Performance Incentive Programs for Ocean-Going Vessels and Locomotives Study

Per Board Resolution No. 19-41 (June 13, 2019)

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Contents

1. Introduction

On June 13, 2020, the Port of Oakland Board of Port Commissioners ("Board") approved its *Seaport Air Quality 2020 and Beyond Plan: The Pathway to Zero Emissions* ("2020 and Beyond Plan" or "Plan"; Board Resolution 19-41.) The 2020 and Beyond Plan provides the planning and policy framework for the Port of Oakland ("Port") to continue its efforts to reduce emissions from Seaport operations and improve air quality. Port staff developed the Plan with substantial stakeholder review, input, and engagement through the 2020 and Beyond Task Force and extensive comments on the Draft Plan (June 29, 2018) and the Revised Draft Plan (December 14, 2018). When the Final Plan was presented to the Board for consideration on June 13, 2019, public commenters requested that the Board include a set of follow-up studies in its Plan approval action. Among the requests was a study of performance incentive programs for ocean-going vessels and locomotives. This study fulfills the Board's direction to study the performance incentive programs.

<u>Summary</u>

This study explores existing incentive programs for ocean-going vessels and locomotives. It examines how some major North American ports have developed their own incentive programs or participate in existing programs, including an evaluation of participation levels.

Most existing incentive programs are focused on ocean-going vessels. Few incentive programs address rail tenants or locomotive emissions specifically, aside from general programs such as those promoting engines with improved standards. Most opportunities for rail emissions reductions lie in encouraging railroad companies to apply for grants to help purchase or retrofit engines. While the Port may be able to develop a new incentive program to address rail tenants specifically, there are no existing models for a program of this nature, as compared to ocean-going vessels where numerous programs exist.

For ocean-going vessels, there is a variety of existing incentive program types, primarily vessel speed reduction, green ship indexes, clean engine incentives, and clean fuel programs. Several port authorities combine multiple incentive types into a single "green port" program that rewards shipping lines for their participation with rebates on dockage fees. In some instances, vessel operators may participate in multiple programs and stack incentives cumulatively.

2. Ocean-Going Vessel Incentive Programs and Opportunities

2.1. Existing Programs

There are four primary types of incentive programs for ocean-going vessels used by major ports in North America: vessel speed reduction, green ship indexes, clean engine programs, and clean fuel programs.

2.1.1. Vessel Speed Reduction (VSR)

The basis of VSR programs is to reward shipping lines for operating at slow speeds in specific environmentally sensitive zones near coasts. The typical reduced speed is 10 to 12 knots. Depending on the entity administering the program, the reward generally takes the form of either a discount on docking fees or an annual incentive payment. The purpose of these programs is to reduce ocean-going vessel emissions near shore. Vessels emit less pollution at slow speeds due to the lower main engine load factors required. In some cases, programs are also intended to protect whale populations by reducing both underwater noise and the possibility of strikes.

Specific programs are discussed in more detail in the Section 2.2 of this study. This discussion includes the programs at the Ports of Los Angeles, Long Beach, and New York/ New Jersey, and the local

Protecting Blue Whales and Blue Skies program, all of which offer financial incentives and media recognition for vessel owners and operators for operating at reduced speeds near ports or coastlines.

2.1.2. Green Ship Indexes

The purpose of a green ship index incentive program is to reward shipping lines for operating vessels with environmental performance superior to regulatory requirements. Several global green ship registry and rating organizations exist and allow vessel operators to register if they have vessels that meet specific environmental criteria, which differ by program. Many of the criteria are focused on emissions, but they also include chemical pollution from antifouling coatings, gear oils, hydraulic fluids, cooling water treatment, cleaning agents, refrigerants, and handling of sewage, garbage, and bilge water.

Typically, programs give each registered vessel a rating based on its environmental performance, and then provide this information to participating entities, including ports. Ports, in turn, can choose to reward shipping lines using vessels registered with a green ship index program. Specific programs in which major North American ports currently participate include the Environmental Ship Index (ESI), RightShip, Clean Shipping Index (CSI), Green Marine, and Green Award. Additionally, some ports have vessel awards based on the International Maritime Organization's (IMO's) energy efficiency design index, which is a measure of energy efficiency required for all new vessels since 2012.

The ports of Los Angeles, Long Beach, New York/New Jersey, and Vancouver BC all participate in a version of green ship index incentive programs.

2.1.3. Clean Engine Programs for Ships

Several North American ports have developed their own in-house programs which reward vessel operators for the use of cleaner than required ocean-going vessel engines. These programs are developed and administered in-house at ports. Rewards are based on EPA engine standards and provide a fixed rebate per call for using vessels with Tier 2 or Tier 3 engine standards.

- Tier 2 standards provide a 15%-25% reduction in oxides of nitrogen (NOx) over Tier 1 standards
- Tier 3 standards use selective catalytic reduction to achieve 80% NOx reductions over Tier 1 standards.
- There are no diesel particulate matter (DPM) or greenhouse gas (GHG) standards associated with any of these tier levels, therefore higher tiered engines do not provide any quantifiable reductions in DPM or GHG. DPM is the pollutant of highest concern for the Port of Oakland and its community.

Typical methodology for these programs is to have vessel operators with eligible vessels register with the sponsoring port and provide verification documents, which the port may also verify separately through ESI data or ship classification societies (e.g. Lloyd's Register).

The ports of Los Angeles, Long Beach, New York/New Jersey, and Vancouver BC all provide incentives for vessels based on EPA engine standards.

2.1.4. Clean Fuel Programs for Ships

Historically, clean fuel programs have been popular worldwide to encourage vessel operators to switch to cleaner fuels, typically while transiting near shore. However, in recent years, environmental regulations have made most of these programs obsolete. This is particularly true in California, where the state implemented shore power regulations to largely eliminate the need to burn fossil fuels while hoteling. Other worldwide programs promoting fuels with lower sulfur content were also largely made obsolete by the IMO 2020 sulfur regulation.

Of the major North American ports surveyed for this study, only the Port of Vancouver (British Columbia) currently operates a clean fuel incentive program for vessels. Shore power is not required by regulation there, and not all facilities have installed shore power infrastructure.

The Port of Oakland closely examined the issue of sulfur content of vessel fuels in Spring 2020 during the Evaluation process for the 2020 and Beyond Plan for Group 1 Suggested Actions.[1] The analysis found that, based on 2019 enforcement data from the California Air Resources Board, the actual in-use fuel sulfur content in California vessels averages about 0.05%. This is cleaner than the maximum allowed by regulation, which is 0.1% sulfur content. The Port analyzed what the possible benefit could be if ships could switch to even cleaner ultra-low sulfur diesel (ULSD) with 0.0015% sulfur (this is the same as on-road diesel fuel in California). There are currently safety and engine design considerations that may preclude ULSD in marine engines. However, if those issues could be resolved and Oakland could achieve a 100% ULSD usage, the near-shore benefit while the vessels are maneuvering between the Bay Bridge and the berths could be around 0.45 tons of DPM reduction.[2]

The analysis looked at the price comparison for ULSD as well. In November 2019, California-compliant marine gas oil (MGO, below 0.1% sulfur) cost about $700/tonne. The price for ULSD, if it were available in the quantities and locations required by vessels, might cost around $825/tonne, or about 18% more.

2.2. Experience at Other Ports

This section discusses the ocean-going vessel incentive programs at four major North American Ports: Los Angeles, Long Beach, New York/New Jersey, and Vancouver BC. While these are not the only ports with incentive programs, they have some of the most robust programs available with significant levels of participation. Each of these ports offers an incentive program with its own unique combination of VSR, green ship indexes, clean engines incentives, and clean fuel incentives.

2.2.1. Port of Los Angeles (POLA) and Port of Long Beach (POLB)

POLA and POLB are considered together as they both operate similar programs and have some joint programs. Both ports have very similar VSR programs. Both also operate green ship index incentive programs, although POLA's is primarily based on the ESI, while POLB has their own Green Ship Incentive Program. Additionally, both POLA and POLB have a unique joint Technology Advancement Program, which provides financial incentives for vessels demonstrating new emission reducing technologies. Each of the programs has different administration methods, registration and documentation requirements, financial structures, and participation levels as described below. Most financial incentives are provided in the form of quarterly or annual rebates on dockage fees.

POLA and POLB VSR

[1] For reference, Group 1 Suggested Actions included all Port-related strategies listed in the West Oakland Community Action Plan, published by the Bay Area Air Quality Management District in October 2019, plus some Suggested Actions selected by Port staff. One of the Suggested Actions promoted by Port staff was the use of ultra-low sulfur diesel in vessels. The Evaluation and Prioritization Memo (April, 2020) and accompanying technical memos (May 2020) are available on the Port's website here: https://www.portofoakland.com/community/environmental-stewardship/maritime-air-quality-improvement-plan/

[2] The analysis found a DPM reduction benefit during berthing as well, however these reductions are based on 2017 levels of shore power usage which was about 68%. New amendments to the At-Berth regulation will start requiring 100% plug-in rates in 2023. As shore power usage increases to meet the new goals, the benefits of ULSD at-berth decrease.

POLA and POLB both adopted one of the earliest VSR incentive programs in the world in 2001. The program rewards vessel operators which approach or depart San Pedro Bay at a weighted average of 12 knots or slower beginning at 20 or 40 nautical miles (nm) from the edge of the Precautionary Zone as shown in Figure 1. Both ports' programs require participating vessel operators to have a 90% minimum compliance rate across all vessel trips in their fleet in a year to be eligible for incentives.

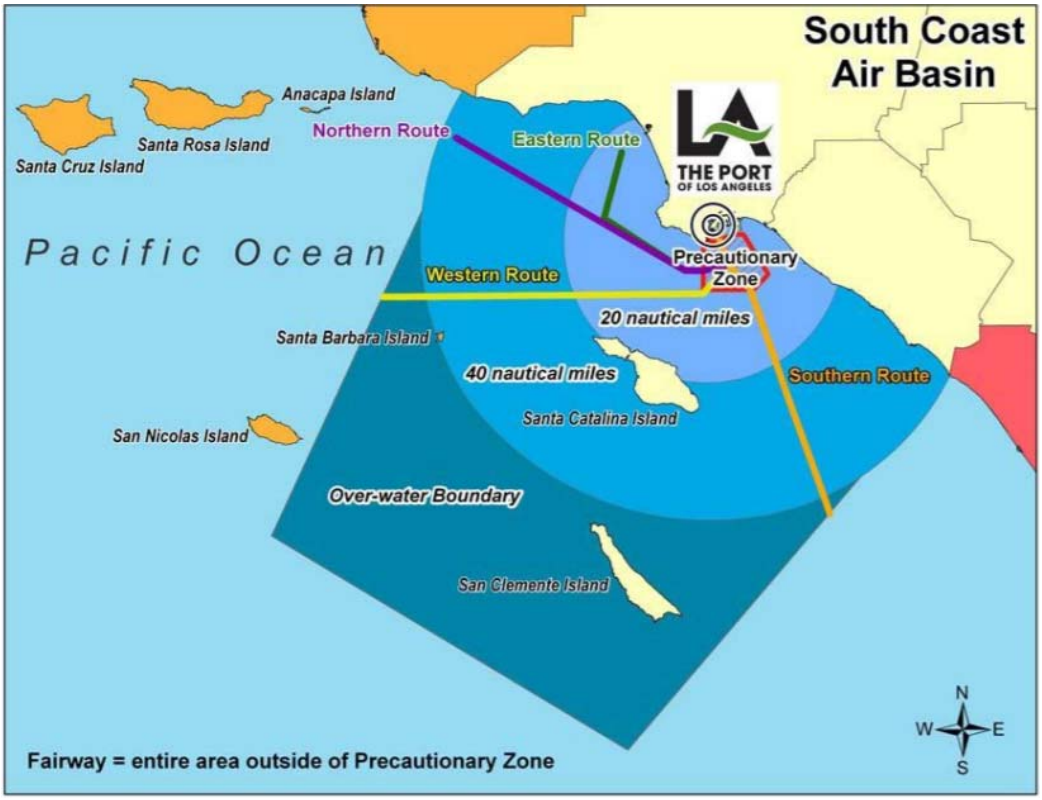

Figure 1: Boundary of the POLA and POLB VSR Programs[3]

Neither VSR program at POLA and POLB requires registration. Participation is based on speed data compiled by the Marine Exchange of Southern California and provided to POLA and POLB. Incentives are provided in the form of an annual rebate to shipping lines.

[3] https://kentico.portoflosangeles.org/getmedia/0e57c1fd-0997-424a-92f3-547f31713b11/VSR-Instruction-Guidelines-2020

Both POLA and POLB provide two tiers of incentives depending on whether vessels comply at the 20 nm or 40 nm boundary lines (incentives cannot be combined). The total incentives differ by port.

For POLA, incentives are[4]:

- Tier 1 (20 nm): A 15% refund on the first day of dockage per vessel visit
- Tier 2 (40 nm): A 30% refund on the first day of dockage per vessel visit

For POLB, incentives are[5]:

- Tier 1 (20 nm): A 15% refund on total dockage fees
- Tier 2 (40 nm): A 25% refund on total dockage fees

The programs are administered internally by port staff, who provide an annual report of vessel activity to all eligible vessel operators, including the calculated incentive amount. Vessel operators review the annual report and report any discrepancies, if noted. Once agreement is reached, the vessel operator then provides an invoice to ports in the amount of the agreed upon rebate, along with required documentation, including the relevant city's Business Tax Registration Certificate and a W-9 for U.S. Entities or a W-8BEN for non-U.S. Entities.

The VSR program has a high level of participation, as noted in Table 1 below summarizing the percentage of annual vessel calls in compliance with VSR. Only 2020 data are available for POLB, but program information indicates participation levels consistently exceed 90%.

Table 1: POLA & POLB VSR Participation Levels – Percent of Annual Vessel Calls of All Types Compliant with VSR[6]

Port & Fiscal Year	Tier 1 (20 nm)	Tier 2 (40 nm)
POLA 2015	93%	83%
POLA 2016	92%	80%
POLA 2017	92%	84%
POLA 2018	91%	84%
POLA 2019	91%	87%
POLA 2020	94%	91%
POLB 2020	98%	93%

While exact emission reductions have not been tabulated as a result of the VSR program, it is well-established that reduced vessel speeds are effective at reducing vessel emissions. A study by the California Air Resources Board estimated that VSR programs reducing vessel speed to 12 knots (like the POLA program) resulted in 61% reductions in CO_2 and 69% reductions in PM2.5, compared to typical vessel cruising speeds of 20-25 knots[7]. It should be noted that vessels within the San Francisco Bay are already limited to a maximum of 15 knots, well below containership cruise speeds of 20-25 knots, so reductions in the Port of Oakland context would be less than noted here.

[4] POLA Tariff No. 4, section 20, Item No. 2045 at https://www.portoflosangeles.org/business/tariff

[5] POLB Tariff No. 4, section 20, Item No. 2045 at https://thehelm.polb.com/download//382/port-tariff/6784/port-tariff-no-4-123119.pdf

[6] Compiled from data provided at https://www.portoflosangeles.org/environment/air-quality/vessel-speed-reduction-program and https://polb.com/download/171/green-flag-program/8975/green-flag-program-operator-compliance-report-2019-annual.pdf

[7] https://ww3.arb.ca.gov/ports/marinevess/vsr/vsr.htm

POLA Environmental Ship Index Incentive Programs

To receive POLA ESI incentives, vessel operators must register each eligible vessel first with International Association of Ports and Harbors' (IAPH) World Ports Climate Initiative ESI program, which provides a point score to each vessel based on NOx, SOx, and CO_2 emissions rates. A higher score indicates superior environmental performance. Once operators have registered with the IAPH, they must then also register with the Los Angeles Harbor Department to be eligible for incentives from POLA. Only vessels registered with the Harbor Department ahead of their call are provided incentives.

Incentives for the POLA ESI Program are based on the score provided to each vessel, as follows[8]:

- 40-49: $750 per call
- 50 or greater: $2,500 per call

Additionally, POLA provides a $5,000 per call incentive to vessels with Tier 3 complaint engines; this information is also provided by the ESI program. This incentive can be combined with the ESI score incentive above.

Administration of the program is similar to VSR, except POLA staff provide reports of vessel activity and incentive calculations quarterly rather than annually.

There is no publicly available data on participation in POLA's ESI program, making it difficult to assess whether the program has had a measurable impact on changing vessel operators' behavior and resulting in reduced emissions, as opposed to simply providing a financial reward to vessel operators who had already planned to use vessels with ESI ratings of at least 40.

POLB Green Ship Incentive Program

POLB's Green Ship program provides financial rewards to vessel operators who use either Tier 2 or Tier 3 compliant engines. Vessels with Tier 2 engines receive $2,500 per call, while vessels with Tier 3 engines receive $6,000 per call.

Vessel operators must register each compliant ship with the POLB ahead of any calls to be eligible, and provide documentation including tax IDs and engine certificates. Reports on eligible vessel visits are provided to vessel operators quarterly, and payments are made to operators via checks from the City of Long Beach.

There are little data available to evaluate the efficacy of this program. POLB's fact sheet for this program states that "the program's goal is to have, by 2023, 50 percent of all ship calls at the Port of Long Beach from Tier 2 vessels and 40 percent from Tier 3, which would reduce nitrogen oxide emissions from ships by 2,700 tons a year."[9] No data are available on current participation rates or whether the program is encouraging vessel operators to use cleaner engines, or simply rewarding those who already do so.

POLA and POLB OGV Technology Advancement Program Demonstration

POLA and POLB have a Technology Advancement Program (TAP) providing incentives to vessels who demonstrate new technologies that provide emission reduction benefits. The TAP is part of the Clean Air Action Plan (CAAP). The total incentive is $750 per eligible vessel call.

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[8] https://www.portoflosangeles.org/environment/air-quality/environmental-ship-index

[9] https://thehelm.polb.com/download/258/green-ship-program/3908/green-ship-incentive-program-fact-sheet-070113.pdf

Demonstrating eligibility for this incentive is far more complex than other POLA and POLB incentive programs, as the purpose is to test new and often unproven technologies. As such, approval of each Port's Board of Harbor Commissioners is typically required for eligibility. In 2019, only one vessel operator participated in the TAP, with two vessels. Specifically, this was the Maersk Ocean-Going Vessel Energy Efficiency Measurement Demonstration Project.

2.2.2. Port Authority of New York/ New Jersey (PANYNJ)

The PANYNJ operates a program called the Clean Vessel Incentive (CVI) Program. The CVI Program combines multiple incentive types into a single program and provides a total score for participation levels each in aspect of the program. The CVI Program combines three types of typical incentives based on Tier 3 engine standards, VSR compliance, and ESI score.

VSR at the PANYNJ

The PANYNJ VSR programs expands on an existing National Oceanic and Atmospheric Administration (NOAA) Right Whale Ship Strike Reduction Rule requiring large vessels to slow down to 10 knots or less near the coast to reduce the probability of whale strikes. The VSR program provides rewards to vessels operating at 10 knots or less within 20 nm of the port, as seen in Figure 2 below. The NOAA rule applies only from November 1 through April 30; the PANYNJ provides incentives year-round. Speeds are verified by the PANYNJ using United States Coast Guard Automated Identification System (AIS) data.

Figure 2: Boundary of the PANYNJ VSR Programs[10]

The PANYNJ VSR program may provide a good model for a potential program at the Port of Oakland, perhaps expanding the timing and geography of the existing local seasonal vessel speed reduction (the Protecting Blue Whales and Blue Skies program). The opportunity for the Port of Oakland is discussed at the end of this section.

[10] https://www.panynj.gov/port/en/our-port/sustainability/clean-vessel-incentive-program.html

For reference, the PANYNJ pays about $60,000 per year to a consultant to administer their VSR program, including all vessel tracking, coordination with participants, and auditing of records[11]. This cost is in addition to the incentive payments.

PANYNJ CVI Program Registration, Administration, and Incentives

The PANYNJ requires all participating vessel operators to first register with the ESI program and have a valid ESI score for each eligible vessel. They may then register for the CVI program by filling out forms provided on the PANYNJ website and providing relevant tax ID documentation. The PANYNJ then reviews registration materials and sends vessel operators confirmation of their enrollment in the program. Only then are registered vessels eligible for incentives for future vessel calls.

As at POLA and POLB, PANYNJ staff provide quarterly reports to enrolled vessel operators detailing vessel activities eligible for reimbursement and calculating incentive amounts. Vessel operators are responsible for reviewing provided reports for accuracy and submitting an invoice for the calculated incentive amounts. The PANYNJ has an annual funding cap of $1.5M for the CVI program; after this is reached, they will cease reimbursements for eligible vessel calls.

As long as the funding cap has not been reached, the PANYNJ provides reimbursements based on the CVI Program's calculated score, which combines a vessel's ESI score with additional points for VSR participation. A CVI score is provided on a per-call basis for eligible calls. Calls are awarded 20 points for VSR compliance in a single direction, or 40 points for compliance in both directions (inbound and outbound trips).

Total CVI score per call is a vessel's ESI score plus VSR score. Incentives are as follows[12:]

- > 90 receives $3,000 per call
- 70-89 receives $2,000 per call
- 40-69 receives $1,000 per call

An additional $5,000 per call is provided for calls with Tier 3 engine standards.

Little recent participation data is available on the program, but the PANYNJ cites that the 2018 CVI programs is associated with 7.1 tons of PM reduction and 15,626 tons of CO2 reduction[13]. Nine major containership lines participate in the program: Evergreen, ONE, ACL, COSCO, Hapag-Lloyd, Yang Ming, NYK, Maersk, and HMM.

[11] Approximate billing from Starcrest LLC to PANYNJ for administration of their VSR program in 2017, per email exchange with A. Agrawal of Starcrest dated 10/9/2020.

[12] https://www.panynj.gov/content/dam/port/our-port/clean-vessel-incentive-program/CVI-Terms-and-Conditions-2020.pdf

[13] https://www.panynj.gov/port/en/our-port/sustainability/clean-vessel-incentive-program.html

2.2.3. Port of Vancouver BC

The Port of Vancouver BC has developed a program called EcoAction which combines numerous incentive types into a single program. The program includes:

- Green ship programs: ESI, RightShip, Clean Ship Index, Green Marine, Energy efficiency design index, and Green Award
- Clean fuel incentives: natural gas and biofuels
- Vessel and engine technologies: Shore power, vapor control, underwater noise reduction, and Tier 3 engines

There is one registration process per vessel for each of the above incentive types included in the EcoAction program. Vessel operators select the relevant incentives for which they wish to apply for each vessel, provide the vessel's name and IMO number, and upload relevant supporting documentation for each incentive type, such as ship index program registration information, engine certification data, etc.

Based on registration information, the Port of Vancouver determines whether each vessel is eligible for one of three levels of incentives: Gold, Silver, or Bronze. Unlike the Ports of Los Angeles, Long Beach, and NYNJ, incentives are built into the billing structure of each call, with lower harbor dues rates depending on the level of incentives achieved.

Port of Vancouver dockage fees are based on gross registered tons (GRT) of each vessel. In 2019, these rates were[14]:

- Gold: $0.050/GRT (47% discount)
- Silver: $0.061/GRT (35% discount)
- Bronze: $0.072/GRT (23% discount)
- Basic (no incentive): $0.094/GRT

Fee rates can be reduced significantly for vessels with superior environmental performance. The Port of Vancouver decides how to categorize each eligible vessel; it is unclear what exact methodology they use to do so. Program information indicates only that vessel categorization is based on performance of environmental measures as determined by the port.

The Port of Vancouver also provides what it calls Blue Circle Awards to fleets with superior environmental performance. The award requires vessel operators to have at least 5 eligible calls, and to have at least 50% of all calls eligible for incentives. 27 total shipping lines received Blue Circle Awards in 2019, including many major containership lines such as CMA-CGM, Hapag-Lloyd, Evergreen, COSCO, HMM, MSC, Maersk, ONE, and Yang Ming.

[14] https://www.portvancouver.com/wp-content/uploads/2019/02/EcoAction-Program-Brochure-Online-v%C6%92-2019_FINALlrg.pdf

Published participation levels in the EcoAction program show only the total eligible calls per year, as given in Table 2 below, which shows participation levels growing over time.

Table 2: Port of Vancouver BC EcoAction Program Participating Vessel Calls[15]

Year	Qualifying Calls
2010	498
2011	332
2012	440
2013	521
2014	520
2015	416
2016	612
2017	762
2018	874
2019	986

For context, there were 3,102 vessel calls in 2019[16], so about 32% all vessel calls participated in the EcoAction program. No estimates of actual emission reductions achieved by the program are available.

Protecting Blue Whales and Blue Skies

The Protecting Blue Whales and Blue Skies program is a VSR program that provides either financial incentives or recognition to shipping lines who voluntarily slow to 10 knots or less along the California coast near the San Francisco Bay or Santa Barbara. A map of boundary of the program in the San Francisco Bay Area is given in Figure 3 below.

The program runs from mid-May to mid-November annually as it is primarily aimed at protecting seasonal whale population. It is a joint program involving several entities, including the Air Districts of Santa Barbara, Ventura County, and the Bay Area, and is administered by the National Oceanic and Atmospheric Administration (NOAA) National Marine Sanctuaries. The program is only open to containerships and auto carriers and requires entire fleets to participate to be eligible for awards.

[15] https://www.portvancouver.com/environment/air-energy-climate-action/marine/
[16] https://www.portvancouver.com/wp-content/uploads/2020/03/Statistics-overview-2017-to-2019.pdf

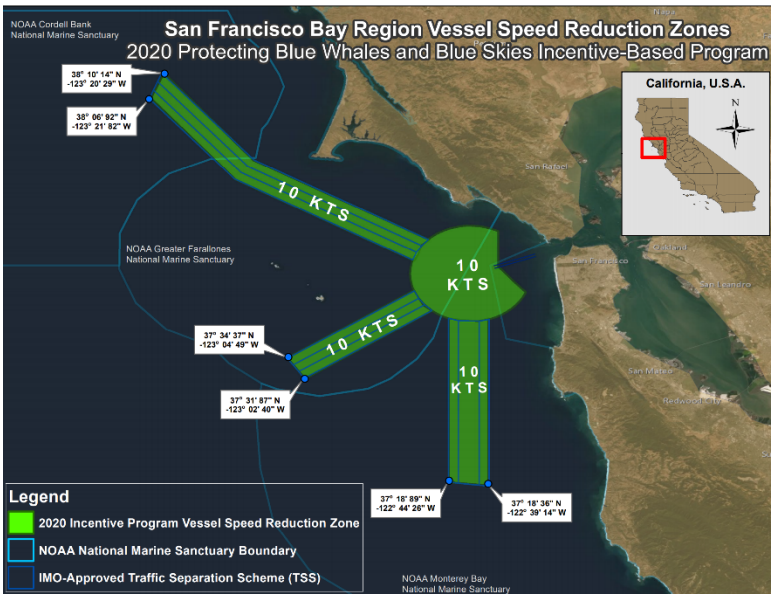

Figure 3: Map of the Protecting Blue Whales and Blue Skies Program around the SF Bay[17]

The registration process for the program is simple, with interested vessel operators only needing to fill out a brief sign-up form available online and sign a Letter of Understanding. AIS data are used to determine speeds of registered vessels to calculate incentive eligibility. The 2020 program has three tiers of incentives[18]:

- Blue Sky: 25% or more of distance traveled at 10 knots or less
- Gold: 50% or more of distance traveled at 10 knots or less
- Sapphire: 75% or more of distance traveled at 10 knots or less

Exact incentive amounts are determined after the program concludes as the program has a funding cap of $200,000 per year, and incentives are scaled to the level of participation of each vessel operator. Alternatively, vessel operators who chose to forgo financial incentives are given additional public recognition.

The program was expanded to the San Francisco Bay Area in 2017. Table 3 show participation levels for the three years of local eligibility for the program, as well as emission reductions estimated by the program. Only GHG and NOx reduction estimates are available.

Table 3: Protecting Blue Whales and Blue Skies Participation in Santa Barbara and San Francisco

Year	2017	2018	2019
Companies	11	12	15
Vessels	44	280	349
Slow Speed Distance (nm)	12,630	46,026	99,019
NOx Reduction (tons)	84	266	536
GHG Reductions (metric tons)	2,630	8,668	17,026

[17] https://www.ourair.org/wp-content/uploads/2019_VSR_Brochure.pdf
[18] http://www.ourair.org/wp-content/uploads/2020-VSR-Attachment-B.pdf

Table 3 indicates the program has had some success in influencing vessel operators' behaviors with only small financial incentives and media recognition. Major containership lines participating include MSC, Hapag-Lloyd, Evergreen, Maersk, COSCO, Yang Ming, Matson, ONE, K Line, NYK, and PIL.

As the program operates only seasonally and the boundary terminates outside of the San Francisco Bay, there may be an opportunity for the Port to provide incentives to vessel operators who comply with program requirement annually, and within the geographic bounds of the San Francisco Bay not covered by the existing program.

2.3. Port of Oakland Ocean-Going Vessel Incentive Opportunities

There are opportunities for the Port of Oakland to develop ocean-going vessel incentive programs similar to those operated at the Port of Los Angeles, Long Beach, NYNJ, and Vancouver BC, but tailored to the local context. The primary two opportunities are an expanded VSR program, and a clean ship incentive program focused on encouraging use of vessels with superior environmental performance. These two opportunities are described in more detail below, however they have low potential for meeting the goals of the 2020 and Beyond Plan to reduce GHG emissions or reduce PM exposure in West Oakland.

Possibilities for VSR at the Port of Oakland

Like the PANYNJ, the Port of Oakland could expand on the existing local VSR program discussed above (Protecting Blue Whales and Blue Skies) and reward shipping lines that operate at slow speeds past the boundary of this existing program when transiting to and from the Port, as well as provide incentives year-round rather than seasonally.

Using the models provided by other existing port VSR programs, a local expanded VSR incentive program would likely require the Port to do the following:

- Develop a set of program requirements and incentives, e.g. minimum percentage of calls in compliance to receive an award, total incentive per eligible call, and a funding cap if desired.
- Provide online registration forms for vessel operators wishing to participate and list documentation that will be needed, such as proof of registration in the Protecting Blue Whales and Blue Skies Program, tax ID documents, etc.
- Develop annual reports of eligible vessel activity based on AIS data to be submitted to each participating vessel operator, and process invoices submitted by operators with agreed upon incentive values.
- Provide annual press releases recognizing participation by shipping lines in the program.
- Add a page to the Port's website recognizing participants

However, it must be noted that there is already a speed limit of 15 knots between the COLREGS demarcation line and the Port of Oakland[19]; see Figure 4 below.

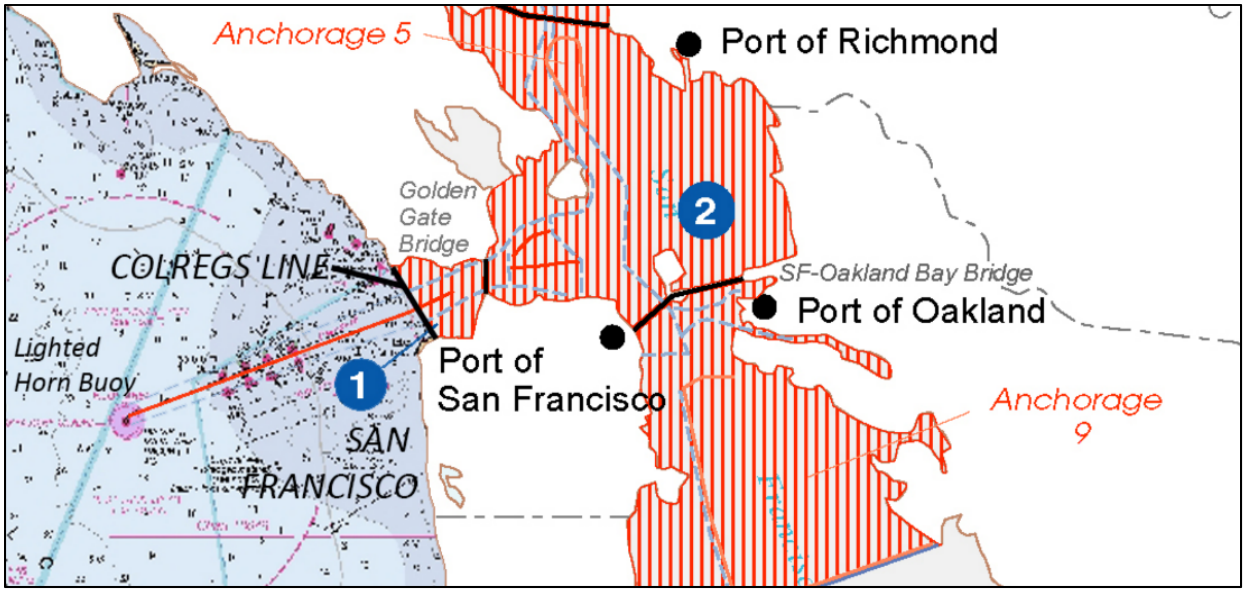

Figure 4: Geographic Limits of the Harbor Safety Plan; red hatching indicates tug escort and 15 knot max speed zone[20]

This existing speed limit already reduces vessel transiting emissions compared to maximum vessel cruising speeds of 20 to 25 knots. An analysis of AIS data shows that vessel speeds rarely exceed 15 knots east of the Sea Buoy where Bar Pilots embark and disembark[21]. A small amount of further reductions may still be possible within the Bay if vessels are incentivized to slow from 15 knots to 12 knots. However, the main benefit of a VSR program would be located west (seaward) of the Sea Buoy.

A VSR program would need to be reviewed by the US Coast Guard and San Francisco Bar Pilots to ensure the program will be safe and not interfere with other marine traffic. Pilots have expressed concern about slowing ships down further within the San Francisco Bay because vessels must maintain sufficient speed to be able to maneuver. Therefore, slowing to 12 knots may not be safe within the Bay.

Possibilities for Clean Ship Incentive Program at the Port of Oakland

As discussed, many ports have developed their own clean ship incentive program. These programs are usually a combination of award for participation in some selected green ship index program, often the ESI, along with additional incentives for using Tier 3 engines. Administration of the program at the Port of Oakland would depend on how the Port developed such a program, should it choose to do so. Based on the models discussed, it would likely require the following:

- Develop a set of program requirements and incentives per vessel call, and a funding cap if desired.

[19] https://www.sfmx.org/wp-content/uploads/2020/05/HSC-Plan-2019-Final.pdf, pg. 29
[20] https://www.sfmx.org/wp-content/uploads/2019/09/2018-07_HSCBayAreaMaps.pdf
[21] "Port of Oakland 2017 Seaport Emissions Inventory," prepared for Port of Oakland by Ramboll, August 2018.

- Develop online registration forms and guidance on required documentation, typically including tax ID information, names and IMO numbers of eligible vessels, and information on registration in a selected global green ship index program (such as the ESI).
- Prepare quarterly reports for each registered vessel operator summarizing vessel calls eligible for funding, and then process invoices for the incentive amounts for each operator until funds are exhausted.

It may be instructive to investigate how many of the vessels which currently call at the Port are already operating with Tier 3 engines or are maintaining ships with ratings indicating superior environmental performance at various green ship index programs, such as ESI scores above 40. This would provide some context as to whether there is an opportunity to influence vessel operator behavior, or whether the Port would just be rewarding vessel operators for activities they were already undertaking.

It is important to note that the benefit of higher tiered engines is reduced NOx emissions. Higher tiered vessels do not reduce PM. Therefore, a Clean Ship Incentive Program would not reduce DPM exposure for workers at the Port or community members in West Oakland.

3. Locomotive Incentive Programs and Opportunities

There are few incentive programs specifically for locomotives. Some grant programs exist which can be applied to locomotives, a few of which are discussed below. All existing locomotive programs are aimed at reducing emissions either through increased EPA engine Tier standards, or new technologies. None could be identified that reward locomotives based on activity levels like the ocean-going vessel programs discussed. Instead, they are fixed incentive programs, generally grants for engine replacements or retrofits.

As such, the primary opportunity at the Port of Oakland to incentive reductions in locomotive emissions is to encourage continued use of existing major grant opportunities for which locomotives are eligible. Some of these programs are summarized below and include programs that have been used recently for locomotive improvements at the Port of Oakland.

There are two types of locomotives: switchers (used for moving rail cars within a rail yard), and line haul (used for pulling entire trains across the region and country). Switchers are generally smaller engines. An incentive program for line hauls would be similar to a Clean Ship program on the waterside, rewarding rail lines for bringing cleaner engines to the Port. An incentive program for switchers would need to be based on percent of work performed by cleaner switchers.

3.1. Existing Grant Programs for Locomotives

This section describes three existing grant and funding opportunities available for locomotives.

3.1.1. Air Quality District Programs

Some California air quality districts have grant programs which are specifically aimed at or can be used to support reducing locomotive emissions. For the Bay Area Air Quality Management District (BAAQMD), this is primarily the Carl Moyer Program, which is a CARB program administered by local air quality districts, with funds available on a first-come, first serve basis. Funds are available for three types of locomotive projects: replacing an existing locomotive with a Tier 4 locomotive, repowering an existing locomotive to Tier 4 standards, or replacing head end power units with a Tier 4 engine. The most recent report on the Carl Moyer program was produced in 2017 and indicates the following regarding locomotives:

Table 4: Carl Moyer Locomotive Funding from 2006-2017 for All Air Districts[22]

	Engine Count	Lifetime PM Eliminated (tons)	Funds Executed	$/ton of PM eliminated
Locomotives - Idle Limiting Device	61	14	$770,598	$55,043
Locomotives - New Purchase	69	126	$54,671,196	$433,898
Locomotives - Remanufacture Kit	3	5	$575,163	$115,033
Locomotives - Repower	52	44	$24,473,446	$556,215

Twenty-eight of the locomotive grants from 2006-2017 in Table 4 went to projects located in the Bay Area, resulting in 33.3 tons of PM reduction for a cost of $13,997,454 ($420,344/ ton of PM).

3.1.2. EPA Diesel Emissions Reduction Act (DERA) Grants

A variety of public entities, including port authorities and air districts, are eligible to apply for DERA grants, which can be used to fund locomotive projects. As rail tenants are not eligible, the Port would have to work with tenants to select viable projects and work with BAAQMD to support applications. This strategy has been used in recent years. Some recent CA-based examples include23:

- In 2018, a $719,500 locomotive replacement grant was awarded at the POLB through a South Coast Air Quality Management District application
- In 2017, a $639,670 locomotive replacement grant was awarded at the Port of Oakland through a BAAQMD application
- In 2016, a $1,420,263 switcher locomotive replacement grant was awarded at the Ports of Richmond and San Francisco through a BAAQMD application
- In 2016, a $523,809 switcher locomotive replacement grant was awarded at the POLB through a South Coast Air Quality Management District application

3.1.3. San Pedro Bay Technology Advancement Program (TAP)

As discussed in the ocean-going vessels incentive section, the TAP is part of the CAAP and aims to help develop and promote new emission reducing technologies, including locomotive technologies. Locomotive projects must demonstrate potential for zero emissions, or hybrid and near-zero emissions engine technologies, or use of alternative fuels with significant emission reductions[24].

The TAP is effectively a grant program which provides up to 50% funding for qualifying projects. The ability to fund at least 50% of the cost of the project is required of any project participant. Because the program targets often unproven technologies by design, eligibility for the project is not a simple process. Among other requirements, applicants must provide a concept paper demonstrating potential benefits and obtain approvals from each port's Board of Harbor Commissioners.

[22] https://ww2.arb.ca.gov/sites/default/files/classic/msprog/moyer/status/2017_moyer_program_stats_29oct2018.pdf, Table 6
[23] https://www.epa.gov/ports-initiative/overview-dera-grants-awarded-ports-projects
[24] https://cleanairactionplan.org/documents/tap-guidelines.pdf

Unlike the ocean-going vessel aspect of the TAP which provides an incentive per vessel call for participating vessels, there is no additional incentive for locomotives aside from funding up to 50% of the cost of the demonstration project.

3.2. Port of Oakland Locomotive Incentive Opportunities

The Port of Oakland has two rail tenants: Burlington Northern Santa Fe (BNSF), which operates Oakland International Gateway railyard (OIG) and the joint venture of Oakland Global Rail Enterprise (OGRE) and West Oakland Pacific Rail (WOPR) which operates the Outer Harbor International Terminal railyard (OHIT). The Union Pacific (UP) is not a Port tenant and the UP railyard is not on Port property.

Given the lack of existing activity-driven locomotive incentive programs to use as a model, the Port would need to develop a new and unproven program to reward the rail lines for increased usage of cleaner locomotives. Two hurdles would be 1) Port does not have an equivalent "dockage" fee for locomotives which is the primary mechanism for rewarding cleaner ships; and 2) there is no equivalent system such as the Marine Exchange for verifying which locomotives arrived/departed from the tenants' yards. The Port would need to rely on the rail lines to engage with the Port and provide relevant data. Tracking information for switcher engines would be even more challenging, but could perhaps rely on estimated number of shifts, or operating hours per year from maintenance records.

The Port of Oakland closely examined the potential of a "Clean Locomotive Program" and the feasibility of electric switchers at Port railyards in Spring 2020 during the Evaluation process for the 2020 and Beyond Plan for Group 1 Suggested Actions. These two strategies are both included in the West Oakland Community Action Plan. The results of the analysis are available in the Line-Haul Locomotive Emissions Reductions memo which can be found on the Port's website: https://www.portofoakland.com/community/environmental-stewardship/maritime-air-quality-improvement-plan/ and are summarized here.

There are currently no fully electric locomotives available. Some hybrid locomotive demonstration projects are under development, such as train consists comprising a combination of an electric engine grouped with a diesel engine.

Line haul engines: OGRE/WOPR does not have any line haul engines; it only has switchers. Line haul locomotives on the OIG rail yard emitted about 0.007 tons of DPM in 2017[25], hence the opportunity pool for reducing DPM exposure in West Oakland is very small, even with 100% fleet turnover to Tier 4 engines.

Switcher engines: In 2017, BNSF switching activity emitted 0.175 tons of PM at OIG. If all switching could be done by Tier 4 engines, that would reduce PM by 0.169 tons, or about 97%. The challenge is, BNSF rotates switchers in and out of the OIG yard based on need and maintenance requirements. The Port would need to require that any Tier 4 switchers be dedicated to OIG.

OGRE already has one Tier 4 switcher, which was funded by a DERA grant and delivered in 2019. The total cost (grant plus matching funds) was $2.57M. It can be assumed that nearly all of OGRE's switching activity is performed by this Tier 4 engine, therefore any benefits of a clean switcher program are already being realized.

[25] From the Line Haul Locomotive Emissions Reductions memo, page 5. The geographic scope of the 2017 emissions inventory is the railyard property boundary, thus the emissions benefit of cleaner line haul locomotives at OIG would be larger and would extend within the airshed northward past Richmond. However, the focus of the 2020 and Beyond Plan is to achieve local exposure reductions.

4. Feasibility Evaluation per 2020 and Beyond Plan Criteria

The 2020 and Beyond Plan includes a detailed approach to evaluating the feasibility of any suggested action. Appendix D of the 2020 and Beyond Plan lists seven different criteria and a description of each. The criteria were applied to both types of performance incentive programs included in this study, and the results are summarized in the table below. For each criterion, a "score" of Low, Medium, or High is given along with a brief explanation.

Criteria	Ocean-Going Vessels	Locomotives
Exposure Reduction	**Low** – The main benefit of a VSR would be seaward of the Sea Buoy, which does not reduce harmful DPM emissions in the vicinity of West Oakland. Since higher Tier level ships do not reduce PM, the main benefit of a Clean Ship program would be to reduce NOx. NOx is not a pollutant of concern in either the 2020 and Beyond Plan or in the West Oakland Community Action Plan.	**Low** – The Port's two rail tenants, BNSF and OGRE, combined emit about 0.26 tons of PM per year from all their activity including switchers and line haul. The participation rate for a prototype Clean Locomotive Program is highly speculative, especially given the transient nature of line haul locomotive operation.
Affordability	**Unknown** – For reference, the Ports of LA/LB offer 15%-30% reductions in dockage fees for vessels participating in VSR, rebates of $750 to $2,500 per call for vessels participating in Clean Ships, and the program might cost on the order of $60,000 per year to administer.	**Unknown** – There are no known Clean Locomotive Programs in the U.S. to use as a reference to estimate the amount of incentive required to change behavior.
Cost-Effectiveness	**Low** – Although the participation rate and cost of a VSR or clean ship program is unknown, the cost effectiveness would be low since neither type of program would reduce PM near the Port.	**Low** – Although the participation rate and cost of a clean locomotive program is unknown, the cost-effectiveness would be low since the maximum amount of PM reductions is only about 0.25 tons/year.
Commercial Availability	**High** – A variety of VSR and Clean Ship programs exist and are used at different Ports in North America and in California. These could be used as models for formulating an Oakland-specific program.	**Low** – There are no known Clean Locomotive Programs in the U.S. to use as a model.
Operational Feasibility	**Medium** – A VSR program is operationally feasible outside the Golden Gate, however the emission reductions would occur far from shore and would not benefit West Oakland. A VSR program within the San Francisco Bay would be	**Low** – A Clean Locomotive program would be challenging to administer because of the lack of independent data on locomotive movements and switcher usage. The Port would need to rely on information provided by the railroads

	challenging because ships are already limited to 15 knots at most, and slowing further would likely be unsafe.	themselves with no method of verification.
Acceptability	**High** – VSR and Clean Ship programs have proven successful at other Ports and have high participation rates.	**Unknown** – No programs of this type exist, so potential participation rates are highly speculative.
Need	**Low** – Because of Oakland's position as a second port of call, and its smaller size compared to the Ports of LA and LB, it is unclear whether performance incentive programs would influence carrier behavior or merely reward vessel operators for decisions based on other factors.	**Low** – Locomotive emissions from the Port's two rail tenants contribute only about 0.6% of DPM emissions. Even if the tenants reached 100% participation and reduced DPM by 85% by going from all Tier 0 to all Tier 4 for both switchers and line haul engines, it would only reduce DPM by 0.25 tons/year.

5. Conclusions for the Port of Oakland

Port staff reviewed the available information and concluded that Ship and Locomotive Performance Incentive Programs would not be not effective for reducing diesel particulate matter emissions or exposure near the Port and in West Oakland.

However, expanding the existing Vessel Speed Reduction program (Protecting Blue Whales and Blue Skies) might reduce greenhouse gas emissions, which is a goal of the 2020 and Beyond Plan. A prudent approach might be to contribute financially to the Protecting Blue Whales and Blue Skies program to try to increase participation. For context the Bay Area Air Quality Management District contributed $80,000 to the program over the most recent two-year period. The port could donate money or could offer non-monetary incentives in the form of recognition for participating carriers on the Port's website, or press releases to publicly thank and congratulate participants.

1. Using Port resources to start a new Vessel Speed Reduction program locally is not recommended for the following reasons:
   - Ships already have a speed limit of 15 knots inside the San Francisco Bay. Therefore, this program would only require ships to slow down by 3-5 knots, which does not reduce emissions significantly. Additionally, San Francisco Bar Pilots have expressed safety concerns about slowing vessels below 15 knots while they are transiting in narrow, restricted, highly trafficked channels.
   - Outside the Golden Gate, the DPM emission reductions are too far away to reduce exposure for the community in West Oakland. The main benefit from the perspective of the 2020 and Beyond Plan would be to reduce greenhouse gas emissions, with a co-benefit of reducing whale strikes.
2. Starting a Clean Ship Incentive program is not recommended because:
   - The Port of Oakland is almost always a second port of call. Carriers select which vessels they put into the North Pacific string based on their needs at the large Southern California ports. Any financial incentives the Port of Oakland offered would be unlikely to influence which vessels come here. Rather, it would reward carriers for decisions they made based on other factors.
   - Further, rewarding carriers for bringing vessels with higher tier engines serves to reduce NOx, but does not provide any benefit for DPM, which is the pollutant of primary concern in Oakland.
3. Starting a new Clean Locomotive Incentive Program in Oakland is not recommended because:

- There are no proven programs anywhere else that can demonstrate a benefit.
- The two rail tenants at the Port, BNSF and OGRE, only emit about 0.269 tons DPM/year combined for both switching and line haul combined. The maximum benefit the Port could achieve is about 0.2 to 0.25 tons DPM/year, even with the most aggressive assumptions for participation for both switchers and line haul engines.