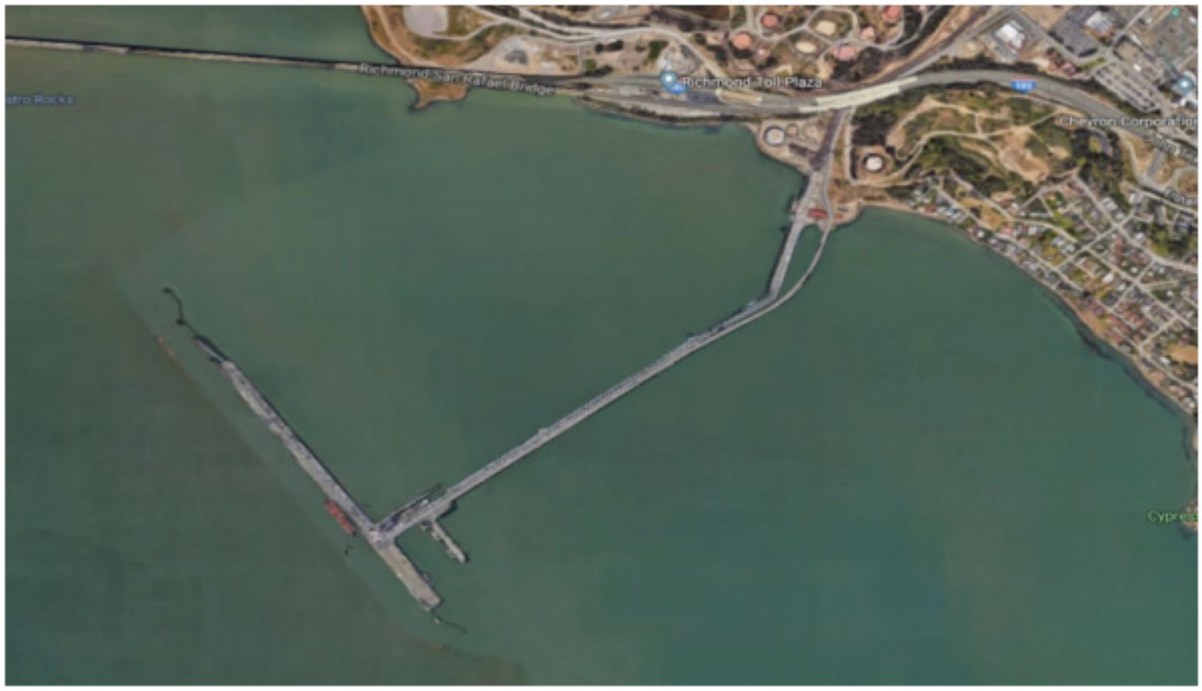
43 See title 17, Cal. Code Regs., Sec. 93130.9 and 93130.10(a).

44 See title 17, Cal. Code Regs., Sec. 93130.6, 93130.7(e)(4), 93130.8(b), 93130.9(d)(5), and 931390.10(b).

45 See title 17, Cal. Code Regs., Sec. 93130.7(b).

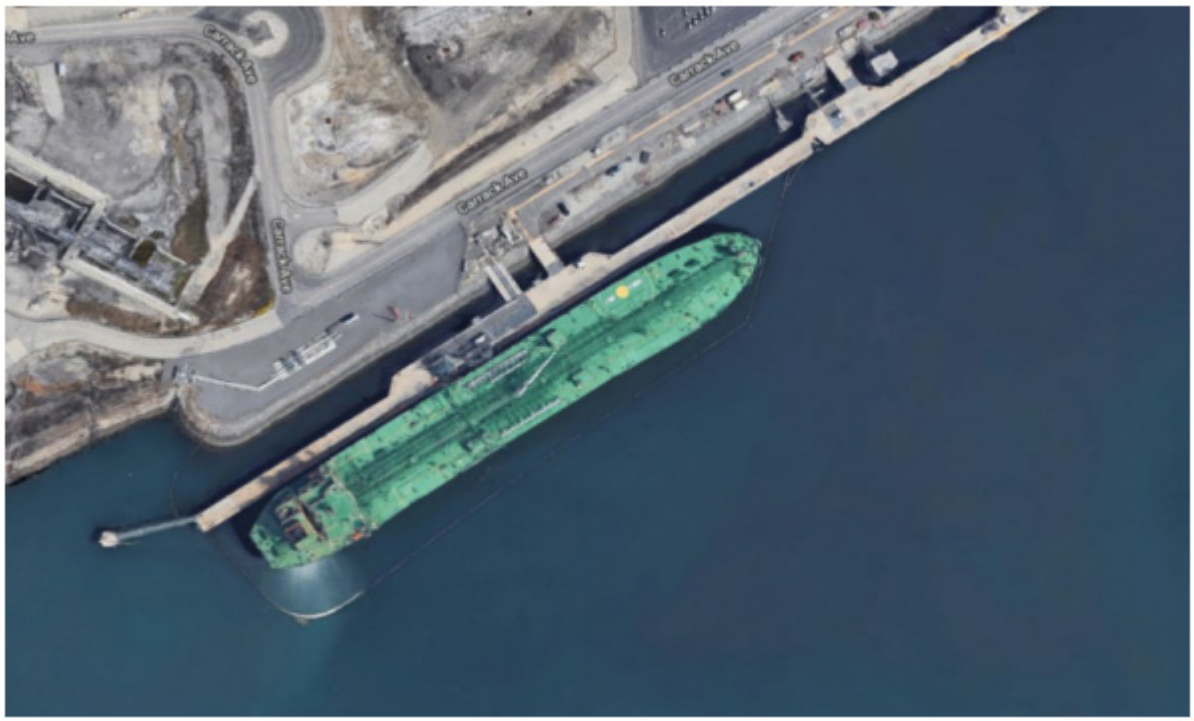
As discussed in Staff's Initial Statement of Reasons (ISOR) for the At Berth Regulation, there are two main tanker terminal types: "T"-shaped wharves (see Figure 4) that are typically seen in Northern California and more traditional terminals (see Figure 5) that are seen at port complexes, such as at the Ports of Los Angeles and Long Beach.[46] Existing tanker terminals may need infrastructure improvements to handle the weight of new emissions control equipment, as well as additional piping and pilings to sufficiently support the control equipment. Marine oil terminals in Northern California have additional complicating factors when considering infrastructure improvements. Northern California marine oil terminals (often referred to as "long wharves") can stretch out over a mile into the San Francisco Bay and Carquinez Straits and can be affected by harsher weather conditions and stronger currents than their Southern California counterparts. Additionally, the structure of the long-wharf style terminals may require longer timelines in performing infrastructure upgrades than are required by more traditional terminals utilized in Southern California.

Figure 4: "T"-shaped Marine Oil Terminal in Northern California[47]



46 See *Staff Report: Initial Statement of Reasons (ISOR)*, pp. III-16-18.
47 See *Staff Report: Initial Statement of Reasons (ISOR)*, p. III-17.

Figure 5: Port-based Marine Oil Terminal in Southern California[48]



Auxiliary Engine Emissions Requirements

Operators of container, reefer, cruise, ro-ro, and tanker vessels docked at regulated California ports, terminals, or berths must reduce emissions from their auxiliary engines during a visit[49] through use of a CAECS that meets the performance standards specified in section 93130.5(d)(1) of the Regulation.

Tanker Auxiliary Boiler Emissions Requirements

Tanker vessels with steam driven pumps must meet the performance standards for auxiliary boilers at berth as specified in section 93130.5(d)(2) of the Regulation, unless that vessel is connecting to shore power to reduce auxiliary engine emissions.[50] Tanker vessels with steam driven pumps that utilize shore power to reduce emissions from their auxiliary engines do not have requirements to control auxiliary boiler emissions. Because boilers cannot be powered by electricity (i.e., cannot be shore powered), this requirement is designed to encourage tanker vessels to use shore power to reduce their auxiliary engine emissions, achieving additional reductions of GHG and DPM while not being required to implement a duplicate emissions control strategy to also control boiler emissions.[51]

Opacity Requirements

All vessels, regardless of type, are required to meet the opacity requirements of the Regulation at berth or at anchor in Regulated California Waters (RCW)[52] as set forth in section 93130.6 of the Regulation.

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48 See *Staff Report: Initial Statement of Reasons (ISOR)*, p. III-17. October 15, 2019.

49 A "visit" is defined for the purposes of this Regulation as "the time period from when the vessel is "Ready to Work" to "Pilot on Board."' Title 17, Cal. Code Regs., section 93130.2(b)(91).

50 Shore power cannot be used in place of boiler operations because boilers are not electrical systems. However, electrically-driven, on-shore pumps can be used to augment or replace boiler operations on tankers to move liquid product to or from a vessel. See *Staff Report: Initial Statement of Reasons (ISOR)*, pp. I-25-34 for more details regarding tanker boiler operations and possible control technologies.

51 See *Staff Report: Initial Statement of Reasons (ISOR)*, p. III-2 through III-3 for more information.

52 Regulated California Waters are defined in section 93130.2(65) of the Regulation.

CARB Approved Emission Control Strategy

Compliance with the At Berth Regulation must be achieved through use of a CAECS. A CAECS must meet the requirements outlined in section 93130.5(d) of the Regulation and must be used for every vessel visit to a regulated marine terminal unless the visit satisfies one of the clauses listed in section 93130.5(b).

Grid-supplied shore power, in which vessel operators shut off a vessel's auxiliary engines and switch to shore power to supply the electrical needs of a berthed vessel, is considered a CAECS for the purposes of the Regulation. All other CAECS must receive approval by CARB through an Executive Order to be used for compliance with the Regulation.[53] Operators with vessels that have commissioned shore power equipment on board must plug into shore power if the berth that the vessel is calling at is equipped with compatible shore power equipment. If distributed generation is used to supply shore power, the electricity generated must meet the performance standards specified in section 93130.5(c) of the Regulation.

If a vessel and/or terminal does not have shore power equipment installed, the vessel operator may utilize an alternative CAECS that reduces auxiliary engine emissions to the performance standards specified in section 93130.5(d)(1) of the Regulation. An alternative CAECS may consist of a barge or land-based capture and control system, vessel-based technologies, alternatives fuels, or any combination the regulated entity chooses, as long as that strategy is CARB approved to meet the emissions reduction requirements of the Regulation.

Compliance Responsibilities

Vessel Operator Requirements

Vessel operators are responsible for meeting all requirements specified in section 93130.7 of the Regulation, including ensuring that any vessel under their control that is destined for a regulated California marine terminal will comply with the At Berth Regulation. Vessels must use a CAECS (including shore power, which is defined as a CAECS in the Regulation) while at any regulated berth, use a Vessel Incident Event (VIE), or pay into the remediation fund to comply with the Regulation, unless the visit qualifies for an exemption from the Regulation.

Terminal Operator Requirements

Operators of terminals that receive 20 or more visits from container, reefer, cruise, roro, or tanker vessels per calendar year are responsible for meeting all requirements specified in section 93130.9 of the Regulation, including ensuring that the terminals are equipped with a CAECS that will enable vessels to comply with the At Berth Regulation. If a terminal operator is not able to ensure that a CAECS is available while the vessel is at berth, they may use a Terminal Incident Event (TIE) or pay into the remediation fund to comply with the Regulation, unless the visit qualifies for an exemption from the Regulation.

If a vessel informs the terminal that they intend to comply with the Regulation using on-board technologies or alternative fuels, then the terminal operator has no further responsibility to assist with the reduction of emissions while the vessel is at berth.

53 The requirements and process for applying to use an emissions control technology are specified in section 93130.5(d).

Port Requirements

Any port or independent marine terminal in California with a berth receiving 20 or more visits from a container, reefer, cruise, ro-ro, or tanker vessel is responsible for meeting all requirements specified in section 93130.13 of the Regulation, including providing any equipment or infrastructure necessary to comply with the Regulation that is outside of terminal operators' contractual ability to provide. If a terminal operator and/or vessel operator elects to purchase, install, and use a CAECS that does not need port assistance or infrastructure to operate in compliance with this Regulation, then the port has no additional responsibility for that equipment.

CAECS Operator Requirements

A CAECS operator may be a vessel, terminal, port, or third-party entity. CAECS operators are responsible for meeting all requirements specified in section 93130.12 of the Regulation, including ensuring that emissions control equipment used as part of a strategy to comply with the Regulation meets the emissions requirements specified in section 93130.5(d) of the Regulation.

Reporting and Recordkeeping Requirements

The At Berth Regulation has reporting and recordkeeping requirements affecting vessel operators, terminals, CAECS operators, and ports during all visits to California ports and marine terminals. Regardless of whether a vessel has an emission control requirement under the Regulation, both the vessel and terminal (and CAECS operator, if applicable) must provide visit information as specified in sections 93130.7(e)(4) and 93130.9(d)(5) of the Regulation, respectively. Visit reporting requirements begin January 1, 2023 for all vessel and terminal operators, even if the terminal does not have emissions control requirements.

Vessel reporting information includes vessel specifics, including vessel name/International Maritime Organization (IMO) number and IMO NO_x tier of the engine, vessel operator contact information, the port/terminal/berth visited, arrival/departure time, time the vessel was declared "Ready to Work", the type of CAECS used and when the vessel started/stopped using the CAECS, type of fuel used in the vessel's auxiliary engine(s) and boiler(s), the sulfur content of the fuel and amount used during the visit, the date/time the pilot boarded the vessel prior to departure, and any information regarding usage of an exception or compliance flexibility (if applicable). Vessel visit reporting begins January 1, 2023 for all vessel operators, even if the vessel does not have emissions control requirements.

Terminal reporting includes vessel specifics such as vessel name/IMO number/IMO engine NO_x tier, terminal operator contact information, arrival/departure date and time, the type of CAECS used and the start/stop time of the vessel using the CAECS (if the terminal is involved), the power meter readings at the time of shore power connect/disconnect (if applicable), and any information regarding usage of an exception or compliance flexibility (if applicable).

Ports are required to submit Wharfinger data annually to CARB's Executive Officer as specified in section 93130.13(d), which includes documenting when each vessel visits the port, the berth that the vessel visited, the vessel's IMO number, contact information for the company operating the vessel, and the dates and times that the vessel was initially tied to the berth and subsequently released from the berth.

CAECS operators must supply CARB staff with much of the same information as vessel and terminal operators to ensure the information aligns, with the addition of the vessel's emissions for NO_x, PM2.5, and ROG (in terms of grams/kilowatt-hour) while the control strategy was in operation. Additionally, CAECS operators must adhere to all reporting and recordkeeping requirements specified in both sections 93130.5 and 93130.12, including reporting any malfunction of a CAECS within 24 hours to CARB as specified in section 93130.12(c).

Port and Terminal Plans

The At Berth Regulation required all regulated terminals operators and ports with regulated terminals to submit Terminal and Port Plans, respectively, to CARB's Executive Officer by December 1, 2021.[54] The Regulation required all Terminal and Port Plans to detail how each entity intends to comply with the emissions reduction requirements of the Regulation by the compliance date specified for the vessel types each entity receives. The Terminal and Port Plans were required to contain all of the elements specified in section 93130.14(a)(3) and 93130.14(b)(3) of the Regulation, respectively, including describing the division of responsibilities between the port and terminal operators, which is necessary to assist CARB staff to determine responsibility for noncompliance incidents. The Regulation required the division of responsibilities to be agreed upon and signed by representatives of both the port and terminal, wherever applicable.[55]

In total, CARB received nine Port Plans, 19 container/reefer Terminal Plans, four cruise Terminal Plans, eight ro-ro Terminal Plan, and 22 tanker Terminal Plans, all of which are available for viewing on CARB's website: *Terminal and Port Plan Submissions | California Air Resources Board*. CARB's responses to each Plan submittal are also available on the website, including a letter confirming Plan completeness or advising operators of Plan deficiencies where applicable. The information shared as part of these Terminal and Port Plans helped shape this Interim Evaluation and will be discussed in further detail in *Assessment of Compliance Readiness* of this Report.

Because ro-ro and tanker vessels have implementation dates several years in the future, updated terminal plans will be required for terminals receiving these new vessel categories. Updated Terminal Plans should note any changes since the submittal of the original plan and are due by February 1 the calendar year prior to the first implementation date (February 1, 2024 for ro-ro and Southern California tanker terminals; and February 1, 2026, for Northern California tanker terminals).

Compliance Flexibilities

The At Berth Regulation provides vessel operators and terminal operators with a limited number of exceptions to the emissions reduction requirements of the Regulation.

Terminal and Vessel Incident Events

VIEs and TIEs are exceptions that are granted to vessel fleet and terminal operators each calendar and are based on a percentage of the total visits a vessel fleet made to a port in a given calendar year.[56] VIEs and TIEs are designed to provide regulated vessel fleets and terminal operators, respectively, with a limited amount of operational flexibility while ensuring that emissions reductions from vessels at berth remain high. VIEs and TIEs are port specific to prevent excess emissions from occurring and having an inequitable impact on other California port communities.

VIEs are calculated based on the number of visits a vessel fleet makes to a regulated marine terminal between January 1 and December 31 of the previous calendar year. Separately, TIEs are calculated based on a percentage of vessel visits to the terminal between January 1st and December 31st in the previous calendar year. In the first two years of implementation, terminal operators will receive 15 percent of their previous calendar year vessel visits as TIEs, while a vessel fleet will receive five percent of their previous calendar year's visits to each port as VIEs.[57] For the initial compliance date of the Regulation (2023), visit information for the calendar year 2021 will be used for calculating VIEs and TIEs. After 2024, both terminal operators and vessel fleets will each receive five percent of their previous year's visits as VIEs and TIEs. The VIE/TIE rates by vessel type per year are shown below in Table 1.

54 See title 17, Cal. Code Regs., Sec. 93130.14.
55 See title 17, Cal. Code Regs., Sec. 93130.14(a)(3)(G) and 93130.14(b)(3)(G).
56 See title 17, Cal. Code Regs., Sec. 93130.11.
57 See title 17, Cal. Code Regs., Sec. 93130.11(b).

Table 1: VIEs and TIEs Rates by Vessel Type per Year

	Type	2023	2024	2025	2026	2027	2028+
TIEs	All Terminals	15%	15%	5%	5%	5%	5%
VIEs	Container/Reefer	5%	5%	5%	5%	5%	5%
	Passenger	5%	5%	5%	5%	5%	5%
	Ro-ro	–	–	5%	5%	5%	5%
	LA/LB Tankers	–	–	5%	5%	5%	5%
	Other Tankers	–	–	–	–	5%	5%

For the initial compliance year (2023), terminal operators and vessel fleets will be granted VIEs and TIEs by January 1, 2023 and the VIE/TIE calculations will be based on 2021 vessel visit activity. Each year after, new VIEs and TIEs will be granted by CARB to each registered vessel fleet and each regulated terminal by February 1st of each calendar year, starting in 2024. VIEs and TIEs will expire on January 31st of each calendar year after they are granted.

In lieu of receiving TIEs and VIEs as explained above, the Regulation provides that vessel and/or terminal operators may alternatively request additional VIEs or TIEs in order to accommodate a new fleet or new terminal, or when an anticipated growth in visits is expected for an existing fleet or terminal that is not reflected in the current year's visits.[58] In particular, if a vessel or terminal operator believes their 2021 visit activity will not accurately reflect their projected 2023 visits (due to port congestion, pandemic impacts, etc.), they may request additional VIEs or TIEs by December 1, 2022 through the aforementioned process to more accurately reflect their anticipated 2023 activity. There is no penalty for requesting additional VIEs or TIEs and not using them; however, vessel and terminal operators must be sure not to use more VIEs or TIEs than the percentage specified in Table 1 for the calendar year, otherwise enforcement actions may occur.

Remediation Fund

The remediation fund is an optional compliance pathway that may only be used in specific limited circumstances set forth in section 93130.15(d) where vessel operators, terminal operators, CAECS operators, and/or ports have attempted to comply with the Regulation. These circumstances include equipment repairs, equipment maintenance, delays in connecting to a control strategy, construction related activities at the terminal that prevent connection to a CAECS, or an unavoidable physical and/or operational constraint that was identified in a terminal plan that was submitted to and accepted by CARB. It is very important that each terminal identifies in their terminal plan any physical and/or operational constraints that could result in a delay in meeting the terminal's compliance dates set forth in the Regulation. Without this site-specific evaluation included as part of a completed port and terminal plan, regulated entities cannot use the remediation fund for a physical and/or operational constraint that is delaying the implementation of a CARB approved emission control strategy at the terminal.[59] The remediation fund allows regulated entities to pay a specified amount of funds that will then be used to fund projects that reduce equivalent emissions in the same port communities that are impacted by the uncontrolled emissions. The amount paid per hour for remediation is based on vessel type and engine classification.[60]

58 Title 17, Cal. Code Regs., section 93130.11(c).
59 See title 17, Cal. Code Regs., section 93130.15(b)(5).
60 See title 17, Cal. Code Regs., section 93130.15(f) for the remediation fund hourly amounts.

The remediation fund is managed by a remediation fund administrator (a third-party entity), who must apply to CARB for the remediation fund administrator role as per the process specified in section 93130.16(c). More details about the obligations of the remediation fund administrator and the public process CARB used to solicit for remediation fund administrators can be found in the Remediation fund administrator process section of this Report.

Innovative Concept Compliance Option

The Innovative Concepts Compliance Option is a voluntary compliance pathway allowing regulated vessel fleets, terminal operators, and/or ports to comply with the Regulation using a project that achieves equivalent emissions reductions near where vessels visit. This compliance option was requested by stakeholders prior to the final adoption of the Regulation and was noticed to the public in the March 2020 15-day notice. All applications for Innovative Concepts projects were due to CARB by December 1, 2021, and this was a one-time submittal opportunity.

Innovative Concepts must achieve equivalent or greater emissions reductions of the same pollutants within the same communities that would otherwise see benefits from direct emissions reductions from vessels at berth. All Innovative Concepts projects include a public comment process and must be approved through an Executive Order by CARB before being used as a compliance pathway for the Regulation. Additionally, Innovative Concepts projects must achieve emissions reductions at the same port or marine terminal, within adjacent communities that are impacted by vessel emissions at berth, or overwater within three nautical miles (nm) of the port or marine terminal, and emissions reductions must be early or above any existing state, federal, or international law (including, but not limited to rules, regulations, and statutes), or any emissions reduction strategy identified as part of an AB 617 Community Emissions Reduction Program[61] (CERP) approved by CARB's Board. Additionally, to be approved, and Innovative Concept project(s) must be able to ensure that the emission reductions achieved through the project(s) are real, surplus, quantifiable and enforceable. Innovative Concept projects cannot include projects that are considered "business as usual" projects; in other words, projects that are reasonably expected to occur to provide benefits to impacted communities in the absence of this Regulation. Innovative Concept projects also cannot include plans that simply involve moving emissions sources to other ports or marine terminals (i.e., reducing emissions by relocating a percentage of a fleet to another port or terminal on the West Coast).

Rulemaking Efforts

CARB staff began rulemaking efforts for the new At Berth Regulation in late 2014. As noted in the Staff Report for the Regulation, CARB staff conducted more than 150 meetings throughout the process of developing the At Berth Regulation, which included phone calls, in-person meetings, and site visits with members of impacted communities, environmental justice advocates, air districts, industry stakeholders (including vessel operators, ports, terminal operators, industry associations, and alternative technology operators), U.S. Coast Guard, California State Lands Commission (CSLC), and other agencies. Meeting formats included public workshops, work group meetings, community meetings, and meetings with individual stakeholders.

61 "Assembly Bill (AB) 617 Community Emissions Reduction Program" means a program and/or plan to achieve emissions reductions in a location that has been selected by CARB's Governing Board to prepare a community emissions reduction program pursuant to Health and Safety Code section 44391.2(c).

CARB's Board considered the At Berth Regulation at three separate Board hearings on December 5, 2019, June 25, 2020, and August 27, 2020. At the initial hearing on December 5, 2019, Board members directed staff to evaluate earlier compliance dates to accelerate the health benefits of the Regulation, explore an alternative compliance pathway in response to industry stakeholder requests for added flexibility (which became the Innovative Concepts Compliance Option), and broaden the scope of the originally proposed Interim Evaluation Report to include bulk and general cargo vessels and vessels at anchor. In response to the Board's direction, staff released a 15-day package on March 26, 2020, proposing the following major changes to the draft regulatory language:

- Acceleration of the ro-ro implementation deadline from 2025 to 2024 and acceleration of the tanker timelines from 2027 (at the Ports of Los Angeles and Long Beach) and 2029 (for all remaining tanker terminals) to 2025 and 2027, respectively.
- Addition of the Innovative Concept Compliance Option to the draft regulatory language in response to both the Board's direction to accelerate the compliance implementation dates and to assist with compliance flexibility as requested by industry stakeholders.
- Addition of language to the Interim Evaluation section of the draft regulatory language committing CARB to reviewing the feasibility of control technologies for bulk and general cargo vessels and vessels at anchor and accelerated the publication date of this Report from July 1, 2023, to December 1, 2022.

These changes were then presented to CARB's Board at the June 25, 2020, Board hearing, where CARB staff discussed the impacts seen during the first few months of the pandemic for various vessel categories and presented the newly developed Innovative Concepts Compliance Option to the Board. Staff also discussed the public comments received for the first 15-day changes, which were generally centered around concerns regarding the timing of implementation dates and the potential for a delay in adopting the At Berth Regulation due to the pandemic. It is important to note that the drafting of the first 15-day change package took place during the very beginning of the U.S. response to the burgeoning global pandemic. As such, some of the proposed changes detailed in the first 15-day package were not yet reflective of the difficulties posed by the pandemic. At this second Board hearing, CARB staff made the recommendation to shift the ro-ro implementation date back to 2025 (as originally drafted) due to pandemic-related concerns. This change, along with a handful of other more minor changes, was included as part of staff's second 15-day change package (released on July 10, 2020).

The third and final Board hearing for the At Berth Regulation took place on August 27, 2020, with CARB's Board ultimately adopting the Regulation via Resolution 20-22 with the second 15-day changes as drafted by staff.

Current Implementation Status

After adoption by CARB's Board in August 2020, the At Berth Regulation was submitted to California's Office of Administrative Law (OAL) for review on November 12, 2020. The Regulation was then approved by OAL and filed with California's Secretary of State on December 30, 2020 and became operative under state law on January 1, 2021.

As discussed in the Overview section, port and terminal plan submittals and applications for the Innovative Concept Compliance Option were due to CARB by December 1, 2021. CARB staff have reviewed and responded to all port and terminal plans submitted to the agency and a summary of those Plans can be found in the Status of Control Technologies chapter of this Report. CARB also received 12 Innovative Concept applications and is currently in the process of evaluating the applications, and is prioritizing the review for Innovative Concept projects that intend to be used for the 2023 compliance period. A summary of the proposed projects, public comments and applicant responses, and the application review process can be found in the *Innovative Concepts* chapter of this Report.

Tools Used in Developing this Report

Multiple sources of information were used by CARB staff to craft this Interim Evaluation Report, including:

- Port and terminal plans
- Innovative Concept applications and public comments
- Tanker solicitation grant project
- Third-party technical Feasibility Studies
- Comment letters from stakeholders
- Portside community meetings
- Industry stakeholder meetings
- Port tours
- Assessment of control technologies for bulk and general cargo vessels and vessels at anchor
- Congestion/at anchor impacts

These sources were used to help CARB staff assess the progress regulated entities are making towards being able to comply with the At Berth Regulation by their respective implementation dates and will be discussed in further detail throughout this Report.

Public Process

CARB endeavored to maintain an open and transparent information sharing process leading up to the preparation of this Interim Evaluation Report and the first implementation date (January 1, 2023) of the Regulation. CARB staff developed and published an *At Berth FAQ* document[62] in November 2021, published all port and terminal plans (original and revisions) along with CARB responses to the Plans on the *At Berth Regulation* webpage in May 2022, and supported and promoted the formal public review process for Innovative Concept applications as set forth in the Regulation language.[63] Details on staff's public engagement process will be detailed in this section of the Report.

62 CARB's *At Berth Frequently Asked Questions* are available on *CARB's website*.
63 Terminal and Port Plan Submissions are available on *CARB's website*.

Innovative Concept Application Comment Period

As part of the adoption of the At Berth Regulation, CARB's Board directed staff to engage directly with local community groups or local AB 617[64] community steering committees to ensure that portside communities were involved in the approval of a regulated entities Innovative Concept application.[65] The At Berth Regulation has a formal Innovative Concept application process that included a public review process. All Innovative Concepts applications received by CARB were published to CARB's website and a public comment docket was opened for each application for a 45 day period. Innovative Concept applicants were then required to respond to all public comments before CARB could consider their application for approval. This process was necessary to allow the public an opportunity to engage in a dialogue and be included in the process for Innovative Concept approval. See the *Innovative Concepts - Application Evaluation and Approval Process* section of this Report for more information about the public process and comments that were received on the applications.

Remediation Fund Administrator Process

As described in the *Remediation Fund* section of this Report, the remediation fund is managed by a remediation fund administrator (a third-party entity), who must apply to CARB for the remediation fund administrator role as per the process specified in section 93130.16(c) of the Regulation. Successful remediation fund administrator applicants will execute a Memorandum of Understanding with CARB, which will include, at a minimum, the elements set forth in section 93130.16(h). Remediation fund administrators may select any project(s) to fund that meet or exceed the emissions reductions required by the Regulation. Additionally, applicants are responsible for ensuring that the funds are used to support projects that achieve the excess emissions resulting from an uncontrolled vessel visit in the same impacted communities. Each project may have a unique process to calculate and confirm that the required emissions reductions have been achieved, but the method must be consistent with CARB's most recent applicable incentive program guidelines as specified in section 93139.16(h)(3).

The Regulation identifies the California Air Pollution Control Officers Association (CAPCOA) and local Air Quality Management Districts (AQMDs) and Air Pollution Control Districts (APCDs) that have jurisdiction in communities adjacent to ports and independent marine terminals as the preferred parties to serve as remediation fund administrators. The process for selecting remediation fund administrators kicked off in February 2022, when CARB first met with CAPCOA and the local AQMDs/APCDs to discuss the remediation fund administration process. This meeting was then followed by a broader meeting with both CAPCOA and relevant AQMDs/APCDs in April to discuss the process for applying to become a remediation fund administrator and answer questions that potential applicants had about the remediation fund and the application process. In May 2022, CARB then issued a letter inviting CAPCOA and the relevant AQMDs/APCDs to apply to become remediation fund administrators, with applications due to CARB by September 29, 2022 (120 days from when the invitation letter was sent, as set forth in section 93130.16(b) of the Regulation). CARB staff then held a third meeting with interested AQMDs and APCDs to discuss any outstanding questions applicants had about the remediation fund administrator role and application process in September 2022.

64 Assembly Bill 617 (AB 617), which was enacted by California in 2017, requires CARB to pursue new community-focused and community-driven actions to reduce air pollution and improve public health in communities that experience disproportionate burdens from exposure to air pollutants. CARB established the Community Air Protection Program (CAPP) in 2017 in response to AB 617. CAPP's focus is to reduce exposure in communities most impacted by air pollution. As part of this program, communities around the State work together to develop and implement new strategies to measure air pollution and reduce health impacts. There are various AB 617 communities located throughout the State that are impacted by marine and port sources.

65 Control Measure for Ocean-Going Vessels At Berth, *Resolution 20-22*. August 27, 2020.

Six entities (five Air Districts and CAPCOA) applied to serve as remediation fund administrator, covering all jurisdictions in California with ports and terminals expected to be subject to the Regulation. At the time of this Report's publication, CARB staff is currently working with the selected applicants to develop MOUs specific to each administrator and anticipate having the remediation fund administration process in place by the initial January 1, 2023 implementation date.

Vessel Reporting System Development

The Regulation requires vessel, terminal and CAECS operators to report the vessel visit information beginning on January 1, 2023. CARB staff is currently developing visit reporting templates for vessel, terminal, and CAECS operators to assist the operators with understanding and reporting the visit information required by the Regulation. The draft reporting templates were beta tested by industry stakeholders in the fall of 2022, which provided CARB staff with an opportunity to collect feedback prior to finalization of the reporting forms. The final templates will be available on CARB's website prior to January 1, 2023.

CAECS Approvals

As part of the implementation of the At Berth Regulation, CARB staff are involved in discussions with technology providers, industry, and academia regarding CAECS feasibility, development, and approvals. Section 93130.5(e) of the Regulation outlines the application process for a CAECS approval, and CARB staff has been working with multiple technology providers to assist in this application process. The process, which can be summarized in three steps, involves the applicant submitting a test plan, all test data in accordance with the test plan, and an application. Staff are currently working with multiple technology providers, and they are all in different stages of the CAECS approval process.

Public Meetings and Workshops

In addition to the formal Innovative Concept public process, CARB staff participated in multiple meetings with industry and members of the public during the 2021-2022 calendar years leading up to implementation of the Regulation and the preparation of this Interim Evaluation Report. Industry stakeholder meetings with CARB staff included a broad spectrum of stakeholders, including vessel operators, terminal operators, and ports. During these stakeholder meetings, CARB staff answered questions regarding implementation and learned about the impacts that the global pandemic is having on the industry and their ability to prepare for upcoming compliance deadlines. Additionally, CARB staff held a webinar on May 17, 2022 to discuss topics such as the Interim Evaluation development process, port and terminal plans, and the Innovative Concepts review process. Staff also solicited for information for this Interim Evaluation Report at that meeting.

During the same time period leading up to implementation of the Regulation, CARB also held many meetings with community groups that are impacted by marine and port emission sources. Portside communities play a vital role in helping CARB staff to better understand localized environmental concerns and how specific communities are impacted by marine and other freight-related emissions from the port. Community residents can promote environmental legislation, advocate for regulations, and increase education and awareness of existing environmental laws. Overall, the participation of community members in the implementation of the At Berth Regulation is important to ensure that citizens are involved to help tackle these air quality issues in an effective manner that serves the needs of their specific communities. The final section of this chapter summarizes CARB's involvement with portside communities thus far during the implementation of the At Berth Regulation.

AB 617 Community Steering Committee

CARB staff attended various AB 617 community steering committee meetings for the Port of Stockton, Wilmington/West Long Beach/Carson, and San Diego Portside Environmental Justice Community. CARB staff utilized these meetings to gain a more thorough understanding of how portside communities around the State are being impacted by marine and port sources and to identify opportunities for members of the public to be involved in the implementation of the At Berth Regulation (primarily through commenting on the Innovative Concept applications and in submitting information to be considered during the drafting of this Report). Attending these meetings re-enforced to CARB staff the need to not delay the implementation of the At Berth Regulation because of the urgent need for the health benefits associated with reducing emissions from vessels at berth.

Site Visits

CARB staff visited the Ports of Los Angeles, Long Beach, Redwood City, and Stockton in 2022 to learn more about the specific operations that occur in these areas. These port tours are discussed in more detail below.

Port of Stockton

CARB staff toured the Port of Stockton in April of 2022. The Port of Stockton encompasses 2,000 operational acres in Stockton, California and operates on an annual budget of $50-60 million. The Port of Stockton is responsible for all berths and does not have assigned terminals for any one company. The Port's revenue is based on leases and wharfage fees and the Port provides over 10,000 jobs. The Port has a railroad connecting to the Port that is serviced by BNSF Railway.

Some of the new commodities that the Port of Stockton has imported include solar panels and equipment, food products including frozen meat from New Zealand, and auto parts. The Port of Stockton is expecting to gain a soda ash contract which would double the amount of product the Port receives and ships out. Through a CARB-funded Zero- and Near-Zero Emissions Freight Facilities (ZANZEFF) grant, the Port of Stockton was able to purchase 12 ZE yard tractors, increasing the percentage of ZE CHE at the port to 60 percent. CARB learned more about the community organization, Little Manila Rising, and how this area is impacted by the freeway and truck traffic that goes directly through their neighborhood. The Port of Stockton discussed the work they have done with community and the plans to install air quality monitors in those neighborhoods. In regard to how the Port intends to comply with the At Berth Regulation by January 1, 2027, the Port stated they are working with a potential CAECS provider Andritz to develop a land-based capture and control system for their tanker berth.

Port of Redwood City

CARB staff toured the Port of Redwood City in May 2022 in order to better understand how their bulk operations worked. During this meeting, CARB staff learned that the Port of Redwood City handles only bulk cargo and operates similarly to the Port of Stockton but provides shippers with a port option closer to destinations in the Bay Area so that cargo does not have to be trucked to the region from Stockton. Staff observed the limited space available to bulk vessels with the main channel at Redwood City and learned about the challenges with berthing vessels at the port due to strong tides in the region. Additionally, as part of this tour, staff also met with Canada Steamship Line (CSL), one of the primary customers that calls the Port of Redwood City, to discuss how their vessels perform during at berth operations and find out what CSL is doing to reduce emissions from their vessels. CARB staff learned that CSL is the primary customer calling the Port of Redwood City, and most of their vessels calling Redwood City are considered "self-unloading" vessels. Self-unloading vessels allow the ship to discharge cargo more quickly than a traditional bulk carrier, reducing the time the ship spends in port. Additionally, self-unloading vessels do not need to line-haul as the crane onboard the ship can move to accommodate a fixed receiving point on shore. During the meeting with CARB staff, CSL advised that the company is not looking into at berth

specific controls for their vessels, but rather they are investigating biofuels as a primary option for reducing emissions in California.

Ports of Los Angeles and Long Beach

In July of 2022, CARB staff received a water tour of the Port of Long Beach, followed by a meeting with POLA/POLB staff and management to discuss concerns the Ports had with complying with the At Berth Regulation in time. Issues raised included the Institute of Electrical and electronics engineers (IEEE) standard for ro-ro vessels and the uncertainty around what the standard will be, issues with long lead times to get materials (especially for breakers), utility companies not being able to meet schedules and not being able to commit to their normal 2-year lead time for new utility projects, demand charges from the utility company, and substation upgrades that are needed. The Ports have begun discussions with Southern California Edison (SCE) on utility design and increasing capacity, but SCE wants very specific project details in order to start planning. The Port of Long Beach conducted a shore power study which showed that there is not enough power available at non-container terminals. The Ports also discussed the issue with having to charge a lot of equipment at once and having only 1-hour to charge equipment between shifts. As far as technology that will be used to comply with the Regulation, the Ports look at capture and control systems as an interim technology until more shore power can come online. CARB staff also discussed with the Ports the current state of control technology and the progress with various CAECS providers to date, the terminal plans received, and the Innovative Concept process.

Clean Air Engineering Maritime (CAEM)

Following the meeting with POLA/POLB, CARB staff met with CAEM to see their barge-based capture and control system, the Maritime Emissions Treatment System (METS1). METS-1 is located at the Port of Los Angeles and provides capture and control services for container vessels. CARB staff also saw the ShoreKat, the break bulk capture and control system that is located on land at the Port of Los Angeles. CAEM is in the process of developing the METS-3 which will be a self-propelled barge that can service containerships, roro, and tanker vessels. CARB staff and CAEM met after the tour to discuss the various control technologies that CAEM is working on and implementation of the At Berth Regulation. CAEM is in close communication with the tanker industry and had previously set up site visits so the tanker industry could tour the METS-1 barge and learn more about their capture and control systems. The open dialog ensures industry is comfortable and well-informed on CAEM's design of their capture and control system for tanker vessels. CAEM indicated they plan to have their capture and control system developed and ready to deploy on tanker vessels before the 2025 implementation deadline. In addition, CAEM indicated they are working with class societies to ensure their barge is certified and safe to control tanker vessels.

STAX Engineering

In July 2022, CARB staff toured STAX Engineering's barge-based capture and control system that is being developed for use on tankers. STAX Engineering is taking part of a grant solicitation project to demonstrate that the commercially available capture and control technology currently used by container vessels can be successfully adapted for use on oil tanker vessels at berth. STAX is a project partner and is responsible for designing, building, and operating a capture and control barge for oil tankers.

The purpose of the visit was to tour the barge, receive an update on the progress of the tanker solicitation grant project, and to discuss any challenges or obstacles with the project. CARB staff learned that the project is quickly progressing and STAX plans on completing all the requirements set forth in the grant agreement in the first half of 2024, before the 2025 deadline. CARB staff was able to board the barge and view the emission reduction system, the capture system, and all the auxiliary systems that support the barge and its operation. The barge had the emission capture system and the emission reduction equipment integrated on board and STAX indicated that they had already started initial testing on vessels.

STAX highlighted that during the design and manufacturing process of their capture and control system they have focused on standardization and replication of parts and components. STAX indicated that this process will enable them to build additional systems quickly and reliably. In addition, STAX also highlighted their plan to conduct a series of safety studies. STAX has already completed the initial safety study, which examined both the barge's design and various operational scenarios, such as the location of the capture and control barge and the tanker vessel during at berth operations. Detailed information regarding this safety study can be found in this report's *Hazard Identification Study for Barge-Based Emission Capture and Control System ("ABS Study")* section. The safety studies are conducted by classification societies and will ensure the technology can safely control tanker vessel emissions while at berth.

San Pedro Bay Community (Port Congestion Concerns)

When the global pandemic began in 2020, California's largest container ports (the Ports of Los Angeles, Long Beach, and Oakland) began experiencing a substantial increase in cargo imports, which resulted in significant congestion at terminals and in surrounding areas. This led to emissions increases from freight-related sources and an abnormally high number of container vessels at anchor (over 100 at any one time in 2021) which negatively impacted air quality in communities near ports.

In August of 2021, CARB staff met with community members from the San Pedro Peninsula Homeowner's Association to discuss how they are being impacted by the increased vessels at anchor. Staff utilized these meetings as an opportunity to discuss the emission and health impacts associated with the increased number of vessels at anchor; to share information about the process and timeline of the Interim Evaluation and how ships at anchor will be analyzed in the Report; and what steps were being considered to reduce anchorage emissions in the future. Detailed information about pandemic-related congestion and the associated health impacts can be found in the *Port Congestion* section of this Report.

Additionally, a community organization within the San Pedro Bay region, the San Pedro Peninsula Homeowners United, Inc., also brought to CARB staff's attention their concerns about tanker vessels anchoring in August/September 2022.[66] While CARB staff have not identified a specific cause for the increase in tanker vessels at anchor, these concerns do re-enforce the need to continue exploring potential opportunities to reduce emissions from vessels at anchor. The feasibility of control requirements for vessels at anchor is further explored in the *Feasibility of Control Requirements for Vessels At Anchor* section of this Report.

Meeting with Deputy Director of Coalition for Clean Air

CARB staff held a meeting with the Deputy Director for the Coalition for Clean Air to discuss community engagement opportunities in July of 2022. Ideas for effective community engagement, how to better structure workshops with community members, and how to broaden CARB's outreach efforts were discussed. A focus of the discussion was how CARB can involve community more into the Regulatory process to make the process a united effort where community concerns are at the forefront.

California Cleaner Freight Coalition

CARB staff routinely participate in monthly meetings with the California Cleaner Freight Coalition, which consists of several health and environmental justice focused stakeholder groups, including the American Lung Association, Coalition for Clean Air, Center for Community Action and Environmental Justice, Earth Justice, Union of Concerned Scientists, and the Sierra Club, among others. Staff used these regular meetings to provide stakeholders with an update about the implementation status of the At Berth Regulation and to hear community-focused concerns about the At Berth Regulation. Staff also used these meetings as opportunity to solicit for comments from these groups on both this Interim Evaluation Report and the Innovative Concept applications.

66 Letter from San Pedro Peninsula Homeowners United, Inc. to CARB, South Coast AQMD, and the Ports of Los Angeles and Long Beach. August 18, 2022. See Attachment D.

CARB Freight Days

In June of 2021, CARB's Transportation and Toxics Division (TTD) held two public meetings called "Freight Days". These meetings were held to give an overview of TTD's Freight programs and regulations and to gather the public's experiences, concerns, and suggestions to help inform future freight programs and regulation development. The event occurred over two evening sessions and covered facility types that affects portside communities including seaports, warehouses, railyards, airports and border crossings. Staff used these meetings to inform the public about the At Berth Regulation and the ongoing implementation process, and also to advise them about upcoming comment opportunities (i.e., the Innovative Concept application process and the drafting of this Interim Evaluation Report).

Future Outreach Efforts

CARB plans to schedule a public workshop to discuss the findings of this Report, tentatively in January 2023. This workshop would allow industry stakeholders, environmental justice advocates, and members of the public an opportunity to hear about CARB staff's findings and to make comments or ask clarifying questions regarding the Report and its conclusions. A summary of the relevant comments made at this public workshop and in the weeks following could then be presented by staff to CARB's Board at the upcoming informational update (tentatively scheduled for April 2023).

CARB staff also intend to hold a statewide community listening session(s) tentatively planned for the 2023-2024 timeframe. At these listening sessions, staff expect to discuss the direction CARB's Board gave to staff at the August 2020 Board hearing (when the At Berth Regulation was officially adopted), provide a presentation on the status of implementation of the Regulation, and discuss potential OGV measures we are considering as well as the challenges to further reducing emissions from OGVs. CARB staff's goal with these future community listening session(s) is to provide an open forum for discussion that engages the community and helps staff identify what future emission reduction strategies should be prioritized based on a community's individual needs.

Assessment of Compliance Readiness

This chapter of the Report will assess the progress being made towards implementation of the At Berth Regulation for all vessel types and will include a summary of the following information:

- Overview of emissions control technologies and their current status
- Summary of port and terminal plans received by CARB
- Feasibility Studies submitted by regulated tanker terminals
- Stakeholder comment letters
- Innovative Concept Applications
- Conversations with technology providers

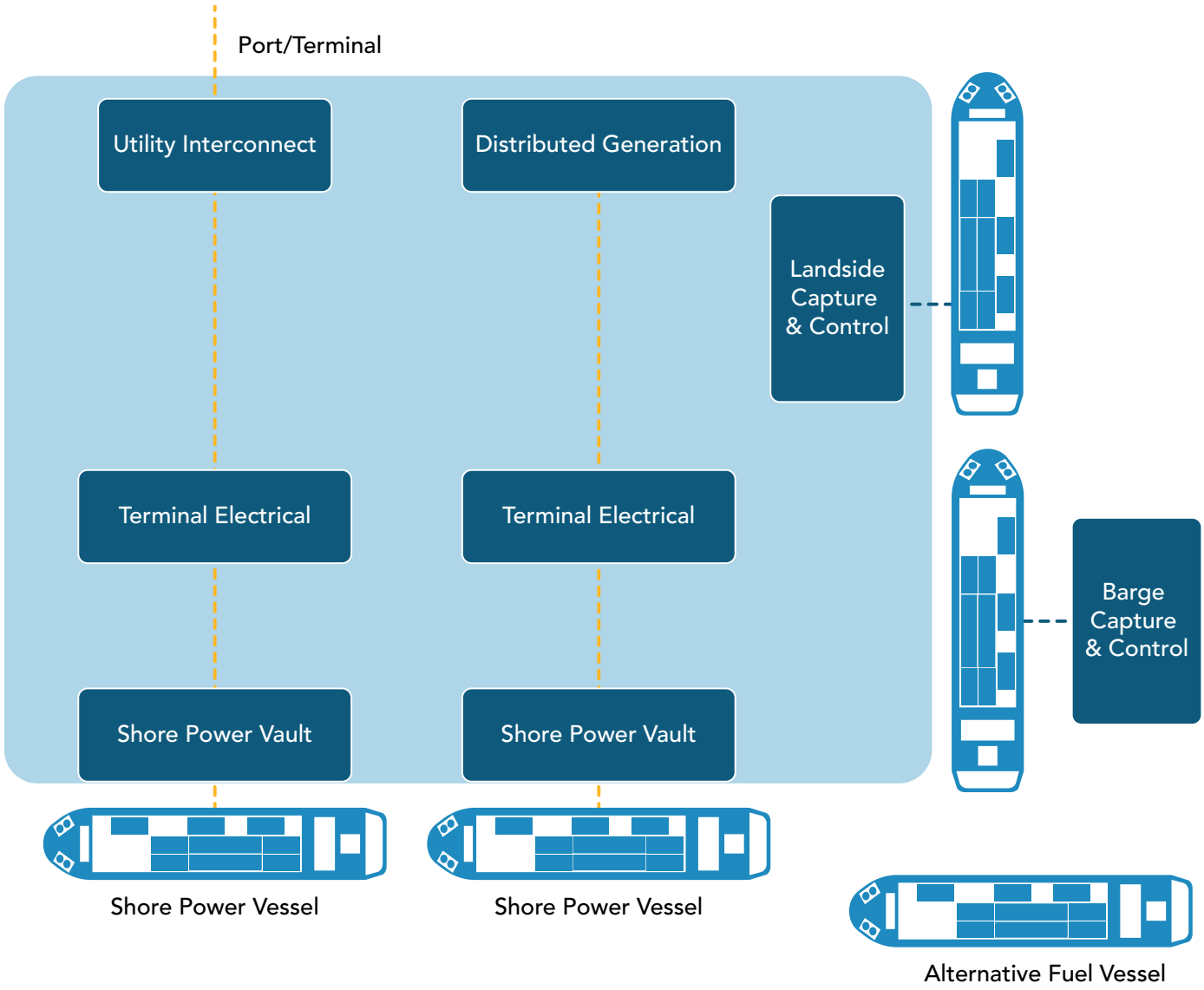
CARB staff performed in-depth reviews of the above information that was submitted to the agency during the drafting of this Report, which helped form staff's recommendation not to make any changes to the At Berth Regulation at this time. Each of these topics will be summarized below, along with CARB staff's analysis and conclusions.

Overview of Emissions Control Technologies

Under the At Berth Regulation, a CAECS must be used by regulated vessels to reduce auxiliary engine emissions and boiler emissions (for tankers with steam driven product pumps only) while at berth. Shore power and capture and control systems were the main compliance pathway under the 2007 Regulation. The expanded use of these control strategies, in addition to other CAECS, will enable additional emissions reductions through the implementation of the Regulation.

CARB staff have been exploring emission reduction technologies with industry, technology providers, and academia throughout the regulatory development and implementation process. Different technologies have been identified as potential compliance pathways with the Regulation, largely depending on the operational needs of specific terminals as highlighted in Figure 6.

Figure 6: Examples of Emission Control Strategies for Vessels At Berth



Shore Power

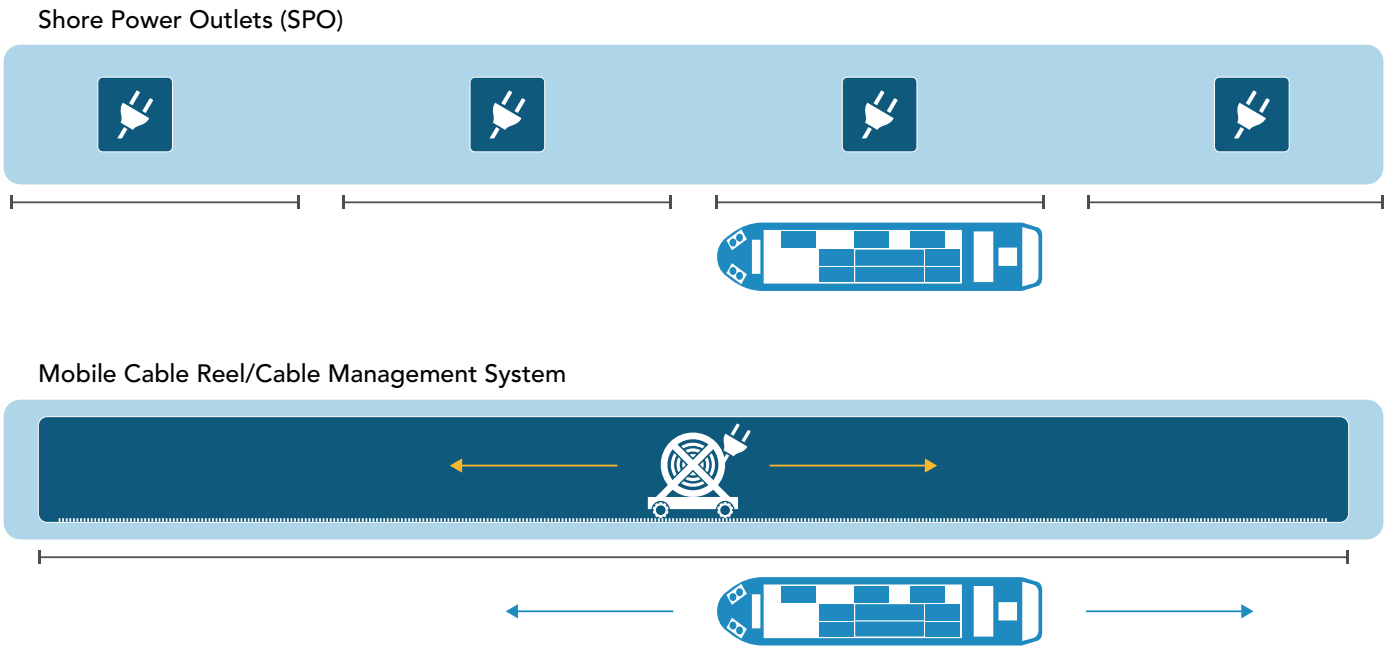
Shore power is electrical power provided to a vessel while at berth, enabling the vessel to shut down its auxiliary engines. Electricity is then transferred to the vessel using electrical cables. Shore power is considered the "gold standard" for reducing emissions from OGVs in California while at berth because it eliminates all emissions from a vessel's exhaust stack and is a proven compliance option that has been successfully demonstrated for all vessel types, including tanker vessels. Shore power is defined as a CAECS in the Regulation and does not require any additional CARB approval to use for compliance with the Regulation.

Shore power has been the primary means of compliance with the 2007 Regulation since its implementation in 2014. Container, reefer, and cruise vessels have successfully utilized shore power and have demonstrated shore power's emission reduction benefits. Industry has indicated these vessel types will continue to primarily use shore power for compliance with the Regulation, while ro-ro and tanker vessels plan to utilize shore power in addition to other technologies such as capture and control.

Cable Management Systems

Cable management systems, as shown in Figure 7 below, facilitate the shore power connection between the vessel and shore. These systems provide flexibility over a more traditional static vault (which is the shoreside connection point for shore power cables). Traditional shore power vault connections require a vessel to line up precisely next to a vault to connect to shore power (high-voltage cables must drop straight down from a vessel to a shoreside vault), which restricts where a vessel can sit at a berth. This has been shown to create challenges with connecting vessels, particularly container vessels, to shore power while at berth under the 2007 Regulation. California container terminals, in particular generally see a wide variety of different sized container vessels and these terminals are typically made up of several berths where vessels can load/offload containers. Cable management systems provide a connection point for a vessel along other areas of the berth, which increases flexibility for terminal operators in how they position vessels at their berths. When using a cable management system, a vessel can drop cables down to the cable management system and then a separate cable on the cable management system is connected to a shoreside vault, similar to an extension cord. This improves the likelihood that a vessel can successfully connect to shore power during a visit. Additionally, cable management systems enable different size vessels to connect to shore power and prepares terminals for changes in future vessel size while accommodating the specific operations of an individual terminal. CARB has seen cable management systems in use at container and cruise terminals under the 2007 Regulation and anticipate continued use with the Regulation due to the added flexibility these systems provide as more vessels are required to reduce emissions at berth.

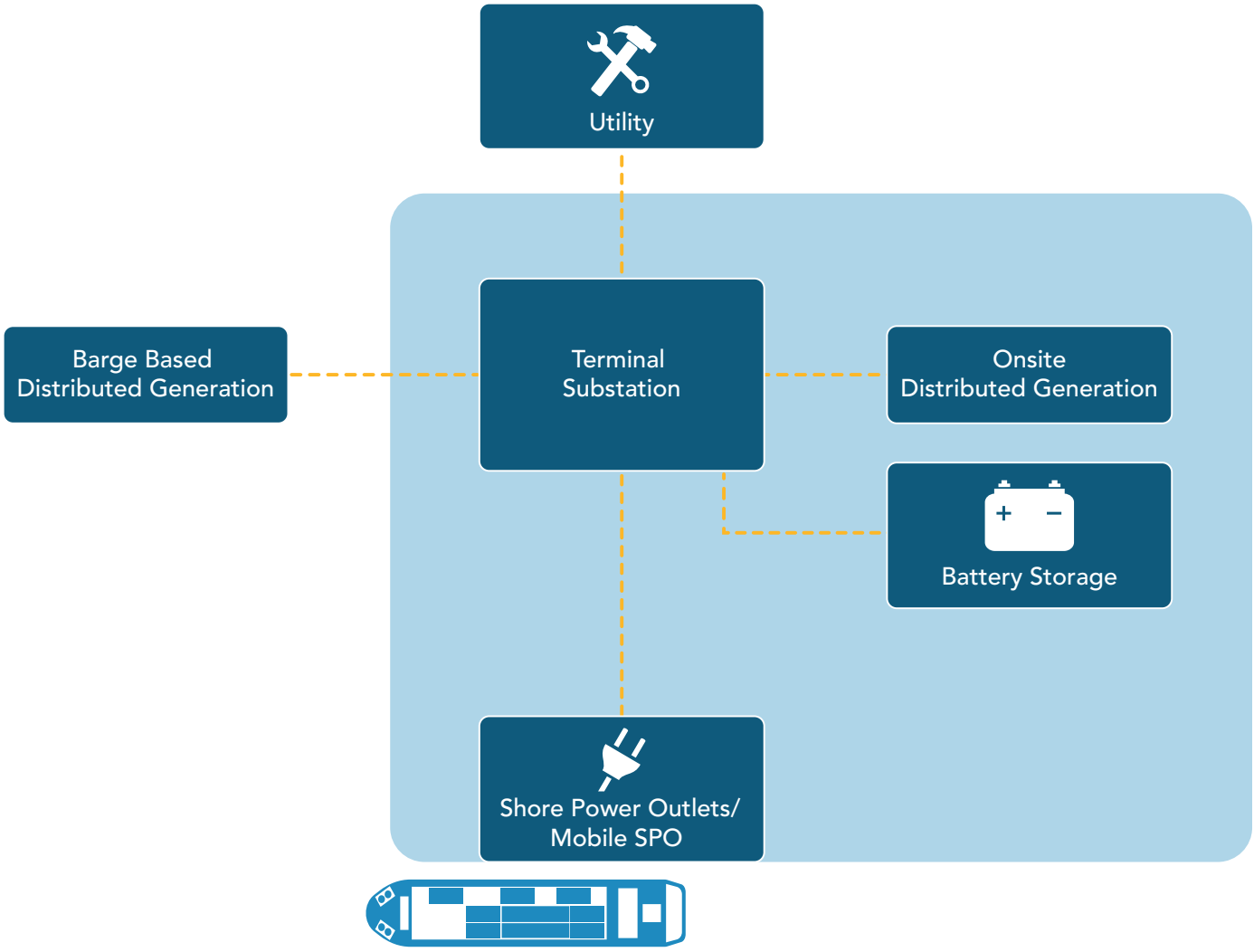
Figure 7: Examples of Shore Power Solutions for Vessels At Berth



Distributed Generation

Distributed generation, as shown in Figure 8, is used to generate and supply electricity for shore power in lieu of grid power and can be barge-based or land-based. Distributed generation offers ports, terminals, and vessels flexibility to provide shore power where it is needed. This allows shore power capability without installing fixed land side infrastructure. As an example, fuel cell technology could be used to generate power near a vessel to supply electricity for shore power. If distributed generation is used to supply shore power, the electricity generated must meet the emissions standards outlined in Section 93130.5(c).

Figure 8: Distributed Generation at a Terminal



Capture and Control Systems

Emission control systems (See Figure 9 below for an example) include exhaust gas scrubbing technologies and after treatment technologies that allow for the capture of auxiliary engine and boiler emissions as they exit the stack and treat the exhaust before it is released to the atmosphere. Capture and control systems used for compliance must be approved by CARB for a vessel type to be considered a CAECS and must reduce emissions to meet the emission rate requirements in section 93130.5(d) in the Regulation.

Capture and control systems utilize proven emission control technologies that have been used for decades on stationary sources and are adapted for marine application. While there is only one CARB approved system currently being utilized for compliance with the 2007 Regulation, this technology has been a proven compliance pathway with the 2007 Regulation and is projected to be further utilized for compliance with the Regulation. Capture and control systems utilize the same basic components (an exhaust gas scrubber and flexible ducting to connect to a vessel's exhaust stack) no matter the type of vessel it is controlling emissions on and can treat a vessel's exhaust while mounted on a barge tied up next to the vessel or from the shore. Another benefit to using a capture and control system is that it requires no changes to the vessel to use, which can be beneficial for tramper style vessels that may visit California only once or twice in the vessel's lifespan.

Figure 9: A Capture and Control System Controlling Emissions on a Container Vessel

Capture and control systems are used as an alternative to shore power and have been approved and utilized since 2015 at the Ports of Los Angeles and Long Beach. Since adoption of the At Berth Regulation, which includes control requirements for tanker and ro-ro vessels, interest in capture and control systems has increased. CARB staff has been in contact and working with multiple companies, all with the intent of entering or expanding operations in the capture and control market. Some of these technology providers are expanding research, testing, and development efforts to roro and tanker vessels. In addition, providers are developing more systems to service container vessels. The development of capture and control systems for ro-ro and tanker vessels are proceeding as anticipated during the rulemaking and CARB staff is working with multiple technology providers.

In September 2020, CARB released a solicitation under the Low Carbon Transportation Program to develop and demonstrate a capture and control system for tanker vessels. CARB's goal under the capture and control solicitation is to demonstrate that the commercially available capture and control technologies currently used by container vessels, or new innovative technologies, can successfully

be adapted for use on oil tanker vessels at berth. This project is currently underway and is expected to be completed in the first half of 2024, ahead of the first compliance deadlines for tanker vessels (2025), as described in the *STAX Engineering* section of this Report.

Alternative Fuels

Alternative fuels have the potential to be a utilized as a strategy to comply with the Regulation. If approved as a CAECS, a vessel could run their auxiliary engines and boilers while at berth when operating on the approved alternative fuel. For an alternative fuel to be considered a CAECS, the control strategy must demonstrate emission rates outlined in section 93130.5(d) of the regulation.

Industry has signaled interest in alternative fuels and its use as a CAECS. The most common alternative fuels discussed are liquified natural gas (LNG), ammonia, hydrogen, and methanol. As industry commits to decarbonization, many shipping lines are looking towards alternative fuels to assist with the global decarbonization of their fleets by the middle of the 21st century.[67,68] CARB staff has heard from shipping lines, including Maersk and CMA CGM, about their intent to use alternative fuels to reduce GHG. Maersk has announced its plans to transition to carbon neutral methanol as a method of reducing GHGs and criteria pollutants.[69] In addition, CMA CGM has released plans to utilize LNG[70,71] an example of which is shown in Figure 10. Alternative fuels are a potential pathway that could be used for compliance with the Regulation, so long as vessel operators can show CARB that the fuel meets the emissions standards required by the Regulation and apply to use the fuel as a CAECS.

Figure 10: LNG-Powered Container Ship at the Port of Los Angeles

67 Maersk. *Sustainability Report 2021*.
68 CMA CGM. *The CMA CGM Group heads towards carbon neutrality by 2050*.
69 Maersk. *A.P. Moller - Maersk accelerates fleet decarbonisation with 8 large ocean-going vessels to operate on carbon neutral methanol*. August 24, 2021.
70 Vessels operating on LNG were excluded from the 2007 Regulation but will be subject to the requirements of the At Berth Regulation. There is a pathway in the At Berth Regulation to comply using alternative fuels such as LNG, but vessel operators must apply to CARB to use LNG as a CAECS following the application process outlined in section 93130.5(e) of the Regulation.
71 CMA CGM. *World premiere: bunkering of a new-generation LNG-powered container ships begins in Rotterdam*. November 13, 2020.

Sources Used to Assess Compliance Readiness

CARB staff used multiple resources to evaluate the status of control technologies that may be used for compliance with the Regulation. Some of these resources are required submittals to CARB (port and terminal plans), while others are voluntary submissions (Feasibility Studies, comment letters) received from industry stakeholders and members of the public. This section of the Report will briefly give a high-level summary of each of the plans that ports and terminals were required to submit to CARB and those plans' overall impact to CARB's analysis for this Report.

Port and Terminal Plans

The Regulation required all regulated terminals operators and ports with regulated terminals to submit terminal and port plans, respectively, to CARB's Executive Officer by December 1, 2021, to inform CARB how the regulated terminals and ports intend to comply with the At Berth Regulation by their compliance start dates. For each port and terminal plan submission, CARB staff expected to see identification of a potential solution for each terminal and if necessary, commitments to evaluate additional strategies as needed; evidence of engagement between ports and terminal staff to develop terminal specific solutions; feasibility assessments to address any potential technological, operational, or physical constraints; and construction and/or equipment installation timelines, etc. As noted in the *Remediation Fund* section of this document, is very important that each terminal identifies in their terminal plan any physical and/or operational constraints that could result in a delay in meeting the terminal's compliance dates set forth in the Regulation. Without this site-specific evaluation included as part of a completed port and terminal plan, regulated entities cannot use the remediation fund for a physical and/or operational constraint that is delaying the implementation of a CARB approved emission control strategy at the terminal.[72] Additionally, port and terminal plans were required to include a division of responsibilities, outlining which tasks ports and terminal operators were responsible for during the preparation for compliance and once the regulatory requirements have begun. This division of responsibilities was to be signed by both the port and terminal operator and will be used by CARB enforcement staff to help make determinations as to which entities may have some level of responsibility during noncompliant vessel visits.

For each port and terminal plan submittal, CARB had 90 days to respond to confirm plan completeness.[73] Within that 90-day period, CARB issued letters or emails to all plan submitters letting them know if their plan was complete or not, and for any plans deemed incomplete, identified the specific deficiencies noted by CARB staff. For incomplete plans, CARB staff requested port or terminal operators to re-submit a revised plan that addresses the identified deficiencies. All port and terminal plans were posted to *CARB's website* for public review, along with CARB's responses to each plan submittal and any revised plans that were submitted addressing CARB staff's request for revisions.[74]

Newly regulated vessel categories (ro-ro and tanker) with later compliance start dates (2025 for ro-ro and Southern California tanker terminals and 2027 for Northern California tanker terminals) also have requirements to submit updated terminal plans by February 1, 2024, and February 1, 2026, respectively. CARB staff note that some initial port and terminal plans for terminals with requirements in 2025 and 2027 may have had a limited amount of information available to provide CARB with for the initial port and terminal plan submittal; as such, staff anticipate significantly more robust plan submittals from ro-ro and tanker vessels when revised terminal plans are submitted in 2024 and 2026.

72 See title 17, Cal. Code Regs., section 93130.15(b)(5).

73 CARB staff confirmed plan completeness by ensuring that the elements of each plan submitted to CARB contained the information set forth in section 93130.14(a) and (b) of the Regulation. Confirming completeness of a port or terminal plan does not constitute CARB approval of the contents of the plan, including the entity's emissions reduction strategy.

74 All port and terminal plans received by CARB can be viewed on *CARB's website*.

Container, Reefer, and Cruise Terminal and Port Plans

CARB received 19 container/reefer terminal plans and five cruise terminal plans, all of which are currently regulated under the 2007 At-Berth Regulation and have a compliance start date for the Regulation of January 1, 2023. Deficiencies noted in the submitted container/reefer/cruise plans were minor, generally involving missing details such as geographic berth coordinates, schedules for installing new shore power vaults or for procuring barge based capture and control systems, or the number of vessels expected to use the port or terminal's selected CAECS, as required by the Regulation (section 93130.14). CARB received sufficient responses to requests for plan revisions from all container/reefer/cruise terminal operators and ports and considers all plans for these vessel categories to be complete.

In general, the container, reefer, and cruise port and terminal plans received by CARB indicate that:

- Shore power is the primary compliance strategy for all 19 container/reefer terminals and all five cruise terminals.
- Two container terminals plan to add capture and control for added flexibility.
- Minimal infrastructure updates needed for equipment installed to comply with 2007 Regulation.
- Compliance pathways submitted in the port and terminal plans generally line up well with CARB staff's assessment during the rulemaking process.[75]
- CARB staff believes the January 1, 2023 compliance deadline can be met.

As noted above, minimal infrastructure updates are needed to prepare container, reefer, and cruise vessels to meet their 2023 compliance date as the majority of these vessels are already required to control emissions at berth under the 2007 Regulation. Container, reefer, and cruise vessel ports/terminals and vessel operators put forth great efforts to install the necessary equipment and supporting infrastructure at their berths and on board their vessels, respectively, to ensure they could comply with the 2007 Regulation and, as such, a large amount of infrastructure already exists at these berths. Given the significant amount of terminal and vessel infrastructure that is already in place, CARB staff believe the January 1, 2023 compliance timeline can be met despite setbacks these sectors experienced during the global pandemic over the past few years.

No port or terminal plan updates are required for the container, reefer, or cruise vessel categories in the future, although CARB encourages port and terminal operators to revise their plans at any time if there is a significant change in their intended pathway to compliance for transparency.

Ro-Ro Terminal and Port Plans

CARB received eight ro-ro terminal plans which provided information on how these terminals intend to comply with the At Berth Regulation by their compliance start date of January 1, 2025. There are eight ro-ro terminals in California, three of which are in Northern California and the remaining are in Southern California. Out of the initial eight ro-ro plans submitted to CARB, six were deemed complete. The two incomplete terminal plans were missing the number of vessels expected to visit the terminal using the control strategy and details on the division of responsibilities, respectively. CARB sent letters asking for terminals to add and/or provide more information on these deficiencies. Following receiving letters of plan incompleteness from CARB, two revised terminal plans were received, and deemed complete.

75 See *Staff Report Appendix E: Berth Analysis*.

In general, CARB staff's analysis of the submitted ro-ro port and terminal plans indicate that:

- About half of the ro-ro terminal plans identified shore power as a main control strategy, with the other half considering barge/land-based capture and control.
- Significant infrastructure installation is necessary for shore power use at ro-ro terminals.
- Majority of Southern California ro-ro terminals (four out of five) indicated they would be able to comply with the At Berth Regulation by January 1, 2025.
- All ro-ro terminals in Northern California stated that the selected control technology would be installed in time for compliance with the At Berth Regulation.
- CARB staff believe the January 1, 2025 compliance deadline can be met by the majority of ro-ro terminal and vessel operators.
    - Operators (vessel or terminal) who experience delays in equipment or infrastructure installation are well positioned to use built-in flexibilities in the Regulation.

The compliance strategies identified by ro-ro terminals are further discussed below, broken down by geographic location (Southern versus Northern California).

Southern California Terminals

There are five ro-ro terminals in Southern California and, similar to Northern California ro-ro terminals, all have a different mixture of control technology options that they are pursuing. The Southern California ro-ro terminals identified: shore power (four terminals), barge-based capture and control (four terminals) and utilizing energy from hydrogen fuel cells for a vessel plug-in (one terminal). Again, this list reflects the fact that some terminals identified more than one emissions control strategy for potential use at their terminal(s). Most of the Southern California ro-ro terminals (four out of five) indicated they would be able to comply with the At Berth Regulation by January 1, 2025. Regarding timing to install emissions control equipment, one terminal said that it would take up to four years to install equipment based on planning, permitting, design, construction, and commission, but it was unclear to CARB staff if this process is already underway.

Northern California Terminals

There are three ro-ro terminals in Northern California, all of which elected to use different control technologies to comply with the At Berth Regulation by 2025, with some terminals identifying more than one potential emissions control strategy. The control technologies identified to be used by ro-ro vessels in Northern California include shore power (one terminal), barge/land-based capture and control (two terminals), and hydrogen fuel cells (one terminal) that would be delivered to the terminal by truck to provide vessels with shore power. All ro-ro terminals in Northern California stated that the selected control technology would be installed in time for compliance with the At Berth Regulation.

Tanker Terminal and Port Plans

CARB received 22 tanker terminal plans in total, 12 from Northern California tanker terminals and 10 from Southern California tanker terminals. This represents all the plans that CARB was anticipating receiving from tanker terminals. Out of the initial 22 tanker plans submitted to CARB by the December 1, 2021 deadline, only eight were initially deemed complete. The main deficiencies in the incomplete tanker port and terminal plans were the lack of identification of a specific control technology to be used for compliance with the Regulation and the lack of a specific timeline to install an emissions control technology. For the incomplete plans, CARB received responses from all 14 tanker terminals whose plans were deemed incomplete and 11 of those revised plans were subsequently deemed complete. Since a revised terminal plan is required to be submitted the year prior to each tanker terminal's compliance year, CARB looks forward to seeing how the pathway toward complying with the Regulation has advanced since the first terminal plan submittal in 2021.

In general, CARB staff's analysis of the submitted tanker port and terminal plans indicate that:

- A mixture of different control technologies was identified by tanker terminal operators to comply with the At Berth Regulation by 2025, including shore power, barge-based capture and control, land-based capture and control, and Innovative Concepts.
- 50 percent of Southern California tanker terminals indicate they would be able to comply with the At Berth Regulation by January 1, 2025
- 25 percent of Northern California tanker terminals indicate they would be able to comply with the At Berth Regulation by January 1, 2027.
- Many tanker terminals did not identify a likely compliance pathway and/or did not commit to installing a control technology by their specific compliance date
    - Terminal operators generally made commitments only to further evaluate safe and feasible control technologies as they are developed for tankers.
- Several tanker terminals claim in their plans that there are no existing CAECS for use on tanker vessels; however, shore power is a proven technology CARB has defined shore power as a CAECS in the Regulation.[76]
- Multiple tanker terminals indicated a potential delay in meeting required implementation dates, but the majority did not provide specific installation schedules or provide site-specific evidence to explain why physical constraints made existing control technologies unusable at their terminals.
    - Reasons generally listed for a delay in compliance included: the need for safety considerations to be thoroughly addressed by technology providers, technology readiness, extended construction schedules, and potentially lengthy permitting processes.
- CARB staff did not receive enough sufficient site-specific information to recommend any changes to the tanker implementation dates at this time.

CARB staff understands the uncertainty surrounding selecting an emissions control strategy for a deadline that is several years in the future (2025 and 2027 for Southern and Northern California terminals, respectively), but expected terminal and port plans to have some level of commitment to a potential control strategy to be reflected in the submittal of the tanker terminal plans. For example, information CARB staff expects to see in a complete terminal/port plan includes examining what specific technologies may be appropriate for each terminal's own unique operations, what specific challenges are present at each individual facility, and outlining what steps need to be taken to address those challenges to ensure each terminal is ready to meet their compliance obligations by the regulatory implementation dates. It is important to note that any terminal that has a physical and/or operational constraint that delays the implementation of a CAECS at a berth(s) and wishes to utilize the remediation fund for compliance, must have a terminal plan that is deemed complete (also referred to as "acceptable") by CARB.[77]

Multiple tanker terminals provided Feasibility Studies discussing their ability to comply with the 2025/2027 regulatory compliance deadlines. These Feasibility Studies included site-specific Feasibility Studies by Moffatt & Nichol (for four tanker terminals) and the Det Norske Veritas (DNV) Study, all of which are discussed in more detail in the *Feasibility Studies* section of this Report.

The tanker plans submitted to CARB are evaluated in this Interim Evaluation based on their location (Northern or Southern California). Due to differences in weather, tides, channel width, permitting requirements, and other considerations, it is important to evaluate terminals selected control technology and timing based on location. This location-based evaluation also helps CARB staff to better understand if one area of the State may experience more delays with meeting the 2025/2027 compliance deadlines.

76 See title 17, Cal. Code Regs., Sec. 93130.5(c).
77 See title 17. Cal. Code Regs., Sec. 93130.15(b)(5).

Southern California Tanker Terminals

There were 10 tanker terminals in Southern California that submitted terminal plans to CARB by the December 1, 2021 deadline, with a mixture of different control technologies selected by operators to comply with the At Berth Regulation by 2025 (with some terminals identifying more than one potential control strategy). The control technologies identified to be used by tanker vessels in Southern California include shore power (two terminals), barge-based capture and control (six terminals), land-based capture and control (three terminals), and Innovative Concepts (one terminal). Additionally, one terminal plan submitted was for a low-activity terminal so had no emission control method selected and another plan was submitted to inform CARB that this berth will be demolished.

Of the tanker plans mentioned above, only 50 percent of Southern California tanker terminals submitted terminal plans that showed they would be able to comply with the At Berth Regulation by January 1, 2025. The majority of the Southern California tanker terminal plans that were deemed incomplete did not commit to installing control technology by the 2025 compliance date and instead made commitments only to further evaluate safe and feasible control technologies as they are developed for tanker vessels. When pressed by CARB staff, most Southern California tanker terminal operators revised their plans to state that compliance could not be achieved at their terminal by 2025 and provided rough estimates of when compliance could be met (e.g., 2026 or 2028). The reasons that tanker terminal operators generally listed for a delay in compliance included: the need for safety considerations to be thoroughly addressed by technology providers, technology readiness, extended construction schedules, and potentially lengthy permitting processes; however, the majority of tanker terminals did not provide site-specific evidence to explain why physical constraints made existing control technologies (such as shore power) unusable at their terminals.

While some of the plans stating that a control technology cannot be installed until after their compliance date were ultimately deemed complete by CARB staff (as noted on CARB's public website) because they met the specific port/terminal plan requirements of the Regulation, regulated entities should note that compliance is still required under the Regulation. If a preferred compliance pathway is not available by a tanker terminal's specific compliance date, CARB expects terminal operators (and vessel operators) to utilize other ways to comply, including using a TIE (or VIE), the remediation fund, and or Innovative Concept (if applicable). CARB looks forward to seeing additional terminal-specific Feasibility Studies, more progress in working with CAECS technology providers, and the updated timelines for installation of control equipment in future revised terminal plan submittals.

CARB staff will continue to closely monitor the progress being made to adapt emissions control technologies for use on tanker vessels at Southern California terminals as well as any infrastructure needed to support these technologies ahead of January 1, 2025.

Northern California Tanker Terminals

There are 12 tanker terminals in Northern California that submitted terminal plans to CARB by the December 1, 2021 deadline, with a mixture of different control technologies selected by operators to comply with the At Berth Regulation by 2027 (with some terminals identifying more than one potential control strategy). The control technologies identified to be used by tanker vessels in Northern California include shore power (three terminals), barge-based capture and control (six terminals), land-based capture and control (three terminals), and Innovative Concepts (two terminals). Additionally, one terminal elected to solely use a package of Innovative Concepts to achieve compliance with the At-Berth Regulation but is also working on evaluating other control technologies during this time. In additional to Innovative Concepts, this particular terminal is also conducting technical feasibility assessments and additional research to identify a control technology including barge-based capture and control, a mobile land-based capture and control, a fixed land-based capture and control, and shore power.

As mentioned previously, the main deficiency in the incomplete tanker plans for tanker terminals, including those in Northern California, was the lack of an identification of a chosen control strategy as well as the absence of a timeline associated with installing control technology to comply with the At Berth Regulation by 2027 for Northern California tanker terminals. Three terminals in Northern California also submitted Feasibility Studies for their specific terminal by Moffatt & Nichol and many plans submitted also included the DNV Report. These are discussed in more detail in the *Feasibility Studies* section of this Report. Given the longer timeline for compliance for Northern California tanker terminals (January 1, 2027), some plans indicated that terminal operators are still actively engaged in a feasibility analysis/study to investigate which potential emissions control technology would be most feasible and best suited for use at their specific terminal. As noted above, CARB looks forward to seeing how these Feasibility Studies contribute to revised terminal plans that are due in 2026, prior to the implementation date for Norther California tanker terminals.

Some of the specific concerns noted in the Northern California tanker terminal plans include the ability to use capture and control systems in the narrow Carquinez Strait channel. Channel-related restrictions, such as space limitation, tides, and currents, are among the reasons why a number of terminals are evaluating land-based capture and control and shore power (as opposed to barge-based systems) as a potential control option. This is generally in line with CARB's *Berth Analysis* that was developed during the At Berth Regulation rulemaking process, after several in-depth conversations with industry stakeholders.[78] However, some Northern California tanker terminals are still exploring barge-based capture and control systems as a pathway for compliance.

Of the Northern California tanker terminal plans that did provide potential timelines for installing control systems, some rough estimates of when compliance could be met were provided. For example, one Northern California tanker terminal in particular provided CARB a timeline for shore power infrastructure installation showing that it would take until 2029 to comply with the Regulation due to: reviewing the Interim Evaluation and other industry developments, permitting, Pacific Gas & Electric's (PG&E) application process, engineering, CSLC Marine Oil Terminal Engineering & Maintenance Standards (MOTEMS) approval, procurement and mobilization, PG&E new service line commissioning, and construction. This particular terminal plan that stated it would take six to 13 years to comply, *after* the control equipment is deemed commercially available, based on the need for: a site specific feasibility study (two years), engineering (one to three years), California Environmental Quality Act (CEQA) permitting - assuming a one-year overlap with engineering (one to three years), contracting/material procurement (one to two years), construction (one to four years), and commissioning (one year).

Overall, over 25 percent of Northern California tanker terminals submitted plans indicating that they would be able to comply with the At Berth Regulation by January 1, 2027. However, similar to the Southern California terminal plans, the Northern California tanker terminals that indicated a potential delay in meeting the required implementation date did not provide site-specific evidence to CARB to explain why physical constraints made control technologies unusable at their terminals. Additionally, some of the plans lacked any specificity regarding how the terminal would attempt to meet their compliance obligations. Instead, the plans demonstrated a lack of engagement with technology providers and a desire to wait for CARB to approve a CAECS before selecting an emissions control technology to pursue. Ports and operators of regulated tanker vessels and terminals and should be aware that the lack of a compliance plan will not excuse regulated entities from their compliance obligations as set forth in the Regulation and that CARB has defined shore power as a CAECS in the Regulation.[79] CARB staff would recommend continued monitoring of the progress being made to adapt emissions control technologies for use on tanker vessels as well as any infrastructure needed to support these technologies.

78 When the At Berth Regulation was developed, CARB received ample information from tanker vessel and terminal operators stating that land-based capture and control systems would most likely be the main method to controlling emissions from tankers, largely due to concerns such as channel restrictions and other limitations facing the use of barge-based system. See *Staff Report Appendix E: Berth Analysis*.

79 See title 17, Cal. Code Regs., Sec. 93130.5(c).

Feasibility Studies

CARB staff considered Feasibility Studies submitted alongside port and terminal plans in its review during the drafting of this Report. Since the adoption of the Regulation, there have been several Feasibility Studies conducted that assess at berth emissions reduction technologies for use by tanker vessels. Four of these Feasibility Studies were performed by Moffatt & Nichol and are sites-specific studies that were submitted to CARB as supporting documentation for a port/terminal plan development. Lastly, a separate, non-site-specific study was performed by DNV as a general review of the challenges generally faced by technologies for the tanker industry to comply with the Regulation. A summary of the Feasibility Studies received by CARB are listed in this section of the Report in brief.

Emissions Control Technology Assessment for Tankers (DNV Report)

The Western States Petroleum Association (WSPA) commissioned DNV, a leading classification society and advisor for the maritime industry, to conduct a technology assessment (referred to hereafter in this Report as the "DNV Report") of shore power and emissions capture and control technologies, both barge-based and land-based, that can be used on tanker vessels to comply with the At Berth Regulation.[80] The DNV Report examines the safety, reliability, and capability of these three emissions reduction strategies to comply with the At Berth Regulation. The general concerns raised in the DNV Report are further evaluated in the *Technology Challenges* section of this chapter.

The DNV Report asserts the following:

- Without international and general maritime standards, it is difficult and costly to implement emissions control technologies on tanker vessels due to the unique requirements for explosion-proof zones, the varying size and configurations of tanker vessels, and the varying ports called upon in multiple global locations.[81]
- There is a broad variety of tanker vessel sizes and operational/physical constraints seen at tanker terminals.
- In addition to logistical, cost, and implementation time concerns, there are many safety concerns, including the ability to ensure all equipment is explosion-proof (required when carrying hazardous cargo).
- Whether there is an insufficient power supply from the electrical grid for the potential demand from the tankers calling at the ports.
- Compliance timelines for installing shore-based infrastructure are too aggressive.

80 The full DNV Report can be found in Attachment A, pp. 91-259.

81 Per the DNV Report, without international standards in place governing the development and use of tanker emissions control systems, moving forward with developing emissions control technologies for tankers may induce unnecessary costs. For example, the DNV Report states that "[The lack] of unified standards for shore power especially the plugs and sockets may induce the tankers cannot use the shore power connection due to its worldwide operation profile (sic)." Furthermore, the DNV Report states that without standards it is not clear how or where the shore power connections will be located on a tanker vessel. Therefore, "the cost [for shore power] is dependent on the vessel type, size, age, and the need for an onboard transformer, as well the where and how the retrofit is performed…Costs may be significantly higher if the shore power connections will be at the cargo manifold area and within the hazardous zone that might require the design and construction of a specialized safe room for the connection point for the shore power." (DNV Report, pp. 6-7, 27; See Attachment A, pp. 100-101, 121).

In order to assess the tanker industry's ability to comply with the timelines set forth in the Regulation, the DNV Report provides two different timelines for analysis: one for both shore power and land-based capture and control and a second timeline for barge-based capture and control systems. The timeline for shore power and land-based capture and control systems outlines a 14-year implementation for tanker vessels, concluding that it is "unlikely that any ports or marine oil terminals will be able to comply with the At-Berth Regulation timeline."[82] The timeline is based on a generalized, non-site specific seven-step process that is stated to include a feasibility study, site design, CEQA review, regulatory/permitting, contracting, construction, and commissioning. The DNV Report does not provide references to similar projects to substantiate the estimated duration of each step. Additionally, the timeline outlined by the DNV Report for the installation of shore power is considerably longer than the timelines CARB staff analyzed for the existing shore power installation at Berth T121, a tanker terminal at the Port of Long Beach. As noted in CARB's ISOR that was published during the rulemaking period for the Regulation, the Berth T121 installation took around four years from the point of project design to operation, which is generally in line with shore power installations for container/reefer berths[83].

The second timeline in the DNV Report was provided for barge-based capture and control systems. The DNV Report estimates that barge-based systems could be implemented for tanker vessels in five years or less and states, "it is even possible some barge-based systems could be in operation on a few tankers prior to the regulatory deadline."[84]

It is worth noting that while high-level Feasibility Studies analyzing the general structure of the Regulation are useful tools in understanding the general challenges that could arise for the tanker vessel category, the DNV study does not assess the progress made in adopting control technologies for use with tanker vessels. The DNV study also does not address the status of landside infrastructure as it currently exists for CARB staff to address in this Report the specific improvements that may be needed to support emission reductions tanker terminals. In addition, CARB already analyzed and accounted for similar concerns about the Regulation raised by the tanker industry during the rulemaking process.[85] As a result, the DNV Report has limited application to the purpose of this Report as required by the Regulation to explain the current status of implementation.[86]

The DNV Report was also attached to several terminal plans submitted to CARB as evidence of their inability to complete implementation of a CAECS at their terminal(s). However, as stated above, the DNV study is not site-specific and does not document physical or operational constraints at any specific terminal. If such terminals were to seek to use the remediation fund on account of a physical or operational restraint identified in their approved plan, as permitted by Regulation section 93130.15(b)(5), a site-specific evaluation showing why any available control options is unable to be installed at a specific terminal would be needed to qualify for use of the remediation fund in case of a physical or operational constraint.

Moffatt & Nichol Feasibility Studies

Moffatt & Nichol, a well-known advisory firm providing engineering and consulting services to marine terminals, provided four Feasibility Studies for CARB's review: three for Phillips 66's Richmond, Rodeo, and Port of Los Angeles's berths and one for Valero's Benicia terminal. At the request of the terminal operators who submitted the Feasibility Studies, CARB staff was only able to share information regarding one feasibility study for the Valero Benicia terminal due to confidentiality concerns.

82 DNV Report, p. 6. See Attachment A, p. 100.
83 See *Staff Report: Initial Statement of Reasons (ISOR)*, pp. III-18-19.
84 DNV Report, p. 6. See Attachment A, p. 100.
85 CARB addressed numerous comments to similar concerns shared with staff during the At Berth rulemaking. See CARB's *Proposed Control Measure for Ocean-Going Vessels at Berth: Final Statement of Reasons (FSOR)*, pp. 157-163, 546-549 and 277-283 (technology feasibility for tankers), pp. 57-58 (implementation timelines) for examples.
86 See title 17, CCR, section 93130.14(d).

Moffatt & Nichol indicate that the feasibility study performed for the Valero Benicia terminal is complementary to the DNV Report and then provides specific information regarding the Benicia terminal. The study sites several concerns surrounding the implementation of shore power and asserts that "shore power is the least favorable from a cost and implementation schedule perspective" and therefore the study focuses on barge-based control and capture systems as a more viable option for compliance. The study also mirrors the DNV Report's assertion that "there is currently no commercially available compliance option that is demonstrated safe for use on oil tankers."[87] This finding runs contrary to CARB findings that show shore power to be a technically feasible and proven compliance option for tanker vessels and note that shore power is already installed and in use at a tanker terminal (Pier T, Berth 121) at the Port of Long Beach.[88] In addition to providing details about the unique aspects of the terminal (such as space constraints for barge placement, potential arrangements for control and capture systems' arm/hood; tidal elevations; wind conditions; typical sizes and classes of vessels that berth at the ports; and potential combinations of moored vessels), the studies provide cost estimates and estimates for when barge-based capture and control system can be operational.[89]

The Valero feasibility study also contains a report of a meeting held between the San Francisco Bar Pilots (SFBP), Valero, and Moffatt & Nichol to discuss barge-based capture and control at the Valero Benicia terminal. The outcome of the meeting was a list of 11 concerns surrounding barge-based capture and control systems and a conclusion that "shore power [is] slightly more favorable compared to capture and control" and that "SFBP views shore-based capture and control as more favorable compared to barge-based capture and control." This Valero study concludes that based on their assumptions,[90] "none of the compliance options discussed can be reasonably implemented [before] January 1, 2027."[91]

This study indicates that Valero will not select a CAECS until after they have reviewed CARB's Interim Evaluation Report. The study assumes this review process will occur over a 6-month period prior to determining a preferred compliance option and initiating a project.[92] However, it is worth noting that nothing in the Regulation or this Report precluded the ports or terminals from acting to ensure compliance with the Regulation requirements after adoption into state law in 2020. This estimated timeframe for implementation of barge-based capture and control systems for the Valero Benicia terminal as listed in the study is based on the publishing of this Interim Evaluation Report, the tanker company's ability to review CARB's findings, as well as the time it takes to obtain any necessary permits.[93]

Hazard Identification Study for Barge-Based Emission Capture and Control System ("ABS Study")

On September 2, 2020, CARB released a grant solicitation to develop, implement and administer a project for a capture and control system for oil tankers.[94] Total funding for the project was up to $10 million from fiscal year (FY) 2019-20 Low Carbon Transportation Allocation. The goal under this grant solicitation is to demonstrate that the commercially available capture and control technology currently used by container vessels or new innovative technologies can be successfully adapted for use on oil tanker vessels at berth. The submittal deadline for the solicitation was November 6, 2020,

87 Valero Benicia Refinery CARB Feasibility Study, Attachment B.
88 See *Staff Report: Initial Statement of Reasons (ISOR)*, pp. III-18-19.
89 Valero Benicia Refinery CARB Feasibility Study, Attachment B.
90 Assumptions include that no in-water work will be permitted from September to November due to delta smelt season; that the risks and technical challenges presented in this report are resolved within the proposed schedule; that Valero will not select a CAECS until after an adequate review of CARB's Interim Evaluation Report; and that Valero will not make a final funding decision until all permits and approvals are received. See Attachment B.
91 Valero Benicia Refinery CARB Feasibility Study, Attachment B.
92 Valero Benicia Refinery CARB Feasibility Study, Attachment B.
93 Valero Benicia Refinery CARB Feasibility Study, Attachment B, p. 43.
94 California Air Resources Board. *2019-2020 Grant Solicitation - Capture and Control System for Oil Tankers Project*. September 2, 2020.

and CARB received three applications, which can be viewed on *CARB's website*.[95] South Coast AQMD's application was selected and was subsequently awarded funding, becoming the project grantee.[96] The solicitation project is currently underway with project partners following the requirements of their grant agreement. Alongside South Coast AQMD, STAX Engineering is a project partner and is responsible for designing, building, and operating the capture and control barge to meet the requirements of the grant agreement. A list of all the project partners for project can be viewed on *CARB's website*.[97] The grant solicitation states all work from the project must be completed by January 1, 2025; however, the project is currently underway and is expected to be completed in the first half of 2024, ahead of the first compliance deadlines for tanker vessels (January 1, 2025). The capture and control system demonstrated through the project is expected to eliminate at least 80% of the criteria pollutants (NO_x, PM2.5, DPM, and ROG) from both the auxiliary engines and boilers of oil tankers using the system while at berth.

A requirement of the tanker grant was to "[s]ubmit a hazard or safety assessment by a classification society (or equivalent), including a consultation with the U.S. Coast Guard."[98] In total, the project will include a safety study that includes comprehensive safety evaluation components and addendums as the development of the project progresses through the design, construction, and testing phases. American Bureau of Shipping (ABS), an industry respected U.S.-based provider of classification services for marine and offshore assets, conducted the first phase of the safety assessment on June 30, 2021 for STAX Engineering (referred to in this Report as the "ABS study"), which examined the preliminary design of the barge-based capture and control system for tanker vessels. Technology providers, industry, class societies, and regulators participated in the first phase of the ABS study and were involved with identifying any potential safety concerns or hazards.

The ABS study, which can be reviewed in Attachment E, examined both the design of the barge as well as various operational scenarios such as the location of the capture and control barge and the tanker vessel during operation. In total, the study focused on hazards that related to the concept of operation for the barge, barge mooring arrangement and procedure, modes of operation and operational procedures, operation of the barge on a tanker in port, emergency events, the use of tugboats to move the barge, weather events, communication and vision concerns, and the safety systems on the barge. Some of the identified hazards that were of concern included man overboard, release of petroleum or chemical product, barge struck by a passing vessel, excessive motion of the barge due to weather or wake, interference of a mooring line, structural failure on the barge, spud failure, and fire. The study also provided recommendations to mitigate potential hazards and or concerns that were identified. Many of the concerns were addressed through the recommendation to develop detailed procedures for operations, emergencies, and maintenance. The study concluded, "There were no unresolvable or unmitigable risks identified during the hazard identification (HAZID) study that would prevent further successful development of the concept. The high risk-ranked scenarios were mostly related to barge mooring and positioning." Additional phases of the ABS safety study will be performed as the system design and construction progress to completion.

95 *Low Carbon Transportation Investments Fiscal Year 2019-20 Capture and Control System Solicitation For Oil Tankers Project*.

96 South Coast Air Quality Management District. *Recognize Revenue, Transfer Funds and Execute Contract and MOU to Develop and Demonstrate Capture and Control System for Oil Tankers Project*. Governing Board Meeting Agenda. January 8, 2021.

97 *LCTI: Capture and Control System for Oil Tankers Project*.

98 *Applications for the Capture and control system Solicitation For Oil Tankers Project*.

Public Stakeholder Engagement

Another key tool that CARB staff used to evaluate the status of compliance readiness for regulated entities is through public stakeholder engagement. As discussed earlier in this Report, starting in fall 2021, CARB solicited comments from stakeholders requesting information to inform this Interim Evaluation Report. In total, CARB received eleven comment letters from shipping lines, terminal operators, ports, industry associations, and environmental advocates by the end of June 2022, which was the soft deadline given to submit comments so that CARB staff had time to digest and incorporate the information into this Report. Several of these comment letters contained information regarding progress and challenges seen with adapting and procuring emissions reductions technologies for use by the compliance dates set forth in the Regulation. The comment letters are attached to this Report (see Attachment A) for public review. This information will be further discussed later in the *Findings* section of this chapter. Additionally, CARB staff solicited and continued to be open to any additional public comments after June 2022, and additional comments about this Report may be submitted prior to the Board's consideration.

Innovative Concept Applications

While the Innovative Concept application and approval process is separate from the Interim Evaluation Report, CARB staff considered the information submitted by applicants and public comments received on the applications regarding the current status of emissions control technologies and the ability for regulated entities to use this pathway for compliance with the Regulation. By reviewing the Innovative Concepts applications, CARB staff learned that there is a strong desire by industry to use capture and control technology strategies both for unregulated emissions sources and ahead of the regulatory implementation dates for soon-to-be regulated sources in order accumulate early reduction credits. Furthermore, CARB staff learned that industry can be very creative in finding options for reducing emissions associated with port activities. More information about the Innovative Concept application and review process is detailed in the section *Innovative Concepts* of this Report.

Technology Providers Perspective

As part of the implementation of the At Berth Regulation and the preparation of this Report, CARB staff have been in communication with multiple technology providers to discuss the challenges and concerns vessel and terminal operators have brought up regarding land and barge-based capture and control systems. Overall, technology providers have shown great interest and willingness to work with industry to provide solutions to these concerns. CARB staff has been told by technology providers they are working with marine engineers, classification societies, and industry to ensure that capture and control systems will be safe, reliable, and available to utilize as a CAECS for compliance with the At Berth Regulation.

Summary of Industry Concerns

CARB staff's review of port and terminal plans, third-party Feasibility Studies, and Innovative Concept applications identified several areas for staff to consider as part of this Report. This section of the chapter will break down the primary concerns identified by stakeholders by vessel category, as each vessel type has unique challenges in meeting the requirements and compliance deadlines of the Regulation.

Container, Reefer, and Cruise Vessels

The majority of container, reefer, and cruise vessels are already subject to emissions control requirements at berth under the 2007 At-Berth Regulation. As such, the potential compliance challenges for this vessel category are primarily associated with the time needed to retrofit each fleet's remaining vessels that do not yet have shore power installed. Some relatively minor amount of vault installations and equipment upgrades are expected at a handful of container terminals across the state to expand access to shore power for increased use by more container, reefer, and cruise vessels.

While all vessel categories expressed some concerns involving the ability of their vessels and terminals to meet the compliance deadlines required by the Regulation, concerns for container, reefer, and cruise vessels were primarily centered around difficulties they face installing shore power equipment on both the vessel and terminal side due to COVID-related delays.[99] As such, these concerns are discussed further in the *COVID Impacts* section of this Report.

Ro-Ro Vessels

CARB received information from multiple ro-ro vessel and terminal operators for the purposes of this Interim Evaluation Report. In general, ro-ro vessel and terminal operators are open to exploring a broad range of emissions control technologies, including shore power (both using the electrical grid and through distributed generation powered by hydrogen fuel cells) as well as capture and control and alternative fuels.

Common concerns expressed to CARB by ro-ro vessel and terminal operators as part of this Interim Evaluation included:[100]

- Availability of non-shore power CAECS for ro-ro vessels
  - No capture and control systems are currently approved for use on ro-ro vessels
  - Limited number of capture and control system providers
- Insufficient shore power infrastructure (terminal and vessel side)
  - Utility construction delays and lack of power capacity with existing electrical equipment may delay ability to use shore power beyond 2025 compliance deadline
- Time out of service needed for vessels to install shore power equipment
  - Multiple stakeholders commented that every ro-ro vessel in their fleet would need to be retrofit with shore power equipment due to the nature of their operations
  - Especially challenging for Jones Act vessels,[101] which are limited in number
- Equipment shortages and installation delays as a result of the global pandemic (see *COVID-19 Pandemic Impacts* for more details)
- Absence of an international shore power standard

99 Stakeholder comment letters can be found in Attachment A.

100 Stakeholder comment letters can be found in Attachment A.

101 According to the *Transportation Institute*, the Jones Act is a cabotage law that imposes restrictions on vessels trading between two ports within the U.S. To be classified as a Jones Act compliant vessel, a vessel to be built and flagged in the U.S., be owned by a company that has at least 75 percent U.S. ownership, and must have a crew that is at least 75 percent U.S. sailors.

Availability of Non-Shore Power CAECS for Ro-Ro Vessels

While there are no CARB approved systems for ro-ro vessels at the time of the drafting of this Report, CARB staff is evaluating several test plans for capture and control systems that are currently being designed for use on these vessel types. Technology providers project the first capture and control system for ro-ro vessels will be approved by the end of 2023. In addition, ro-ro vessel operators are currently engaged with technology providers to ensure capture and control systems will be available by compliance deadlines. For example, at least one ro-ro vessel operator has already agreed to a contract to provide funds for a barged-based capture and control system from a technology provider to meet the 2025 compliance date.[102]

Insufficient Shore Power Infrastructure and Capacity

Multiple ro-ro vessel and terminal operators commented to CARB about concerns surrounding the lack of availability of shore power infrastructure at existing ro-ro terminals and the amount of time that it may take for utility companies to install appropriate equipment enabling the use of shore power for ro-ro vessels. For example, the Port of Los Angeles advised CARB staff that the Los Angeles Department of Water and Power (LADWP) is no longer committing to project timelines identified in their 2018 Electric Service Requirements Manual due to workload and resource constraints. Given that some terminals will need additional power capacity brought to their terminals to provide additional or new shore power connections for vessels, delays by utility companies could hamper the ability for ports and terminals to install new shore power infrastructure in time to meet compliance deadlines.[103] Additionally, some ports and terminal operators expressed concerns that utility companies in California will not be able to support increased use of shore power and future port electrification efforts without significant upgrades to existing power supply infrastructure, which could cost in the hundreds of millions of dollars.[104]

CARB staff understand that there are concerns about the ability for ro-ro terminals to design and install shore power infrastructure in time to meet the compliance deadline of 2025 that is set forth in the Regulation, and that the time to retrofit vessels with shore power may also be difficult, particularly in the face of pandemic-related equipment supply shortages (as detailed in the *COVID Impacts - Findings* section of this Report). Requests were received from multiple ro-ro vessel and terminal operators, along with the Port of Long Beach, asking CARB to either delay the ro-ro vessel compliance requirements to 2027 or increase the number of VIEs granted to roro operators beginning in 2025. However, there are significant ongoing efforts in California to increase the capacity of the electrical grid to support the large-scale shift to electric vehicles and equipment as required by Governor Newsom's Executive Order N-79-20,[105] and CARB anticipates there being sufficient power to the ports to allow vessel and terminal operators and ports the ability to comply with the Regulation using shore power if that is their chosen pathway.[106] Additionally, the Regulation does have flexibilities built into it (VIEs/TIEs and the remediation fund – see the Summary section of this chapter for explanation of how these flexibilities can be used for compliance in this situation) that provide compliance pathways for regulated entities if installing shore-side equipment or retrofitting vessels takes longer than the 2025 deadline. Additionally, some ro-ro vessel operators are exploring the use of shore power using distributed generation powered by hydrogen fuel cells. Such a solution could address some of the lengthy timelines for installing shore power infrastructure on the shore-side, eliminating lengthy construction and permitting concerns.

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102 Mitsui O.S.K. Lines. *MOL an CAEM signs a contract for development and use of new Marine Exhaust Treatment System for car carriers in California*. May 10, 2022.

103 Email from Amber Coluso, Air Quality Environmental Specialist with the Port of Los Angeles, to CARB staff. July 25, 2022. See Attachment C.

104 See comment letter from the Port of Hueneme in Attachment A.

105 State of California. *Executive Order N-79-20*.

106 For an additional summary about some of the ongoing efforts throughout the state to expand grid capacity, see Response to Comments on the Draft Environmental Analysis prepared for the Advanced Clean Cars II Program, Master Response 1, p. 6-13: *ACC II RTC Document (ca.gov).*

CARB staff note that distributed generation shore power does not relieve the concerns on the vessel side, as vessel operators will still have to retrofit the vessels in their fleet in order to use a high voltage shore power connection. One ro-ro operator advised CARB that current equipment ordering lead times and installation capacity from equipment suppliers, the operator could install shore power equipment on around 30 percent of the ro-ro vessels in their fleet by the 2025 compliance date in the best-case scenario, with that number increasing to around 75-80 percent of the vessels in their fleet by 2027.[107] Some vessel operators may be more impacted than others; due to the restrictions and requirements for Jones Act vessels, some of which are main service providers to the Hawaiian Islands, there are not replacement vessels available to supplement during the time a vessel is out of service for shore power retrofits. It is important to note that regulatory flexibilities, including VIEs/TIEs and the remediation fund, can be used to comply with the Regulation for equipment installation delays. Additionally, VIEs/TIEs can also be used for vessel substitution, meaning that a vessel operator could bring in a limited number of vessels without needing to control emissions at berth while other vessels in their fleet are being retrofit for shore power.

International Shore Power Standard

An additional concern raised by multiple ro-ro vessel and terminal operators is the absence of an international shore power standard for ro-ro vessels. Shore power electrical standards are developed and published by the International Electrotechnical Commission (IEC), the International Organization for Standardization (ISO), and IEEE, and the Regulation does not provide specific electrical standard requirements for shore power. The Regulation states that shore power is electrical power supplied by either the local utility or by distributed generation to a vessel at berth. Industry has stated that the standard is still being developed, and there has yet been a determination on what that standard will be. The standard will determine whether the electrical power will be 11 kilovolt (kV) or 6.6 kV. CARB staff received letters from stakeholders stating the shore power standard will not be published until 2023 and expressed concerns regarding meeting the compliance deadlines without having a shore power standard in place.[108] Stakeholders indicated they cannot purchase the required electrical equipment or start land side infrastructure upgrades without knowing what the final standard will be. CARB staff understands the hesitancy behind installing shore power equipment before a shore power standard is established; however, the localized health benefits achieved by the Regulation cannot wait for an international body to set a shore power standard. As with the 2007 Regulation, CARB expects vessel operators and terminals will work together to utilize shore power systems that work best for all parties while the international shore power standard is being established. In addition, the Regulation provides flexibility through the use of VIEs/TIEs, the remediation fund, and Innovative Concepts for compliance.

107 Stakeholder comment letters can be found in Attachment A.
108 Stakeholder comment letters can be found in Attachment A.

Tanker Vessels

As with ro-ro vessels, numerous potential compliance challenges were identified by stakeholders for tanker vessels. This section of the Report will focus on tanker specific compliance challenges.

Common concerns expressed to CARB by tanker vessel and terminal operators as part of this Interim Evaluation included: [109]

- Lack of CARB approved emissions control technologies for tanker vessels
- Timeline to adapt emissions control technologies for use on tanker vessels
  - Additional time needed for HAZID studies
  - Extended design timelines are necessary to develop new stack connection systems that can make multiple connections (to allow for the controlling of both auxiliary engine and boiler emissions at the same time)
  - CEQA permitting concerns
- Power availability and compatibility (for shore power equipment)
- Safety concerns
  - Includes the need for new personnel training and the development of new safeguards designed to mitigate hazards associated with operating an emissions control technology on a vessel carrying hazardous cargo
- Logistical and operational constraints
  - Lack of shore power connection standards on tankers
  - Varying berthing directions at tanker terminals
  - Channel and land-side physical constraints
  - Emergency break-away time restrictions for tankers
- Utility construction delays and lack of power capacity with existing electrical equipment

Availability of CAECS for Tanker Vessels

One of the primary concerns identified by tanker vessel and terminal operators during this Interim Evaluation process was the lack of CARB approved emissions control technologies for tanker vessels. Some operators and Feasibility Studies went as far as to say there were no CARB-approved emissions control technologies available for tanker vessels. CARB disagrees with this assessment as shore power is a CARB-approved emissions control technology (defined as a CAECS in the Regulation) and may be used for compliance by any regulated vessel or terminal without additional approval needed by CARB. In fact, shore power is already being used to control tanker vessel emissions at Pier T at the Port of Long Beach and on ro-ro vessels in Europe.[110] Additionally, the Ports of Rotterdam (Netherlands) and Gothenburg (Sweden) are actively exploring the use of shore power systems for tanker vessels at the time of the publication of this Report.[111,112] None of the information provided to CARB staff as part of this Interim Evaluation indicates that tanker vessels are not technologically capable of utilizing shore power as long as the proper equipment is installed and any existing safety and international standards are met. CARB understands that some shore power installations may be prolonged due to circumstances outside of the control of vessel/terminal operators and ports (permitting, utility construction projects, etc.); however, there are compliance flexibilities (VIEs/TIEs, remediation fund, and Innovative Concepts) in the Regulation designed to address these types of delays.

109 Stakeholder comment letters can be found in Attachment A.
110 See *Staff Report: Initial Statement of Reasons (ISOR)*, p. III-14 and III-18-19.
111 Port of Gothenburg. *Green Cable – Shoreside power for tankers.* Accessed September 23, 2022.
112 The Maritime Executive. *Rotterdam and Stolt Test Shore Power for Chemical Tankers.* May 6, 2022.

Regarding capture and control technologies, similarly to ro-ro vessels, while there are no CARB approved systems for tankers at the time of the drafting of this Report, CARB staff are working with several companies that are pursuing technologies for use on tanker vessels. As noted in the *Feasibility Studies* section of this chapter, the first capture and control system for tanker vessels (a land-based system) is scheduled to be completed by the first half of 2024, and CARB staff anticipates that more systems (both land and barge-based) will come online more quickly following the completion of this first system.

Timeline to Adapt Emissions Control Technologies for Tanker Vessels

Each of the third-party Feasibility Studies submitted to CARB as part of this Interim Evaluation process evaluated the ability for regulated entities to meet the compliance timelines. As discussed in the *Feasibility Studies* section of this chapter, the DNV Report concluded that it would take about 14 years for a tanker terminal to install a land-based emissions control system (shore power or a capture and control system), while a barge-based capture and control system for tankers could be functional within five years. As mentioned in the *Feasibility Studies* section above, the 14-year timeframe is not based on existing conditions at any specific site or substantiated with references to similar projects and also concludes that, "it is even possible some barge-based systems could be in operation on a few tankers prior to the regulatory deadline."

The *Feasibility Studies* vary in their timeline assessments depending on the specific terminal that is being evaluated. For land-based systems, the general consensus from the Feasibility Studies is that land-based technologies are not able to be installed and used for compliance by the 2025/2027 tanker deadlines, while tanker terminals may be able to design and procure a barge capture and control systems by (or within a year of) the 2027 compliance start date.

CARB staff understands that a barge-based capture and control system may not be an option for every tanker terminal; however, if tanker terminals claim that a physical and/or operational constraint will delay its ability to implement its preferred CARB approved control strategy to achieve emission reductions from vessels at berth according to the requirements of the Regulation, that terminal operator must provide to CARB a technical feasibility study evaluating if there are any other emission control options that could be implemented more quickly at the terminal.[113]

Furthermore, CARB notes that, based on information submitted as part of port and terminal plans, some terminals appear be waiting for this Interim Evaluation Report to be published before pursuing a pathway towards compliance. However, CARB expects all regulated entities to have begun exploring compliance options prior to the submittal of port and terminal plans and prior to the publication of this Report. Failure to pursue a compliance pathway will not excuse regulated entities from their compliance obligations.

Safety Concerns

The primary safety concerns expressed to CARB are generally associated with the unique requirement for tanker vessels and tanker terminals to have hazardous zones (as a result of the hazardous cargo many tanker vessels carry).[114] These hazardous zones have specific international requirements that must be complied with that include the installation of electrical equipment, cables, and wiring in these hazardous zones.[115] Any electrical equipment installed within the hazardous zone, must generally be rated as explosion-proof. But according to the DNV Report submitted to CARB, there is currently no marine-use socket that complies with this requirement.[116]

Industry has also expressed safety concerns regarding using capture and control systems on tanker vessels. While capture and control systems are a proven technology and its utilization on container vessels while at berth is well established and accepted, the adaptation of this technology to tanker

113 See title 17, Cal. Code Regs., Sec. 93130.14(a)(3)(H).
114 DNV Report. See Attachment A, pp. 91-259.
115 The International Convention for the Safety of Life at Sea (SOLAS) Chapter II-1, Part D, Regulation 45.11.
116 DNV Report. See Attachment A, pp. 91-259.

vessels has raised concerns within the tanker industry. The primary safety concerns have to do with the hazardous zones on the tankers, the ability to stop the capture and control process and disconnect the system from the tanker in an event of an emergency, the ability for the system to be intrinsically safe, and the interface between the capture hood and the tankers emission stack. Other safety concerns mentioned by industry regarding control and capture systems included risks associated with barge collisions with tankers due to unforeseen swells.[117]

While CARB understands that safety concerns do exist for the utilization of capture and control systems on tanker vessels, CARB staff also note that technology providers are actively working with industry and class societies to ensure safe use of these systems. As discussed earlier in this chapter, ABS recently conducted a safety feasibility study to examine barge-based capture and control for tanker vessels and ABS concluded that there were no unresolvable or unmitigable risks. Additional information regarding this safety study can be found in the *Feasibility Studies* section of this Report.

Power Availability and Compatibility

Based on IMO auxiliary engine power output data and a shore power technology assessment from the U.S. Environmental Protection Agency (EPA), the DNV Report estimates that the maximum power output capacity for the Ports of Long Beach and Los Angeles may need to be doubled to accommodate the maximum number of tanker vessels calling on these ports.[118] Furthermore, each vessel will have a different peak load factor which will need to be considered when designing infrastructure for shore power. For example, tanker vessels berthing at the Port of Long Beach have an average estimated monthly auxiliary engine energy requirement of 3,108 mega-watt-hours (MWh) and a peak, or maximum, estimated monthly auxiliary engine energy requirement of 5,422 MWh. If the port power grid that supports shore power is designed based on the average requirements, yet multiple vessels are using maximum energy for their auxiliary equipment while berthing, the grid will not support all vessels.[119] The voltage and frequencies for tankers would need to be accommodated for by using step-down transformers and frequency converters. This equipment may be cost or space prohibitive for smaller vessels.[120]

CARB staff understands the above concern raised by the DNV Report. However, this is not a new concern for vessels utilizing shore power; container, refrigerated cargo, and cruise terminals faced similar power availability and compatibility challenges when installing and utilizing shore power in the early years of the 2007 Regulation. CARB anticipates that newly regulated tanker (and ro-ro) terminals will be able to resolve these concerns with proper planning and communication with their utility providers, same as container, refrigerated cargo, and cruise terminals successfully adapted for the 2007 Regulation.

Logistical and Operational Constraints

Tanker vessel and terminal operators expressed numerous logistical and operational concerns with reducing emissions from tanker vessels at berth, some of which are unique to tanker vessels and others that are more general.

117 DNV Report, pp. 67-68. See Attachment A, pp. 161-162.
118 DNV Report, p. 34. See Attachment A, p. 128.
119 DNV Report, p. 33. See Attachment A, p. 127.
120 DNV Report, p. 34. See Attachment A, p. 128.

Shore Power Connection Points

For shore power, the arrangement of where connections to shore power can occur may restrict some tankers from being able to connect. For example, if the shore-side shore power connection happens to be toward the stern of the vessel, but the ship-side connections are starboard, and there is not sufficient servicing length of the cables or cable management equipment to reach the front of the vessel, the vessel will not be able to connect to shore power. Standards for power management onboard tankers would help mitigate this problem. This would especially be the case if SOLAS and IEC developed standards for explosion-proof power management capability through the hazardous zones.

CARB recognizes the need to engage with the international standards organizations such as the ISO and IEEE to harmonize design and performance standards if shore power is to be broadly adopted across the tanker industry and encourages industry to begin these conversations, if not already underway, to assist tanker stakeholders who wish to utilize shore power as their primary compliance option.

Berth Positioning

Additionally, tanker vessel and terminal operators advised that some terminals allow for berthing either portside or starboard side depending on external conditions. This could require cable management to extend significant distances (up to 2,000 feet) to accommodate the berthing direction in conjunction with hazardous zones.[121] While berthing direction constraints are not a unique problem (container vessels utilizing shore power for compliance with the 2007 Regulation have similar berthing direction constraints[122]), CARB understands that the presence of a hazardous zone on the vessel may further complicate a tanker vessels ability to connect to shore power, but sees this as a hurdle that can be successfully overcome by industry given the success other vessel categories have had in using shore power for compliance with the 2007 Regulation.

Channel and Land-Side Physical Constraints

There are also water and land-side physical constraints to consider. As was extensively noted in CARB staff's rulemaking documents for the Regulation, including the *ISOR*[123] and *Berth Analysis*[124] document, many tanker terminals may not have the structural integrity to accommodate either shore power equipment or shore-based capture and control systems and could require significant infrastructure upgrades if a land-based emissions control strategy is selected.[125] Lastly, tanker terminals located in narrow channels may not be able to use barge-based capture and control systems if those systems block the ability of other vessels and water craft from passing through the channel.[126] Again, this concern is not unique to tanker terminals, but rather could be a potential issue for any terminal located in a narrow passage way. As discussed earlier in this Report, CARB understands that a barge-based capture and control system may not be an option for every tanker terminal. This was a primary reason that the Regulation was written not in a prescriptive manner, but with the flexibility to allow each vessel and terminal operator to select the best emissions control strategy that worked best or their unique operations.

121 DNV Report p. 38. See Attachment A, p. 132.
122 See *Staff Report: Initial Statement of Reasons (ISOR), p. II-10.* October 15, 2019.
123 See the *rulemaking documents* for CARB's Proposed Control Measure for Ocean-Going Vessels At Berth.
124 See CARB's *At Berth ISOR - Appendix E - Berth Analysis*.
125 See the *rulemaking documents* for CARB's Proposed Control Measure for Ocean-Going Vessels At Berth.
126 DNV Report, p. 77. See Attachment A, p. 171.

Emergency Break-Away Time Restrictions for Tankers

Since the beginning of the regulatory development period for the Regulation, tanker vessel and terminal operators have expressed concerns about the need for emissions control technologies to allow tanker vessels to meet the required 30-minute time limit to leave a berth during an emergency event (as per the California Code of Regulations, Title 2 § 2340, subsection (c)(28)). As noted in CARB staff's Final Statement of Reasons (FSOR) document, one reason for the extended timelines provided in the Regulation for tanker vessels is to provide technology providers ample time to work with vessel and terminal operators for the design, construction, and deployment of safe control systems to use on tanker vessels.[127] This includes the development of safety protocols and operational standards that would undoubtedly consider requirements like this 30-minute emergency break-away requirement. DNV Report indicates that the manual shore power disconnection process itself takes up to 15 minutes, which may inhibit the ability to evacuate within 30 minutes in the event of an emergency; however, the DNV Report also provides suggestions on how to mitigate this risk. Additionally, concerns over a 30-minute break away do not preclude a tanker vessel operator from selecting other options for compliance. In particular, CARB staff added the Innovative Concept Compliance Option (at industry's request) to address concerns such as these from vessel and terminal operators, as Innovative Concepts provides a compliance pathway where regulated entities can reduce emissions from sources other than vessels at berth, eliminating concerns such as the 30-minute break-away requirement.

Separately, capture and control systems for tanker vessels are being designed to meet the safety standards for emergency break-away. Barged-based systems utilize several safety features which make the barge intrinsically safe and able to disconnect from the vessel if an emergency event arises. The barges are self-propelled and use spuds to stay in position, eliminating the need to use mooring lines. In addition, the exhaust capture hood and the vessel's stack are the only point of contact between the barge and vessel. This contact point is designed to be intrinsically safe and meet emergency break-away requirements. Land-based capture systems, meanwhile, are designed to be positioned on land and away from any hazardous zones onboard the vessels. Much like with a barge system, this leaves the exhaust capture hood and the vessel's stack are the only point of contact between the capture system and vessel and this contact point is designed to be intrinsically safe and meet emergency break-away requirements.

127 See CARB's *Proposed Control Measure for Ocean-Going Vessels at Berth: Final Statement of Reasons (FSOR)*, pp. 257-258.

Conclusions

CARB staff's review of the information provided by the port and terminal plans, Feasibility Studies, Innovative Concept applications, and stakeholder comments indicates that most vessel and terminal operators are actively pursuing a compliance pathway that include shore power (grid-based or distributed generation) or capture and control, with a handful of vessel operators considering alternative fuels as an emissions reduction strategy. Additionally, compliance options selected by regulated terminal operators and ports generally reflect CARB staff's *Berth Analysis*[128] that was prepared and presented during the rulemaking efforts for the At Berth Regulation.

The information analyzed as part of this Report indicates a general concern from stakeholders about the availability of CARB approved technologies for newly added vessel categories and expresses a lack of confidence that these technologies can be adapted for use on ro-ro and tanker vessels in time to meet the compliance deadlines required by the Regulation. While CARB staff agree that there are concerns that must be overcome to meet the emissions reductions deadlines of the Regulation, there were no new concerns brought to CARB staff's attention during this Interim Evaluation technology and feasibility study review that are not addressable within the boundaries of the Regulation as it is currently written.[129]

In general, container, reefer, cruise and ro-ro vessel and terminal operators and ports have expressed confidence in moving towards a compliance option that would be operable by the required implementation dates of 2023 (for container, reefer, cruise) and 2025 (for ro-ro). While some concerns were expressed by industry stakeholders regarding the ability to meet the compliance timelines established in the Regulation, largely as a result of pandemic-related equipment and supply chain delays, the majority of container, reefer, and cruise vessel operators, terminal operators, and ports are well positioned to take advantage of the compliance flexibilities that exist in the Regulation to fill in the gaps where any delays in control equipment installation may occur. Additionally, it is important to note that there was a lack of specific data provided to CARB identifying the scope of impacts from anticipated delays. Despite repeated requests from CARB staff for more specific data, no detailed information was provided identifying the percentage of vessel/visits these types of delays might impact. Because the majority of container, reefer, and cruise vessels are already complying with the 2007 Regulation, CARB cannot make a recommendation to delay the potential health benefits of the Regulation without knowing the scope of the potential problem, especially since the Regulation already provides for compliance pathways in the event of pandemic-related delays.

Conversely, some tanker terminal operators have been more hesitant to commit to an emissions control strategy and are less optimistic about the ability to meet the compliance deadlines of 2025 (for Southern California tanker terminals) and 2027 (for Northern California tanker terminals). CARB staff's review of the DNV Report, ABS Study, and the Moffatt & Nichol Report for the Valero Benicia terminal indicate that while timelines for installation of emissions control technologies may vary, these technologies are generally feasible for use on tankers with additional consideration of site and vessel-specific safety considerations.

While CARB staff's review of tanker port and terminal plans indicate that around 50 percent of Southern California tanker terminals and around 25 percent of Northern California tanker terminals state they expect to be able to comply with the Regulation by 2025 and 2027, respectively, it is important to reiterate that the majority of tanker terminal operators did not provide complete terminal plans to CARB. The submission of incomplete terminal plans did not provide CARB staff with adequate information to assess compliance readiness. Additionally, there were a few tanker terminal plans that pointed to waiting until CARB approves a strategy before they will explore

128 See CARB's *At Berth ISOR - Appendix E - Berth Analysis*.

129 CARB addressed numerous comments to similar concerns shared with staff during the At Berth rulemaking. See CARB's *Proposed Control Measure for Ocean-Going Vessels at Berth: Final Statement of Reasons (FSOR)*, pp. 157-163, 188-192, 546-549 and 277-283 (technology feasibility for ro-ro and tanker vessels), pp. 57-58 (implementation timelines) for examples.

their compliance pathway(s). Incomplete and underdeveloped plans such as these do not provide sufficient information to CARB to inform staff whether these terminals can meet the compliance obligations by 2025/2027. While CARB acknowledges that there may be challenges facing some tanker terminals in adapting and installing emissions control equipment, it is worth noting that ports and operators of regulated vessels and terminals and should be aware that the lack of a compliance plan will not excuse regulated entities from their compliance obligations as set forth in the Regulation. For those regulated terminal and vessel operators that are unable to reduce emissions at berth by the compliance start dates of the Regulation and wish to utilize the physical/operational constrain clause in the remediation fund as a compliance pathway, those parties must submit a complete terminal plan that appropriately identifies a physical and/or operational constraint that is delaying the implementation of a CARB approved emission control strategy at the terminal.[130]

CARB staff understands that there are some concerns that may delay some terminals and vessel fleets from fully realizing their chosen pathway to compliance by the Regulation's implementation dates. The ability for terminals and vessels to install and retrofit emissions control technologies, respectively, will vary largely on the unique characteristics of each terminal and vessel category. CARB staff recognizes that there is no single compliance solution for every terminal throughout California and that the unique characteristics of tanker and ro-ro vessels (both physical and operational) and construction activities at certain ro-ro and tanker terminals may present challenges or require more complicated installations than other vessel categories, which may result in some project timing uncertainties.

The At Berth Regulation was developed with uncertainties in mind and provides compliance flexibilities (VIEs/TIEs, remediation fund option, and Innovative Concepts) that should accommodate the challenges as outlined in this chapter of the Report. The Regulation provides several pathways towards compliance that give regulated entities compliance flexibility to accommodate situations where a regulated entity has attempted to procure or install a CAECS and is facing delays in designing/building/installing a technology or is otherwise unable to use it: VIEs/TIEs, the remediation fund, and Innovative Concepts.[131] As mentioned in Introduction of this Report, vessel and terminal operators can use VIEs and TIEs, respectively, to exempt any visit(s) they choose (up to 20 percent of total visits in 2023/2024 and up to 10 percent of total visits from 2025 onward). Additionally, regulated entities can use the remediation fund to remain in compliance if they qualify for one or more of the criteria outlined in section 93130.15(b) of the Regulation. As long as an entity can show CARB documentation to qualify for one the eligible basis under Regulation section 93130.14(b), such as showing the equipment was ordered in a timely manner, but has not been received (such as COVID-related equipment shortages, labor delays or lack of available engineering staff to install the equipment, etc.), then a vessel/terminal operator or port can pay into the remediation fund to ensure their visits to regulated California berths remain in compliance with the Regulation. This mechanism was written into the Regulation to allow for flexibility during extraordinary circumstances.

Lastly, if a regulated entity has an Innovative Concept approved for use by CARB, they may also use that Innovative Concept to comply with the Regulation. As noted in the Complaince Flexibilities section of this Report, the Innovative Concept Compliance Option was added to the Regulation at the request of the regulated industry stakeholders because it provides a compliance pathway using potentially lower cost projects beyond reducing emissions directly from a vessel at berth.

130 See title 17, Cal. Code Regs., Sec. 93130.14(a)(3)(H).

131 See title 17, Cal. Code Regs., Sec. 93130.11 (Vessel Incident Events (VIE) and Terminal Incident Events (TIE)), 93130.15 (Remediation Fund Use), and 93130.17 (Innovative Concept Compliance Option).

Innovative Concepts

Overview

The Innovative Concepts Compliance Option ("Innovative Concepts") provides vessel operators, terminal operators, CAECS operators, and ports a way to comply with the Regulation by reducing emissions from vessels or other sources in and around the port. The Innovative Concepts option was developed in response to the need for accelerated emission reductions in California's port communities, as well as industry's request to have to flexibility to reduce emissions more quickly through alternative projects in situations where vessel emissions reductions might take an extended period of time to achieve (due to infrastructure buildout, technology development, vessel modifications, etc.). Once a project is approved by CARB for the Innovative Concepts compliance option, the Innovative Concept can be renewed and used permanently for compliance, as long as the emission reductions used for compliance are in excess of other requirements. Innovative Concept projects also give regulated entities an opportunity to achieve early emissions reductions for added flexibility in the initial years of the Regulation.

In choosing to comply with the At Berth Regulation through use of an approved Innovative Concepts, a regulated entity is electing to follow an alternative compliance pathway that includes a commitment to achieve emissions reductions that are real, quantifiable, verifiable, and enforceable from vessels at berth or from different unregulated emissions sources that are impacting the same port communities. Innovative Concepts must achieve equivalent or greater emissions reductions of the same pollutants within the same communities that would otherwise see benefits from direct emissions reductions from vessels at berth. All Innovative Concepts projects must be approved by CARB's Executive Officer through an Executive Order by CARB before being used as a compliance pathway.

Innovative Concepts Details

CARB received a total of 12 Innovative Concept applications by the December 1, 2021 deadline. Many of the applications contain several individual projects that the applicants put forth in the anticipation that one or more of the projects would meet the Innovative Concept requirements. Since the December 1, 2021 deadline, two applications have been withdrawn. This resulted in a total of 63 total projects that would require evaluation by CARB staff. Some of the proposals include using hydrogen fuel cells for cold ironing, using on-board wind power generators, using capture and control technology for the vessel exhaust, and deploying a LNG vessel. Table 2 provides a comprehensive list of the Innovative Concept applications received by the deadline and are currently under consideration by CARB.

Table 2: List of Innovative Concepts[132]

#	Applicant/Description
1.0	**CAEM** put forth the following eight separate project proposals:
1.1	Pre-compliance emissions (tankers – Southern California)
1.2	Pre-compliance emissions (tankers – all ports other than Long Beach and Los Angeles)
1.3	Pre-compliance emissions (ro-ro – all California ports)
1.4	Unregulated emissions (bulk liquid barges – all California ports)
1.5	Bulk and general cargo vessels
1.6	Container ships at-anchor (capture and control)
1.7	Minimizing emissions control connect/disconnect times
1.8	Capture and control performance that exceeds the requirements of the control measure
2.0	**Carnival:** Exceed existing requirements
3.0	**Chevron Richmond:** A list of 14 separate project proposals:
3.1	Replace one or more locomotives with lower emitting locomotives
3.2	Replace five steam boilers with two, more efficient boilers in their refinery
3.3	Replace diesel air compressors with an electric equivalent
3.4	Optimize the ammonia slip from fluidized catalytic cracker to a level lower than existing air permits
3.5	Replace the emissions reduction device with new duplicative vapor recover units that will eliminate the need for natural gas combustion while still controlling ROG
3.6a	Install a new heat exchanger on three of the heaters at the Taylor Katalytic de Nitrification plant
3.6b	Conduct an overall thermal energy study on the plant to reduce overall firing rates of the heat exchangers (3.6a and 3.6b are listed on the application as a single concept although they are unique projects)
3.7	Eliminate most of the generators within the North Ranch trailers within the Chevron Refinery by installing electrical energy
3.8	Install solar panels in the northern end of the Richmond Refinery
3.9a	Install a solar power generation in or near the Richmond Refinery for shore power
3.9b	Instead of using solar panels as indicated in 3.9a, procure electricity for shore power usage that is from a source with lower total emissions than electricity from the grid (3.9a and 3.9b are listed on the application as a single concept although they are unique projects)
3.10	Accelerate adoption of vessels with tier II auxiliary engines or above, prior to CARB at-berth implementation date
3.11	Accelerate the use of tier III vessels much earlier and well beyond what otherwise would be expected under the "business-as-usual" scenario
3.12	Upgraded combustion and control systems for auxiliary boilers for ships
3.13	Proactively seek dual-fuel tier III auxiliary engines (LNG, methanol, ammonia, hydrogen and/or other fuels) for use on vessels at Richmond Long Wharf as a deliberate, early-adoption choice
3.14	Shore power or capture and control systems for barges/tugboats
4.0	**Hapag Lloyd:** LNG-powered vessel
5.0	**Intrepid:** Two separate project proposals:
5.1	Continuing controls under the existing fleet averaging concepts
5.2	Enter into an agreement with CARB to provide additional emissions reductions through financial contributions to (unspecified) emissions reductions programs
6.0	**Matson:** Two separate Innovative Concepts were proposed:
6.1	Continuing controls under the existing fleet averaging concepts

132 Two Innovative Concept applicants (Matson and Carnival) have withdrawn their applications.

#	Applicant/Description
6.2	Funding emissions reduction programs:
7.0	**Pasha Hawaii:** Two separate project proposals:
7.1	On-Board wind power in conjunction with other energy management improvements
7.2	Capture and control systems for steam propulsion boilers
8.0	**Port of Hueneme:** Capture and control systems for non-shore-power ro-ro vessels at berth prior to January 1, 2025
9.0	**Shell:** Ten various project proposals as follows and a general proposal for an amendment allowing project proposals for yet-to-be identified sources after the initial due date:
9.1	Pre-compliance emissions reductions for Shell tankers at berths 168 and 169 at the Port of Los Angeles using capture and control systems for the auxiliary engines and/or boilers
9.2	Pre-compliance emissions reductions for all tankers at all other terminals (Port of Los Angeles/ Port of Long Beach) using capture and control systems for the auxiliary engines and/or boilers
9.3	Pre-Compliance emissions reductions for ro-ro vessels at the Port of Los Angeles and Port of Long Beach using capture and control systems for the auxiliary engines
9.4	Capture and control systems for the auxiliary engines of liquid bulk barges that are used to offload cargo and provide power for other miscellaneous equipment on the barge
9.5	Use capture and control systems for the auxiliary engines on bulk and general cargo vessels
9.6	Use capture and control systems for container ships at-anchor
9.7	Minimizing capture and control systems connect and disconnect times
9.8	Vessel speed reduction
9.9	Pre/post-compliance emissions utilizing shore side infrastructure to reduce tanker vessel discharge emissions
9.10	Use capture and control systems to exceed the requirements of the rule
10.0	**Tesoro, Long Beach:** Ten various project proposals:
10.1	Pre-compliance capture and control systems for tankers
10.2	Emissions reductions using grid power for to move liquid cargo
10.3	Pre-compliance emissions reductions for tankers
10.4	Pre-compliance emissions reductions for ro-ro vessels
10.5	Capture and control systems for bulk liquid barges
10.6	Capture and control systems for bulk and general cargo vessels
10.7	Capture and control systems for container ships at-anchor
10.8	Minimizing emissions control connect/disconnect times
10.9	Vessel speed reduction
10.10	Use capture and control systems to exceed the requirements of the rule
11.0	**Tesoro, Marathon Martinez:** Nine separate project proposals for potential emissions credit generation for their Amorco and Avon terminals as follows:
11.1	Use capture and control systems for the auxiliary engines and/or boilers of tankers prior to the compliance date
11.2	Use capture and control systems for the auxiliary engines and/or boilers of tankers other than the Amorco and Avon terminals prior to the compliance date
11.3	Use capture and control systems for the auxiliary engines of ro-ro vessels in Northern California ports prior to the compliance date
11.4	Use capture and control systems for the auxiliary engines on liquid bulk barges that are used to offload cargo and provide power for other miscellaneous equipment on the barge

#	Applicant/Description
11.5	Use capture and control systems for the auxiliary engines on bulk and general cargo vessels which are exempted from the At-Berth regulation
11.6	Use capture and control systems for the auxiliary engines on container vessels which are at anchor
11.7	Minimizing capture and control systems connect/disconnect times
11.8	Vessel speed reduction
11.9	Capture and control systems performance to exceed the requirements of the rule
12.0	**Wallenius Wilhelmsen:** Early adoption of plug-in cold ironing using hydrogen-powered fuel cells or other sources of CARB approved shore power

Application Evaluation and Approval Process

The approval process outlined in section 93130.17 the Regulation for an Innovative Concept application is shown in Figure 11. The first step in the process was for applicants to provide an application to CARB by the December 1, 2021, deadline, describing how the Innovative Concept will meet the requirements listed in section 93130.17 of the Regulation. For example, some of the requirements are:

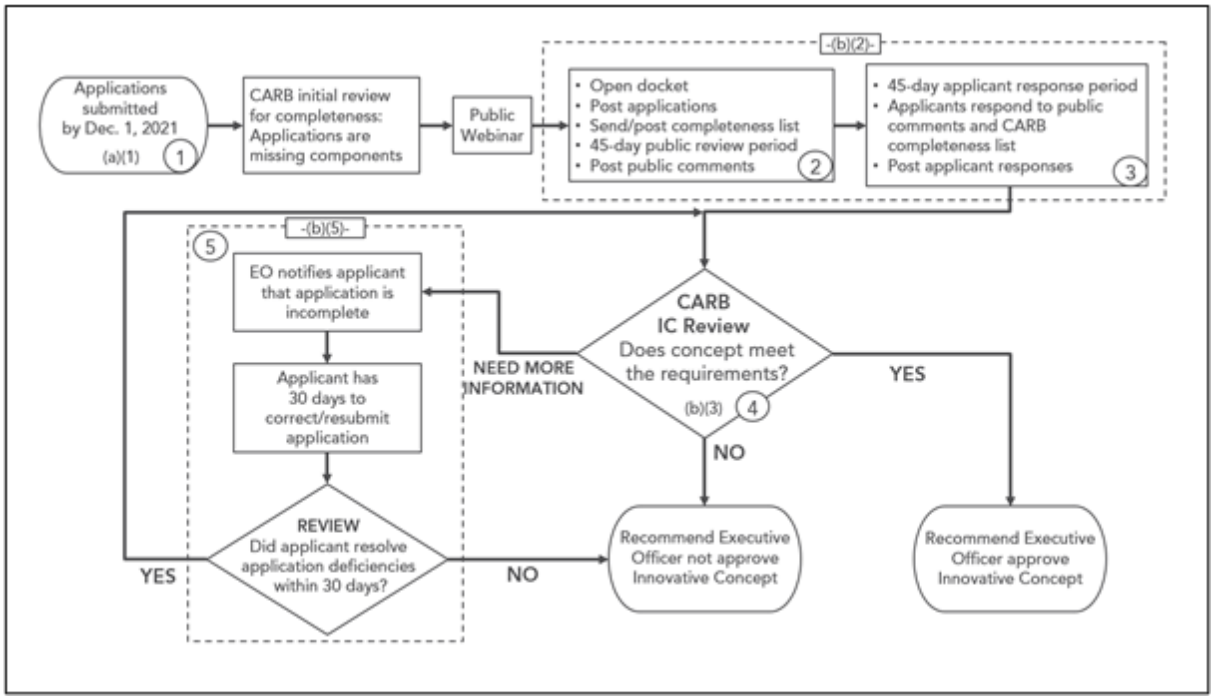
- The application must demonstrate how concept will reduce NO_x, PM 2.5, and ROG emissions equivalent to or greater than the level that would have been achieved by the Regulation, while not increasing GHG
- The application must show that the emission reductions will be in and around the port or marine terminal
- The application must demonstrate that emissions at other ports or marine terminals will not increase.
- The application must show that the proposed Innovative Concept is not "business as usual", that is it must not be intended to comply with any other law or regulation or be part of current economic and technological trends
- The application must explain how the Innovative Concept will achieve reductions that are real, quantifiable, verifiable, and enforceable.

For a complete list of the Innovative Concept application requirements refer to Sections 93130.17 (a) and (b) of the Regulation.

CARB staff's initial review indicated that all applications received were missing some degree of required information. CARB staff hosted a webinar on May 17, 2022 to discuss the Innovative Concepts application evaluation process and address the incompleteness of the applications CARB had received, in order to be transparent to the public and equitable to all applicants. After the webinar, the Innovative Concept applications were posted on CARB's website starting a 45-day public review period, shown as step two in Figure 11. Each application has its own page on CARB's website as well as its own public comment docket. All public comments received for each Innovative Concept application were posted on the application's respective docket. Additionally, as part of the public comment period, CARB sent out letters to the applicants listing the specific information that was missing from their application. CARB staff also posted a checklist that applicants could use to ensure that a complete application was posted on our website. The checklist can be found on CARB's *At Berth Regulation Innovative Concept Applications* page.

After the 45-day public review period ended and all the public comments were posted, the applicants had 45 days to respond to public comments as indicated by step three in Figure 11. This 45-day period also gave applicants an opportunity to address the identified information missing from their applications. The applicants' responses were also posted on each application's individual webpage. The 45-day applicant response period concluded, and CARB staff is now conducting a comprehensive evaluation of each Innovative Concept application as shown in Figure 11 step four. If CARB staff finds that some information is still missing from the applications, section 93130.17(b)(5) in the Regulation allows for the Executive Officer to request more information as shown in Figure 11 step five.

Figure 11: Innovative Concepts Application and Approval Process Flow Chart



Innovative Concept Evaluation

As mentioned above, all applications were missing some required information, and CARB sent out notifications requesting completed applications. The responses from the applicants have been received and are currently being reviewed by CARB staff to ensure that applicants have addressed each requirement for Innovative Concepts under section 93130.17(b)(3) of the Regulation. Many of the Innovative Concepts are complex. In some cases in which there are multiple proposed projects, the Innovative Concept depends on the aggregation of the emissions reductions from multiple projects to meet the overall reduction requirements. Some of the projects within the Innovative Concepts will require CEQA reviews, which often take many months to conduct. The At Berth Regulation has several implementation dates for the various types of ocean vessels. One provision of the Regulation allows approved Innovative Concepts to achieve reductions prior to these implementation dates and use them toward compliance when the regulation takes effect for that type of vessel. Therefore, applicants are relying on timely approval to achieve as many early reduction credits as possible before their vessel category compliance is required. CARB staff are currently taking each of these factors into consideration and prioritizing the evaluations of the applications accordingly.

Summary

CARB staff's review of the Innovative Concepts applications revealed that a wide variety of projects are being explored by operators of all vessel categories to reduce emissions from vessels and other sources of pollution at California ports and marine terminals. In general, CARB staff found that almost half of the proposed Innovative Concept proposals enhance the scope of barge-based capture and control systems to allow companies to bank emissions reductions credits (for a limited period of up to five years) by reducing emissions from currently unregulated vessel categories.

Many applicants are also proposing to use Innovative Concepts projects to achieve early emissions reductions ahead of their vessel-specific compliance dates in order to bank emissions reductions credits that could provide increased flexibility for vessel and terminal operators, including those that are working towards more permanent infrastructure solutions (such as shore power or land-based capture and control systems that may have an extended design and installation schedule). Two applicants are also pursuing an Innovative Concept to maintain the fleet averaging structure of the 2007 Regulation for added flexibility.

While these Innovative Concept projects have yet to finish going through CARB's evaluation process, CARB staff's initial observation is that the shipping industry is exploring a broad suite of emissions reductions opportunities at this time both to ensure regulated entities have flexibility they need to comply with the At Berth Regulation and also in response to an increasing international push for cleaner shipping.

COVID-19 Pandemic Impacts

This chapter summarizes the impacts of the global COVID-19 pandemic (pandemic) and assesses the implications the pandemic may have on the industry's ability to comply with the upcoming implementation dates for the At Berth Regulation. This chapter also examines the air quality and health impacts associated with pandemic-related port congestion and the associated increase in vessel anchorage near the Ports of Los Angeles and Long Beach.

Overview

The COVID-19 pandemic began impacting the shipping industry and California ports generally in the first quarter of 2020. Container vessels and terminals initially saw a dramatic decrease in activity as lockdowns halted global trade in the first and early second quarter of 2020. Cruise vessels were forbidden to sail under orders of the Centers for Disease Control and Prevention (CDC), effectively halting the cruise industry across the globe. Ro-ro vessel visits dropped as auto imports suffered. Consumer demand for gasoline decreased sharply as consumers stayed home during lockdowns, lowering demand for crude oil imports typically brought into California by tanker vessels. But ultimately, these severe impacts to the industry would be short-lived, as will be discussed later in this chapter.

Initially, the pandemic's impacts to the shipping industry brought fears of a deep recession. Industry groups implored CARB to postpone adoption of the new At Berth Regulation in the initial months of the global pandemic amid fears and forecasts that the decrease in global trade would persist throughout the year(s) to come.[133,134] However, in an update to CARB's Board on June 25, 2020, CARB staff contended that the initial months of the pandemic were too uncertain to risk delaying the health benefits associated with the Regulation, and recommended adoption of the Regulation with close monitoring of the situation with future adjustments if necessary. CARB's Board directed staff not to delay the rulemaking, but to adjust the implementation dates for container, reefer, and cruise vessels (implementation start shifted from 2021 to 2023) and for ro-ro vessels (implementation start shifted from 2024 to 2025) and to continue monitor the impacts from the pandemic to the shipping industry. Tanker implementation dates were not adjusted due to the urgent need for emissions reductions from this vessel category, given that tanker vessels make up a significant portion of the emissions from vessels at berth (roughly 50 percent of projected PM2.5 emissions from vessels at berth statewide in 2020) and the tanker industry was already showing signs of recovery by the August 2020 Board Hearing.[135] More information about the pandemic recovery for each vessel category can be found later in this chapter of the Report. CARB staff committed to closely monitoring the industry's economic recovery from the global pandemic and to updating CARB's Board via publication of this Interim Evaluation Report and a forthcoming informational update to the Board as to whether or not these implementation dates required further adjusting (either forwards or backwards).[136]

133 See public comments posted to *ogvatberth2019 comment log* that were received during the rulemaking's 15 Day Comment Periods.

134 Miller, G. *US import plunge inevitable as canceled sailings mount*. Freight Waves. April 21, 2020.

135 *Update on the Status of the Proposed Control Measure for Ocean-Going Vessels At Berth*, slide 13. CARB Board Meeting, Staff Presentation. June, 25, 2020.

136 See CARB's *Proposed Control Measure for Ocean-Going Vessels at Berth: Final Statement of Reasons*, p. 63.

Resources Used for Evaluation

To assess the impacts of the global pandemic on both California port communities and the international shipping industry, CARB staff examined impacts to the OGV emissions inventory and air quality modeling data as well as information provided from the regulated industry. This information included:

- OGV emissions inventory summaries highlighting the emissions impacts of increased freight movement and congestion near the San Pedro Bay Ports (SPBP)[137]
- Health risk analysis data to assess impacts from port congestion (CARB generated)[138]
- Container throughput data publicly available from the Ports of Los Angeles[139], Long Beach,[140] and Oakland[141]
- Crude oil refinery input using publicly available data from the California Energy Commission[142] (as a surrogate for tanker vessel activity)
- Comment letters from industry stakeholders and environmental advocates
- Letters from shore power equipment manufacturers
- News and journal articles highlighting congestion and industry impacts

Despite gloomy economic projections at the onset of the global pandemic, by the third quarter of 2020, California's two largest container ports, the Ports of Los Angeles and Long Beach, were posting record high container volumes as imports surged, with the Port of Oakland posting record high cargo volumes in the first quarter of 2021.[143,144,145,146,147,148] Now, nearly three years into the global pandemic, there is ample evidence of a strong economic recovery for the majority of vessel sectors, as discussed in the vessel specific impacts section of this chapter.

Vessel Specific Impacts

The global pandemic had unique impacts on each of the vessel categories subject to emission control requirements of the At Berth Regulation: container/reefer, cruise, roro, and tanker vessels. The next section of this Report will detail the unique impacts from the pandemic to each specific vessel category regulated by the At Berth Regulation and evaluate their economic recovery since the start of the pandemic, as well as staff's assessment of what (if any) impacts the pandemic may have on future compliance with the new Regulation.

137 California Air Resources Board. *Emissions Impact of Freight Movement Increases and Congestion near Ports of Los Angeles and Long Beach: Jan. 2022*. January 27, 2022.
138 See Attachment F.
139 Port of Los Angeles. *Container Statistics*.
140 Port of Long Beach. *Port Statistics.*
141 Port of Oakland. *Facts & Figures*.
142 California Energy Commission. *Refinery Inputs and Production*.
143 Port of Los Angeles. *Port of Los Angeles July Volumes are Strongest of 2020*. August 13, 2020.
144 Ellingson, A. *Port of Long Beach posts busiest month ever in July despite coronavirus*. L.A. Business First. August 14, 2020.
145 Port of Los Angeles. *August cargo volume exceeds 954,000 TEUs at Port of Los Angeles*. September 15, 2020.
146 Littlejohn, D. *Long Beach port cargo marks record month in August*. Press Telegram. September 11, 2020.
147 Port of Los Angeles. *A record September at Port of Los Angeles as cargo volume exceeds 903,000 TEUs*. October 19, 2020.
148 Port of Oakland. *Port of Oakland reports record cargo surge in March*. April 13, 2021.

Container and Reefer Vessel Impacts

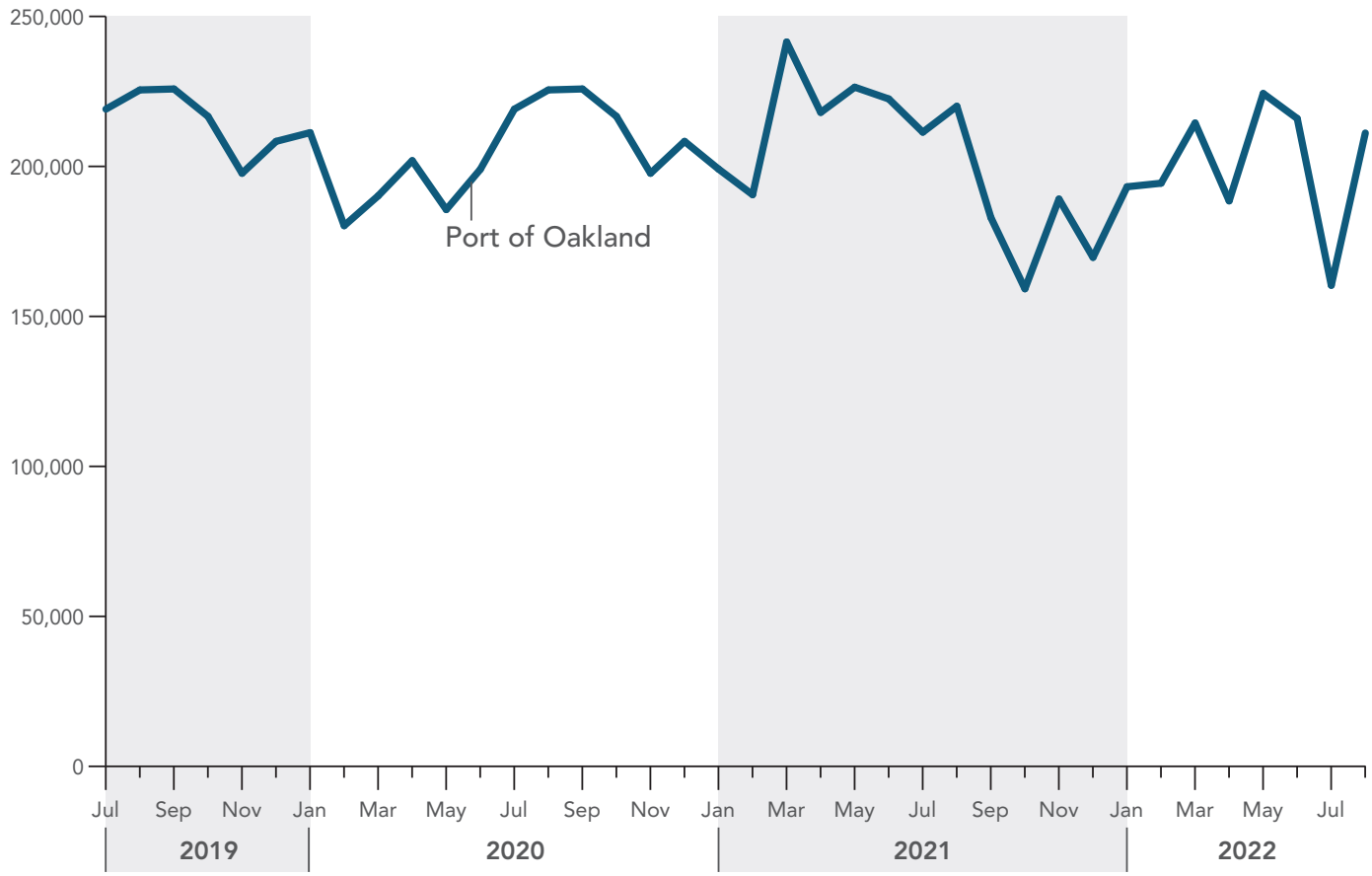
California has some of the busiest container ports in the U.S., handling 40 percent of all containerized imports and 30 percent of all exports in the country with most of that cargo arriving from Asia.[149,150] As noted above, perhaps the most noticeable example of the impacts of the global pandemic to the shipping industry and California's ports can be seen by examining container throughput data from the state's three largest ports – the Ports of Los Angeles, Long Beach, and Oakland. The amount of containerized cargo (measured in twenty-foot equivalent units or "TEUs") arriving at these three California ports initially plummeted in the first quarter of 2020 as signs of a global pandemic became evident, with the ports experiencing double digit declines in container throughput in February/March 2020, as shown in Figure 12. Container throughput decreased throughout the first and second quarters of 2020, with the Port of Los Angeles experiencing up to around a 30 percent decrease in container throughput in March and May 2020. However, despite these initial sudden declines in container volumes, container throughput then experienced a drastic increase of up to 25-30 percent at the Ports of Los Angeles and Long Beach in the second and third quarters of 2020, as can also be seen in Figure 12.

Figure 12: Container Throughput (in TEUs) at the Ports of Los Angeles and Long Beach[151,152]

149 California Association of Port Authorities. *About CAPA*.
150 Port of Los Angeles. *Facts & Figures*.
151 Port of Los Angeles. *Container Statistics*.
152 Port of Long Beach. *Port Statistics.*

Driven largely by strong U.S. consumer demand for imported goods during pandemic-related lockdowns, container imports surged at California ports, particularly at the Southern California ports of Los Angeles and Long Beach. At the Port of Oakland, California's third largest container port, gains and losses in container throughput were less dramatic than at its Southern California counterparts during the early days of the pandemic, largely due to the type and amount of cargo that is imported and exported through this port. Varying cargo volume decreases of up to 10-20 percent occurred in the first and second quarters of 2020 at the Port of Oakland, before rebounding in the spring of 2021 (as shown in Figure 13). However, labor and congestion issues at the port in the third and fourth quarters of 2021 resulted in marked decreases in container throughput at the Port of Oakland as vessels began skipping calls to the Port due to port congestion issues largely stemming from labor shortages.[153,154]

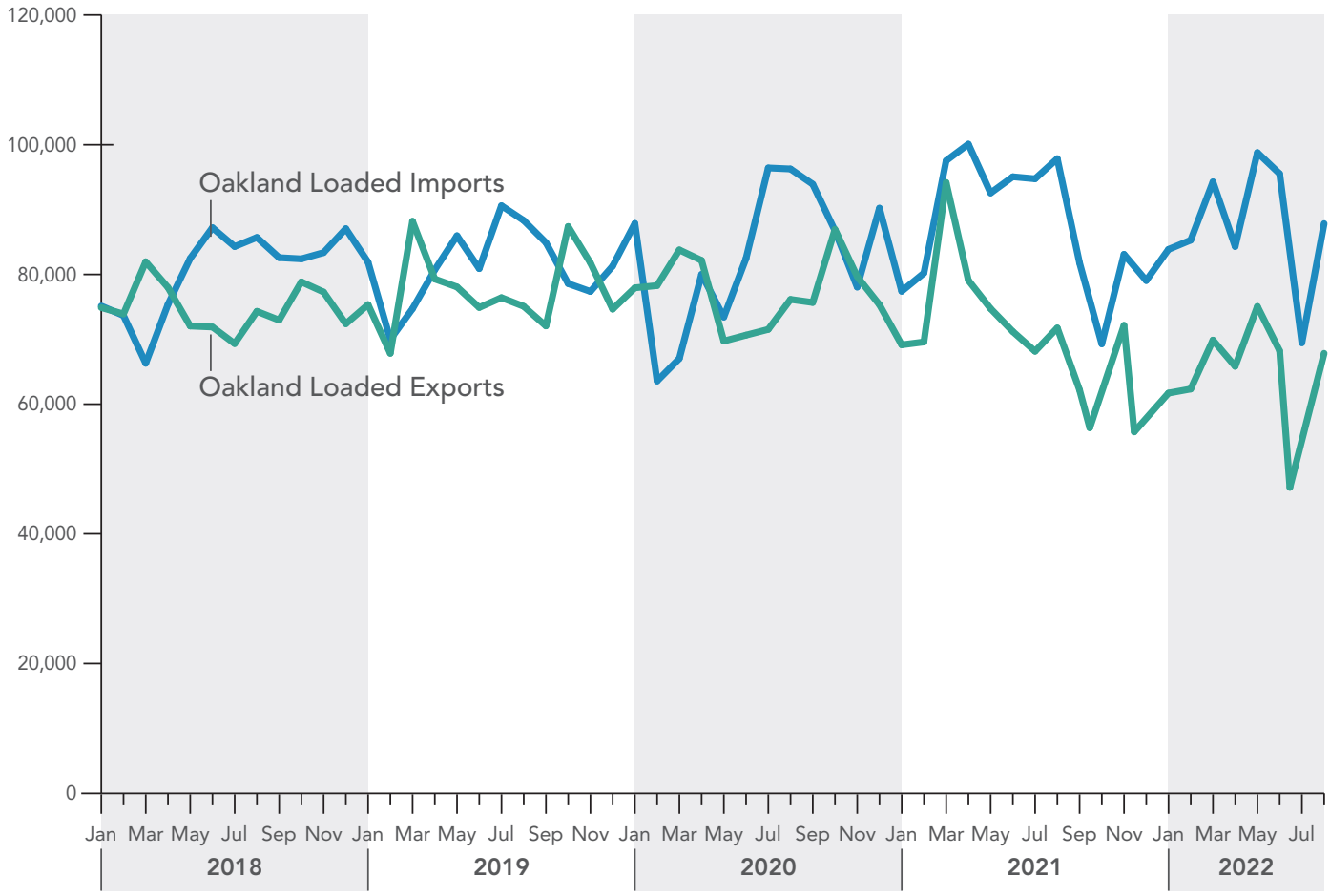
Figure 13: Container Throughput (in TEUs) at the Port of Oakland[155]



153 Berger, P. *Oakland port seeks to recover lost shipping services*. Wall Street Journal. October 12, 2021.
154 Port of Oakland. *Port of Oakland cargo volume off; blame vessel bypass*. Press Releases. November 29, 2021.
155 Port of Oakland. *Facts & Figures*.

This decline in ships visiting the Port of Oakland also reduced the number of exports leaving the port (see Figure 14), which hampered the ability of California and other U.S. suppliers to export their products, especially for agricultural exporters attempting to ship perishable goods.[156,157]

Figure 14: Full Exports vs. Full Imports (in TEUS) at the Port of Oakland[158]



156 Port of Oakland. *Port of Oakland cargo volume off; blame vessel bypass*. Press Releases. November 29, 2021.
157 Goodman, P. *How America's farmers got cut out of the supply chain*. New York Times. April 20, 2022.
158 Port of Oakland. *Facts & Figures.*

As is noted in this chapter, impacts from the global pandemic generated a significant amount of volatility in cargo volumes for California's container ports. However, even as the uncertainty surrounding the pandemic ebbs, U.S. consumer demand remains strong with California's container ports continuing to set records in container throughput through the second quarter of 2022 at the time of the drafting of this Report, leading to record-breaking profits for many container shipping companies despite supply chain disruptions, as shown in Figure 15.[159,160,161,162,163]

Figure 15: Container Shipping Industry Net Income By Quarter From 2016[164]

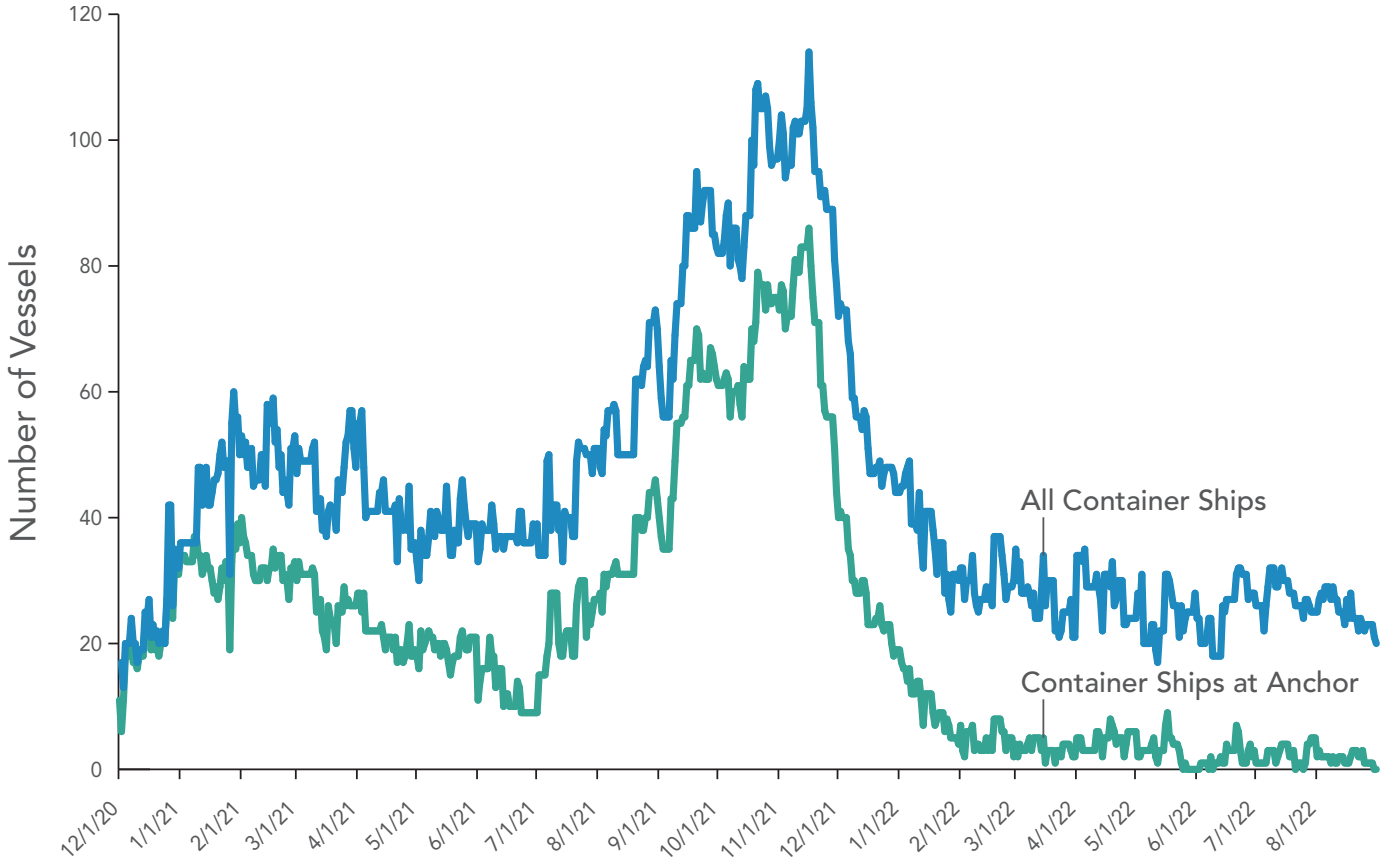
Source: Blue Alpha Capital

159 Port of Los Angeles. *Port of Los Angeles sets new June cargo record*. July 13, 2022.
160 Port of Long Beach. *Strongest June on record at Port of Long Beach*. July 13, 2022.
161 Chambers, S. *Container shipping lines smash profits made by Facebook, Amazon, Netflix and Google*. Splash 247. November 22, 2021.
162 Blenkey, N. *Container shipping earnings hit all time high*. MarineLog. November 22, 2021.
163 Miller, G. *Maersk: Shipping profits stay 'super strong' as supply chain pain persists*. American Shipper. August 3, 2022.
164 Chambers, S. *Q2 liner results highest ever recorded in history of transportation*. Splash247. September 5, 2022.

Port Congestion

Increased consumer demand and COVID-related supply chain disruptions (including labor shortages) led to port congestion, which in turn led to shipping delays and an increased number of container vessels anchoring off the Ports of Los Angeles and Long Beach beginning in the third quarter of 2020, as shown in Figure 16.[165,166]

Figure 16: Anchored Containerships off the Ports of Los Angeles and Long Beach[167]



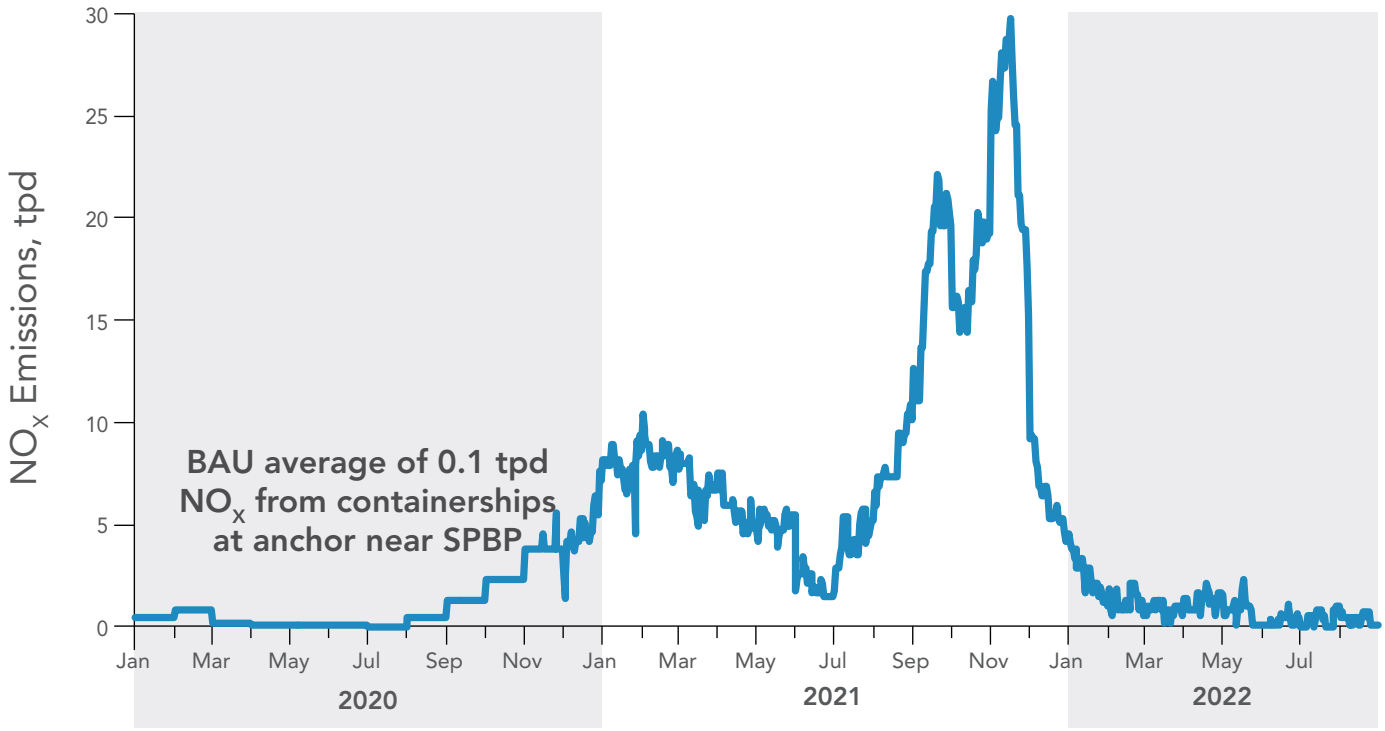
165 Saraiva, A. *Clogged warehouses and rail delays signal new supply chain woes*. gCaptain.

166 United States International Trade Commission. *The impact of the COVID-10 pandemic on freight transportation services and U.S. merchandise imports*.

167 Anchorage information gathered from publicly available daily anchorage updates from the *Southern California Marine Exchange* Twitter page.

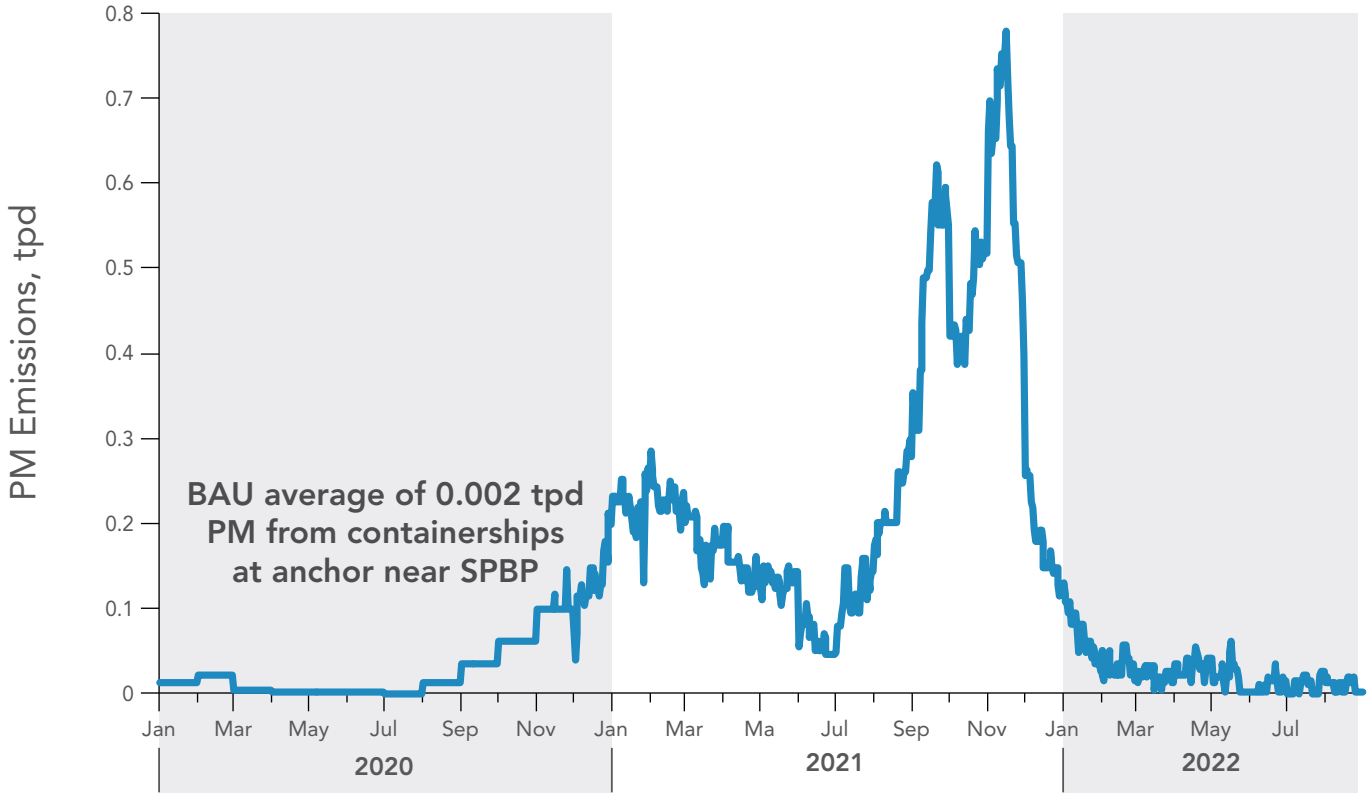
CARB's emissions inventory shows that the increased number of vessels sitting at anchor/loitering off the SPBP (Ports of Los Angeles and Long Beach) resulted in significant increases in NO_x and PM emissions, as shown in Figures 17 and 18 below.

Figure 17: NO_x Emissions from Anchored Container Vessels at the San Pedro Bay Ports[168]



168 CARB, Emissions *Impact of Freight Movement Increases and Congestion near Ports of Los Angeles and Long Beach: June 2022*. June, 30, 2022.

Figure 18: PM Emissions from Anchored Container Vessels at the San Pedro Bay Ports[169]



When at anchor, marine vessels rely on their auxiliary engines to provide power needed for critical shipboard functions like refrigeration, cooling, and circulating fresh and saltwater, similar to at berth operations. The auxiliary engine emissions from anchored vessels have substantial implications for portside communities from increased PM emissions, as well as contributions to smog-forming NO_x. In addition, the activity of trucks and locomotives moving these containers in/out of the ports increased significantly in 2021.

To resolve safety and air pollution concerns surrounding the increased number of container vessels waiting at anchor and loitering (drifting/idling without anchoring) around the Channel Islands, the Pacific Maritime Management Services (PacMMS), along with the Pacific Maritime Association (PMA), the Pacific Merchant Shipping Association (PMSA), and the Marine Exchanges of Alaska, San Francisco Bay Region, and Southern California, developed and instituted a "vessel queuing system" for container ships in November 2021 to reduce the number of vessels anchoring and loitering near the Ports of Los Angeles and Long Beach.[170] This vessel queuing system requires container vessels arriving on east-bound voyages (i.e., from Asia) to drift more than 150 miles off the coast of California while awaiting a berth at the Ports of Los Angeles and Long Beach and 50 miles off the California coast if calling the Port of Oakland. Additionally, vessels traveling north/south to a California port are required to drift more than 50 miles off the coast of California and Mexico when awaiting a berth. More details about the vessel queuing system can be found on the PacMMS website: *Container Vessel Queuing Process for Los Angeles, Long Beach, and Oakland (pacmms.org)*.

169 CARB, Emissions *Impact of Freight Movement Increases and Congestion near Ports of Los Angeles and Long Beach: June 2022*. June, 30, 2022.

170 PacMMS. *Container Vessel Queuing Process for the Ports of Los Angeles, Long Beach, and Oakland*.

The vessel queuing system has been highly successful in reducing the number of vessels anchoring/loitering directly off the Ports of Los Angeles and Long Beach, significantly reducing the overall emissions impact of port congestion from vessels anchoring on surrounding port communities by the first few months of 2022, as shown in Figures 17 and 18.[171]

Emissions increases associated with pandemic-related port congestion impacted California's portside communities as a result of increased vessel, truck, rail, and cargo handling equipment activity in and around the ports. Despite anchorage emissions from container vessels returning to near-normal levels (due to the vessel queuing system in place since December 2021, as discussed above), emissions have increased since November 2021 for port trucks, rail, and cargo handling equipment as cargo volumes remain high at the ports amid severe rail congestion and shoreside labor disruptions.[172,173,174]

Emissions Inventory Impacts

With the increase in emissions from vessels at anchor during the pandemic, CARB staff made updates to CARB's emissions inventory to include AIS-based vessel tracking. By including AIS data as part of the inventory, CARB staff is able to profile modes of activity for ocean going vessels that include anchoring, transiting, maneuvering, and hoteling. Using these methods, CARB staff evaluated the emissions impacts of port congestion and found significant increases in anchorage emissions beginning in November 2020. To put these numbers into context, the increase in NO_x emissions from containerships at anchor during the pandemic is equivalent to almost 20 percent of the additional 108 tpd NO_x reductions needed to attain the 80 ppb ozone standard in the South Coast Air Basin by 2023. The increase in NO_x emissions is roughly equivalent to the total emissions from 5.8 million passenger cars in South Coast. Additionally, the increased diesel PM emissions is comparable to the exhaust PM emissions from almost 100,000 Class 8 diesel trucks.[175]

CARB staff conducted a follow-up analysis of the emissions impacts of freight movement increases and congestion near Ports of Los Angeles and Long Beach in June 2022.[176] Following a significant peak in November 2021, excess emissions from containerships at anchorages have decreased and remain close to business-as-usual levels since January 2022. While activity remains high in the ports, the implementation of the vessel queuing system moved a significant number of vessels waiting in queue to drive 50 to 150 nm offshore, reducing the impact of the emissions. It is always preferable for industry to take responsibility and lead to enact swift changes to address new unprecedent situations.

Loitering vessels far off the coast (as per the vessel queuing system) has shifted emissions away from the traditional anchorage areas and reduced emissions from this activity in the communities near the ports of Los Angeles and Long Beach. By utilizing AIS-based vessel tracking, CARB has a good strategy to monitor both anchorage and loitering activity.

171 Schuler, M. *Marine Exchange: New Ship Queueing Process at Los Angeles and Long Beach is Working*. gCaptain.
172 California Air Resources Board. *Emissions Impact of Freight Movement Increases and Congestion near Ports of Los Angeles and Long Beach: June 2022*. June 30, 2022.
173 LaRocco, L. A. *Over $31 billion in trade is rail-landlocked or stuck at anchor off U.S. coasts*. CNBC. July 15, 2022.
174 Barria, C. and Baertlein, L. *Clogged California ports face new labor risk from trucking*. Reuters. July 19, 2022.
175 California Air Resources Board. *Emissions Impact of Ships Anchored at Ports of Los Angeles and Long Beach: Quantifying emissions impacts of congestion in container vessels near San Pedro Bay Ports in California*. November 09, 2021.
176 California Air Resources Board. *Emissions Impact of Freight Movement Increases and Congestion near Ports of Los Angeles and Long Beach: June 2022*. June 30, 2022.

Health Impacts of Port Congestion

In order to assess the health impacts associated with the increased number of container vessels at anchor, CARB staff evaluated the reduction in adverse health impacts including cardiopulmonary mortality, hospitalizations for cardiovascular and respiratory illness, and Emergency Room (ER) visits for asthma. The full write up discussing the methodology and background behind CARB's analysis can be found in Attachment F.

Staff estimates that the total number of statewide health impacts associated with (for the year 2021) the BAU and port congestion scenarios are (Table 3):

- 507 cardiopulmonary deaths were associated with BAU, and 59 added deaths due to port congestion.
- 63 hospital admissions for cardiovascular illness associated with BAU scenario and 8 added cases due to port congestion scenario.
- 75 hospital admissions for respiratory illness associated with BAU scenario and 9 added cases due to port congestion scenario; and
- 263 ER visits for asthma associated with BAU scenario and 32 added cases due to port congestion scenario.

The health impacts presented in this document are an aggregation of impacts from all modes of transport associated with OGV emissions. BAU scenarios include emissions from eight air basins (listed in Table 3), whereas the port congestion scenario only includes emissions from the South Coast air basin.

Table 3: Air Basin-Level Estimated Mortality and Morbidity Incidents for 2021 under the BAU and Port Congestion Scenarios

	Health endpoints				
	Air basins	Mortality, cardiopulmonary	Hospital admissions, cardiovascular	Hospital admissions, respiratory	ER visits
BAU	North Central Coast	18	2	3	11
	North Coast	5	0	0	2
	Sacramento Valley	0	0	0	0
	San Diego	40	4	5	17
	San Francisco Bay Area	75	9	11	44
	San Joaquin Valley	1	0	0	0
	South Central Coast	155	18	22	74
	South Coast	214	28	34	115
	Statewide Total*	507	63	75	263
Port Congestion	South Coast	59	8	9	32

Cruise Vessel Impacts

Due to the nature of their business, the cruise industry was one of the most negatively impacted businesses during the global pandemic and California's cruise terminals were no exception. With the onset of the pandemic and associated lockdowns, the CDC issued a "No Sail Order" for the cruise industry on March 14, 2020 due to the risk of introducing, transmitting, or spreading the COVID-19 virus onboard cruise vessels.[177] This No Sail Order mandated that all "commercial, non-cargo, passenger-carrying vessels operating in international, interstate, or intrastate waterways and subject to the jurisdiction of the U.S. with the capacity to carry 250 or more individuals (passengers and crew) with an itinerary anticipating an overnight stay onboard or a twenty-four (24) hour stay onboard for either passengers or crew."[178] The CDC's No Sail Order was extended multiple times, effectively stopping normal operations in California for cruise vessels from the date of issue until Summer/Fall 2021.[179] The impact to the cruise industry can be seen, for example, by examining the passenger volume at the Port of Los Angeles which received over 650,000 cruise passengers in 2019, but only 173,000 in 2020 and just over 150,000 in 2021.[180]

The CDC's Conditional Sailing Order allowed cruise lines to resume operations in the U.S. but required cruise vessel operators to adhere to strict testing and social distancing requirements, among other elements.[181] Carnival cruise line was the first cruise vessel operator to resume sailing out of California (Port of Long Beach) in August 2021. [182]The CDC's Conditional Sailing Order expired January 15, 2022, transitioning to a voluntary program for cruise lines in first quarter of 2022.[183] The CDC eventually ended its pandemic program for cruise ships in July 2022, with vessel activity expected to resume near-normal levels at California cruise terminals in the Fall of 2022 based on CARB staff's conversations with port staff.

Separately, while cruise vessels were not permitted to sail with passengers during the time the No Sail Order was in effect, cruise vessels were permitted to dock ("berth") at California ports and anchor/loiter in California waters perform necessary work onboard the vessels, including picking up supplies and fuel. This activity resulted in some cruise vessels calling California ports despite the cancellation of cruise itineraries, including many cruise ports that are regulated under the 2007 Regulation.

Ro-Ro Vessel Impacts

Impacts to the ro-ro (auto carrier industry) were largely driven by a decline in vehicle sales due to lockdowns and quarantine-related disruptions that saw consumers staying at home and spending money on essential supplies instead of on more luxury items like vehicles.[184] This decline in vehicle sales led ro-ro vessel operators to place of number of the vessels in their fleets into "cold lay-up."[185] Due to the unprecedented nature of the global pandemic, forecasts for automotive sales volumes in the U.S. varied widely, with a worst-case scenario showing volumes falling sharply in 2020 then recovering to pre-pandemic levels around 2027-2028, a base case scenario with vehicle sales

177 Centers for Disease Control and Prevention. *CDC COVID-19 Orders for Cruise Ships*.

178 Centers for Disease Control and Prevention. *U.S. Department of Health and Human Services Centers for Disease Control and Prevention (CDC). Order Under Sections 361 & 365 of the Public Health Service Act (42 U.S.C. §§ 264, 268) and 42 Code of Federal Regulations Part 70 (Interstate) and Part 71 (Foreign): No Sail Order and Other Measures Related to Operations*. March 14, 2020.

179 Centers for Disease Control and Prevention. *CDC COVID-19 Orders for Cruise Ships*.

180 Port of Los Angeles. *Facts and Figures*.

181 Smith, M. and Levin, J. *U.S. CDC clears path for cruise ships to return to service*. gCaptain. November 2, 2020.

182 *Carnival resumes cruises from California for first time in 17 months*. ABC10 News.

183 Schuler, M. *U.S. CDC's Conditional Sailing Order for cruise ships set to become voluntary*. gCaptain. January 13, 2022.

184 Automotive from UltimaMedia. *Global vehicle demand forecast 2020-2030: The drastic impact of the coronavirus crisis*. March 2020. Provided to CARB staff by the Port of Hueneme.

185 Cold lay-up means that a vessel is taken out of operation and anchored in a secure area with no crew onboard to reduce costs. More details available at: *Cold lay-ups: Understanding how we temporarily mothball ships - Wallenius Wilhelmsen*.

dropping sharply in 2020 but then gradually but steadily increasing to pre-pandemic volumes by 2024-2025, and a best-case scenario with demand returning to pre-pandemic levels by the end of 2020.[186]

Signs of recovery for the auto industry began to show in late 2020, when projections of the car trade market were upgraded from an expected 34 percent decrease to a 21 percent decrease with a projected return to nearer normal volumes for 2021.[187] Additionally, major car carrier shipping lines, such as Wallenius Willhelmsen, began taking vessels back out of cold layup in January 2021.[188] By mid-2021, volumes of cars being shipped hovered at around 5 percent below pre-pandemic levels and researchers indicated demand could have been even stronger if it weren't for pandemic-related shortages of semi-conductors needed to manufacture vehicles.[189]

Despite equipment and labor shortages that continue to impact the auto carrier industry, the ro-ro industry experienced a strong recovery in 2021 and 2022 with oneyear charter rates for a 6,500 CEU (Car Equivalent Units) climbing from a low of $10,000 per day in mid-2020 to an all-time record high of $55,000 per day in the second quarter of 2022.[190,191] Daily rates for the car carriers took roughly two years to recover from the global pandemic, which is considerably faster than the last auto carrier boom from 2002-2008.[192]

Tanker Vessel Impacts

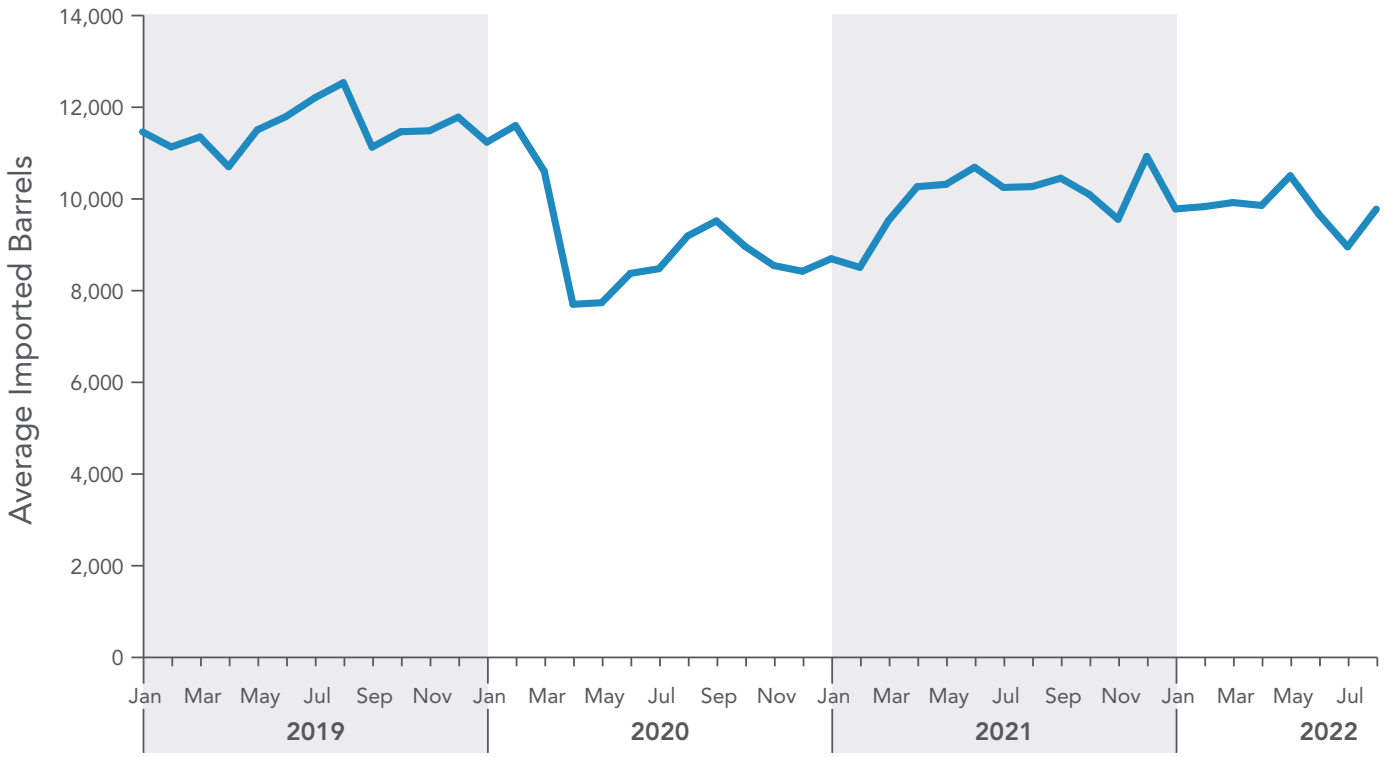
While tanker vessels import and export multiple types of liquid bulk products into California, one of the primary products that marine oil terminals import is crude oil, which is refined into gasoline and other products for both the California market and for exporting to other markets (domestic and international). When the global pandemic initially began and governments began to order lockdowns across the U.S., including in California, consumer demand for gasoline dropped rapidly as many people canceled travel plans and began working from home.[193] This sudden decrease in consumer demand, which led to increased oil supply and a resulting decrease in storage space, began a brief period of extreme market volatility that saw the price of oil fall from around $40/barrel in early March 2020 to below $0 for a brief period of time in April 2020.[194,195] However, market prices quickly rose back to around $40/barrel by June 2020, with prices remaining stable in the $40-$50 per barrel range through the end of 2020. Oil prices then rose steadily throughout 2021, reaching prices near $80 per barrel by the end of the calendar year as consumer demand returned faster than

186 Automotive from UltimaMedia. *Global vehicle demand forecast 2020-2030: The drastic impact of the coronavirus crisis*. March 2020. Provided to CARB staff by the Port of Hueneme.
187 Chambers, S. *Car carriers rally*. Splash247. December 7, 2020.
188 Chambers, S. *Wallenius Wilhelmsen takes car carriers out of cold layup*. Splash247. January 6, 2021.
189 Chambers, S. *Car carriers leave Covid in the rear-view mirror*. Splash247. June 21, 2021.
190 Schuler, M. *Auto transport company Wallenius Wilhelmsen reports record quarterly earnings*. gCaptain. November 9, 2021.
191 Chambers, S. *Car carrier rates accelerate to record levels*. Splash247. May 16, 2022.
192 Chambers, S. *Car carrier rates accelerate to record levels*. Splash247. May 16, 2022.
193 The demand for gasoline was impacted more severely than other refined petroleum products, such as diesel, which is used in commercial and industrial sectors. According to the U.S. Energy information Administration (EIA): "Distillate fuel oil is primarily consumed as diesel fuel, the predominant fuel of the trucking, locomotive, and agricultural sectors. Continued demand for distribution of necessities such as food and medical supplies and increased home deliveries for goods likely contributed to relatively stable demand for distillate fuel in the initial weeks following the shutdown."
Sources: U.S. Bureau of Labor Statistics. *From the barrel to the pump: the impact of the COVID-19 pandemic on prices for petroleum products*. Monthly Labor Review. October 2020.; U.S. Energy Information Administration. *COVID-19 mitigation efforts result in the lowest U.S. petroleum consumption in decades*. Today in Energy. April 23, 2020.
194 U.S. Bureau of Labor Statistics. *From the barrel to the pump: the impact of the COVID-19 pandemic on prices for petroleum products*. Monthly Labor Review. October 2020.
195 U.S. Energy Information Administration. *Crude oil prices briefly traded below $0 in spring 2020 but have since been mostly flat*. Today in Energy. January 5, 2021.

oil companies could produce refined petroleum products.[196,197] Prices in 2022 saw a steady decline as production of petroleum products began to outpace consumer demand.[198]

Because CARB staff does not have access to real-time vessel visit data, staff monitored refinery input levels of crude oil made publicly available by the California Energy Commission (CEC) to track the impacts to tanker vessels and California marine oil terminals. Given that the majority of crude oil imported into California is brought in by marine tanker vessel,[199] tracking the rise and fall of crude oil refinery input provides a proxy for understanding the potential impact of the pandemic on tanker vessel operators and marine oil terminal operators. As can be seen in Figure 19, refinery inputs of crude oil dropped significantly between March 2020 and April 2020, highlighting the impacts of decreased consumer demand during the earliest days of the pandemic.

Figure 19: California Energy Commission Refinery Input - Crude Oil (by thousands of barrels)[200]



196 U.S. Energy Information Administration. *Crude oil prices increased in 2021 as global crude oil demand outpaced supply*. Today in Energy. January 4, 2022.
197 U.S. Energy Information Administration. *EIA forecasts crude oil prices will fall in 2022 and 2023*. Today in Energy. January 12, 2022.
198 U.S. Energy Information Administration. *EIA forecasts crude oil prices will fall in 2022 and 2023*. Today in Energy. January 12, 2022.
199 California Energy Commission. *Crude oil imports by transportation type*.
200 California Energy Commission. *Refinery Inputs and Production*.

However, despite the initial drop in demand for petroleum products during the initial months of the pandemic, consumer demand began to rebound starting in May 2020 as lockdowns and other pandemic-related restrictions began to ease.[201] While refinery inputs in California have not reached pre-pandemic levels (as shown in Figure 19), several oil companies, including many of those with marine oil terminals in California, recorded record profits in 2022 alongside stronger consumer demand and surging energy prices.[202,203] Additionally, U.S. crude exports have surged to record highs due to increased global demand for U.S. oil.[204]

Findings

CARB staff solicited for information about how the global pandemic has impacted vessels calling California ports. Vessel and terminal/port operators identified a number of key challenges associated with the global pandemic (see Attachment A):

- Difficulties in procuring and installing emissions control equipment (for shore power and capture and control systems), largely due to COVID-related lockdowns (including restricted travel and access for key engineering and technical personnel and lack of access to shipyards) and supply chain/manufacturing delays and shortages of key equipment parts.
    - Comment letters included notices and responses from key equipment vendors and manufacturers confirming equipment and personnel shortages and force majeure events associated with the pandemic that could result in delays to control equipment installations and retrofits.
- Lack of ability to dry dock vessels to install emissions control equipment due to personnel shortages and the need for more vessels to handle increased consumer demand.
- Reduction in vessel capacity (11 percent decrease globally, 20 percent for trans-Pacific voyages to Los Angeles) and vessel visits to California ports due to port congestion and labor delays.[205]
    - For example, a major container vessel operator reported to CARB staff that the number of vessel calls made to California ports decreased from 500 calls in 2019 to 322 calls in 2021, a decrease of around 35 percent, largely due to extended wait times and longer than usual wait times at berth.

CARB staff received numerous comment letters from industry stakeholders outlining the issues vessel and terminal/port operators are experiencing as a result of the pandemic, and these comment letters included some additional letters from equipment manufacturers and providers detailing the difficulties faced in meeting the CARB timelines for implementation of the At Berth Regulation (see Attachment A). The inability for vessel operators to install shore power equipment on container, reefer, and cruise vessels that were not yet shore power capable or procure alternatives to shore power during 2021 and 2022 may potentially impact the ability for vessel and terminal operators to comply with the Regulation through use of shore power.

201 U.S. Bureau of Labor Statistics. *From the barrel to the pump: the impact of the COVID-19 pandemic on prices for petroleum products*. Monthly Labor Review. October 2020.
202 Grantham-Phillips, W. *Oil giants reap record profits as war rages in Ukraine, energy prices soar: Here's how much they made*. USA Today. May 7, 2022.
203 Bousso, R. and Valle, S. *Big Oil set to open taps with another record quarter*. Reuters. July 21, 2022.
204 Robertson, H. *US oil exports have hit a record as WTI crude trades at its cheapest in 3 years. Here's what's going on*. Business Insider. July 28, 2022.
205 Blenkey, N. *Container shipping earnings hit all time high*. MarineLog. November 22, 2021.

CARB has received information from multiple stakeholders that they planned to complete shore power installation and/or complete retrofit projects that would allow their vessels to be compliant with the Regulation by January 1, 2023, but that pandemic-related disruptions have extended these timelines (see Attachment A). CARB did not receive a large amount of data from stakeholders identifying what percentage of the fleet pandemic-related delays may impede from complying with the Regulation through use of shore power beginning in 2023. Overall, CARB believes the number of container, reefer, and cruise vessels that these delays will impact will be relatively small, as the majority of these vessel categories are already complying with the 2007 Regulation. But the shift to the Regulation's new "every visit" structure may cause some vessel and terminal operators to look for alternative solutions to compliance if shore power cannot be installed by January 1, 2023. Additionally, some vessel operators may be more impacted than others; Jones Act[206] carriers, for example, have less ability to swap their vessels out during periods of equipment retrofits because Jones Act vessels must be U.S. flagged and there are significantly fewer in existence than non-U.S. flagged vessels.

Some ro-ro vessel operators that have expressed plans to utilize shore power as their main compliance pathway have also reported difficulty procuring shore power equipment (see Attachment A). One ro-ro operator in particular has identified an estimated delivery time of 12-15 months for one vessel due to component shortages, raw material price increases, reduced capacity due to high demand, and logistics disruptions than have led to higher lead times and rates with lower schedule reliability. The vessel operator also provided documentation from equipment manufacturers stating that further installation delays could occur as a result of any future pandemic-related travel restrictions. This particular fleet estimates that shore power installation could take around 15 months per vessel, with four vessels being retrofit concurrently; in total, the fleet could potentially have 40 vessels fully equipped before January 1, 2025, and 80-100 vessels before January 1, 2027.

Despite pandemic-related supply chain disruptions, the development of capture and control systems is progressing as anticipated during the rulemaking. CARB staff are working with several companies that are pursuing technologies for use on regulated vessel types, including container, ro-ro, and tanker vessels. More information about the progress being made in adapting emissions control technologies for use on ro-ro and tanker vessels can be found in the Status of Control Technologies chapter of this Report.

206 According to the Transportation Institute, the Jones Act is a cabotage law that imposes restrictions on vessels trading between two ports within the United States. To be classified as a Jones Act compliant vessel, a vessel to be built and flagged in the U.S., be owned by a company that has at least 75 percent U.S. ownership, and must have a crew that is at least 75 percent U.S. sailors. More information on the Jones Act can be found at: *Five Things to Know about the Jones Act*

Summary

In general, despite the volatility experienced by the shipping industry over the past few years, the industry has recovered well from the impacts of the global pandemic and is in good position to comply with the Regulation when considering economic status. As discussed earlier in this chapter, both container shipping lines and oil companies experienced record-breaking profits in both 2021 and 2022 since the onset of the pandemic, while auto carrier volumes and cruise passenger demand are actively recovering to near pre-pandemic levels.

According to conversations with and comment letters received from impacted industry stakeholders, supply chain disruptions have impacted the ability for vessel owner/operators, terminal operators, and ports to procure and install some of the equipment necessary to ensure their vessels will be able to reduce emissions on the timelines required by the At Berth Regulation. Some stakeholders have requested that CARB delay the At Berth Regulation and keep the 2007 Regulation (with its fleet averaging requirements) in place until 2025 or allow for fleets to utilize the remediation fund for vessels that are not shore power capable and have no access to an alternative solution (i.e., no capture and control system is available for use). Others have requested that CARB increase the number of VIEs/TIEs available in the early years of Regulation implementation to account for pandemic-related delays, or that CARB delay the ro-ro and Southern California tanker implementation deadlines to 2027. CARB believes that the Regulation already provides the flexibility needed for vessels to comply with the Regulation and that no adjustments are needed to the regulatory compliance deadlines at this time based on the concerns that were presented by regulated stakeholders as part of this Interim Evaluation Report.

CARB staff do note the difficulties presented to the shipping industry as a result of the pandemic, particularly for those vessel categories with implementation deadlines beginning January 1, 2023. In this circumstance, there are specific compliance pathways in the Regulation to accommodate situations where a regulated entity has attempted to procure or install a CAECS and is unable to use it – VIEs/TIEs, the remediation fund, and Innovative Concepts. As mentioned in Introduction of this Report, vessel and terminal operators can use VIEs and TIEs, respectively, to exempt any visit(s) they choose (up to 20 percent of total visits in 2023/2024 and up to 10 percent of total visits from 2025 onward). Additionally, regulated entities can use the remediation fund to remain in compliance if they qualify for one or more of the criteria outlined in section 93130.15(b) of the Regulation. If an entity can show CARB documentation proving that the equipment was ordered in a timely fashion and there was an unpreventable delay (such as pandemic-related equipment shortages, labor delays or lack of available engineering staff to install the equipment, etc.), then a vessel/terminal operator or port can pay into the remediation fund to ensure their visits to regulated California berths remain in compliance with the Regulation. This mechanism was written into the Regulation to allow for flexibility during extraordinary circumstances, such as the global pandemic. Lastly, if a regulated entity has an Innovative Concept approved for use by CARB, they may also use that Innovative Concept to comply with the Regulation.

Feasibility of Control Requirements for Bulk and General Cargo Vessels

Overview

As part of the initial rulemaking process for the At Berth Regulation, CARB evaluated the feasibility of emission reduction requirements of bulk and general cargo vessels but ultimately elected not to include these vessel categories in the Regulation. The decision to exclude bulk and general cargo vessels from the control requirements was due to a combination of factors, including the relatively lower at berth emissions contribution when compared to other vessel categories, high costs to implement emission control technologies, volatile market fluctuations in the products shipped by these vessels (generally lower cost commodities), and operational complexities to control at berth emissions.[207] In addition, bulk vessels are relatively newer vessels on average compared to other categories like reefer vessels; CARB inventory staff analyzed the population-weighted average age distribution of bulk and general cargo vessels visiting California and found that the age of the vessels with the most frequent vessel visits are around eight years old.[208] However, CARB staff committed to reevaluating bulk and general cargo vessels as part of the Interim Evaluation. The evaluation includes previous knowledge and information used in the Regulation rulemaking and information received since the adoption of the Regulation. As part of the Interim Evaluation, CARB staff reached out to bulk and general cargo vessel operators and ports to solicit updated information for this analysis. The results of CARB staff's outreach efforts will be summarized in the next section of this chapter.

Engagement with Bulk and General Cargo Operators

In support of the development of the Interim Evaluation, CARB staff committed to reexamining the bulk and general category vessel sector and evaluating what technology advances and/or operational changes may have occurred since the development and adoption of the Regulation. Staff engaged with industry stakeholders to understand how these vessels operate in California, examine their impact on air quality and health, and explore potential emission reduction strategies. CARB solicited input from stakeholders during a webinar on the At Berth Regulation Implementation Updates on May 17, 2022.[209] However, due to a lack of response from bulk and general cargo stakeholders, CARB staff sent a follow-up informal survey with targeted questions designed to assist CARB staff with an up-to-date evaluation of the bulk and general cargo sector. The survey asked for information on the frequency of line-hauling, as described below, if bulk/general cargo visits have increased or decreased over the past 5 years, what containerized cargo (if any) that shifted to bulk vessels, any bulk activity expansions that have occurred or are planned, the age distribution of bulk vessels, the percentage of vessels on tramp/liner schedules, and if any new technologies to control emissions from bulk/general cargo vessels have been developed or are being looked further into. In addition to the informal survey, Staff toured the Port of Stockton and the Port of Redwood City and met with port staff to discuss port operations and the impact of bulk and general cargo operations on nearby communities. Between the four survey responses CARB received from bulk vessel operators and the port tours/meetings that staff attended, insight was gained into the operations of nearly 70 percent of the bulk activity in Northern California. CARB staff was unable to glean much additional insight about bulk operations in Southern California, which receives around 50

207 California Air Resources Board. *Staff Report: Initial Statement of Reasons (ISOR)*, p. III-4 through III-5. October 15, 2019.

208 Source: 2020 Automatic Identification System (AIS) data used for the updated OGV 2020 model.

209 California Air Resources Board. *At Berth Regulation Implementation Updates Webinar*. May 17, 2022.

percent of the bulk vessel visits to California, however; more evaluation is needed to assess changes (if any) in the bulk operations at the Ports of Los Angeles, Long Beach, and San Diego. The updated information received through this outreach has been included in the analysis.

Unique Operational Challenges

Bulk and general cargo vessels provide unique emission control and operational challenges not seen in other vessel categories. Common emission reduction strategies such as shore power and capture and control systems can be more difficult to utilize on some bulk and general cargo vessels because of how these vessels operate while at berth. In addition, the physical geography of California's bulk and general cargo ports and terminals provides unique challenges.

Line-Hauling

Bulk vessels frequently utilize a technique called line-hauling when loading or offloading product from the vessel. Loading and offloading bulk vessels is not as simple as emptying all the vessel hulls in order of convenience. Line-hauling allows for the loading or offloading of a bulk vessel's hatches in a proportional manner and is typically used at berths that operate with a fixed loading arm or spout. Line-hauling is used to properly distribute cargo weight while loading and offloading; too much cargo loaded or discharged from any one hatch without proper weight distribution could cause the vessel to sink. It is crucial to keep cargo level and weight distribution across the hulls evenly distributed in order to maintain stability of the vessel, as well as keep the structural integrity of the hull intact. This technique potentially makes connections to shore power or capture and control systems more complex. Line-hauling would require the shore power or capture and control connection to be connected and disconnected multiple times throughout the vessels visit to allow the vessel to move up and down the berth to facilitate the loading or offloading of product. In addition, land-based capture and control systems may also potentially be in the way of on-dock cranes used to load and offload the vessel and would also require the land-based system to move along the berth while the vessel conducted its operations.

The percentage of bulk vessels that utilize line-hauling varies depending on the operational needs of the bulk vessels itself and the physical infrastructure of the berth that vessel is visiting. For example, the Port of Stockton indicated to CARB staff that in 2021, around 30 percent of vessels that visited the Port had to utilize line-hauling operations at their Port. The Port of West Sacramento indicated 65 to 70 percent of the vessels that call the Port require line-hauling and that it is only required for imported bulk cement. However, at the Port of Redwood City, Pabco and CSL stated none of their vessel's line-haul during offloading. However, CSL did indicate line-hauling is the norm for loading operations and is standard practice at the berths their vessels call at the Port of Long Beach (berths 212/214).

Liner Versus Tramp Vessels

Bulk and general cargo vessels typically transport lower value commodities and generally operate on an on-demand market (also known as a spot market). In California, bulk and general cargo vessels operate on a non-liner or tramp service more frequently than the other vessel types.[210] These vessels do not operate on routine schedules or routes, making it difficult to predict when a certain vessel will be visiting California. A vessel may visit a port in California only once a year or even less frequently. All four responders from the informal survey indicated their vessels operate 100 percent on tramp schedules. CARB understands the challenges operators face in retrofitting all vessels in one's fleet, in particular those on tramp schedules, in order to comply with the At Berth Regulation in which the ship may visit once or less per year. For this reason, it is important that if bulk ships are regulated in the future, that a more cost-effective method of control is considered to handle these tramp visits.

210 California Air Resources Board. *Staff Report: Initial Statement of Reasons (ISOR)*, p. III-5. October 15, 2019.

Physical Port/Berth Constraints

Bulk and general cargo terminals are generally smaller in comparison to large containers terminals, which often present some physical constraints and generally do not have high-voltage electricity available at bulk vessel berths. Both barge and land-based capture and control systems can present challenges at smaller bulk and general cargo terminals due to narrow channels and/or footprint issues on land. Richmond is one example of this, along with Stockton and other marine terminals in the Carquinez area. For example, the Port of Richmond is operating at an old terminal originally constructed for much smaller vessels and space on the dock is limited. Additionally, the Port of Richmond has a naturally narrow channel and does not provide enough room for a barge at any location (see Figures 20 and 21 for examples). It is CARB's understanding that the US Coast Guard will not allow a barge carrying a capture and control system to block navigable access to waterways and channels.[211]

Figure 20: Port of Richmond

The Port of Stockton has a 225-foot-wide channel which makes a barge bunkered next to a vessel challenging because the barge would effectively block the channel. This would require the barge to have to disconnect and reconnect to allow other vessels to pass.

211 Based on CARB staff's conversations with harbor pilots during the At Berth Regulation rulemaking period.

Figure 21: Port of Stockton

Emissions profile and growth

As the Regulation goes into effect, emissions from regulated vessels will be reduced. In turn, emissions from unregulated bulk and general cargo vessels will account for a larger percentage of overall emissions from OGVs. The California Emissions Projection Analysis Model (CEPAM)[212] is a tool used for air quality modeling and tracking the progress of the State Implementation Plan. According to CEPAM 2019 V1.03, emissions data for bulk and general cargo vessels currently account for around eight percent of the total at berth emissions from vessel auxiliary engines statewide in 2022; however, in 2037, bulk and general cargo vessels are projected to account for around 18 percent of the total at berth emissions from vessel auxiliary engines statewide. In addition, three out of the four responses of the informal survey indicated their fleets saw an overall increase in activity and increase in vessel visits over the past five years.[213]

CARB staff found that growth at some bulk ports and terminals has occurred over the past few years and that some California ports are planning for future growth. The Port of Stockton, for example, reported to CARB staff during an in-person port tour in April 2022, that an increase in bulk vessel visits occurred during the pandemic as some cargo shifted to bulk transport during container ship backlogs experienced at the Port of Oakland.[214] Additionally, the Port of Oakland approved a proposal to expand bulk vessel operations at the port through the Eagle Rock Aggregates Oakland Terminal Project, which would increase the number of bulk vessels moving sand and gravel into the Port of Oakland.[215] While this expansion has been approved by the Port of Oakland, it is currently being challenged by nearby environmental advocates and the State of California due to the additional emissions these new operations would bring to the West Oakland port communities.[216,217]

212 *CEPAM 2019 V1.03, Standard Emissions Tool*.
213 All four email survey responses can be found in Attachment G.
214 CARB staff conversation with Jeff Wingfield, Director of Environmental & Public Affairs with the Port of Stockton.
215 Port of Oakland. *Eagle Rock Aggregates Oakland Terminal Project*. November 2020.
216 Sciacca, A. *Port of Oakland approves controversial sand and gravel operation*. The Mercury News. February 25, 2022.
217 Mukherjee, S. *Attorney General: Oakland port plan would pollute air, shorten life spans*. August 9, 2022.

Findings

In general, CARB staff's analysis of the bulk and general cargo vessel sector indicates many of the same findings from the rulemaking process for the Regulation. Bulk and general cargo vessels present unique emission reduction challenges which are not as prevalent in the other regulated vessel categories. Traditional emission reduction methods (such as shore power and capture and control) are more difficult to implement for these vessels. However, despite the challenges, industry has signaled emission reductions are possible.

A comment received on this Interim Evaluation mentioned that there are currently thirteen zero-emission or hybrid bulk and general cargo vessels on the water or currently under development.[218] In addition, one specific bulk vessel operator, CSL, reported in their 2021 Sustainability Report, that they are presently conducting a shore power feasibility study for their Australian ports fleet.[219] CSL will start by looking at shore power for its Australian pneumatic cement fleet, since the ships visit the same port regularly and the onboard pneumatic offloading system[220] uses more fuel than traditional bulk vessel offloading systems. [221] CSL is working with stakeholders to understand the infrastructure requirements, both onboard the vessel and onshore. CSL is also exploring the use of biodiesel to decarbonize their existing fleet. They have successfully tested B100 biodiesel fuel on their vessels and expanded the testing to half of the vessels in their fleet.[222]

A bulk shipping company from Japan is looking into equipping one of its bulk ships with a hard sail wind propulsion system and rotor sails by 2024.[223] The company estimates that the hard sail and rotor sails could reduce the vessel's emissions by as much as 20 percent. China-flagged coastal container ships, cruise ships, ro-pax (combination ro-ro and passenger) vessels, 3,000-tonne class and above passenger ships, 50,000-tonne class and above dry bulk carriers that are nearly built on or after January 1, 2020, will also be equipped with a shore power system.

Additionally, CARB staff have heard from community members, particularly those in the Stockton and West Oakland/Richmond communities, during various port outreach and AB 617-related meetings about the importance of pursuing emissions reductions from bulk vessels due to the large number of bulk vessels that call these ports. For example, while bulk and general cargo vessels only make up around 11 percent of the vessel visits statewide, they make up roughly 70 percent of the total vessel visits to the Port of Stockton and around 20 percent of the visits to the Oakland/Richmond terminals as compared to around 16 percent of total visits at the Port of Long Beach and only 8 percent at the Port of Los Angeles.[224] As such, growth in bulk and general cargo vessel activity at some of California's smaller ports may have an outsized impact on disadvantaged communities located near these ports and marine terminals.

218 Comment letter from Pacific Environment. See Attachment A.
219 Canada Steamship Lines (CSL). *Corporate Sustainability Report 2021*.
220 A pneumatic offloading system on a bulk vessels uses air to move cargo out of a vessel's cargo holds. CSL's pneumatic self-unloading vessels to handle powdered cargoes, such as cement. These systems allow for a fully enclosed, dust-free environment during cargo operations. More information on CSL's pneumatic self-unloading vessels is available on CSL's website: *Pneumatic Self-Unloaders*
221 Canada Steamship Lines (CSL). *Corporate Sustainability Report 2021*.
222 Biofuels International. *CSL to run biodiesel on half its fleet*. March 23, 2021.
223 Manifold Times. *Japan: MOL to equip second bulk carrier with 'Wind Challenger' hard sail system*. August 11, 2022.
224 See Table I-1: 2017 California Port and Marine Terminal Vessel Visits in the *Staff Report: Initial Statement of Reasons (ISOR)*, p. I-7.

Summary

In summary, CARB staff found that increased activity from currently unregulated bulk vessels in already heavily impacted port communities coupled with the fact that bulk vessels will account for an increasingly larger percentage of total OGV emissions as container, reefer, cruise, ro-ro, and tanker vessels reduce their emissions at berth points to the need for further reductions from bulk vessels at berth.

Emissions control technologies are evolving and there are technology demonstrations underway to determine of at berth emissions control strategies are suitable for the bulk and general cargo sector. For example, CARB's Advanced Technology and Demonstration Pilot Projects program awarded funding to demonstrate the feasibility of a land-based capture and control system for bulk and general cargo vessels as part of The Port of Los Angeles Multi-Source Green Omni Terminal Project ("Green Omni project").[225] The completion of the Green Omni project confirmed the feasibility of utilizing land-based capture and control for these vessel types, when not performing line-hauling operations (these systems must be removed from a vessel when performing line-hauling). The project demonstrated that land-based capture and control could be a feasible emission reduction option for incidences where there is adequate land side berth space, and the vessel does not have to line-haul while at berth. Emissions from this vessel category are projected to grow from increased activity, confirming the need to explore emission reduction strategies for these vessels further.

Further investigation into bulk and general cargo vessels is recommended to determine the most effective method to reduce emissions from these vessel categories. Given the fact that bulk vessels can be difficult to reduce emissions from while at berth due to their specific operations, pursuing at berth controls may not be the most effective method of achieving emissions reductions from this vessel category. Rather, pursuing a regulatory pathway that requires cleaner vessels (i.e., cleaner engines, fuels, etc.) may be most appropriate to achieve emissions reductions from the bulk vessel category. Such a measure would also help to achieve emissions reductions from vessels in-transit, which make up the bulk of emissions from ocean-going vessels. As mentioned in the *Background Background* section of this Report, significant reductions are needed from vessels in-transit to help the South Coast reach attainment with the 2037 ozone standard.

225 California Air Resources Board. *Advanced Technology Demonstration and Pilot Projects*.

Feasibility of Control Requirements for Vessels At Anchor

Overview

There are four main modes of operation for OGVs: in-transit, maneuvering, at berth, and at anchor. While vessels are at anchor and at berth, the auxiliary engines are operating but the main engines are generally turned off (as opposed to maneuvering and in-transit, when both the auxiliary and main engines are operating). As part of the adoption of the At Berth Regulation, CARB's Board directed staff to evaluate the feasibility of emissions reductions from vessels at anchor as part of this Interim Evaluation Report. As noted in *COVID-19 Pandemic Impacts* the importance of evaluating the impact of at anchor emissions became particularly important during the pandemic, as the number of container vessels anchored off the San Pedro Bay (near the Ports of Los Angeles and Long Beach) soared as a result of port congestion. Anchorage impacts associated with the pandemic will be discussed later in this chapter and can also be found in the *Port Congestion* section of this Report.

Background

An anchorage is a location where a vessel safely keeps position on the water by anchoring or mooring to a buoy. An example of vessels waiting at anchor can be seen in Figure 22. Special anchorage areas are assigned around major port areas. On the National Oceanic and Atmospheric Administration (NOAA) nautical charts in San Pedro Bay[226], San Diego Bay[227], and San Francisco Bay[228], anchorage locations can be identified as thin green circles. Each circle is a parking spot for an ocean-going vessel that is waiting for its next move, generally to a terminal at the nearest port. These anchorage areas are typically located within 10 miles of a port. Under ideal circumstances, vessels will be constantly making productive movements (loading/unloading cargo or arriving/departing the port area, leaving anchorages largely unoccupied. Vessels sitting at anchor are generally waiting for their next task and are not earning revenue; it generally does not behoove a vessel operator to leave a vessel at anchor for an extended period of time.

226 National Oceanic and Atmospheric Administration. *San Pedro Bay; Anaheim Bay Huntington Harbor*. October 1, 2015.
227 National Oceanic and Atmospheric Administration. *Approaches to San Diego Bay*. December 1, 2005.
228 National Oceanic and Atmospheric Administration. *Entrance to San Francisco Bay*. June 1, 2013.

Figure 22: Vessels anchoring offshore

From a vessel operator perspective, anchorage locations are ideally located in shallow and protected waters near a port. Vessels generally wait at anchor for a position at a terminal, and the quicker a vessel can respond once a berth is available, the better. From a community perspective, anchorage activity is ideally as short as possible and located as far away as possible with consideration of residential and public areas. Emissions from vessels at anchor impact communities downwind with greater impacts to those close to the source. Spending time at anchor is a disbenefit to both the vessel operation and the community, but sometimes a necessity. For example, it is typical to see a few vessels at anchor waiting for a limited resource, like a specific terminal to handle a specialized cargo like an oil terminal. In general, tanker and bulk vessels are often seen waiting at anchorage areas more often than container, refrigerated cargo, and cruise vessels due to the nature of their cargo and operations. Additionally, some vessels also "moor" in California waters, meaning they tie up to a fixed object (such as a mooring buoy), versus dropping an anchor. Mooring activity is commonly performed by tanker vessels that perform cargo operations at the El Segundo offshore terminal in Southern California and by cruise vessels visiting harbors that are too small or shallow to receive large OGVs (such as Santa Barbara and Catalina Island). But it is not typical to see many vessels at anchor waiting long periods of time.

As noted in *Figures 17 and 18* in the *COVID-19 Pandemic Impacts* section of this Report, emissions from vessels anchoring are typically low; however, emissions can increase rapidly if the number of vessels sitting at anchor rises significantly, as they did during the global pandemic, especially in Southern California. This can lead to health impacts for the surrounding port communities. As such, CARB staff are motivated to examine both technological and operational solutions to reducing emissions from vessels at anchor.

Technologies and operations to reduce emissions at anchor

The solutions currently being used to reducing emissions at berth have potential to be applied to reduce emissions at anchor. The logistics and the challenges are different, but the same strategies can apply. Potential technological solutions include capture and control, alternative maritime power (AMP) like shore power, and the use of cleaner vessels. The technological solutions at anchor have

added complications of building infrastructure in a more remote and less hospitable environment (subject to higher winds, waves, tides, vessel traffic) than in a port. Equally important to consider are operational solutions that can reduce the time and activity at anchor. Operational changes could also be considered to reduce emissions at anchor, including limiting the amount of anchorage activity around the port and relocating anchorages away from port areas.

As the need grows to reduce vessel emissions further to reach California's air quality attainment goals, the anchorage region is an opportunity for new technologies to be developed. Unregulated emissions at anchor may provide an opportunity for public funds to create projects that reduce emissions at anchor and spur development in this area. Reducing vessel emissions in-transit is the most direct way to reduce emissions at anchor.

Capture and Control

A capture and control barge, in concept, could come alongside a vessel at anchor to control emissions from a vessel's auxiliary engines. At anchor, vessels are not as secure, and both the vessel and the barge will experience increased relative motion from water movement from tide action or passing vessel wakes. This adds challenges for ensuring a maximum capture efficiency, as well adds complications from movement of a capture boom arm from the relative motion of the vessel/barge. Additionally, vessels at anchor are further away from the home berth for a capture and control system, adding time and emissions to bring the control strategy to the vessel. As of today, CARB has not seen capture and control at anchor attempted but looks forward to evaluating emissions and reduction data associated should it occur.

Alternative Maritime Power

Shore power is the best way to reduce emissions at berth since it eliminates auxiliary engine emissions that impact those that live and work around the ports. Providing electricity to a vessel at anchor has the same potential to reduce emissions, but with significant new challenges to implement such a strategy. One possibility is to provide electricity from a power source on a barge that can be brought to an anchored vessel. Potential sources of power include battery banks, or generators like fuel cells, microturbines, diesel or reciprocating engines. The source of fuel for these systems play a major factor to determining the effectiveness of the solution to reduce emissions. Zero carbon fuels are ideal for this application to maximize emission reductions. In a first of a kind demonstration, Sandia labs built a barge-based hydrogen fuel cell system to provide alternative maritime power to vessels.[229] While this system provided only 100 kilowatts (kW) of electricity, a scaled-up version could potentially provide a hoteling load for a vessel at anchor while simultaneously reducing emissions by eliminating the need for the vessel's auxiliary engines.

Undersea cabling can bring electricity to an anchorage to provide electricity to a vessel. Undersea cables are used to bring electricity offshore to oil rigs as well as bringing electricity ashore from offshore wind farms. Currently vessels in El Segundo utilize anchorage terminals to offload oil to a refinery nearby. If a vessel were able to also connect to shore power electricity via undersea cabling, then vessels at anchor could connect to shore power directly. Conceivably, a shore power buoy could allow the cabling to be brought to the vessel similar to how a tanker vessel in El Segundo anchorage terminal is able to find and connect to undersea pipelines. However, this strategy does not exist today and would be more expensive than installing shore power at a berth due to the underwater cabling, and the difficulty of connecting to shore power from a vessel at sea.

229 Pratt, J. and Chan, S.H. *Maritime Fuel Cell Generator Project*. Sandia National Laboratories. May 2017.

Onboard Strategies

Onboard strategies are emission reduction strategies that remain on a vessel to reduce emissions over a variety of activities including while at anchor. Any onboard strategies on a vessel would also reduce emissions at anchor. For example, a vessel with a new Tier III engine or an onboard emissions treatment system for compliance with the at berth regulation could likely run the same system at anchor. Additionally, a vessel complying with the Regulation by using alternative fuels as a CAECS would be able to reduce emissions from using the alternative fuels at anchor as well. The transition to clean vessels, through retrofit with onboard strategies reduces emissions at anchor, and everywhere the vessel operates.

Operational Solutions

Independent of technological solutions, there are some operational solutions to reduce local emissions from OGV at anchorages. Two approaches include limits on anchorage activity around the port and relocating anchorages away from port areas. A limit on anchorage activity could be enacted with a set limit on the time a single vessel is allowed in anchorage or on the total number of vessels allowed in an anchorage in any given time. As described in the *Port Congestion* section of this Report, the vessel queuing system developed by PacMMS integrates both these concepts. While a hard limit on anchorage stay time is not imposed under the vessel queuing system, using vessel queues has reduced anchorage stay times by allowing vessels to slow steam across the Pacific and arrive closer to their expected berthing time. Additionally, placing a surge of vessels at loitering locations further from the port reduces the total number of vessels at anchor at any given time. At this time, CARB is satisfied with the solution implemented by the vessel queuing system to limit impacts of emissions at anchor especially during periods of high activity. CARB will continue to monitor the achievements of the vessel queuing system and explore whether there is a need to further regulate this activity.

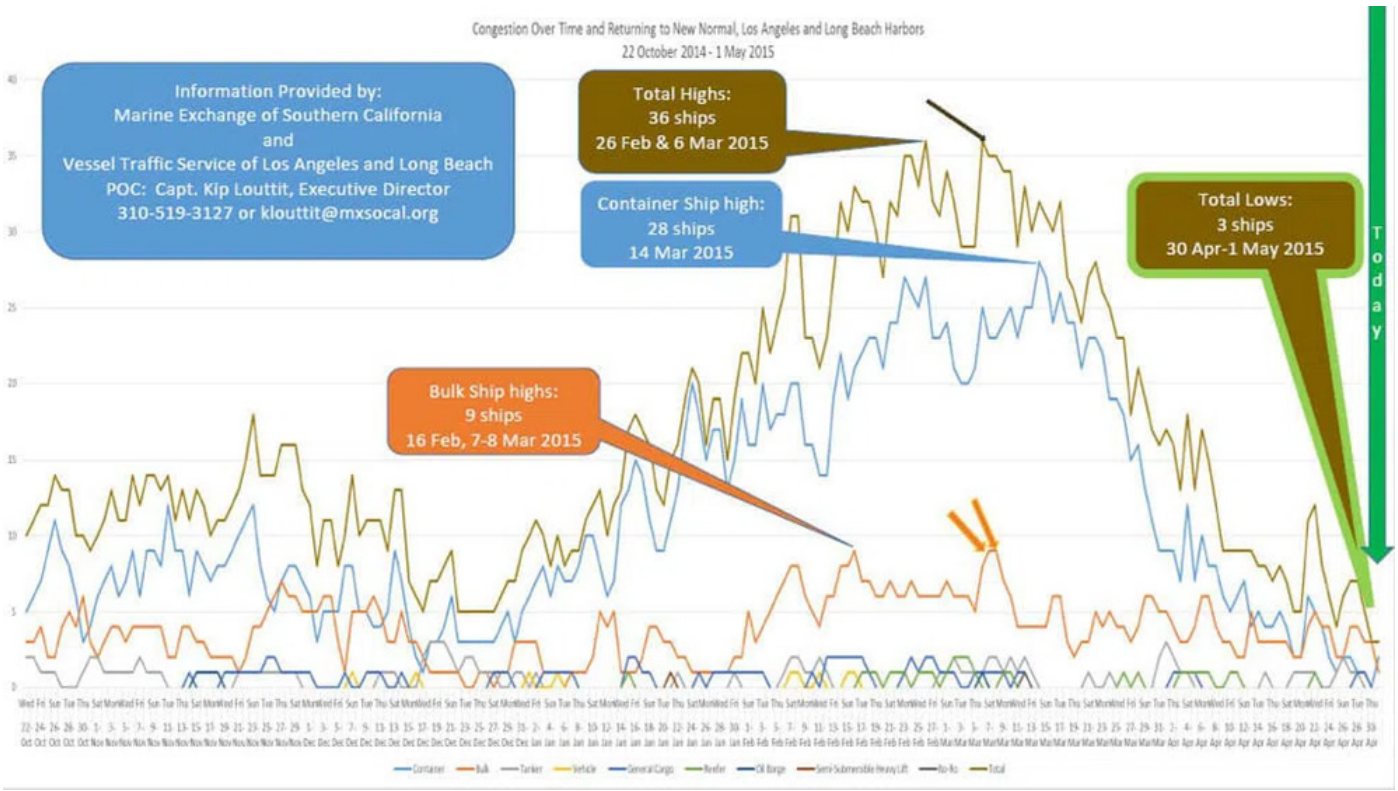
Major shipping delays and impacts at anchor

In California waters, long wait times at anchor are unusual, but do occur periodically alongside other major events that impact shipping. Two major events occurred in the last decade that resulted in an increase in vessels at anchor: 1) a labor dispute in 2014-2015 between the International Longshore and Warehouse Union (ILWU), the union that represents dock workers on the West Coast of the U.S., and the Pacific Maritime Association (PMA), the organization that handles labor relations for employers of the shipping industry on the U.S. Pacific coast, and 2) the COVID-19 pandemic, which is detailed in the *Port Congestion* section of this Report. Both of these events resulted in a significant increase in the number of vessels at anchor and added extensive time to the duration of vessel stays at anchor.

First, the labor dispute began on June 30, 2014, when the contract between ILWU, and PMA expired. Normal vessel congestion was compounded by complications and delays during the labor negotiations between ILWU and PMA.[230] It took ILWU and PMA nearly nine months to come to terms on a new contract. Over the course of the dispute, ships backed up at anchorages outside of Los Angeles, Long Beach, San Francisco, impacting operations at all West Coast ports. During this time, cargo throughput and anchorage wait times increased steadily until a deal was struck on February 20, 2015. As shown in Figure 23 below, the vessel backlog reached a peak of 36 vessels at anchor in Southern California on February 16, 2015. The backlog of vessels at anchor took another 3 months to clear.[231]

230 Mahoney, B. *Perez brokers end to West Coast ports impasse*. February 20, 2015.
231 Dupin, C. *Congestion disappears from ports of Los Angeles, Long Beach*. American Shipper. May 1, 2015.

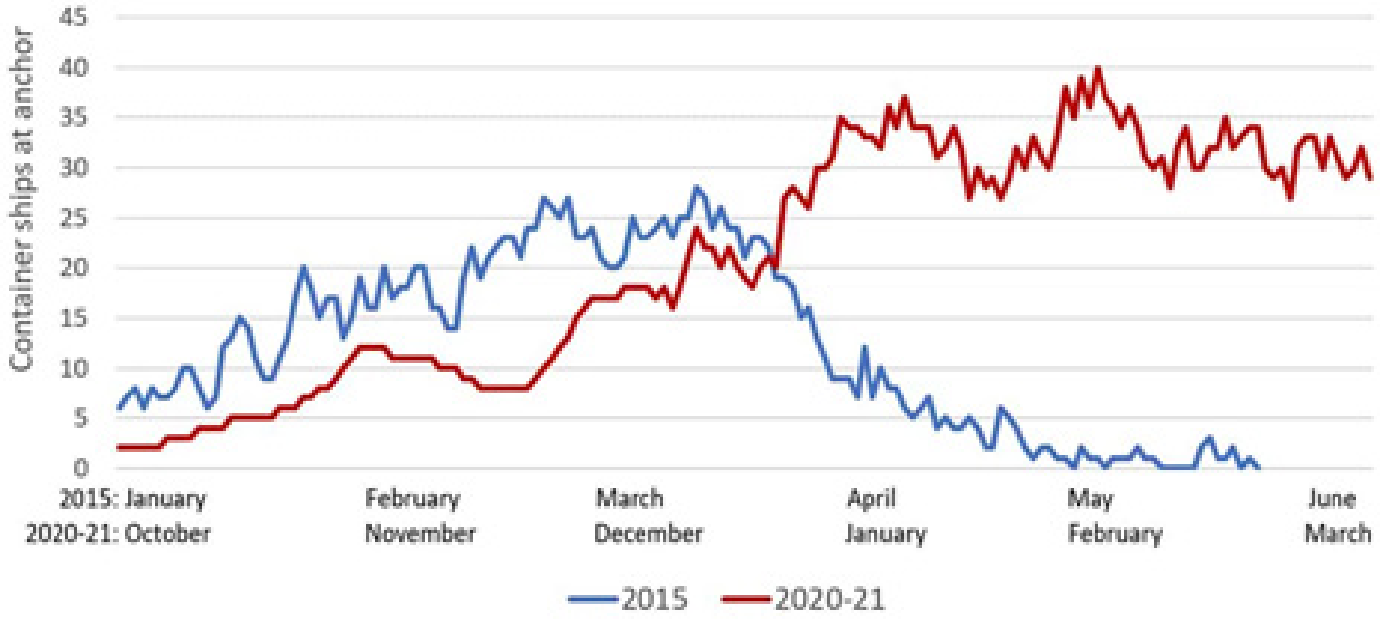
Figure 23: Congestion during ILWU and PMA 2014-2015 Labor Negotiations[232]



As noted in *COVID-19 Pandemic Impacts* of this Report, the port congestion crisis in 2020/2021 associated with the global pandemic resulted in significantly more vessels at anchor and awaiting berths in California regulated waters. In 2020 and 2021, the pandemic resulted in a significant number of unforeseen situations for the shipping industry, including a pause to the cruise industry in California, negative oil prices followed by record high oil prices, and a collapse of the auto market followed by a swift rebound. This chaos caused disruptions to both the supply side and demand side of the economy, resulting in a significant increase to the number of vessels at anchor and the duration of a vessels stay at anchor.

232 Dupin, C. *Congestion disappears from ports of Los Angeles, Long Beach*. American Shipper. May 1, 2015.

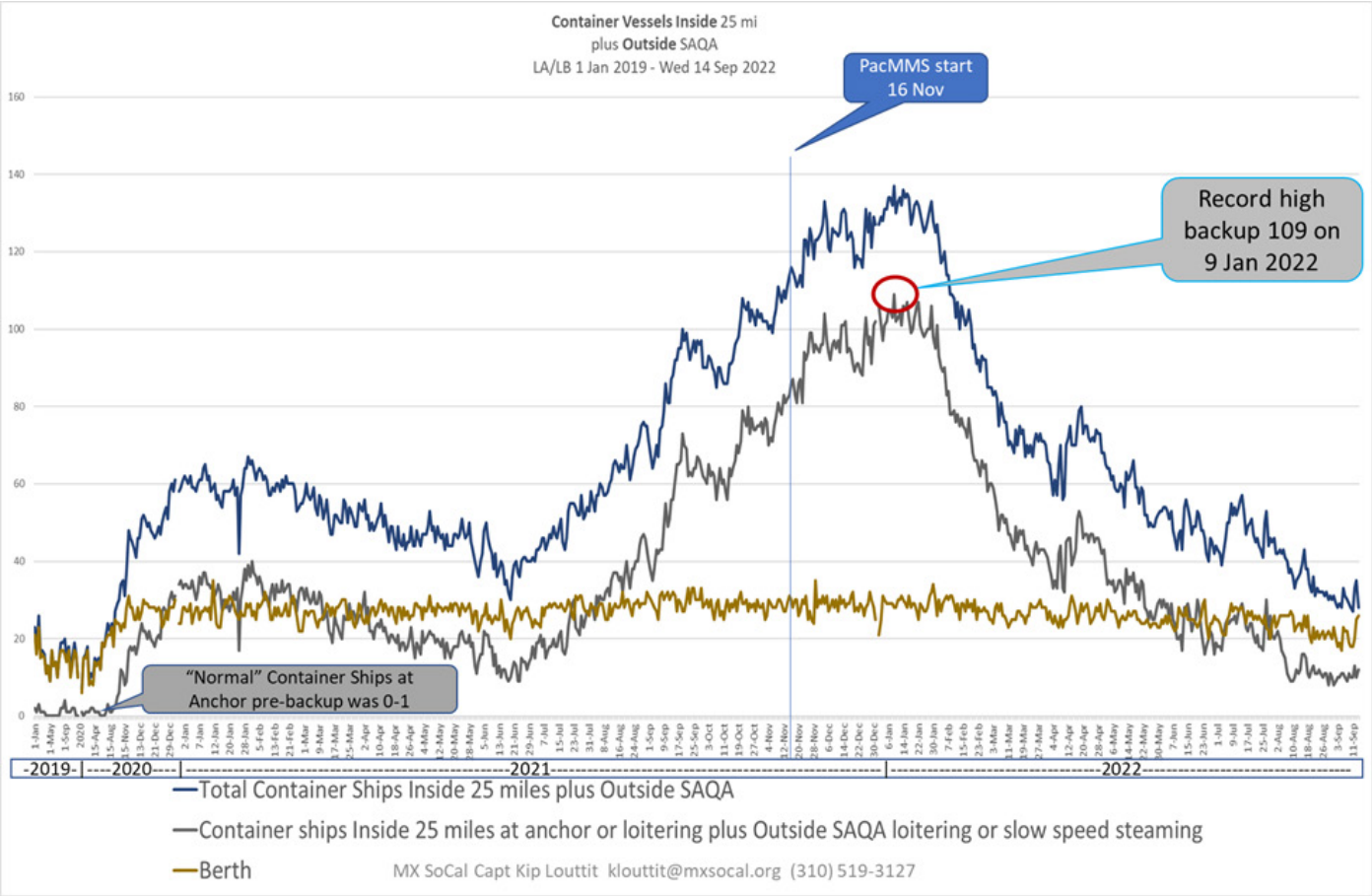
Figure 24: California Congestion Crisis: 2015 Versus 2020-21[233]



The COVID pandemic created a worse situation than the 2014-2015 labor-related congestion, as highlighted in Figure 24. The maximum number of 28 container vessels at anchor in 2015 was dwarfed by the 40 vessels at anchor and a record high 109 container vessels within 25 miles of California regulated waters, either at anchor or loitering in the region. Like the 2015 congestion, the congestion seen in 2021 took months to bring under control. Differently than the congestion in 2015, however, a solution was instituted in the middle of the crisis to dramatically change how and where vessels wait. This shifted activity away from the port communities, as shown in Figure 25 below, and put loitering vessels further away from the California coast, while also eliminating the race to reach California waters and get in line for the next available berth.

233 Miller, G. *California port pileup leaves old records in the dust.* American Shipper. March 8, 2021.

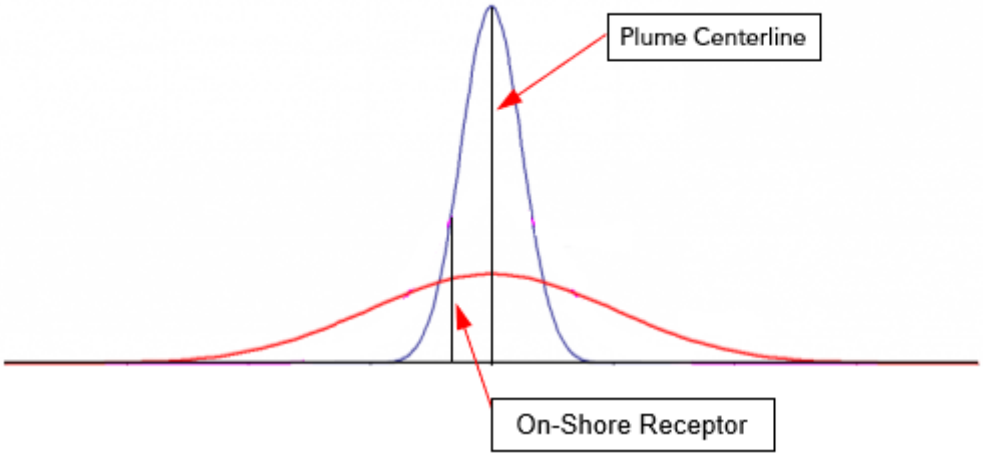
Figure 25: Congestion during the COVID-19 Pandemic



Emissions At Anchor

As noted with the vessel queuing system detailed in the *Port Congestion* section of this Report, reducing the number of vessels at anchor has a direct impact on emission reductions since fewer auxiliary engines will produce less emissions. Moving the location that vessels anchor also has some clear benefits and yet raises some concerns. Typically, when emissions leave a stack, the highest concentration of emissions will follow the plume's centerline (as shown in Figure 26). The highest concentration of emissions are close to the source, and the impacts of the emissions are felt more closer to the source. The blue line represents the emissions as received from a receptor as they travel a distance away from a source. The red line represents the same receptors but with the source moved further away. Moving the source away from a receptor has clear benefits to those closest to the plume's centerline, as the emissions are reduced for the receptor. As emissions are transported, further from the source and centerline of the plume, they will spread out in lower concentrations. The impact of shifting an emissions source away from receptors is complex and can increase emissions in outlying areas even as it reduces emissions near the original source location. A receptor further from the center line may even receive higher emissions as the plume from the new source location has spread to cover a wider area, but at lower concentrations.

Figure 26: Generalization of Emissions from an Exhaust Plume



Even as anchorage and loitering locations are pushed further out, the emissions from anchorage locations still make it onshore in lower concentrations but spread over a wider area. CARB expects that the localized emissions at the port will improve under this strategy, but the impacts of this change are not fully understood, and more investigation is needed to fully understand the impacts of the vessel queuing system and increased offshore loitering. As indicated in the *Port Congestion* section of this Report, the risk of increased anchorage emissions and associated negative health impacts would be reduced if industry continues to operate the vessel queuing system or is able to reinstate a voluntary vessel queuing system again should the need arise. However, it is also important to note that the vessel queuing system is not a legal requirement, meaning there are no laws or regulations in place preventing vessels (and their emissions) from returning to the anchorage areas close to shore in the absence of this system.

Summary

Many of the technology solutions at anchor have significant hurdles to implement; however, the need to reduce emissions from vessels at anchor remain. Through industry's actions, excess emissions associated with pandemic-related port congestion have been reduced with limits to anchorage activity through a vessel queuing system. While shifting activity further from the port has shown to reduce emissions to the nearby port community, emissions are likely still getting to the shore, albeit at reduced concentrations. More research and investigation is needed in this area to determine the direct impact vessels anchoring farther offshore are having on California's port communities. At this time, the best approach to reducing the potential impacts from vessels at anchor appears to be accelerating the transition to cleaner vessels.

CARB is supportive of implementing solutions to reducing emissions at anchor and sees vessels at anchor as an additional opportunity to help further the development of maritime emissions control technologies. Additionally, as an unregulated emission source, projects to reduce at anchor emissions would be eligible for grant funding opportunities that would not be available if the activity were regulated.

Most importantly, onboard solutions provide the best benefit to emissions at anchor because they would also reduce emissions in all modes of operations. Clean vessels are the best option to reduce emissions at anchor, and support CARB's greater clean air goals. Clean vessels that are capable of meeting and exceeding Tier III emissions standards or utilizing zero emission fuels will result in benefits to vessels in every mode, including vessels at anchor/loitering/mooring, transiting, maneuvering, and also at berth.

Conclusion

In conclusion, CARB's Interim Evaluation Report allowed CARB staff to evaluate how the adaptation and installation of emissions control technologies and infrastructure necessary for compliance with the Regulation are progressing and if any revisions to the implementation timeline are necessary. The Report also gave CARB staff the opportunity to re-evaluate the feasibility of control technologies for bulk and general cargo vessels and vessels at anchor to determine if increased activity, further advancements in technology, or any operational changes would warrant inclusion in the Regulation, as directed by CARB's Board at the December 5, 2019, Board Hearing.

A thorough review of stakeholder comment letters, port and terminal plans, Innovative Concept applications, and third-party Feasibility Studies submitted to CARB shows that most vessel and terminal operators are actively pursuing a compliance pathway that will enable them to comply with the compliance deadlines established in the Regulation. The majority of terminal operators and ports intend to pursue shore power (grid-based or distributed generation) or capture and control, with a small percentage of vessel/terminal operators considering alternative fuels or Innovative Concepts as an emissions reduction strategy. These compliance options selected by regulated terminal operators and ports generally reflect CARB staff's *Berth Analysis* that was prepared and presented during the rulemaking efforts for the At Berth Regulation.

The information analyzed as part of this Report do indicate that many regulated entities share concerns regarding the ability of vessels and terminals to design/procure/install emissions reduction technologies in time to meet the compliance deadlines of the Regulation, as well as the technical feasibility and safety of using shore power and capture and control systems on tanker vessels. While CARB staff note that there are challenges facing the shipping industry, particularly for new vessel categories, in complying with the At Berth Regulation, it is also important to note that there were no new significant technological feasibility or timeline concerns brought to CARB staff's attention during the drafting of this Report that cannot be accommodated by the compliance pathways of the Regulation as it is currently written. As such, CARB staff are confident that the Regulation as it is written accommodates the concerns shared by regulated entities and that the majority of regulated entities should be able to comply with the Regulation by the required emissions reductions deadlines. In some cases, CARB staff have not seen sufficient site-specific information to indicate that compliance with the emissions reductions deadlines are not achievable, such as with many of the tanker terminals who provided only general, non-site-specific studies indicating an inability to comply with the emissions reductions deadlines in the Regulation but offered little evidence of attempts to explore compliance pathways. Additionally, it is worth noting that some tanker terminals noted to CARB that they were not pursing a compliance pathway until after the publication of this Report. However, nothing in the Regulation or this Report precluded the ports or terminals from acting to ensure compliance with the Regulation requirements after adoption into state law in 2020.

It is also important to note that while there are concerns from some vessel and terminal operators regarding the feasibility and safety of using emissions control technologies such as shore power and capture and control to comply with the Regulation, a failure to investigate control technologies and perform site-specific Feasibility Studies does not excuse regulated entities from their compliance obligations. All methods of achieving the required emissions reductions should be explored by regulated entities prior to the compliance deadlines, and CARB recommends that vessel/terminal operators and ports communicate with CARB regarding any challenges they specifically may experience with design, procurement, and installation of emissions control equipment. While CARB staff note that there are challenges facing the shipping industry in complying with the At Berth Regulation and recognizes there is no single compliance solution for every terminal throughout California, it is also important to note that there were no new significant technological feasibility or timeline concerns brought to CARB staff's attention during the drafting of this Report that are not

addressable within the boundaries of the Regulation as it is currently written. Additionally, as noted in the *COVID-19 Pandemic Impacts* of this document, all regulated vessel categories have recovered or are recovering steadily from the global pandemic.

Most importantly of all, it is critical not to delay the implementation of emissions reductions from vessels at berth given the health benefits that the Regulation is anticipated to provide to portside communities. As discussed earlier in this Report, CARB's Board considered the need to achieve reductions from vessels at berth so important that they directed staff to move the implementation dates earlier (at the December 2019 Board hearing). Many of California's already-burdened port communities bore the brunt of increased emissions during the global pandemic as a direct result of port congestion and more vessels anchoring offshore.

The Regulation provides several pathways towards compliance when direct emissions reductions are not possible during a vessel's visit to a regulated California port or marine terminal: VIEs/TIEs, the remediation fund, and Innovative Concepts. As mentioned in Introduction of this Report, vessel and terminal operators can use VIEs and TIEs, respectively, to exempt any visit(s) they choose (up to 20 percent of total visits in 2023/2024 and up to 10 percent of total visits from 2025 onward). Additionally, regulated entities can use the remediation fund to remain in compliance if they qualify for one or more of the criteria outlined in section 93130.15(b) of the Regulation. As long as an entity can show CARB documentation proving that the equipment was ordered in a timely fashion and there was an unpreventable delay (such as COVID-related equipment shortages, labor delays or lack of available engineering staff to install the equipment, etc.), then a vessel/terminal operator or port can pay into the remediation fund to ensure their visits to regulated California berths remain in compliance with the Regulation. This mechanism was written into the Regulation to allow for flexibility during extraordinary circumstances. Lastly, if a regulated entity has an Innovative Concept approved for use by CARB, they may also use that Innovative Concept to comply with the Regulation.

Regarding the inclusion of bulk/general cargo vessels and vessels at anchor, while CARB staff did not find that technologies or vessel operations have significantly changed such that controlling emissions from these vessel categories would be any more cost effective than what was shown with the rulemaking documents published for the At Berth Regulation. However, CARB does recognize the potential impacts these vessels may have on both air quality and public health. As noted in *Feasibility of Control Requirements for Bulk and General Cargo Vessels* of this Report, emissions from bulk vessels are projected to grow from increased activity, confirming the need to further explore emission reduction strategies for bulk vessels. Additionally, vessels at anchor have shown to be a significant source of pollution over the past two years, particularly during the peak of port congestion in 2021. Although much of the anchorage activity has been reduced as a result of the vessel queuing system (as described in *COVID-19 Pandemic Impacts* of this Report), CARB staff does not yet have a full understanding of the impacts from emissions associated with vessels drifting farther (50 to 150 nm) offshore. While business-as-usual anchorage emissions are relatively low in comparison to at berth and in-transit modes of operation (as shown in Figures 27 and 28), further investigation is needed to determine if further regulation may be necessary for vessels at anchor to protect public health.

Figure 27: 2037 Projected NO_x Emissions from Ocean-Going Vessels by Mode of Operation[234]

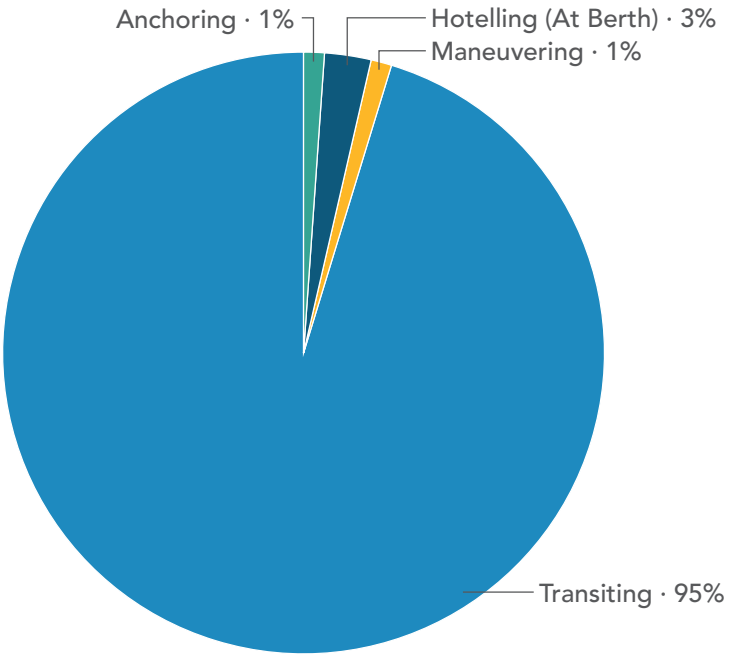
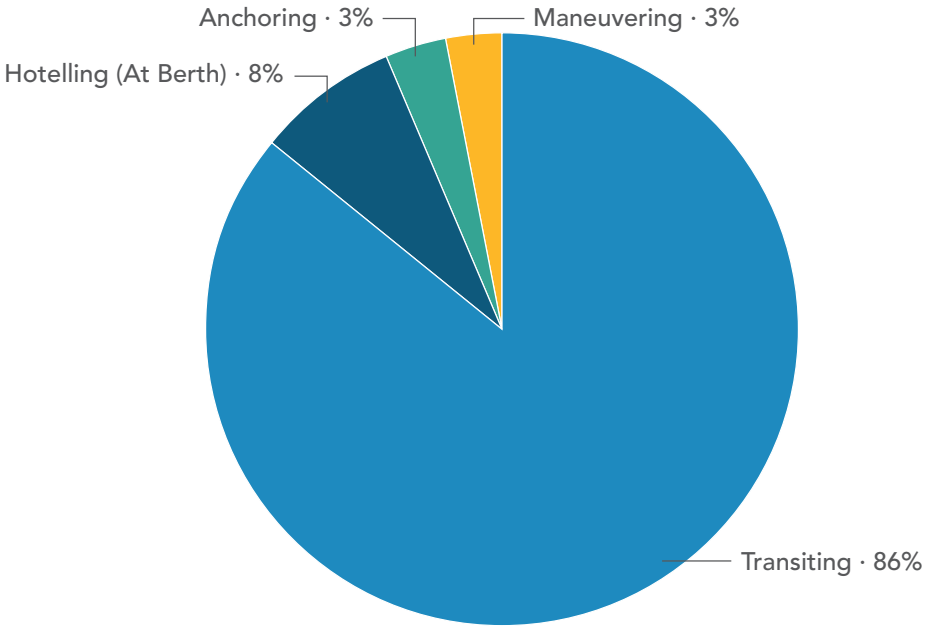


Figure 28: 2037 Projected PM2.5 Emissions from Ocean-Going Vessels by Mode of Operation[235]



234 Includes emissions from OGVs up to 100nm offshore. *CEPAM 2019 V1.03, Standard Emissions Tool.*
235 Includes emissions from OGVs up to 100nm offshore. *CEPAM 2019 V1.03, Standard Emissions Tool*

Future Efforts

While the Regulation is expected to achieve considerable reductions from vessels at berth, a significant amount of emissions is also needed from the transiting, maneuvering, and anchoring of OGVs in and around California's ports and marine terminals or they will continue to impact the health of portside communities. Tackling in-transit emissions from vessels will be necessary to see a significant reduction in NO_x and PM emissions, especially for the South Coast Air Basin. CARB will continue to push for federal action to reduce emissions from OGVs, as outlined in CARB's *2022 State Strategy for the State Implementation Plan;* however, some additional state-led efforts may need to be considered to achieve necessary NO_x and PM reductions from OGVs. In addition to continuing to pursue federal action, CARB staff would recommend that CARB's Board consider directing staff to prioritize the exploration of measures to achieve additional reductions from OGVs while in-transit, maneuvering, and at anchor in California waters.

Addressing in-transit emissions would move California in line with other progressive efforts to mitigate the impact of shipping pollution. For example, the European Union (EU), developed the *"Fit for 55" plan*[236] to address in-transit emissions GHG emissions and climate change. The Fit for 55 plan will place several new requirements on the shipping industry, including subjecting vessels to the EU Emissions Trading System which requires polluting vessels to purchase allowances for each ton of carbon dioxide emitted.[237] Additionally, in the U.S., Congressman Alan Lowenthal recently proposed the *Clean Shipping Act*, which is legislation designed to reduce pollution from the shipping industry in the U.S. It is important to note, however, that the majority of efforts to reduce pollution from the shipping industry, such as the Fit for 55 plan or the Clean Shipping Act, primarily focus on the reduction of GHG emissions. Given the air quality challenges facing California, a more robust approach addressing NO_x, PM2.5, DPM, and ROG, in addition to GHGs, may be necessary in California to meet NAAQS and reduce the health burdens posed by the shipping industry on California's port communities.

236 The EU's *"Fit for 55"* plan targets a net reduction in GHG emissions by at least 55 percent by the year 2030, before achieving climate neutrality by 2050.

237 NAPA. *How the Fit for 55 legislation will affect the shipping industry – and how you can prepare.* February 3, 2022.

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