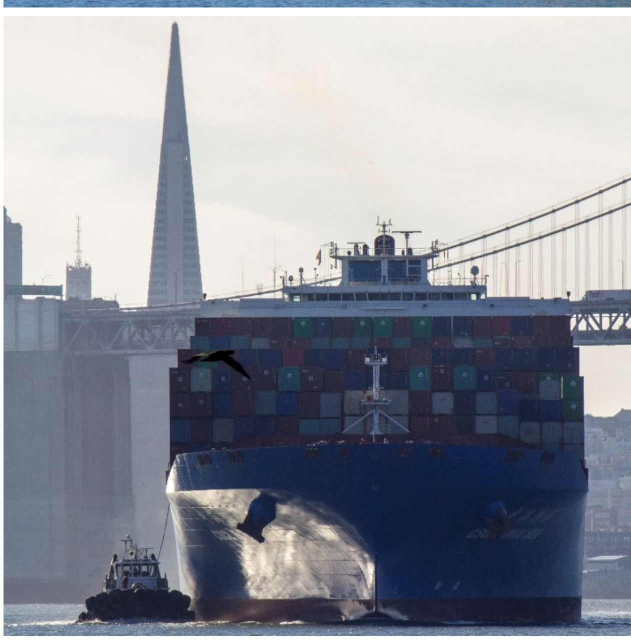
Appendix H
2019 Update to Inventory for Ocean-Going Vessels At Berth: Methodology and Results



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CALIFORNIA
AIR RESOURCES BOARD

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1. Summary and Background

This report covers the 2019 updates to the California Air Resources Board's (CARB) inventory for ocean-going vessels (OGV) that visit California's ports and marine terminals while operating at berth. The previous inventory was released in 2014, and the 2019 inventory updates include improvements to vessel visit data, emissions factors, information on vessel compliance with CARB's existing At Berth Regulation ("Existing Regulation"), and growth forecasts.[1] These updates were completed to support new regulatory development efforts, and provide data to support CARB staff's 2018 Health Risk Assessment (HRA) at specific California ports and marine terminal complexes (MTC).[2,3]

OGVs included in this inventory are defined as commercial vessels greater than 400 feet in length, with a carrying capacity of 10,000 gross tons, and are propelled by a diesel marine compression ignition engine with a displacement of greater than or equal to 30 liters per cylinder. These vessels are an important part of California's trade economy, but are also a significant source of pollution in areas near ports and MTCs. Specifically, the vessels' diesel auxiliary engines and boilers produce particulate matter (PM) and oxides of nitrogen (NOx), which is a precursor to secondary PM formation, both of which have a large impact in port communities and surrounding areas. The 2019 inventory update focused on updating emissions of PM and NOx for at berth activity in detail to support CARB staff's HRA at the Ports of Los Angeles and Long Beach (POLA and POLB) and the Richmond Port Complex. It does not cover emissions generated at anchorage or other modes of activity.

Major updates to methodology and data sources include:

- Updated data source for 2016 vessel visits and vessel information based on IHS-Markit data for California and South Coast Marine Exchange data for POLA and POLB
- Updated growth rates based on Freight Analysis Framework (FAF)[4] for most ports and MTCs, and Mercator[5] Report for POLA and POLB

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[1] 17 CCR § 93118.3. Airborne Toxic Control Measure for Auxiliary Diesel Engines Operated on Ocean-Going Vessels At-Berth in a California Port, https://ww3.arb.ca.gov/regact/2007/shorepwr07/93118-t17.pdf.

[2] Marine Terminal Complexes (MTCs) are CARB-defined groups of independent marine terminals and/or smaller ports (public and/or private) that are located in close geographical proximity to each other. MTCs represent a group of regionalized emission sources that have an impact to the surrounding community.

[3] California Air Resources Board, Preliminary Health Analyses: Ocean-Going Vessels At Berth and At Anchor (November 5, 2018), https://www.arb.ca.gov/ports/shorepower/meetings/11052018/prelimhealthanalyses.pdf.

[4] The FAF growth forecast is a commodity-based forecast, forecasting total tonnage of various goods moved in or out of different regions of the State. FAF includes other modes of transportation (rail, air, trucking, etc.) but for this analysis, only water-based trade was considered.

[5] Mercator International LLC, Oxford Economics, San Pedro Bay Long-term Unconstrained Cargo Forecast, July 12 2016, pg 265, http://acta.org/revenue_finance/March%20%202016%20Meeting%20Item%208.pdf (last accessed 9/12/2019).

- Updated emission factor data based the approaches used by US EPA, academic institutions, and others
- Updated container vessel size forecast and freight efficiency parameters based on studies by Mercator[5] Report for POLA and POLB
- Delayed expected introduction of Tier III marine engines to 2030 or later, based on a study by Starcrest and POLA and POLB
- Updated data from the Starcrest's vessel boarding program in POLA and POLB

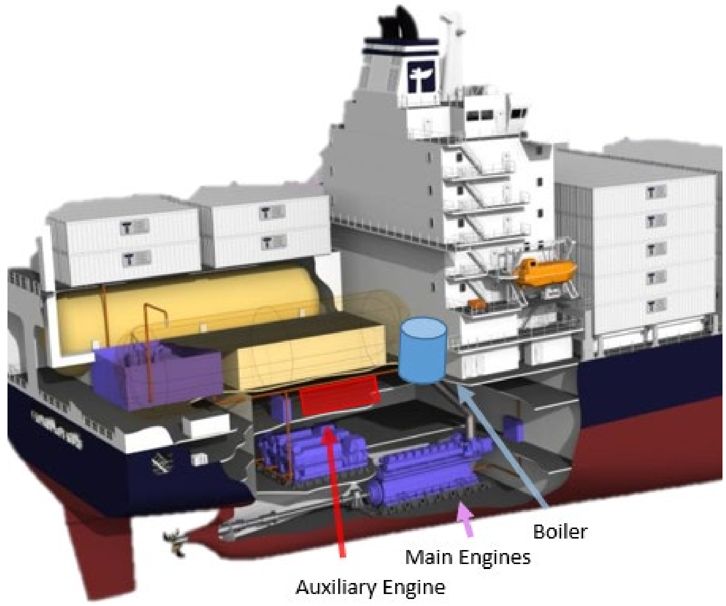
Overall, the largest impact on the emissions inventory since the 2014 OGV inventory is the reduction of PM emissions based on updated, lower emission factors as further discussed in section 3.4 of this document.

2. Ocean-Going Vessel Background and Description

In most cases, OGVs are powered by main engines for propulsion, auxiliary engines to supply vessels with power, and boilers to heat fuel, water, and provide other necessary vessel functions (illustrated in Figure 1). The main propulsion engines are larger, consume more fuel, and produce the majority of emissions from an OGV. However, the majority of activity from these propulsion engines occurs in transit between ports and marine terminals, and not while the vessel is at berth. These main propulsion engines are subject to Tier standards set by the International Maritime Organization (IMO) that provide emissions limits (based on the year the vessel's keel was laid), and are not covered by CARB's At Berth Regulation.[6] The auxiliary engines and boilers, while far lower in power when compared to main engines, are often run continuously during a vessels stay at port, and are responsible for essentially all of the emissions while the vessel is at berth.

[6] United States Environmental Protection Agency, International Standards to Reduce Emissions from Marine Diesel Engines and Their Fuels, https://www.epa.gov/regulations-emissions-vehicles-and-engines/international-standards-reduce-emissions-marine-diesel (last accessed 9/12/2019).

Figure 1: Example OGV Engine Illustration



This report focuses on auxiliary engines and boilers, and their associated emissions at berth. Emissions from main engines, auxiliary engines, and boilers *while not at berth* are not included in this report.

CARB and industry categorize the OGVs covered by the emissions inventory as shown in Table 1, depending on the type of goods moved by the vessel, and Table 2, dividing tanker vessels and container vessels into size bins based on their capacity. These vessel categories and size bins are useful in understanding vessel functions (i.e., the type of commodity they carry) and common characteristics (i.e., the average engine size). The only vessel type included in the inventory that does not specifically move freight is the passenger cruise category.

Table 1: Ocean-Going Vessel Categories

Vessel Type	Primary Function or Description
Auto*	Transports automobiles and trucks.
Bulk Cargo	Transports dry bulk items such as mineral ore, fertilizer, wood chips, or grains.
Container	Transports a wide variety of cargo in standard-sized containers.
General Cargo	Transports non-containerized cargo such as steel, palletized goods, and heavy machinery.
Cruise	Used for passenger transport and pleasure voyages.
Reefers	Transports perishable commodities that require refrigerated transportation, mostly fruits, meat, fish, vegetables, dairy products, and other foods. Cargo may be carried in bulk holds or in refrigerated containers.
Ro-ro*	Transports large wheeled cargo such as large off-road equipment, trailers or railway carriages. Ro-ro is an acronym for “roll on-roll off”.
Tankers	Transports liquids in bulk, including both non-edible liquids such as crude oil and chemicals, and edible liquids such as molasses and fruit juices.

*Auto and ro-ro vessels are referred to as separate vessel categories for the purposes of the emissions inventory, but are considered the same category under “ro-ro” for regulatory purposes (as seen in the regulatory text and main Staff Report).

Table 2 details the size bins utilized within the inventory. Size bins are used in vessel categories where large variation in vessel and engine sizes are observed, as well as variation in behavior. The siz bins namely cover container and tanker vessels. Container vessels are sorted by size bin according to the twenty-foot equivalent units (TEUs, or containers) they can carry, with size bins for every 1,000 TEUs (after the first category which includes 0 to 1,999 TEU capacity vessels). For tankers, size bins are based on the deadweight tonnage (DWT) of tanker capacity, as shown at the bottom of Table 2.

Table 2: Container and Tanker Category by Capacity

Vessel Type	Size Bin	Min Capacity	Max Capacity	Capacity Unit
Container	**1**	0	1999	TEU
Container	**2**	2000	2999	TEU
Container	**3**	3000	3999	TEU
Container	**4**	4000	4999	TEU
Container	**5**	5000	5999	TEU
Container	**6**	6000	6999	TEU
Container	**7**	7000	7999	TEU
Container	**8**	8000	8999	TEU
Container	**9**	9000	9999	TEU
Container	**10**	10000	10999	TEU
Container	**11**	11000	11999	TEU
Container	**12**	12000	12999	TEU
Container	**13**	13000	13999	TEU
Container	**14**	14000	14999	TEU
Container	**15**	15000	15999	TEU
Container	**16**	16000	16999	TEU
Container	**17**	17000	17999	TEU
Container	**18**	18000	18999	TEU
Container	**19**	19000	19999	TEU
Container	**20**	20000	20999	TEU
Container	**21**	21000	21999	TEU
Container	**22**	22000	22999	TEU
Container	**23**	23000	23999	TEU
Container	**24**	24000	24999	TEU
Container	**25**	25000	25999	TEU
Tanker	**Seawaymax**	0	60000	DWT
Tanker	**Panamax**	60001	80000	DWT
Tanker	**Aframax**	80001	120000	DWT
Tanker	**Suezmax**	120001	200000	DWT
Tanker	**VLCC**	200001	315000	DWT
Tanker	**ULCC**	315001	520000	DWT

2.1. Ocean-Going Vessel Marine Engines and Operations

OGVs are generally equipped with multiple engines and power sources, which include:

- Main engine(s) that provide thrust with displacement greater than or equal to 30 liters per cylinder
- Auxiliary engines used primarily to supply a vessel with power for various on-board functions
- Auxilary boilers used to produce steam for uses other than propulsion, such as heating of residual fuel and liquid cargo, heating of water for crew and passengers, powering steam turbine discharge pumps, freshwater generation, and space heating of cabins

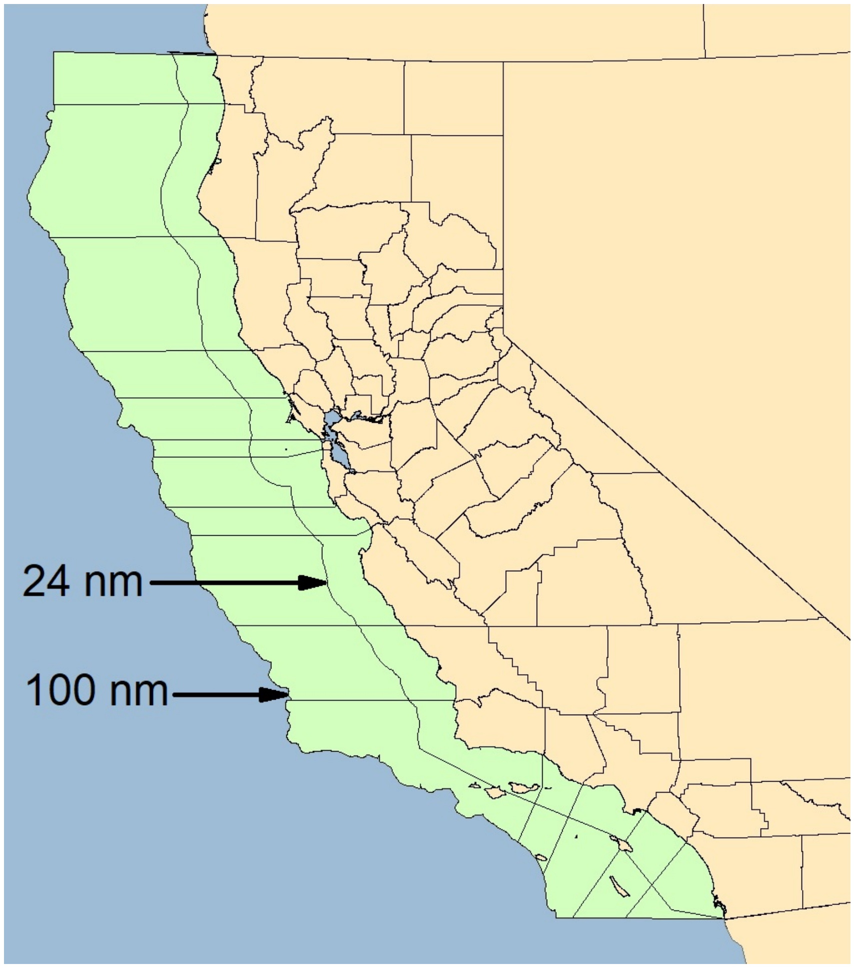
Four operating modes are used to characterize OGV activity: transiting, maneuvering, at berth, and at anchorage. Transiting is the operation of vessels on the open ocean between ports and marine terminals. Maneuvering is the slow speed operation while in port. At berth and at anchorage operations occur when a vessels is moored to a dock or has dropped anchor, respectively. Engine use characteristics are dependent on the operating mode.

- Transiting: Main engine (and limited auxiliary engine and auxiliary boiler use)
- Maneuvering: Main engine (and limited auxiliary engine and auxiliary boiler use)
- At Berth: Auxiliary engine and auxiliary boiler used (and main engine off)
- Anchorage: Auxiliary engine and auxiliary boiler used (and main engine off)

2.2. Geographical Areas

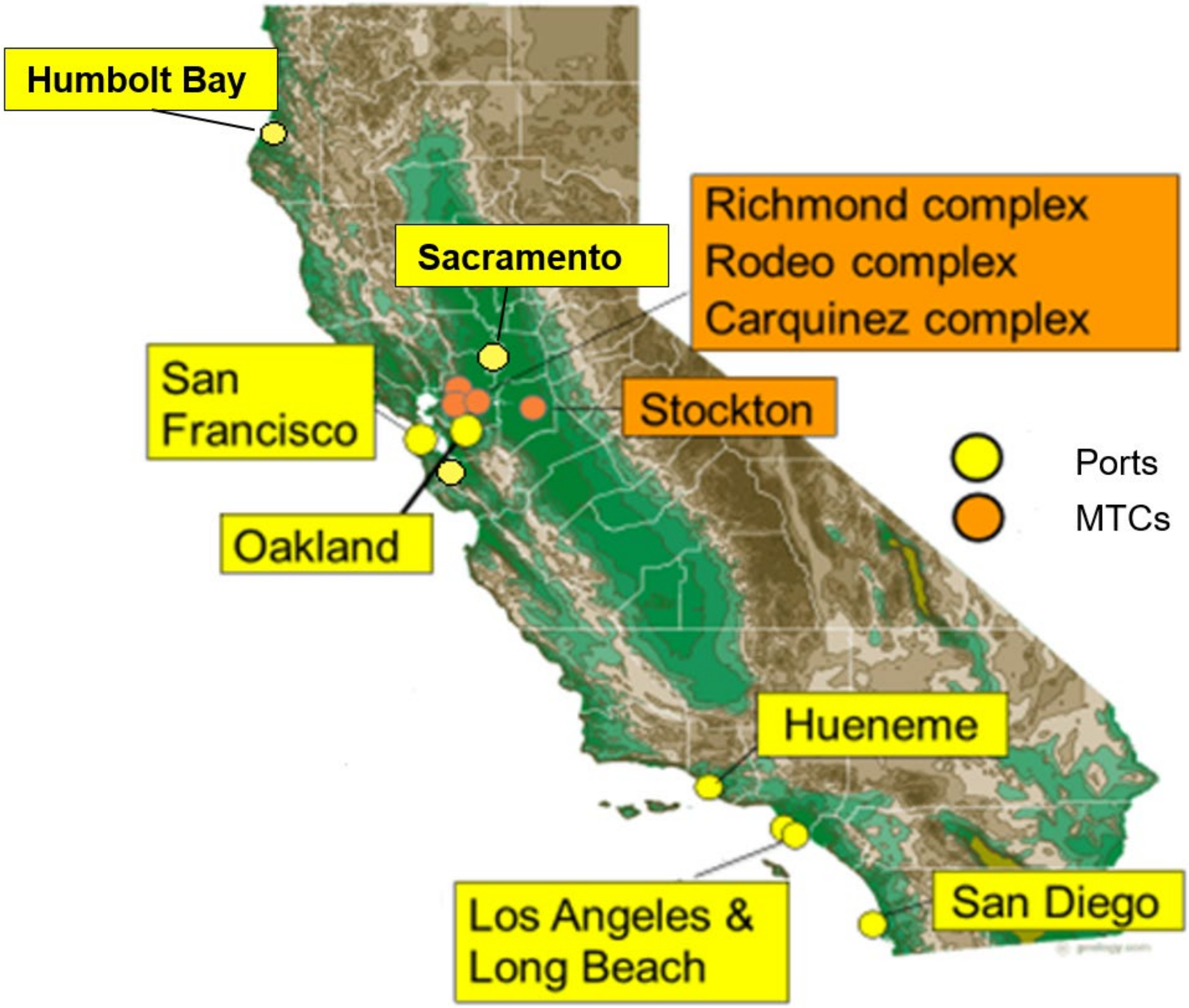
The OGV inventory covers an area within 200 nautical miles (nm) of the California coastline and divides this area into four sub-areas by their distance from shore: 0-3 nm, 3-24 nm, 24-100 nm, and 100-200 nm. Figure 2 shows the California territorial waters represented by the inventory which are colored green and the land mass is colored yellow. The boundaries for 24 nm and 100 nm are notated by arrows in the green territorial waters section.

Figure 2: California Territorial Waters with 24 and 100 nm Boundary



California port locations are shown below in Figure 3. While the majority of ports are in the Bay Area, the vast majority of California freight goods movement occurs at POLA and POLB, located in the South Coast Air District.

Figure 3: California Ports and MTC Locations



The MTCs listed are used for the HRA and not in the inventory. The list of all ports used in the inventory are listed in Table 3.

Table 3: California Ports and Marine Terminals in Inventory

Port Name		
Avon Terminal*	Los Angeles	Sacramento
Benicia Terminal*	Martinez Terminal*	San Diego
Crockett*	Oakland	San Francisco
Eureka	Oleum Terminal**	Selby Terminal**
Hueneme	Redwood City	Stockton
Long Beach	Richmond	

*Marine terminals located within the Carquinez complex
**Marine terminals located within the Rodeo complex

3. General Emissions Inventory Methodology and Sources

Broadly, the following steps describe the inventory process, with more detail included later in the report, along with the source data:

1. Vessel transponder data along with GIS mapping determines the number of vessel visits for each port in California (grouped by vessel type and vessel size)
2. Vessel broadcasting data also determines the average length of stay for all vessel visits (by vessel type, size and port)
3. Information on average engine effective power (based on the Starcrest Vessel Boarding Program) is combined with vessel visit and duration information provided by ports as well as industry
4. Future years are forecasted by applying a growth rate (specific to port, vessel type, and in some cases vessel size) and assuming an equivalent age distribution of vessel visits in the future
5. Shore power compliance data from CARB's Enforcement Division is used to determine reduced engine activity time – and therefore reduced emissions – resulting from
   CARB's At Berth Regulation
6. Emissions are calculated for base and future years using the Equation 1:

$$\mathbf{Emission\ per\ vessel\ engine} = \mathbf{Activity} \times \mathbf{EP} \times \mathbf{EF} \qquad \textbf{(Equation 1)}$$

Where:
Activity: Time the engine is running (hours)
EP: Effective Power: average power output for an engine (kW)
EF: Emission factor (grams of pollutant per kW-hr)

The following sections cover the input data, and methodology used to create the OGV inventory.

3.1. Base Year Vessel Visits and Time At Berth

The inventory updates for vessel visits and time at berth are based on:

- 2016 IHS-Markit Vessel Registry data for vessels that visited California[7]
- 2016 IHS-Markit at berth times for California[8]
- 2016 South Coast Marine Exchange Arrival and Departure Data[9]

The IHS-Markit data is used for the majority of California territorial waters, and the South Coast Marine Exchange is used specifically for POLA and POLB.

IHS-Markit gathers data on OGV visits by use of the automatic identification system (AIS) information, which is broadcasted by vessels. OGVs primarily use AIS for collision avoidance, by continuously broadcasting their location, speed, and other information to other vessels in the area. This broadcasted information provides IHS-Markit with the exact location of vessels in California waters, updated every few seconds during the vessel visit. IHS-Markit combines this location with geographic boundary mapping of berth and anchorage areas to determine when a vessel could be considered at berth (i.e. the broadcasted location data from the vessel falls inside the port boundary). IHS-Markit aggregates this second-by-second broadcasted data and supplies CARB with the vessel visit total length in hours. CARB uses this data as the basis for vessel visit count, location, and duration.

Similarly, the South Coast Marine Exchange obtains information by monitoring the AIS broadcast around POLA and POLB, as well as being the area's vessel traffic service (VTS) provider. The VTS provides navigation assistance in areas that are heavily congested, and maintains detailed tracking, coordination, and communication with vessels on movement data. In particular, the Marine Exchange data includes not only the port, but the specific berth for each vessel stay. Additionally, the direct communication allows the Marine Exchange data a higher level of quality assurance than the statewide data provided by IHS-Markit, and so is used by CARB staff to determine vessel visits within POLA and POLB.

The previous public release of the OGV inventory used 2006 activity data from the California State Lands Commission (CSLC), Entrances and Clearances data for the Marine Invasive Species Program[10], and data collected directly from all of the California port officials responsible for vessel docking, also known as Wharfingers. CSLC's data contained the port of arrival, the previous port, and the next port of arrival. The

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[7] IHS-Markit California Vessel Registration Information for 2016, last accessed January 11, 2018.
[8] IHS-Markit California Movement 2016, last accessed January 11, 2018.
[9] Marine Exchange of Southern California Arrival/Departure Information for 2016, last accessed November 30, 2017.
[10] California State Lands Commission, Marine Invasive Species Program, http://www.slc.ca.gov/Programs/MISP.html (last accessed 9/12/2019).

Wharfinger's data included visit specific at berth and at anchorage times. However, there were a number of uncertaines with these data sets that led CARB staff to change data sources for the 2019 update. For example, CSLC data is submitted by the vessel operators and the Wharfinger data is collected by individual ports. This can lead to a number of issues and errors, including errors that come naturally from information being transcribed by hand by many users. Also, port and vessel identification had numerous variations in abbreviations and naming systems, leading to inconsistencies. Furthermore, the level of detail, information, and quality assurance in the data had large variations depending on the port or area of the State.

Table 4 lists the updated 2016 IHS-Markit information and the 2016 South Coast Marine Exchange vessel visit counts according to port and vessel type. Note that for POLA and POLB data from South Coast Marine Exchange were used, while IHS-Markit data was used for all other ports.

Table 4: 2016 Vessel Visit Counts

Port	Auto	Bulk	Container	Cruise	General	Reefer	Ro-ro	Tanker	Total
Avon	-	1	-	-	-	-	-	68	69
Benicia	124	11	-	-	-	-	-	84	219
Crockett	-	14	-	-	3	-	-	-	17
Eureka	-	5	-	-	-	-	-	-	5
Hueneme	237	-	67	-	3	43	-	12	362
Long Beach*	186	199	919	258	28	1	2	443	2036
Los Angeles*	83	89	1261	118	47	17	24	236	1875
Martinez	-	-	-	-	-	-	-	161	161
Oakland	-	19	1533	-	-	-	1	-	1553
Oleum	-	-	-	-	-	-	-	78	78
Redwood City	-	55	-	-	-	-	-	-	55
Richmond	104	74	-	-	-	-	-	400	578
Sacramento	-	18	-	-	12	-	-	1	31
San Diego	237	6	10	54	21	-	6	16	350
San Francisco	6	46	63	53	2	-	-	43	213
Selby	-	-	-	-	-	-	-	29	29
Stockton	-	105	-	-	37	-	-	57	199
Total	977	642	3853	483	153	61	33	1628	7830

*South Coast Marine Exchange Data is used for POLA and POLB

3.2. Vessel Visit Length

Vessel visit length is the duration a vessel stays at berth during a port visit, and determines activity for auxiliary engines and boilers since those are the primary emissions sources while at berth. The auxiliary engines and boilers are both assumed to be active during the full length of the vessel visit (e.g., a ten hour vessel visit would result in ten hours of auxiliary engine time and boiler usage time).

The information on vessel visit length is based on the same data sources used in port visits; POLA and POLB vessel visit length information is based on data from the South Coast Marine Exchange, and all other ports are based on IHS-Markit vessel visit data.

Occasionally, a vessel's record shows an abnormally long stay time at berth, up to six months in some cases. There were some outliers seen in all vessel categories, with bulk vessels having the largest count of long vessels visits, but tankers seeing the largest emissions impact. This is due to the generally higher power load used by a tanker vessel at berth versus a bulk vessels, laregly due to the nature of tanker cargo operations while at berth. Discussions with the tanker industry and comments provided during the public workshops suggested that most of these longer visits are likely for repairs, vessel overhauls, or vessel storage, during which time the vessel's auxiliary engine or boilers are not likely to be constantly in operation.

Based on these discussions with industry, CARB staff determined that vessel visits above 300 hours (shown in Table 5) must not be included in vessel visit averages, as they do not represent time where an auxiliary engine or boiler is consistently operating. Instead of assuming that these abnormally long vessel visits are operating the entire time, the inventory reflects that the auxiliary engines and boilers would only operate for the average stay as calculated from that vessel type at that specific port. This allows for a more representative estimate of a vessel's emissions during an atypical stay.

Table 5: 2016 Vessel Visit Count over 300 Hours Per Visit

Port	Auto	Bulk	Container	Cruise	General	Reefer	Ro-ro	Tanker	Total
Benicia	-	8	-	-	-	-	-	-	8
Crockett	-	3	-	-	-	-	-	-	3
Long Beach	-	-	2	-	-	-	2	-	4
Oakland	-	-	4	-	-	-	1	-	5
Richmond	-	5	-	-	-	-	-	-	5
Sacramento	-	3	-	-	-	-	-	-	3
San Diego	-	-	1	-	-	-	-	8	9
San Francisco	-	-	2	1	-	-	-	1	4
Stockton	-	3	-	-	3	-	-	-	6
Total	-	22	9	1	3	-	3	9	47

Table 6: 2016 Vessel Visit Average Time Used For Long Visits

Port	Auto	Bulk	Container	Cruise	General	Reefer	Ro-ro	Tanker
Benicia	-	240	-	-	-	-	-	-
Crockett	-	213	-	-	-	-	-	-
Long Beach	-	-	62	-	-	-	33	-
Oakland	-	-	23	-	-	-	33	-
Richmond	-	74	-	-	-	-	-	-
Sacramento	-	76	-	-	-	-	-	-
San Diego	-	-	49	-	-	-	-	173
San Francisco	-	-	7	24	-	-	-	5
Stockton	-	104	-	-	104	-	-	-

Replacing the long visits with the averages listed in Table 6 results in the following reductions in overall activity. Table 7 shows the total reduction in hours based on the changes in vessel visit stays (note that the reductions are the total reductions for each vessel type at each port and not per vessel visit).

Table 7: 2016 Reductions in Total Vessel Activity Hours

Port	Auto	Bulk	Container	Cruise	General	Reefer	Ro-ro	Tanker	Total
Benicia	-	480	-	-	-	-	-	-	480
Crockett	-	261	-	-	-	-	-	-	261
Long Beach	-	-	476	-	-	-	534	-	1010
Oakland	-	-	1108	-	-	-	267	-	1375
Richmond	-	1130	-	-	-	-	-	-	1130
Sacramento	-	672	-	-	-	-	-	-	672
San Diego	-	-	251	-	-	-	-	1016	1267
San Francisco	-	-	586	276	-	-	-	295	1157
Stockton	-	588	-	-	588	-	-	-	1176
Total	-	3131	2421	276	588	-	801	1311	8528

The minimum, average, and maximum time at berth in hours are listed below in Table 8. These values are shown by by vessel type and port, and do not include the long vessel visits that were over 300 hours. If no vessels of a specific vessel type visited a port named in the IHS-Markit or Marine Exchange data set in 2016, the values are blank, representing no vessel visits or activity.

These vessel visit averages are applied to each vessel visit, by port, vessel type, and vessel size. For example, there were 104 vessel visits from auto carrier vessels at the Port of Richmond, as shown in Table 4 above. The average time at berth for auto vessels in

Richmond is 19 hours, as illustrated in Table 8 below. The inventory shows all 104 vessel visits at 19 hours each for a total of 1,976 hours for auto carrier vessels at berth in Richmond in the base year inventory.

Table 8: 2016 Minimum, Average, and Maximum Time At Berth (Hours)

Arrival Port	Auto			Bulk			Container			Cruise		
	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.
Avon	-	-	-	1	1	1	-	-	-	-	-	-
Benicia	1	22	74	155	234	279	-	-	-	-	-	-
Crockett	-	-	-	74	206	294	-	-	-	-	-	-
Eureka	-	-	-	70	130	271	-	-	-	-	-	-
Hueneme	1	15	54	-	-	-	7	35	80	-	-	-
Long Beach	5	14	38	10	54	237	2	61	229	8	13	17
Los Angeles	8	22	168	13	73	238	10	54	227	10	12	37
Martinez	-	-	-	-	-	-	-	-	-	-	-	-
Oakland	-	-	-	60	124	200	1	23	95	-	-	-
Oleum	-	-	-	-	-	-	-	-	-	-	-	-
Redwood City	-	-	-	7	41	204	-	-	-	-	-	-
Richmond	6	19	91	1	63	282	-	-	-	-	-	-
Sacramento	-	-	-	1	60	296	-	-	-	-	-	-
San Diego	6	25	270	16	56	105	1	49	98	10	13	65
San Francisco	1	29	64	1	9	27	1	1	7	1	20	228
Selby	-	-	-	-	-	-	-	-	-	-	-	-
Stockton	-	-	-	20	98	261	-	-	-	-	-	-

Continued: Table 8: 2016 Minimum, Average, and Maximum Time At Berth (Hours)

Arrival Port	General			Reefer			Ro-ro			Tanker		
	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.
Avon	-	-	-	-	-	-	-	-	-	10	53	152
Benicia	-	-	-	-	-	-	-	-	-	1	24	99
Crockett	200	229	277	-	-	-	-	-	-	-	-	-
Eureka	-	-	-	-	-	-	-	-	-	-	-	-
Hueneme	110	132	172	40	68	89	-	-	-	13	53	288
Long Beach	11	43	160	6	6	6	33	33	33	7	38	295
Los Angeles	6	63	160	7	35	94	15	34	181	7	44	294
Martinez	-	-	-	-	-	-	-	-	-	15	49	178
Oakland	-	-	-	-	-	-	33	33	33	-	-	-
Oleum	-	-	-	-	-	-	-	-	-	10	49	208
Redwood City	-	-	-	-	-	-	-	-	-	-	-	-
Richmond	-	-	-	-	-	-	-	-	-	1	40	220
Sacramento	88	164	282	-	-	-	-	-	-	1	1	1
San Diego	12	43	97	-	-	-	25	32	42	6	117	291
San Francisco	1	1	1	-	-	-	-	-	-	1	1	5
Selby	-	-	-	-	-	-	-	-	-	11	42	105
Stockton	21	89	250	-	-	-	-	-	-	18	49	175

3.3. Effective Power (EP)

Effective power for vessel auxiliary engines and auxiliary boilers are represented by the average power produced by the engines while in use, measured in Kilowatts (kW). Effective power is the combination of maximum power and the average load factor on the engines. For example, an engine that could produce 2,000 kW at maximum power that is running at 50 percent average load would have an effective power of 1,000 kW. As this report focuses on at berth emissions, only the effective power for the auxiliary engines and the boilers are included. Starcrest refers to this metric as 'effective engine load', however because CARB inventories use the term load to reflect a different engine metric (percent of total hosepower used on average), it will be referred to as effective power in this report to avoid confusion.

The effective power for auxiliary engines (Table 9) and boilers (Table 10) are based on the Starcrest's Vessel Boarding Program (VBP).[11,12] The VBP is conducted in POLA and POLB, on vessels of all types and sizes, and collects data on the effective power of each vessel type and size bin (Table 2 has a detailed description of size bins). Although collected for POLA and POLB, this information represents the most detailed source on effective power of OGVs available, and therefore is used for the entire State. The values used for the State are combined with the 2016 emission inventories for POLA and POLB. The effective power is a weighted average between the two inventories, based on the arrival visits of the two ports.

[11] Starcrest Consulting Group, LLC, Port of Los Angeles Inventory of Air Emissions – *2016*, Technical Report APP# 160825-520 A (July 2017), pgs. 15-17, https://kentico.portoflosangeles.org/getmedia/644d6f4c-77f7-4eb0-b05b-df4c0fea1295/2016_Air_Emissions_Inventory.

[12] Starcrest Consulting Group, LLC, *Port of Long Beach* Air Emissions Inventory – *2016 (July 2017),* pgs. 5-7, http://www.polb.com/civica/filebank/blobdload.asp?BlobID=14109.

Table 9: Auxiliary Engine Effective Power

Vessel Type	Size Bin	Berth Hotelling (KW)		
		Los Angeles	Long Beach	Weighted Average for Other Ports
Auto	**-**	859	1284	1159
Bulk	**-**	150	210	190
Bulk - Self Discharging	**-**	-	179	179
Container	**1**	429	720	709
Container	**2**	1035	1039	1036
Container	**3**	516	641	597
Container	**4**	1161	1136	1153
Container	**5**	945	1107	1007
Container	**6**	990	832	988
Container	**7**	2456	845	2326
Container	**8**	902	1008	951
Container	**9**	1037	924	973
Container	**10**	1450	981	1122
Container	**11**	1500	1500	1500
Container	**12**	1780	2000	1945
Container	**13**	982	1317	990
Container	**14**	1500	-	1500
Container	**17**	1000	1000	1000
Container	**18**	1000	-	1000
Cruise	**-**	6004	5445	5620
General	**-**	722	572	661
Misc	**-**	228	467	228
Reefer	**-**	890	1091	900
Ro-ro	**-**	751	229	711
Tanker	**Seawaymax**	820	605	784
Tanker	**Panamax**	623	679	654
Tanker	**Aframax**	-	724	724
Tanker	**Suezmax**	-	2509	2509
Tanker	**VLCC**	-	1171	1171
Tanker	**ULCC**	-	1171	1171

The effective power for boilers for all vessel types and size bins is shown in Table 10 below.

Table 10: Boiler Effective Power

Vessel Type	Size Bin	Berth Hotelling (kW)		
		Los Angeles	Long Beach	Weighted Average for Other Ports
Auto	**-**	314	314	314
Bulk	**-**	125	125	125
Bulk - Self Discharging	**-**	-	132	132
Container	**1**	273	273	273
Container	**2**	361	361	361
Container	**3**	420	420	420
Container	**4**	477	477	477
Container	**5**	579	579	579
Container	**6**	615	615	615
Container	**7**	623	623	623
Container	**8**	668	668	668
Container	**9**	677	677	677
Container	**10**	581	581	581
Container	**11**	790	790	790
Container	**12**	790	790	790
Container	**13**	612	612	612
Container	**14**	612	-	612
Container	**17**	647	647	647
Container	**18**	647	-	647
Cruise	**-**	612	612	612
General	**-**	160	160	160
Misc	**-**	96	96	96
Reefer	**-**	304	304	304
Ro-ro	**-**	259	259	259

For tankers, effective power is divided into two different modes; loading and discharging. While loading, the vessel is taking on products and the auxiliary engines run at a relatively lower power. While discharging, the vessel is off-loading products, and the auxiliary engines have a high effective power.[13]

[13] For background, when discharging a tanker vessel, the energy necessary to move fuel comes from the vessel. When loading, the energy necessary to move fuel comes from the land-based pumps and engines.

Table 11 below shows the effective power for both loading and discharging based on the tanker size, directly from the Starcrest VPB and Ocean Going Vessel inventory for POLA and POLB.

Table 11: Boiler Effective Power by Tanker by Mode and Vessel Size (KW)

Vessel Type and Size	Discharging	Loading
Tanker - Chemical	568	875
Tanker – Handysize / Seawaymax	2586	875
Tanker - Panamax	3421	875
Tanker - Aframax	5030	875
Tanker - Suezmax	5843	875
Tanker - VLCC	6000	875
Tanker - ULCC	6000	875

Table 12 below shows the split between discharing and loading expressed as a percentage by vessel size and location. The Starcrest VBP is again the primary source of data on the effective power at different loads, as well as the split of time between discharging and loading for tankers in California. However, for the Richmond Complex, the times for discharging and loading are based on information provided to CARB by the Chevron Richmond Refinery.[14]

Table 12: Tanker Percent Times Discharging and Loading

Vessel Type	Richmond		Rest of CA (based on POLA/POLB)	
	Discharging	Other/Loading	Discharging	Other/Loading
Seawaymax	35%	65%	85%	15%
Panamax	65%	35%	90%	10%
AfraMax	38%	62%	100%	0%
SuezMax	63%	37%	100%	0%
VLCC	N/A	N/A	100%	0%
ULCC	N/A	N/A	100%	0%

The combination of percent time and effective power for each mode can be combined into an overall effective power for tankers, specific to location.

[14] Chevron comment letter to CARB: Re:Chevron Commetns to Proposed At Berth At Anchor Regulaion Emission Inventory and Preliminary Health Analyses – Technical Appendix, dated March 21, 2019.

Table 13: Resulting Boiler Effective Power for Tankers

Vessel Type	Effective Power at Richmond MTC (KW)	Rest of CA (based on POLA/POLB) (KW)
Seawaymax	1,480	2,325
Panamax	2,540	3,178
AfraMax	2,462	5,030
SuezMax	3,992	5,843
VLCC	-	6,000
ULCC	-	6,000

For the Richmond area specifically, CARB also adjusted effective power for Seawaymax vessels based on data provided by Chevron Richmond Refinery illustrating unique operational characteristics of these vessels at the Richmond Complex. Chevron Richmond Refinery introduced two unique Seawaymax vessels into their operation in 2018. For these two vessels, the electrical generators that provide power to the pumps are coupled to steam turbuines served by boilers, rather than auxiliary engines. Per the information provided by the Chevron Richmond Refinery, these two vessels account for 70 percent of their Richmond terminals crude deliveries. In the 2016 baseline data, seawaymax visits account for 75 percent of crude vessel capacity, so based on this information, auxiliary effective power for Seawaymax vessels is set to zero during berth times.

The effective power for boilers during this time is increased by the equivalent amount (based on the average effective power for Seawaymax auxiliary engines at Richmond, or 1,480 KW), to reflect the increased load on the boilers providing electricity. This assumes equivalent efficiency for electricity generation between the auxiliary engines and the boiler-generator system. While we acknowledge that there are some differences in efficiency, data is lacking on boiler-generator system power generation efficiencies. Although this shift maintains the same overall power consumption, the main difference is the auxiliary engines produce diesel particulate matter (DPM), while the boilers do not.[15]

3.4. Emission Factors (EF)

Emission factors for vessels vary by pollutant, operating mode, engine type, fuel type, and fuel sulfur content. CARB uses the best available information for each emission factors, from a variety of sources. This update of the CARB OGV inventory selects emissions factor sources consistent with the US EPA and the IMO. The sources used for CARB's analysis are listed in Appendix A.

The change that has had the largest singular impact to the inventory is a reduction to the PM emission factor for auxiliary boilers, and an increase to the NOx emission factor for auxiliary engines. As compared to previous inventories, the PM factor has been reduced by approximately 33 percent for boilers, when changing he source from the Entec (2002) paper to the EPA (2009) paper.

[15] Boilers produce particulate matter, but because the boilers do not have a compression ignition engine, these emissions are not treated as DPM.

For auxiliary engines, the NOx emissions factors have been increased slightly based on the values used by Starcrest for POLA and POLB emission inventory. The emission factors for at berth operations are provided in full detail in Appendix A.

4. Future Year Forecasts

Future year forecasts are developed by applying region or port-specific growth forecasts to the base year of the inventory. The age distribution of the vessel visits is not changed in future years, but is held constant. This methodology is known simply as a ‘static age distribution model’. In most emissions inventories, CARB applies a survival curve in combination with a purchasing rate to the base year inventory to forecast future age distributions, or uses a lifecycle curve to estimate future year age distributions.[16] These methods were considered for CARB’s OGV inventory but discarded for the reasons described below:

(1) The general impact of a survival/turnover methodology is largely a ‘smoothing’ of the age distribution to reflect a more general distribution in future years. Essentially, the data contains fewer outliers and more closely resembles the survival curve used in the methodology. This method works well to smooth out inventories based on small sample sizes with irregular results. However, the OGV inventory includes all vessel visits across the State in a full year and not a small sample of such visits, which could have unrealistic outliers. Applying a survival curve would replace the real-world, non-simulated, non-adjusted distribution of visits in a given year. This could result in a less representative age distribution based on the assumptions of the survival curve rather than the real-world data.

(2) Applying a survival rate can also be appropriate if it can provide reasonably accurate forecasts of captive populations of equipment. OGVs however, are not captive to California and are part of a larger international fleet. Modeling the turnover of the international fleet and the subset that visits California is possible but would require a unacceptably large number of assumptions, and the end result would be less likely to be accurate than using the real-world age distribution from the vessel visit data.

Note that using the static age distribution methodology does not mean that future year inventories show the OGV fleet getting progressively older. Rather, the average age and age distribution stays the same in all future years

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[16] For more information on survival rates, see additional off-road inventory documentation: California Air Resources Board, Mobile Source Emissions Inventory, https://www.arb.ca.gov/msei/msei.htm (last accessed 9/12/2019).

4.1. Freight Analysis Framework

The primary source for growth forecasts is the Freight Analysis Framework (FAF) v. 4.3.1[17] (dated March 2017). This data was used for all vessel types and regions of the State outside of POLA and POLB, and Port of Hueneme. Data used for POLA, POLB, and Port of Hueneme will be discussed later in this chapter.

FAF is produced through a partnership between Bureau of Transportation Statistics (BTS) and Federal Highway Administration (FHWA).It collects data from a variety of sources to create a comprehensive picture of freight movement among States and major metropolitan areas by all modes of transportation. Main sources of information are the Commodity Flow Survey (CFS) and international trade data from the Census Bureau. FAF provides forecasts as estimates for tonnage and value by regions of origin and destination, commodity type, and mode. The FAF forecast is used in forecasts by California Statewide Freight Forecasting Model (CSFFM) developed by CalTrans, as well as the Bay Area Metropolitan Transportation Commission for San Francisco Bay Area Goods Movement Plan.[18]

CARB has selected the FAF growth rates for use in forecasting the OGV inventory because; (1) the methodology[19] is robust and comprehensive, and is checked against historical growth trends for accuracy; (2) it covers intermodal freight movement in detail, again using historical trends to note shifts in modal choices (e.g., movement on rail versus OGV), (3) FAF is one of the few forecasting tools that covers all of the freight goods transported by OGV's represented in the inventory (except for cruise vessels), and (4) FAF is one of the few forecasting tools that covers all regions of the State.

FAF divides the State into four main regions: San Francisco, Los Angeles, San Diego, and all other California areas combined. Table 14 maps the California Ports to their associated FAF regions. Where FAF is not used for a port, represented in the table as "N/A". For POLA and POLB, CARB Staff used data from the Mercator International Study. And for the Port of Hueneme information was supplied by the port through a submitted comment letter.[20] The details of the study are discussed in Section 4.2.

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[17] US Department of Transportation, Freight Facts and Figures 2017, Freight Analysis Framework v4.3.1 (Mar. 2017), https://ops.fhwa.dot.gov/freight/freight_analysis/faf/.

[18] Metropolitan Transportaton Commission, San Francisco Bay Area Goods Movement Plan, February 2016, https://mtc.ca.gov/sites/default/files/RGM_Full_Plan.pdf (last accessed 9/12/2019).

[19] This methodology is not described in detail in this report, but is available on FAF's website. US Department of Transportation, Freight Facts and Figures 2017, Freight Analysis Framework v4.3.1 (Mar. 2017), https://ops.fhwa.dot.gov/freight/freight_analysis/faf/.

[20] Port of Hueneme comment letter to CARB: Port of Hueneme Forecasted Future Growth Rates, dated November 27, 2017.

Table 14: California Ports and FAF Regions

California Ports	FAF Regions	California Ports	FAF Regions
El Segundo	Los Angeles	**Oakland**	San Francisco
Eureka	Rest of California	**Oleum**	San Francisco
Hueneme	N/A	**Redwood City**	San Francisco
Long Beach	N/A	**Richmond**	San Francisco
Los Angeles	N/A	**Sacramento**	San Francisco
Avon	San Francisco	**San Francisco**	San Francisco
Benicia	San Francisco	**Selby**	San Francisco
Crockett	San Francisco	**Stockton**	San Francisco
Martinez	San Francisco	**San Diego**	San Diego

The FAF commodities are mapped to the vessel type using the groupings shown in Table 15. The total import and export tonnage of these groups of commodities was combined to determine the expected growth for a vessel type. The underlying assumption being that increases in imports and export tonnage of commodities would require and associated increase in the vessels needed to transport those commodities. For example, tanker growth is based on the aggregated sum of basic chemicals, crude petroleum, fuel oils, and gasoline.

Table 15: Vessel Type Assignment for FAF Commodity Categories

Vessel Type	FAF Commodity Category	Vessel Type	FAF Commodity Category
Auto	Motorized vehicles	**Container**	Alcoholic beverages
Bulk cargo	Animal feed		Articles-base metal
	Building stone		Base metals
	Cereal grains		Electronics
	Coal		Furniture
	Coal-not elsewhere classified		Miscellaneous manufactured prods.
	Fertilizers		Mixed freight
	Gravel		Newsprint/paper
	Logs		Paper articles
	Metallic ores		Pharmaceuticals
	Milled grain prods.		Plastics/rubber
	Natural sands		Precision instruments
	Nonmetal min. prods.		Printed prods.
	Nonmetallic minerals		Textiles/leather
General cargo	Chemical prods.		Tobacco prods.
	Live animals/fish		Waste/scrap
	Machinery		Wood prods.
Reefer	Meat/seafood	**Tanker**	Basic chemicals
	Other ag prods.		Crude petroleum
	Other foodstuffs		Fuel oils
Ro-ro	Transport equip.		Gasoline

CARB staff do not assume any vessel practice changes or system efficiency changes in the growth analysis except for POLA and POLB as discussed in section 4.2. Therefore, if tonnage increases 35 percent over 20 years for a vessel type in a specific region, the total activity from that vessel type was modeled as increasing 35 percent over the same period. For forecasting years between FAF's 5 year increments, the average annual compound growth rate was used (e.g., growth from 2020 to 2021 is determined by the average annual compound growth rate from 2020 to 2025).

The totals tons by FAF region are shown in Table 16 below. This is shown for summary purposes only. The growth rates modeled include both region and vessel type. The years shown are the product of FAF methodology and were not selected by CARB.

Table 16: Freight Analysis Framework (FAF) Freight Totals (annual tons)

FAF Region	Freight Type	2007	2015	2020	2025	2030	2035	2040
Los Angeles	**Water Freight**	155,767	210,078	254,189	309,253	367,723	419,347	482,672
San Francisco	**Water Freight**	57,085	77,410	90,673	105,944	120,562	134,535	151,964
San Diego	**Water Freight**	2,589	2,891	3,368	3,808	4,219	4,711	5,371
Sacramento	**Water Freight**	3,960	5,863	6,871	8,240	9,660	11,180	13,074
Remainder of State	**Water Freight**	6,689	7,921	8,297	8,571	8,327	8,326	8,613
Total		226,090	304,162	363,398	435,816	510,491	578,100	661,694

The resulting growth rates from the FAF analysis are shown in Table 17 below, by region and vessel type. These growth rates are used in the OGV inventory from 2016 to 2050 for all ports and independent marine terminals except for POLA and POLB and Hueneme.

Table 17: Annual Growth Rates by Region and Vessel Type

Region	Vessel Type	Compound annual growth rate (CAGR)
Los Angeles	**Auto**	0.028
Los Angeles	**Bulk cargo**	0.032
Los Angeles	**Container**	0.045
Los Angeles	**General cargo**	0.049
Los Angeles	**Reefer**	0.041
Los Angeles	**Ro-ro**	0.049
Los Angeles	**Tanker**	0.015
Rest of California	**Bulk cargo**	0.040
Rest of California	**Container**	0.048
Rest of California	**General cargo**	0.041
San Diego	**Auto**	0.026
San Diego	**Bulk cargo**	0.003
San Diego	**Container**	0.038
San Diego	**General cargo**	0.042
San Diego	**Reefer**	0.048
San Diego	**Ro-ro**	0.048
San Diego	**Tanker**	0.043

Region	Vessel Type	Compound annual growth rate (CAGR)
San Francisco	Auto	0.027
San Francisco	Bulk cargo	0.021
San Francisco	Container	0.046
San Francisco	General cargo	0.051
San Francisco	Reefer	0.041
San Francisco	Ro-ro	0.048
San Francisco	Tanker	0.011

4.2. Mercator Forecast for POLA and POLB

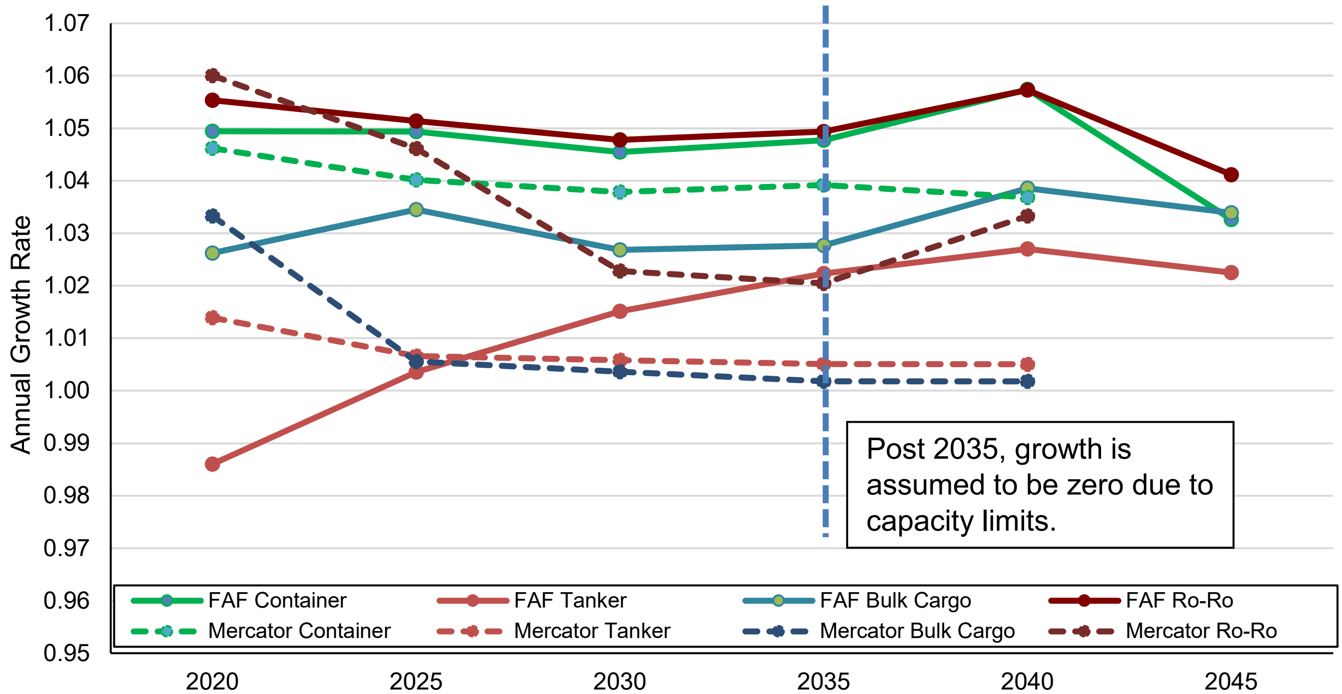
Mercator International, a consultancy group, was commissioned by POLA and POLB to create a port-specific growth study of their Ports to determine future investment needed, regional transit planning, and future emissions forecasting[21]. The most recent study completed was the 2016 analysis, and focused on freight growth as well as forecasting the size of container vessels that visit the ports. CARB staff is using the Mercator growth rates for POLA and POLB for the following reasons; (1) the analysis was port specific and not regional, and (2) the forecasting accounts for berth space, port capacity, shipping lanes, and additional features not included in FAF. POLA and POLB and the South Coast Area Group (SCAG) transportation planning both use the Mercator analysis, and have expressed support for its use in CARB's OGV emissions inventory.

To determine the impact of using Mercator forecasts as opposed to FAF, CARB compared the average annual Mercator growth rates against the FAF growth for POLA and POLB for the years 2020 to 2040, shown in Figure 4. Overall, the Mercator rates were 1 to 2 percentage points lower annually than the FAF rates, but the largest category – container vessels – was less than a half percentage point different through 2035. Ultimately, whether the FAF forecast or the Mercator forecast was used for growth, the total effective power and total emissions from OGVs at POLA and POLB in 2030 saw a shift of only 3 percent. Given the uncertainty inherent in all forecasting, this is not considered to be a significant difference.

In Figure 4, each type of vessel is assigned a color. The FAF forecast uses a solid line of the color, and the Mercator forecast uses a dotted line of the same color. To compare container vessels, for example, compare the solid and dotted green lines in the figure.

[21] Mercator International LLC and Oxford Economics – San Pedro Bay Long-term Unconstrained Cargo Forecast. July 2016 http://acta.org/revenue_finance/March%20%202016%20Meeting%20Item%208.pdf, page 265

Figure 4: FAF 4.3.1 and 2016 Mercator Annual Growth Rate Comparison for POLA and POLB



In addition to port specific growth rates, the Mercator report also provided a forecast of the distribution of container vessel sizes. Figure 5 shows the combination of container vessel size shifts, growth rate, and capacity at POLA and POLB according to the Mercator report forecasting. The increase in container vessel size over time is clearly visible. Container vessels capable of carrying over 12,000 TEUs transport only a few percent of effective TEUs in 2016, but are projected to deliver almost 60 percent of effective TEUs by 2030.

Although the growth rates continue through at least 2040, POLA and POLB are projected to reach their physical capacity in terms of TEU movement before then, with limited ability to expand based on land use and port characteristics. As stated in the Port Master Plan, the capacity projection for the Ports is 42 million TEUs per year.

Both the growth rates from the Port Master Plan and the Mercator Forecast from 2016 applied growth rates show that POLA and POLB will reach this combined capacity limit by 2035. At that point, the estimated growth rate is zero. CARB staff applied this capacity limit. As a result, post-2035 growth is assumed to be zero for POLA and POLB.[22]

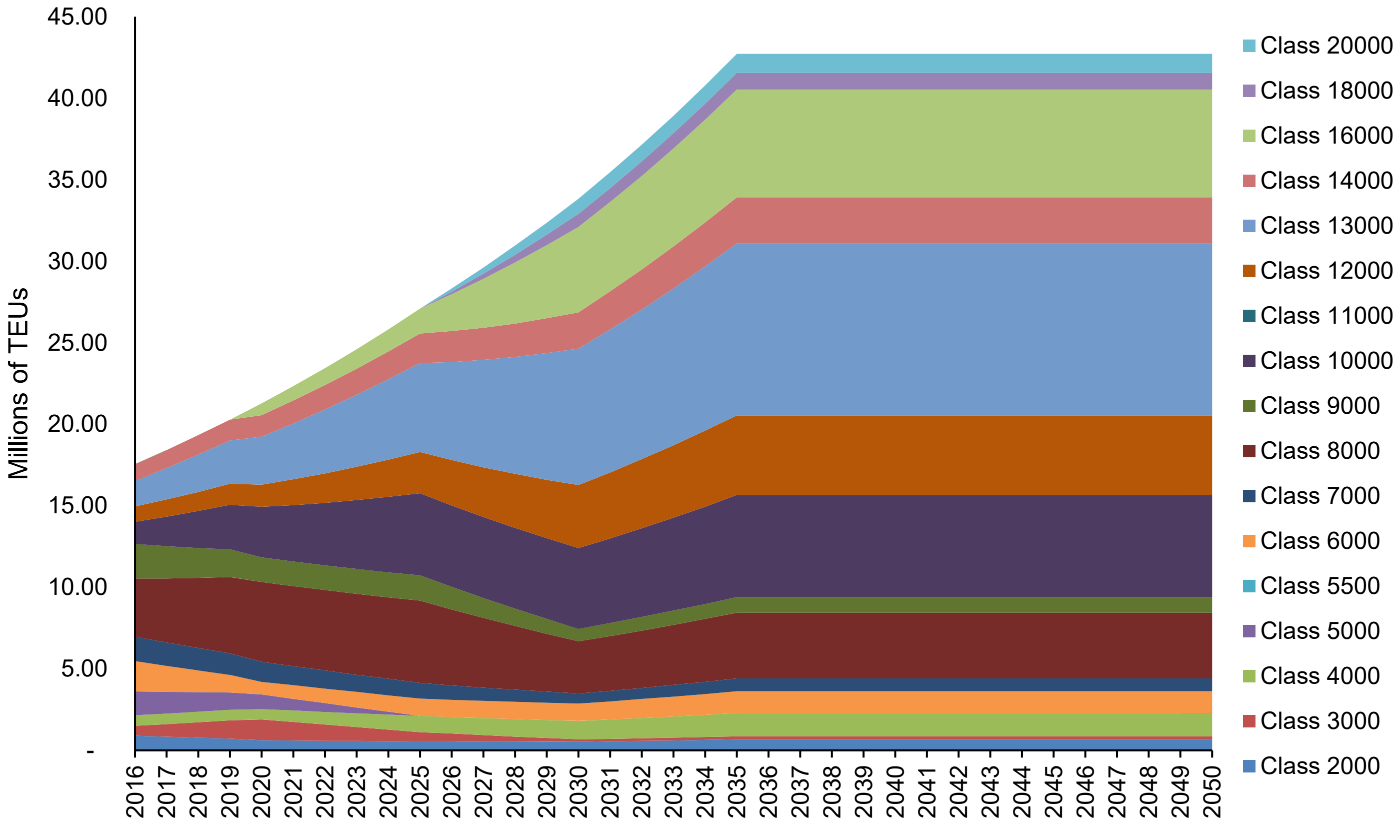
This change in container vessel sizes was included for POLA and POLB as they were the only ports included in the study. Other ports may see a shift over time but could be limited

[22] https://www.portoflosangeles.org/getmedia/2f2b99a8-f0c3-4e01-9bfe-ba34de05293d/amendment-28

by berth size and channel depth, port space and capacity, and other limiting factors. Any shifts in vessel sizes for other ports will be reviewed in future inventories.

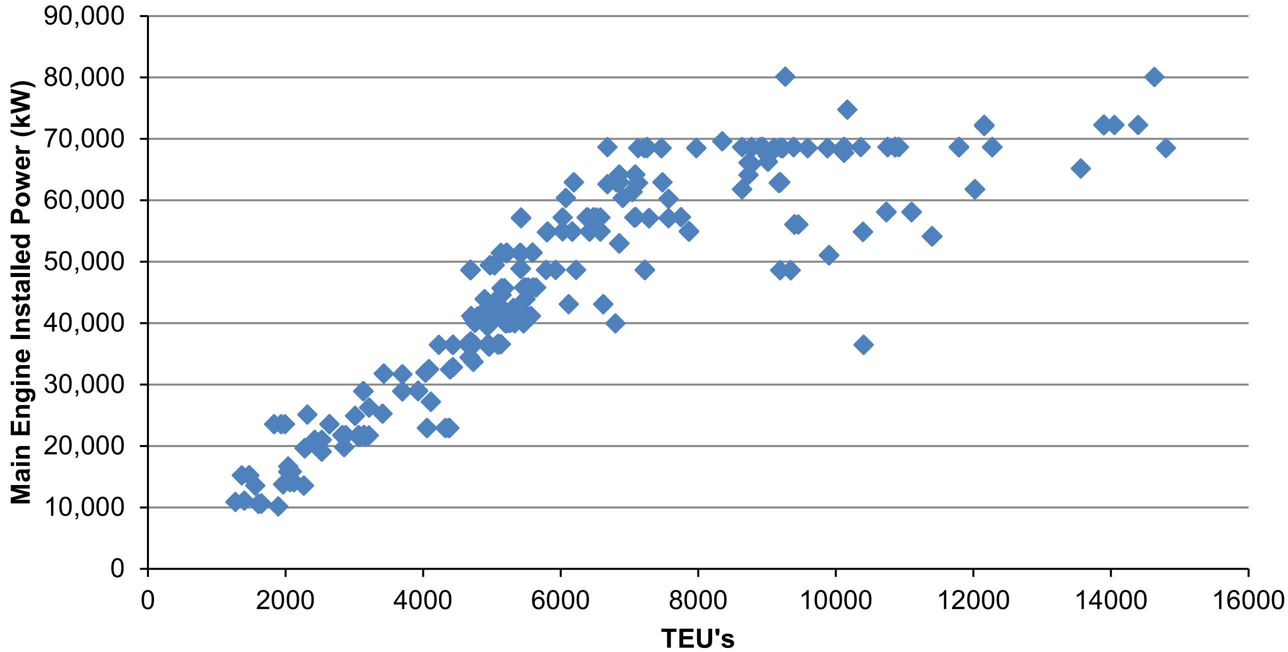
The combination of container vessel size shifts, growth rate, and capacity of POLA and POLB is shown in Figure 5. Note that vessel size bins are detailed in Table 2 of this document.

Figure 5: Capacity Growth by Container Size Forecast for POLA and POLB



This shift in container vessel sizes essentially increases the effiency of OGV transport in POLA and POLB, as larger vessels are considerably more efficient on the basis of kW-hr per TEU delivered. As shown in Figure 6, although the average TEU capacity is increasing, main engine power is not increasing at the same rate. At a certain point, the engines power levels off while TEU capacity continues increasing. Figure 6 shows that vessels of approximately 8,000 TEU's capacity and larger have a fairly constant average engine power and for vessels with a capacity 8,000 TEUs, the engine power to capacity relationship is fairly linear. This data was taken from the Army Corps of Engineers Entrances and Clearances database[23].

Figure 6: Container Vessel Main Engine to Capacity in 2014



Although this graph shows the main engine power, Table 9 and Table 10 in previous sections show that auxiliary engine power and boiler power have a non-linear relationship with vessel size as well. Larger vessels show a small increase (on average) in auxiliary engine and boiler sizes but overall are much more efficient on a per-TEU basis.

4.3. Freight Analysis Forecast and Port of Oakalnd

The FAF forecast for poerts in Northern California is significantly higher than the observed growth in TEU movement over the past 5 to 8 years for the Port of Oakland. The FAF forecast averages about 4.6 percent annual growth in the forecast, while the Port of Oakland has seen, roughly, 2 percent growth annually over this time. Based on this discrepancy, and comments received from the Port of Oakland, staff carefully considered whether FAF was an appropriate source for growth rates for this specific port.

Specifically, staff compared the projected rate of TEU growth (4.6 percent annually) against historic rates. Over the 1990 to 2018 periods, Port of Oakland has averaged 2.7 percent year-over-year growth. However, considering pre-recession periods, the port averaged

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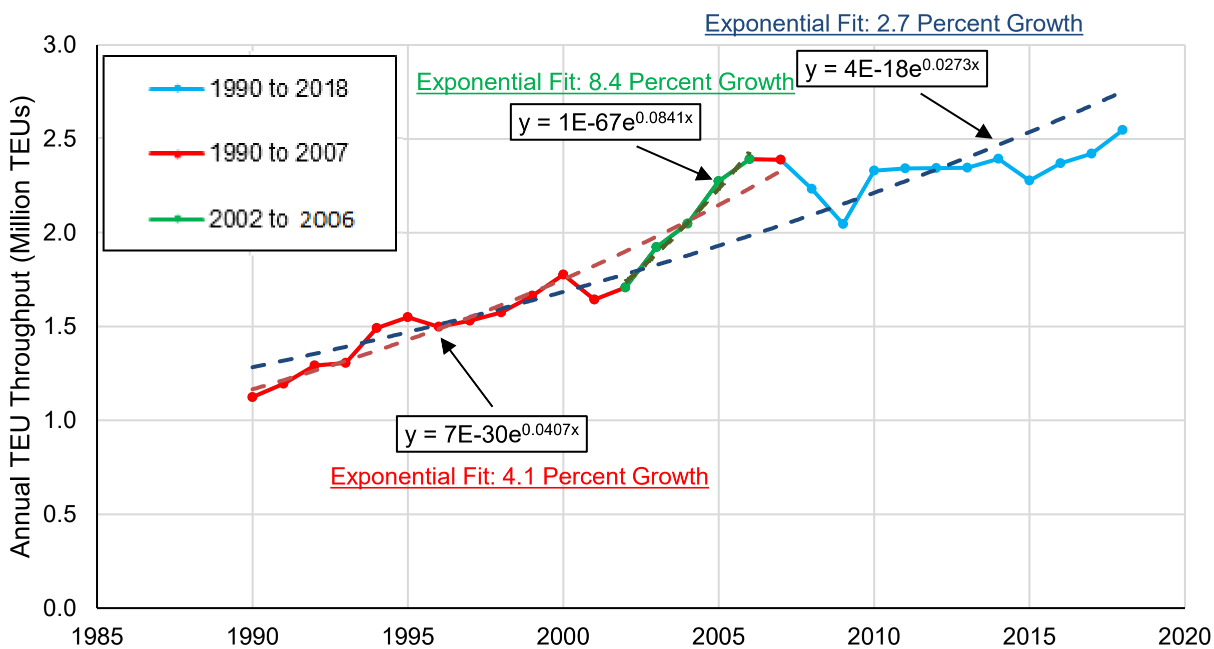
[23] US Army Corps of Engineers, Foreign waterborne transportation: Foreign cargo Inbound and Outbound Vessel Entrances and Clearances, https://usace.contentdm.oclc.org/digital/collection/p16021coll2/id/2763 (last accessed 9/12/2019).

over 4 percent growth for a span of 17 years (1990 to 2007). In best-fit exponential trend, Port of Oakland averaged 4.1 percent growth over this period, where in absolute growth (only 2007 values and 1990 values), the port average 4.5 percent annual growth. In short period such as 5 years (2002 to 2007), the port has averaged as high as 8.4 percent annual growth. These exponential trends are shown below, while the absolute change is:

$$\left(\frac{2007\ TEU}{1990\ TEU}\right)^{\frac{1}{2007-1990}} = \left(\frac{2{,}387{,}911}{1{,}124{,}123}\right)^{\frac{1}{2007-1990}} = 4.53\%\ \text{compound annual growth}$$

Based on this data, long term historical data supports that 4 to 5 percent growth rate is not unrealistic over a two decade period.

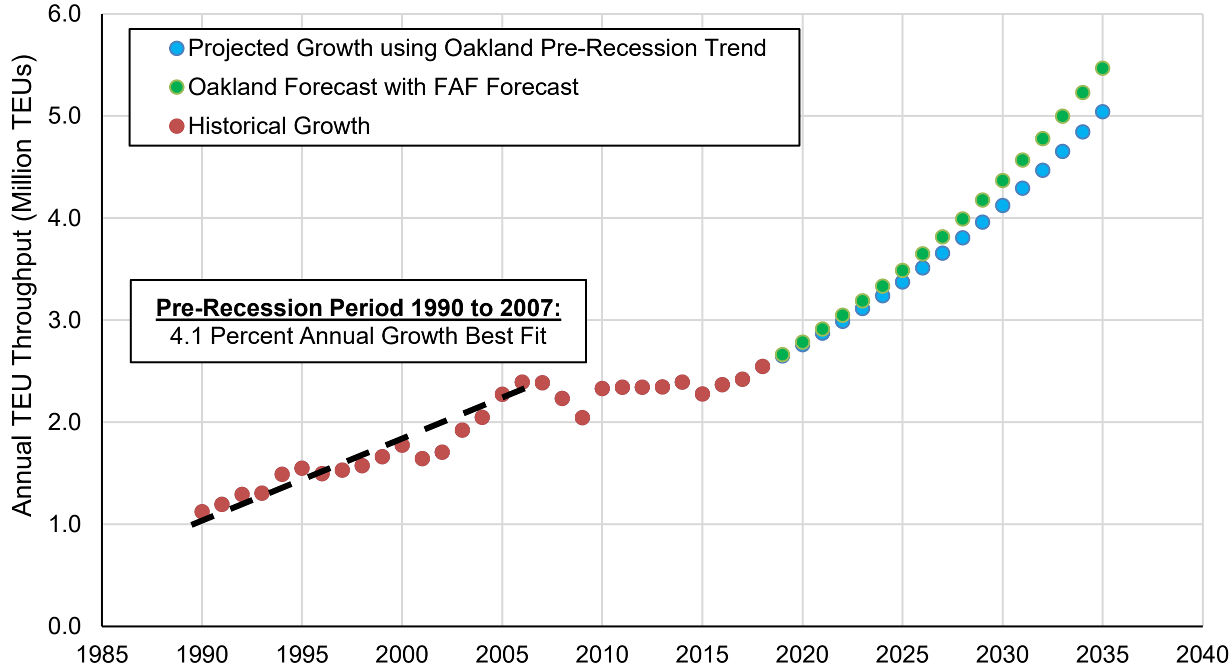
Figure 7: Historical Port of Oakland TEU Growth Trends



CARB also compared FAF growth projections with a projection of Port of Oakland growth using pre-2008 recession trends. FAF forecasts and pre-recessions trends are very similar. This shows that although the FAF data is showing a slightly higher growth rate compared to pre-recession trends in Oakland, it is a reasonable match with observed long term periods of expansion at the Port of Oakland.

In Figure 8, the red dots represent historical data, while green dots represent the forecast using FAF. The blue dots represent a forecast using the pre-recession growth in TEUs from the Port of Oakland (the 1990 to 2007 trend).

Figure 8: Comparing Historical Growth and FAF Growth in Port of Oakland



Disclaimer

This analysis should not be used to conclude that staff assumed, on their own, that the Port of Oakland would revert to a period of expansion and high growth. Rather, the data here was used only to determine whether the FAF forecast, although high, was a reasonable match with long term periods of growth at Port of Oakland, and was not unbelievably or unrealistically high.

4.4. Engine Tier Availability and Introduction

Previous inventories assumed vessels would incorporate Tier III engines in approximately 2016, when Tier III engines are required in all new marine vessels. However, based on an analysis conducted by Starcrest for POLA and POLB, the introduction of Tier III in the OGV inventory forecast has been delayed from 2030 to 2040.[24]

The reason for this delay can be attributed largely to two factors, (1) POLA and POLB as well as the ports in the western United States, rarely receive visits from the newest container vessels, which tend to be larger vessels that more commonly service Asian and European freight routes, and (2) the very large number of vessel builds ordered

[24] Starcrest Consulting Group, LLC, Port of Long Beach, Port of Los Angeles, San Pedro Bay Ports, Clean Air Action Plan 2017: Draft – Bay Wide Ocean Going Vessel International Maritime Organization Tier Forecast 2015-2050 (July 2017), http://www.cleanairactionplan.org/documents/vessel-forecast-draft.pdf/.

immediately prior to the Tier III marine standard introduction. Vessel builds that began prior to the Tier III marine standards initial date may have Tier II marine engines installed, even if the vessel is put into service at a later date. Further details are available from Starcrest and POLA and POLB[15]. The starting year for each vessel type and container size bins[25] is listed below in Table 18.

Table 18: Marine Engine Tier III Introduction Dates at California Ports

Vessel Type	Size Bin	Year Start
Auto	**-**	2037
Bulk	**-**	2040
Container	**1**	2030
Container	**2**	2040
Container	**3**	2030
Container	**4**	2030
Container	**5**	2030
Container	**6**	2040
Container	**7**	2030
Container	**8**	2040
Container	**9**	2040
Container	**10**	2032
Container	**11**	2037
Container	**12**	2037
Container	**13**	2037
Container	**14**	2037
Container	**15**	2037
Container	**16**	2030
Container	**17**	2030
Container	**18**	2037
Container	**19**	2030
Container	**20**	2040
Cruise	**-**	2026
General	**-**	2030
Reefer	**-**	2030
Ro-ro	**-**	2030

[25] Container size bins are described in Table 2.

Vessel Type	Size Bin	Year Start
Tanker	-	2030
Tanker	Seawaymax	2030
Tanker	Panamax	2030
Tanker	Aframax	2030
Tanker	Suezmax	2030
Tanker	VLCC	2030
Tanker	ULCC	2030

The net impact of this change is an increased number of Tier II marine engines in the inventory, well past 2040. This change increases the NOx emissions relative to earlier adoption of the Tier III marine standard, but is not enough to off-set the lower NOx emission factors (as shown in the emissions results section).

CARB did receive comments from stakeholders suggesting that a small number of tankers and container vessels may arrive with either Tier III engines or operational improvements that allow the vessels to operate at similar emissions levels to Tier III. Where data is available, the inventory reflects operational shifts in effective power (noted in Section 3.3). However, the inventory does not reflect lower emissions on a per-ship basis (for example, technologies installed on a single Tier II vessel to reduce emissions below average Tier II emission levels). The Existing Regulation provides a mechanism to verify emission reduction strategies, and any stakeholder engaging in emissions reduction strategies may coordinate with CARB as outlined in the California Code of Regulations (CCR) title 17, chapter 1, subchapter 7.5, 93118.3(e)(2)(D).[26] Strategies verified following this process would be reflected in the inventory.

Although vessels have arrived in California ports with Tier III engines as of August, 2019, these vehicles are an extreme exception and not commonplace. CARB staff considered adjusting the forecast based on these visits. However, part of the reasoning (in the Starcrest report) behind delaying the forecast for Tier III vessels included the fact that these vessels generally service routes between Asia and Europe. Therefore it is not surprising that Tier III vessels exist, and could make a single visit or small number of visits to California ports, without significantly altering the schedule of vessels visits and general behavior of the international fleet. CARB staff will carefully monitor Tier III vessel visits to California ports for future inventory work, but currently do not believe the small handful of visits to date support changing the Tier III arrival date.

[26] 17 CCR § 93118.3. Airborne Toxic Control Measure for Auxiliary Diesel Engines Operated on Ocean-Going Vessels At-Berth in a California Port, https://ww3.arb.ca.gov/regact/2007/shorepwr07/93118-t17.pdf.

5. Regulations Included in the OGV Inventory

5.1. Fuels

Two regulations control the sulfur content of fuel used in California waters. The first of the regulations is CARB's OGV Clean Fuel Regulation ("Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline"), commonly referred to as the Clean Fuel Regulation. Implementation for this regulation began in July 1, 2009, and is currently in its second and final phase.[27] CARB's Clean Fuel Regulation requires fuel used by marine vessel operators be a distillate fuel with a sulfur content equal to or less than 0.1 percent, during operation within the 24 nm regulatory zone off the California coast. The second fuel regulation in place is the North American Emission Control Area (ECA)[28], which reduced the allowable sulfur content of marine fuels to 0.1 percent beginning January 1, 2015. This regulation requires that 0.1 percent sulfur fuel to be used within 200 nm of the United States and Canadian coasts. The sulfur content of the fuel affects SOx and PM pollutants. Appendix A contains emission factors and impacts of the Clean Fuel Regulation.

Vessels can file for a research exemption under the Clean Fuel Regulation and if approved, test ultra-low residual fuel oil (or scrubbers) instead of diesel fuels as part of research and testing projects, but the number of vessels that utilize this research exemption are few and such exemptions for ultra-low sulfur residual fuel oil are not included in the inventory.

5.2. Shore Power and the Existing At Berth Regulation

In December 2007, CARB approved the "Airborne Toxic Control Measure for Auxiliary Diesel Engines Operated on Ocean-Going Vessels At-Berth in a California Port" Regulation, also called "the At-Berth Regulation" or "Existing Regulation".[29,30] A brief explanation is provided in this report to explain the modeling of the regulation but for any in-depth understanding of the regulation please refer to the regulation documentation.

[27] California Air Resources Board, Ocean-Going Vessels Fuel Rule, https://www.arb.ca.gov/ports/marinevess/ogv.htm.
13 C.C.R. §Section 2299.2, Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels Within California Waters and 24 Nautical Miles of the California Baseline (2011), https://ww3.arb.ca.gov/ports/marinevess/documents/fuelogv13.pdf.
17 CCR § 93118.2 et al, Airborne Toxic Control Measure for Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels Within California Waters and 24 Nautical Miles of the California Baseline, https://ww3.arb.ca.gov/ports/marinevess/documents/fuelogv17.pdf.

[28] International Maritime Organization, MARPOL Annex VI Regulation 14 - Sulphur oxides (SOx) and Particulate Matter (PM) – Regulation 14, http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Sulphur-oxides-(SOx)-–-Regulation-14.aspx.

[29] 13 C.C.R. § Section 2299.2, Airborne Toxic Control Measure For Auxiliary Diesel Engines Operated On Ocean-Going Vessels At- Berth In A California Port, https://ww3.arb.ca.gov/regact/2007/shorepwr07/2299-t13.pdf.

[30] 17 CCR § 93118.3. Airborne Toxic Control Measure for Auxiliary Diesel Engines Operated on Ocean-Going Vessels At-Berth in a California Port, https://ww3.arb.ca.gov/ports/shorepower/finalregulation.pdf or https://ww3.arb.ca.gov/regact/2007/shorepwr07/93118-t17.pdf.

The Existing Regulation requires container vessels, passenger vessels, and refrigerated-cargo vessels to connect to shore power for a percent of their visits or use an approved alternative to shore power, and reduce their at berth emissions across their fleet by a percentage, if the vessels are in a fleet that meet the visit threshold. Fleets must also report their total time in port and total time on shore power to CARB. Implementation for the Existing Regulation began in 2014 with the requirement that applicable fleets spend 50 percent of their at-berth time connected to the electric grid and not run on auxiliary engines for power, then increased to 70 percent of the fleet at-berth time in 2017. The final phase of implementation will occur in 2020, when the requirements increase to 80 percent of an applicable fleets time at-berth.

The requirements of the regulation impact each port in different ways, depending on the percent of the fleets in the port subject to the regulation based on their number of vessel visits in California ports, and the stringency of the regulation.

To forecast the Existing Regulation’s impacts, the inventory compares data from CARB enforcement team and the statewide inventory of vessels time at berth. The following example shows a fictional port to demonstrate how the inventory calculates at berth reductions. This is an example only, and the data in the example is not intended as a realistic evaluation of the regulation, only an example to illustrate how the regulation is applied and how inventory models the regulation.

Example (data is not based on real information)

The statewide inventory shows that container vessels in a port spend 10,000 hours at berth over the course of a year. Enforcement data informs the inventory that applicable fleets spend 6,000 hours per year at the port (meaning that only 60 percent of the total vessel at berth hours in the port are subject to the Existing Regulation, due to exemptions based on number of visits per year and vessel type). Enforcement data also shows that vessels vists covered by the regulation are spending 3,000 hours on electric shore power in 2016 to meet the 50 percent shore power requirement of the regulation (3000/6000 = 50 percent). To meet the regulatory requirement of 70 and 80 percent in 2017 and 2020, the regulated fleets would need to spend at least 4,200 and 4800 hours on shore power respectively. This means that although fleets are meeting the 80 percent requirement of the shore power regulation in 2020, the total hours of their at berth operation is reduced by 52 percent (1 – 4,800/10,000 = 0.52) The inventory calculations are shown in Table 19.

Table 19: Existing At-Berth Regulation Requirement Levels (Example with fictitious activity data)

Calendar Year	At Berth Hours from All Vessels in Example Port	At Berth Hours of Vessels Covered by Existing Regulation	Existing At Berth Regulation Percent Time on Shore Power Requirement	Hours on Shore Power	Reduction Factor from Existing Regulation for All Vessel Visits at Example Port
2016	10,000	6,000	50%	3,000 (6,000 hrs * 50% = 3,000 hrs)	30% (3,000 hrs / 10,000 total port hrs = 30%)
2017	10,000	6,000	70%	4,200	42%
2020	10,000	6,000	80%	4,800	48%

The reduction factors are averaged by port, vessel type, and by vessel size. Table 19 shows the percent of time on shore power (out of total time for all vessels at berth, not just impacted fleets) and the projected time on shore power after the 2020 regulatory requirements are implemented. In some cases, fleets at certain ports met or exceeded requirements of the regulation and therefore no further increases in the shore power usage were projected.

Table 20 below shows a sample of the control factors included in the inventory based on the Existing Regulation. The control factor is both a reduction in power supplied by auxiliary engines as well as the percent reduction in emissions. For example, a 65 percent reduction in auxiliary engine use is assumed to achieve a 65 percent emissions reduction.If a record has a “N/A” value it indicates there was no activity for that year.

Table 20: Percent of Time on Shore Power by Year

Arrival Port	Vessel Type	Size Bin	2016	2020	2030
Hueneme	**Container**	**1**	32%	85%	85%
Hueneme	**Container**	**2**	32%	85%	85%
Hueneme	**Reefer**		32%	85%	85%
Los Angeles / Long Beach	**Container**	**1**	34%	40%	43%
Los Angeles / Long Beach	**Container**	**2**	18%	21%	25%
Los Angeles / Long Beach	**Container**	**3**	21%	24%	29%
Los Angeles / Long Beach	**Container**	**4**	55%	65%	75%
Los Angeles / Long Beach	**Container**	**5**	46%	54%	N/A
Los Angeles / Long Beach	**Container**	**6**	70%	83%	90%
Los Angeles / Long Beach	**Container**	**7**	68%	74%	74%
Los Angeles / Long Beach	**Container**	**8**	70%	82%	83%
Los Angeles / Long Beach	**Container**	**9**	43%	55%	69%
Los Angeles / Long Beach	**Container**	**10**	22%	26%	36%
Los Angeles / Long Beach	**Container**	**11**	77%	N/A	N/A

Arrival Port	Vessel Type	Size Bin	2016	2020	2030
Los Angeles / Long Beach	Container	12	95%	95%	95%
Los Angeles / Long Beach	Container	13	34%	41%	48%
Los Angeles / Long Beach	Container	14	96%	96%	96%
Los Angeles / Long Beach	Container	16	N/A	0%	0%
Los Angeles / Long Beach	Container	17	0%	0%	44%
Los Angeles / Long Beach	Container	18	N/A	N/A	41%
Los Angeles / Long Beach	Container	20	N/A	N/A	32%
Los Angeles / Long Beach	Cruise		54%	54%	54%
Oakland	Container	1	8%	11%	11%
Oakland	Container	2	1%	1%	1%
Oakland	Container	3	40%	57%	57%
Oakland	Container	4	46%	67%	67%
Oakland	Container	5	33%	48%	48%
Oakland	Container	6	51%	74%	74%
Oakland	Container	7	69%	74%	74%
Oakland	Container	8	45%	68%	68%
Oakland	Container	9	52%	62%	62%
Oakland	Container	10	0%	13%	13%
Oakland	Container	11	63%	86%	86%
Oakland	Container	12	82%	82%	82%
Oakland	Container	13	19%	49%	49%
Oakland	Container	14	8%	56%	56%
Oakland	Container	17	0%	84%	84%
San Diego	Container	1	91%	92%	95%
San Diego	Container	3	0%	0%	95%
San Diego	Cruise		28%	30%	30%
San Francisco	Cruise		16%	17%	17%

6. Summary of Proposed Regulation

The new Control Measure For Ocean-going Vessels At Berth ("Proposed Regulation") is designed to achieve additional emissions reductions of DPM, $PM_{2.5}$, NO_x, GHGs, and ROG beyond those realized by the Existing Regulation; further reduce adverse health impacts to the communities surrounding ports and terminals; and increase the clarity and enforceability of regulatory requirements for vessels. The Proposed Regulation would accomplish this by:

- Introducing emission control requirements to additional ports, MTCs, vessel visits, and vessel types that are not covered by the Existing Regulation, and

- Implementing a regulatory structure that is based on requirements applying to each individual vessel visit, with the actions of each single visit determining compliance. This represents a change in the regulatory structure from the Existing Regulation, which is an annual fleet-based regulation where compliance is based on a fleet's yearly performance.

The Proposed Regulation would expand covered vessels to include auto carriers, roll on-roll off (ro-ro) vessels, crude tankers and product tankers. This requirement would include diesel-fueled auxiliary engines, as well as auxiliary engines that operate on liquefied natural gas (LNG) engines and other alternative fuels.

Regulated vessels would be required to use a CARB approved control strategy, such as shore power, a barge or land-based capture and control system, or other to-be-determined control technology, to control emissions while at berth. The Proposed Regulation would also require boiler emissions controls for tanker vessels operating boiler-powered, steam-driven pumps to off-load cargo (typically crude products). To obtain CARB approval, a control technology must be able to show that it can reduce a vessel's emissions by at least 80 percent from the default emissions of an ocean-going vessel's auxiliary engine and boiler.[31]

The Proposed Regulation would base emission control requirements on the number of annual visits made by regulated vessel types to specific terminals by setting vessel visit thresholds for terminals. The Proposed regulation would place requirements on any container, reefer, cruise, ro-ro, or tanker terminal in California that receives 20 or more visits from any of these specific vessel types. If the terminal visit threshold is exceeded, then all berths at that specific terminal are included in the regulation.These thresholds were set considering past activity and per vessel emission levels for different vessel types.

Table 21 lists ports that are subject to the Existing Regulation and ports and MTCs that would likely be subject to control requirements under the Proposed Regulation, based on the proposed terminal thresholds and 2017 vessel activity information.

Table 21: Affected Ports and Marine Terminal Complexes*

Existing Regulation	Proposed Regulation	
Ports	**Ports**	**MTCs**
Los Angeles Long Beach Oakland San Francisco San Diego Hueneme	Los Angeles Long Beach Oakland San Francisco San Diego. Hueneme	Stockton Marine Terminal Complex Richmond Marine Terminal Complex Carquinez Marine Terminal Complex Rodeo Marine Terminal Complex

[31] Default emission rates of auxiliary engines on ocean-going vessels are 13.8 g/kW-hr for NOx and 0.17 g/kW-hr for DPM. Default emission rates of tanker auxiliary boilers on ocean-going vessels are 2.0 g/kW-hr for NOx and 0.17 g/kW-hr for PM2.5. These emission rates represent a typical vessel operating on marine diesel oil with a sulfur content of 0.10 percent.

The Proposed Regulation would phase in from 2021 through 2029 with full implementation achieved by 2029. The proposed implementation timeline is summarized in Table 22. Vessel categories that are already regulated would have new requirements beginning in 2021 under the Proposed Regulation. Previously unregulated vessel categories would have an exception for control requirements until 2023 to allow for infrastructure buildout and production of capture and control systems. Specifically, emission control requirements for tankers would begin in 2027 at the Ports of LA/LB, with control requirements for the remainder of the tanker terminals statewide beginning in 2029 to allow the tanker industry to address operational issues that may arise during the initial implementation period.

Table 22: Implementation Timeline for the Proposed Regulation

2021	2025	2027	2029
Container, Reefer, and Cruise			
	Ro-ro		
		Tankers - POLA/POLB Terminals	
			Tankers – Remaining Statewide Terminals

7. Emissions Results

The emissions results included in this section are intended to provide an overview and visualization of the emissions distribution among ports and MTCs, vessel types, as well as engine types and tiers. For a comprehensive version of the inventory output, the 2019 CARB OGV Model or Off-Road Inventory Online (ORION) should be used.[32,33]

The contribution to statewide at-berth criteria emissions for each port is shown in Figure 9. In most cases the relative contribution to NOx and PM to the statewide inventory for each port are comparable in magnitude (i.e., visually this means the red and blue bars for the port are of a similar height). In some cases such as Richmond, the relative contribution to PM is higher than the contribution to NOx. This can largely be attributed to the tanker activity in the Richmond complex, and the fact that tanker boilers have a higher PM contribution than NOx. In other areas, such as San Francisco, the relative contribution to PM is lower than NOx, as the area sees very few tankers.

[32] California Air Resources Board, MSEI - Documentation - OFFROAD - Diesel Equipment, Ocean Going Vessels, DRAFT 2019 OGV Emissions Inventory Model, can be accessed https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-offroad-0. Direct link: https://ww3.arb.ca.gov/msei/ordiesel/draftogvmodel2019march.zip (last accessed 9/12/2019).
[33] California Air Resources Board, OFFROAD2017 – ORION, https://www.arb.ca.gov/orion/ (last accessed 9/12/2019).

Figure 9: 2016 Statewide At-Berth NOx and PM 2.5 Emissions by Port

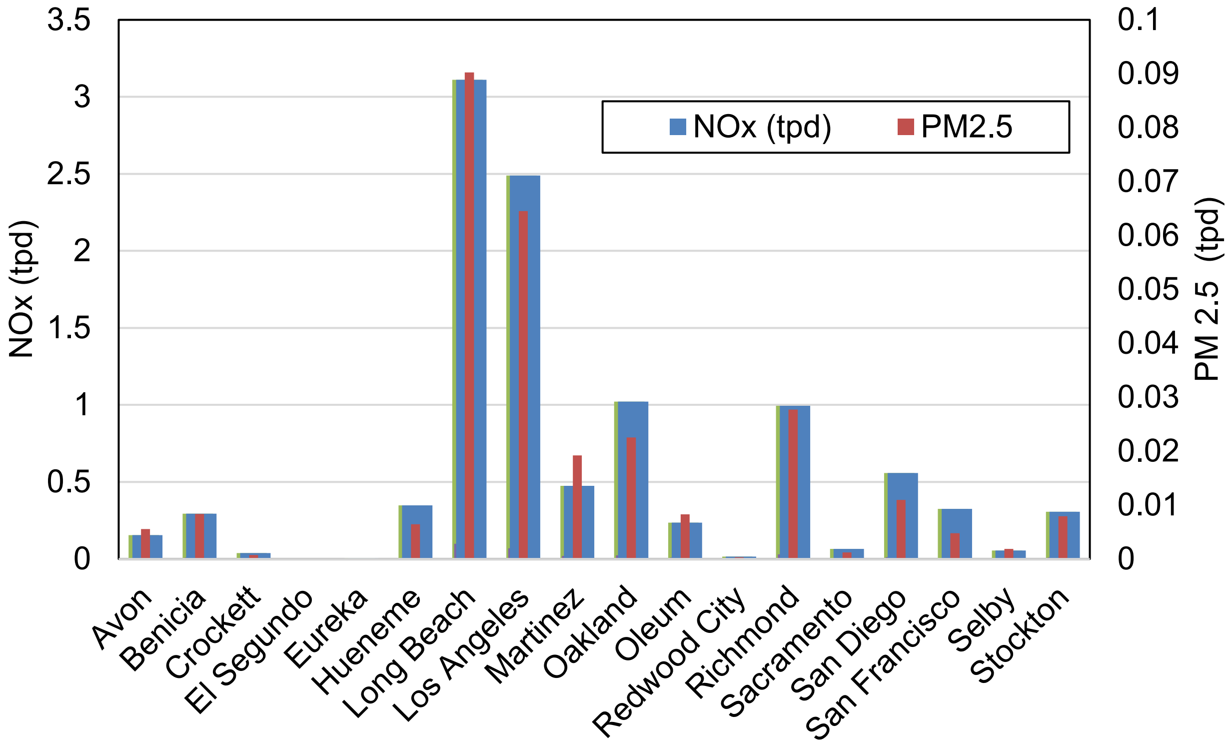
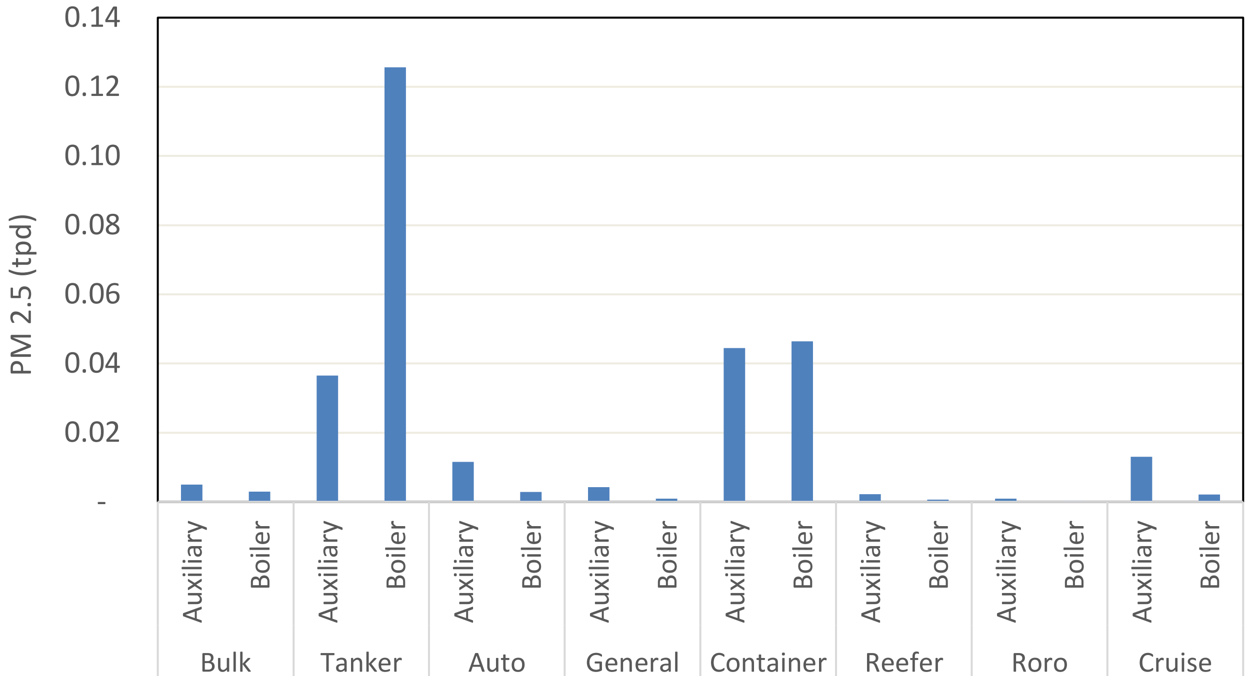


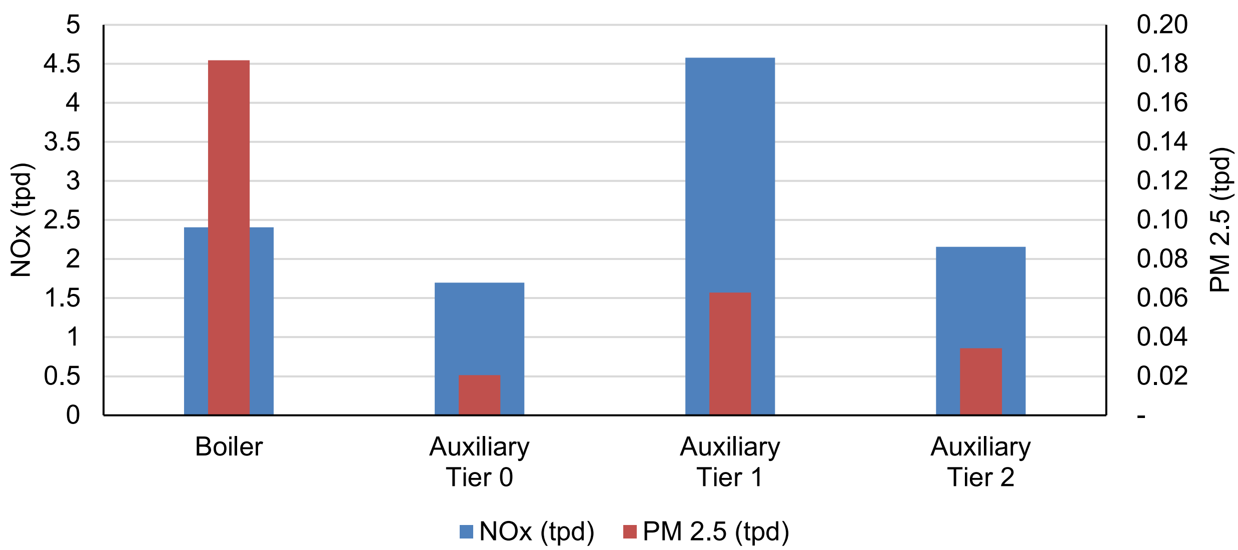
Figure 10 below shows the contribution to statewide at-berth PM emissions by each vessel type and each engine type on the vessel. Tankers and containers are by far the largest overall contributors, in particular tanker boilers.

Figure 10: 2016 Statewide At-Berth PM 2.5 Emission by Vessel and Engine Type



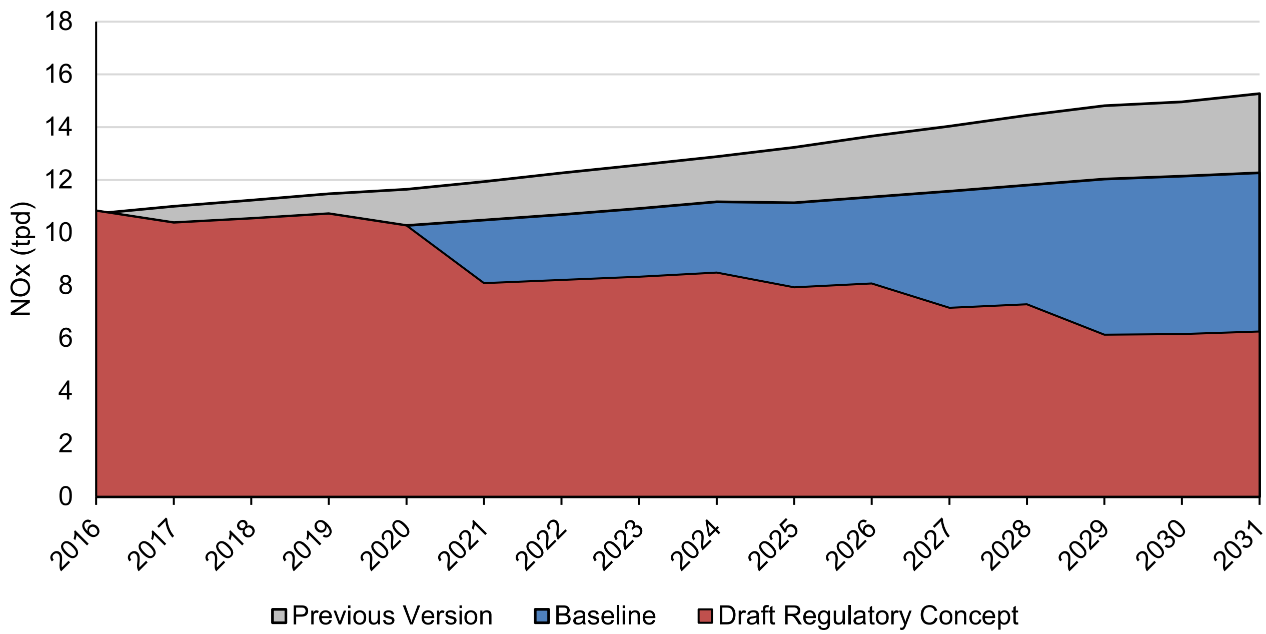
Splitting the auxiliary engines into engine tier standards and comparing against boilers shows that boilers are the largest contributor toward PM emissions, while auxiliary engines are the largest contributor towards NOx emissions. This is shown below in Figure 11.

Figure 11: 2016 Statewide At-Berth NOx and PM 2.5 by Engine Type and Tier



This emissions inventory not only reflect the updates to the baseline, but also provides scenario analysis for the new Proposed Regulation as described earlier. The following charts show the impact of the updates on the inventory, and the impact of Proposed Regulation. As shown in Figure 12, At Berth NOx emissions are lower than previous inventory estimates, and are further reduced in 2021 and 2025 vessels by the Proposed Regulation. Reductions also accur in 2027 and 2029 when implementation begins for tankers

Figure 12: Statewide At Berth NOx Emissions



Similarly, statewide PM emissions from at-berth vessels (shown in Figure 13 and Figure 14) are lower than previous inventory (i.e., 2014 OGV model) forecasts. . Additionally PM emissions are listed in two units, PM 2.5 and Diesel PM (DPM). The DPM emissions are those produced by diesel engines, so it excludes emissions from auxillary engines.

Figure 13: Statewide At Berth PM 2.5 Emissions

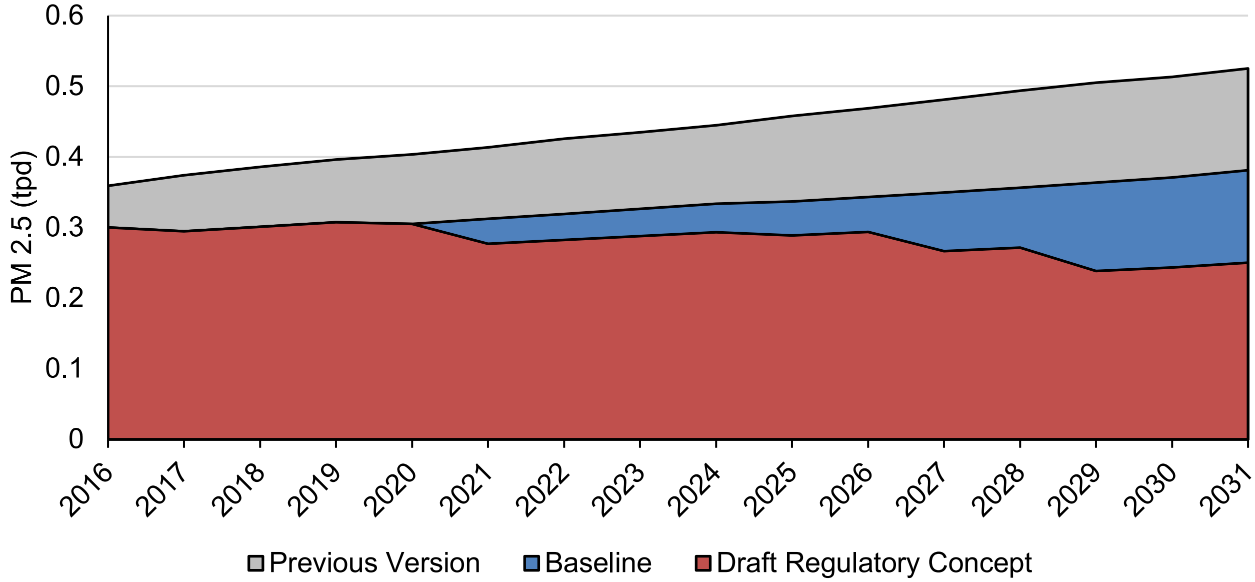


Figure 14: Statewide At Berth DPM Emissions

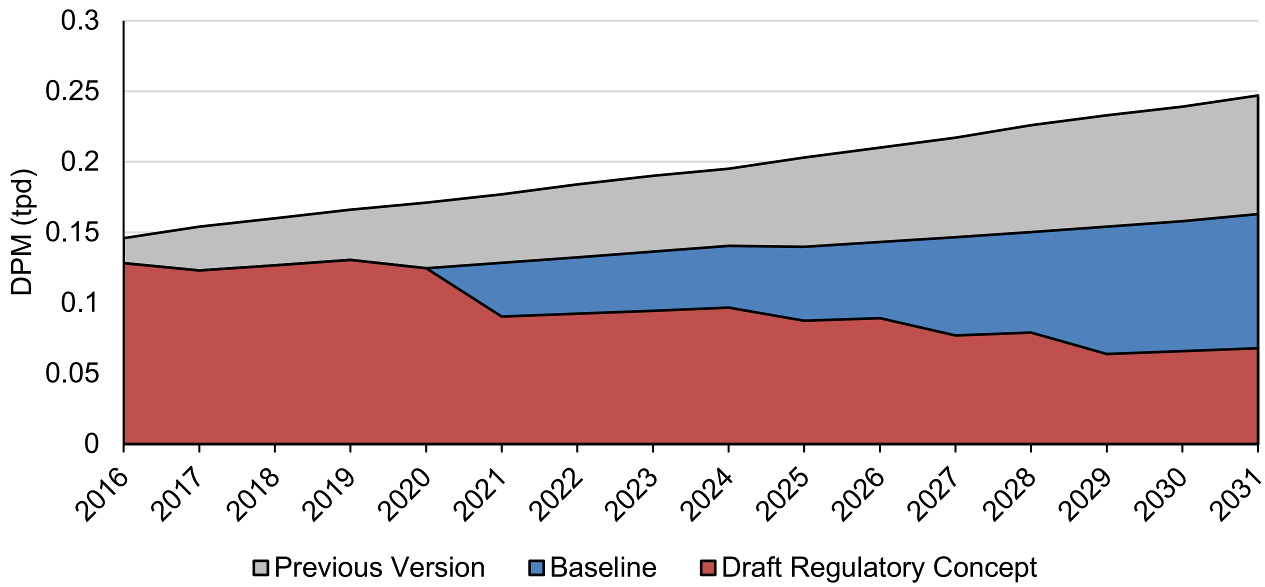


Figure 15 and Figure 16 show the NOx and PM emissions from POLA and POLB, also included in the 2018 HRA, for both the baseline and the Proposed Regulation scenarios. Similarly, Figure 16 and Figure 17 show the same information for the Richmond Complex.

Figure 15: NOx Emissions Forecast At POLA and POLB

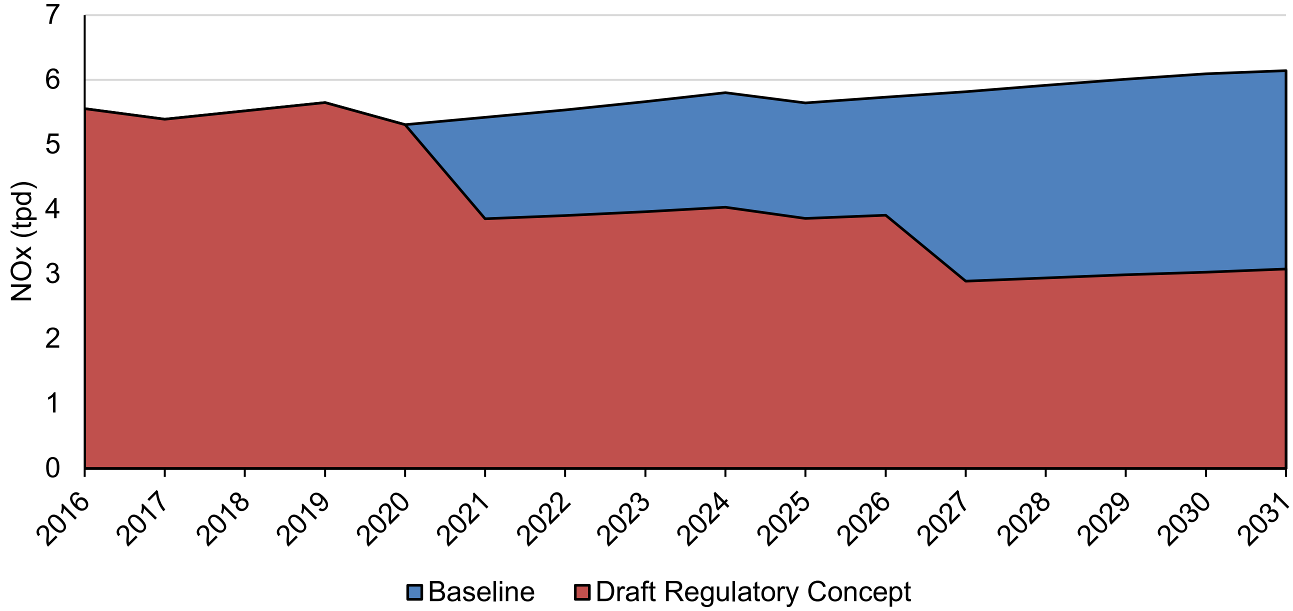


Figure 16: PM 2.5 Emission Forecast at POLA and POLB

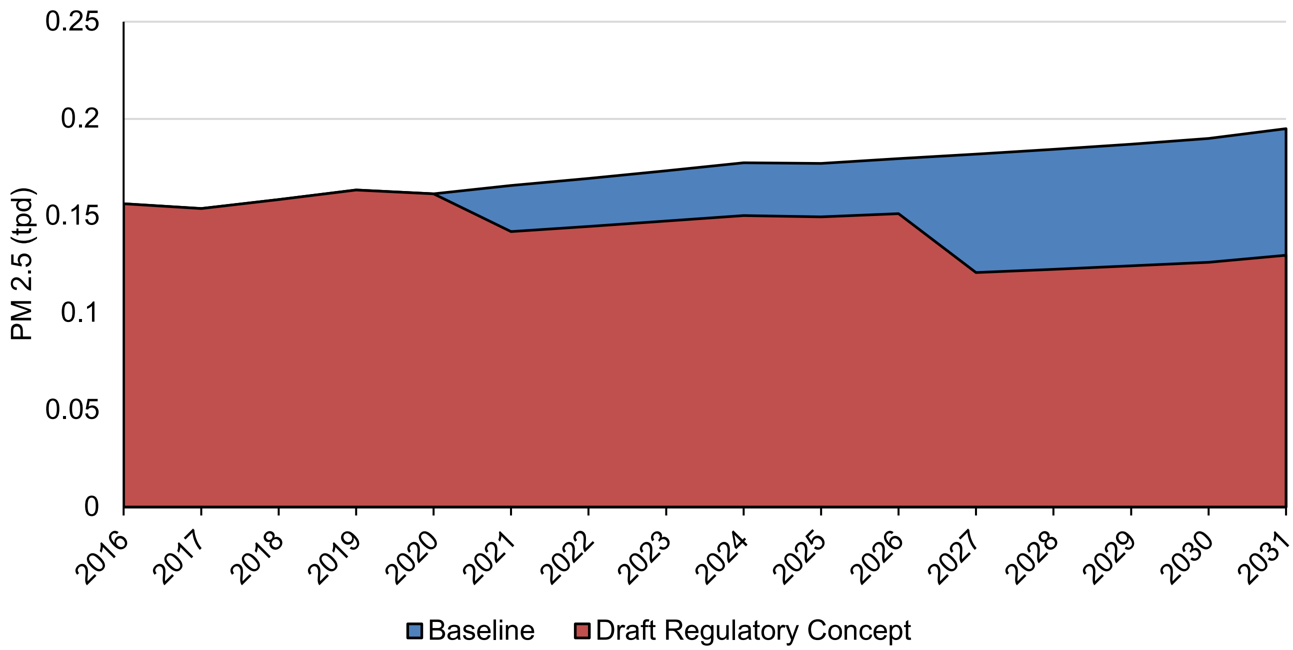


Figure 17: DPM Emission Forecast at POLA and POLB

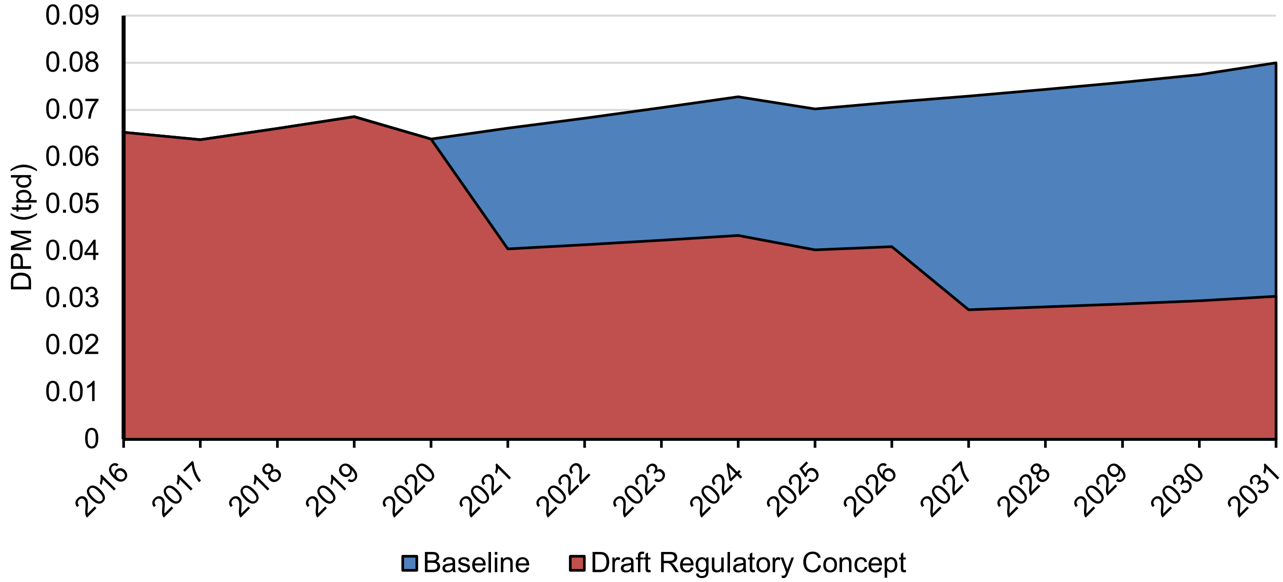


Figure 18: NOx Emission Forecast at the Port of Richmond

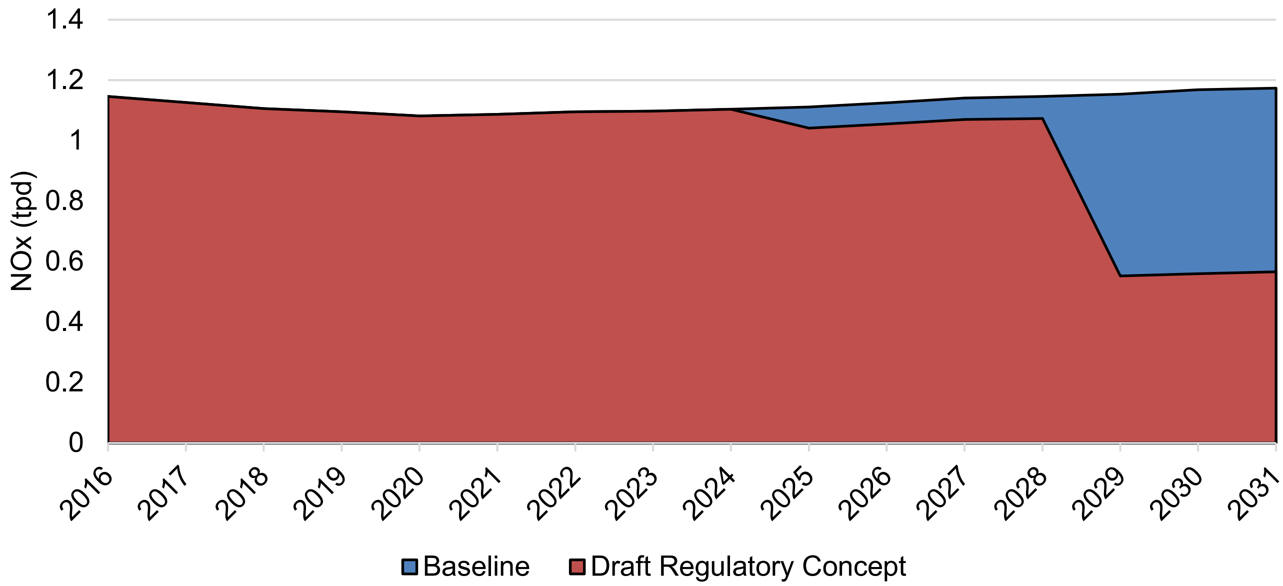


Figure 19: PM 2.5 Emission Forecast at the Port of Richmond

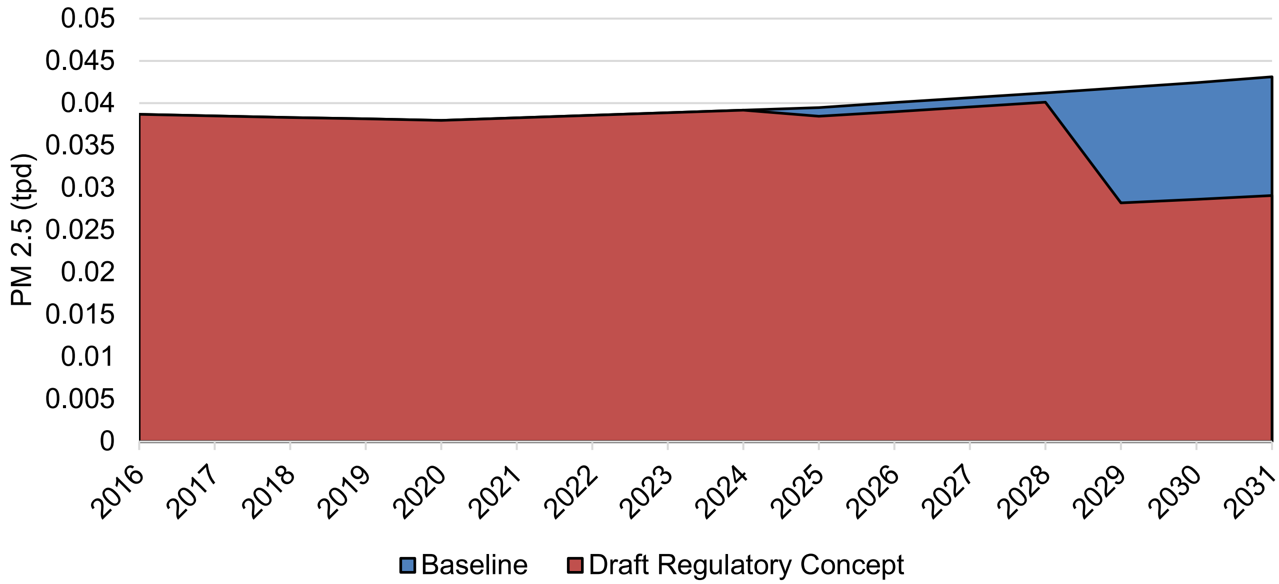


Figure 20: DPM Emission Forecast at the Port of Richmond

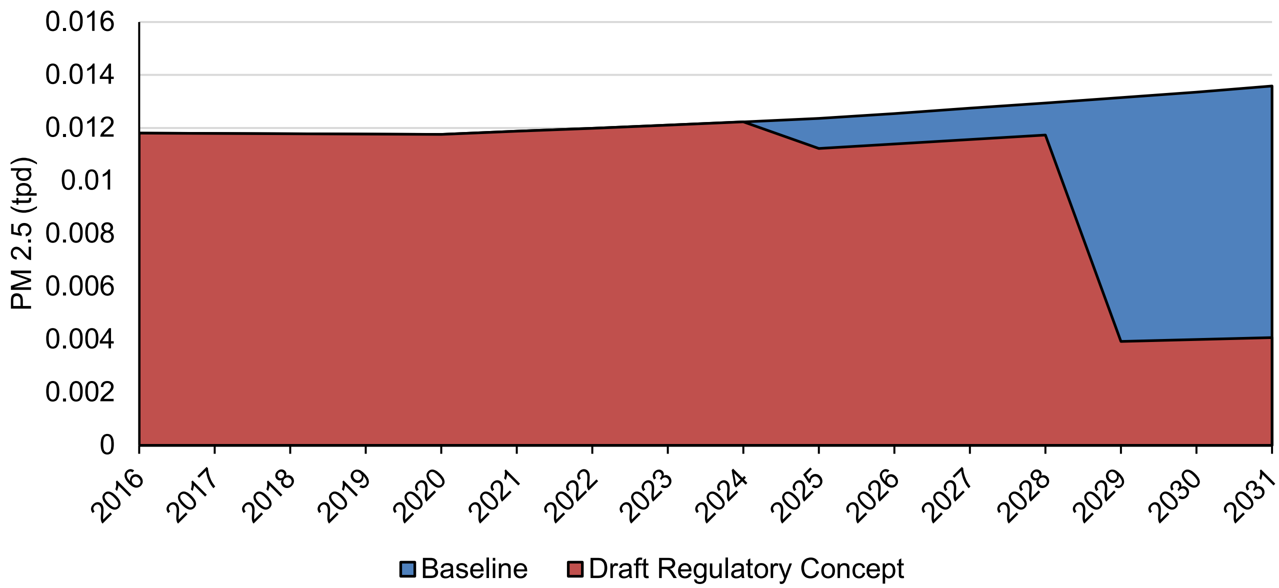


Table 23 shows the emissions under the Existing Regulation, at a statewide level and also for the two ports in the associated HRA.

Table 23: Statewide NOx, DPM and GHG At Berth Emissions under Existing At Berth Regulation

Calendar Year	Statewide			Bay Area			South Coast		
	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)
2016	10.50	0.28	0.13	3.61	0.10	0.04	5.60	0.15	0.07
2017	10.23	0.28	0.12	3.48	0.10	0.04	5.53	0.15	0.07
2018	10.23	0.28	0.12	3.34	0.10	0.04	5.65	0.16	0.07
2019	10.41	0.29	0.13	3.37	0.10	0.04	5.78	0.16	0.07
2020	10.16	0.29	0.13	3.27	0.10	0.04	5.63	0.16	0.07
2021	10.36	0.30	0.13	3.32	0.10	0.04	5.75	0.17	0.07
2022	10.59	0.31	0.13	3.39	0.10	0.04	5.88	0.17	0.07
2023	10.83	0.31	0.14	3.46	0.11	0.04	6.03	0.18	0.08
2024	11.10	0.32	0.14	3.53	0.11	0.04	6.19	0.18	0.08
2025	11.38	0.33	0.15	3.61	0.11	0.04	6.37	0.19	0.08
2026	11.64	0.33	0.15	3.69	0.11	0.05	6.51	0.19	0.09
2027	11.94	0.34	0.16	3.78	0.12	0.05	6.67	0.19	0.09
2028	12.23	0.35	0.16	3.87	0.12	0.05	6.84	0.20	0.09
2029	12.51	0.36	0.17	3.95	0.12	0.05	7.00	0.20	0.09
2030	12.72	0.37	0.17	4.04	0.12	0.05	7.16	0.20	0.10
2031	12.88	0.38	0.18	4.09	0.13	0.05	7.25	0.21	0.10
2032	12.37	0.39	0.18	4.18	0.13	0.05	6.67	0.22	0.10
2033	12.61	0.40	0.19	4.28	0.13	0.06	6.80	0.22	0.11
2034	12.37	0.41	0.20	4.30	0.14	0.06	6.53	0.23	0.11
2035	12.48	0.42	0.20	4.32	0.14	0.06	6.61	0.24	0.11
2036	12.34	0.43	0.21	4.32	0.15	0.06	6.48	0.24	0.12
2037	12.23	0.44	0.21	4.35	0.15	0.07	6.33	0.24	0.12
2038	12.15	0.45	0.22	4.42	0.16	0.07	6.17	0.24	0.12
2039	11.95	0.46	0.22	4.33	0.16	0.07	6.05	0.24	0.12
2040	11.80	0.46	0.23	4.38	0.17	0.07	5.84	0.24	0.12

Appendix A: Emission Factors

Emission Factors (all in g/kW*hr)

Engine type	Mode	Fuel type	Fuel S content (%)	Tier ID	CH4	N2O	NH3	ROG	CO	SOx	NOx	HC	PM 10	PM 2.5	CO2	TOG	Fuel Used
Auxiliary	At Berth	Distillate	0.1	0	0.008	0.033	0.001	0.520	1.10	0.424	13.800	0.40	0.182	0.168	676	0.620	217
Auxiliary	At Berth	Distillate	0.1	1	0.008	0.033	0.001	0.520	1.10	0.424	12.200	0.40	0.182	0.168	676	0.620	217
Auxiliary	At Berth	Distillate	0.1	2	0.008	0.033	0.001	0.520	1.10	0.424	10.500	0.40	0.182	0.168	676	0.620	217
Auxiliary	At Berth	Distillate	0.1	3	0.008	0.033	0.001	0.520	1.10	0.424	2.600	0.40	0.182	0.168	676	0.620	217
Auxiliary	At Berth	Distillate	0.3	0	0.008	0.033	0.001	0.520	1.10	1.273	13.800	0.40	0.250	0.230	676	0.620	217
Auxiliary	At Berth	Distillate	0.3	1	0.008	0.033	0.001	0.520	1.10	1.273	12.200	0.40	0.250	0.230	676	0.620	217
Auxiliary	At Berth	Distillate	0.3	2	0.008	0.033	0.001	0.520	1.10	1.273	10.500	0.40	0.250	0.230	676	0.620	217
Auxiliary	At Berth	Distillate	0.3	3	0.008	0.033	0.001	0.520	1.10	1.273	2.600	0.40	0.250	0.230	676	0.620	217
Auxiliary	At Berth	Distillate	1	0	0.008	0.033	0.001	0.520	1.10	4.242	13.800	0.40	0.489	0.450	676	0.620	217
Auxiliary	At Berth	Distillate	1	1	0.008	0.033	0.001	0.520	1.10	4.242	12.200	0.40	0.489	0.450	676	0.620	217
Auxiliary	At Berth	Distillate	1	2	0.008	0.033	0.001	0.520	1.10	4.242	10.500	0.40	0.489	0.450	676	0.620	217
Auxiliary	At Berth	Distillate	1	3	0.008	0.033	0.001	0.520	1.10	4.242	2.600	0.40	0.489	0.450	676	0.620	217
Auxiliary	At Berth	Residual	2.7	0	0.008	0.036	0.001	0.460	1.10	11.983	14.700	0.40	1.436	1.321	707	0.510	227
Auxiliary	At Berth	Residual	2.7	1	0.008	0.036	0.001	0.460	1.10	11.983	13.000	0.40	1.436	1.321	707	0.510	227
Auxiliary	At Berth	Residual	2.7	2	0.008	0.036	0.001	0.460	1.10	11.983	11.200	0.40	1.436	1.321	707	0.510	227
Auxiliary	At Berth	Residual	2.7	3	0.008	0.036	0.001	0.460	1.10	11.983	2.309	0.40	1.436	1.321	707	0.510	227
Boiler	At Berth	Distillate	0.1	99	0.002	0.045	0.006	0.110	0.20	0.587	1.995	0.10	0.164	0.151	934	0.130	300
Boiler	At Berth	Distillate	0.3	99	0.002	0.045	0.006	0.110	0.20	1.636	1.995	0.10	0.164	0.151	934	0.130	300
Boiler	At Berth	Distillate	1	99	0.002	0.045	0.006	0.110	0.20	1.760	1.995	0.10	0.589	0.542	934	0.130	300
Boiler	At Berth	Residual	2.7	99	0.002	0.049	0.006	0.110	0.20	16.100	2.100	0.10	1.465	1.348	950	0.130	305

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Appendix B: Emissions Results for 2016

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
NC	NCU	Eureka	At Berth	Bulk	-	Bulk	Auxiliary	0	Distillate	17100	0.260	0.00316	0.00343	0.00343	0.00800	12.92
NC	NCU	Eureka	At Berth	Bulk	-	Bulk	Auxiliary	1	Distillate	45220	0.608	0.00836	0.00908	0.00908	0.02115	34.18
NC	NCU	Eureka	At Berth	Bulk	-	Bulk	Auxiliary	2	Distillate	85310	0.987	0.01576	0.01714	0.01714	0.03990	64.48
NC	NCU	Eureka	At Berth	Bulk	-	Bulk	Boiler	-	Distillate	97125	0.214	0.01615	0.01755	0	0.06279	101.46
SC	SC	Long Beach	At Berth	Auto	-	Auto	Auxiliary	0	Distillate	586454	8.921	0.10837	0.11779	0.11779	0.27425	443.23
SC	SC	Long Beach	At Berth	Auto	-	Auto	Auxiliary	1	Distillate	1819630	24.470	0.33624	0.36548	0.36548	0.85095	1375.24
SC	SC	Long Beach	At Berth	Auto	-	Auto	Auxiliary	2	Distillate	667584	7.727	0.12336	0.13409	0.13409	0.31219	504.55
SC	SC	Long Beach	At Berth	Auto	-	Auto	Boiler	-	Distillate	832728	1.831	0.13844	0.15048	0	0.53837	869.87
SC	SC	Long Beach	At Berth	Bulk	-	Bulk	Auxiliary	0	Distillate	4560	0.069	0.00084	0.00092	0.00092	0.00213	3.45
SC	SC	Long Beach	At Berth	Bulk	-	Bulk	Auxiliary	1	Distillate	1105420	14.866	0.20427	0.22203	0.22203	0.51695	835.45
SC	SC	Long Beach	At Berth	Bulk	-	Bulk	Auxiliary	2	Distillate	1128410	13.060	0.20852	0.22665	0.22665	0.52770	852.83
SC	SC	Long Beach	At Berth	Bulk	-	Bulk	Boiler	-	Distillate	1472625	3.238	0.24483	0.26612	0	0.95208	1538.31
SC	SC	Long Beach	At Berth	Bulk	-	Self-discharging	Auxiliary	2	Distillate	99703	1.154	0.01842	0.02003	0.02003	0.04663	75.35
SC	SC	Long Beach	At Berth	Bulk	-	Self-discharging	Boiler	-	Distillate	73524	0.162	0.01222	0.01329	0	0.04753	76.80
SC	SC	Long Beach	At Berth	Container	1	Fully Cellular	Auxiliary	0	Distillate	687421	10.457	0.12703	0.13807	0.13807	0.32147	519.54
SC	SC	Long Beach	At Berth	Container	1	Fully Cellular	Auxiliary	1	Distillate	613853	8.255	0.11343	0.12330	0.12330	0.28707	463.94
SC	SC	Long Beach	At Berth	Container	1	Fully Cellular	Auxiliary	2	Distillate	131674	1.524	0.02433	0.02645	0.02645	0.06158	99.52
SC	SC	Long Beach	At Berth	Container	1	Fully Cellular	Boiler	-	Distillate	834834	1.836	0.13879	0.15086	0	0.53974	872.07
SC	SC	Long Beach	At Berth	Container	2	Fully Cellular	Auxiliary	0	Distillate	1589989	24.186	0.29381	0.31936	0.31936	0.74356	1201.68
SC	SC	Long Beach	At Berth	Container	2	Fully Cellular	Auxiliary	1	Distillate	2690488	36.182	0.49717	0.54040	0.54040	1.25820	2033.41
SC	SC	Long Beach	At Berth	Container	2	Fully Cellular	Auxiliary	2	Distillate	355219	4.111	0.06564	0.07135	0.07135	0.16612	268.47
SC	SC	Long Beach	At Berth	Container	2	Fully Cellular	Boiler	-	Distillate	1969255	4.331	0.32739	0.35586	0	1.27316	2057.09
SC	SC	Long Beach	At Berth	Container	3	Fully Cellular	Auxiliary	0	Distillate	137969	2.099	0.02549	0.02771	0.02771	0.06452	104.27
SC	SC	Long Beach	At Berth	Container	3	Fully Cellular	Auxiliary	1	Distillate	601015	8.082	0.11106	0.12072	0.12072	0.28106	454.23
SC	SC	Long Beach	At Berth	Container	3	Fully Cellular	Auxiliary	2	Distillate	465408	5.387	0.08600	0.09348	0.09348	0.21765	351.75
SC	SC	Long Beach	At Berth	Container	3	Fully Cellular	Boiler	-	Distillate	1070580	2.354	0.17799	0.19346	0	0.69215	1118.33
SC	SC	Long Beach	At Berth	Container	4	Fully Cellular	Auxiliary	0	Distillate	51128	0.778	0.00945	0.01027	0.01027	0.02391	38.64
SC	SC	Long Beach	At Berth	Container	4	Fully Cellular	Auxiliary	1	Distillate	2168563	29.163	0.40072	0.43557	0.43557	1.01413	1638.95
SC	SC	Long Beach	At Berth	Container	4	Fully Cellular	Auxiliary	2	Distillate	723543	8.374	0.13370	0.14533	0.14533	0.33836	546.84
SC	SC	Long Beach	At Berth	Container	4	Fully Cellular	Boiler	-	Distillate	2718423	5.978	0.45194	0.49124	0	1.75751	2839.68

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SC	SC	Long Beach	At Berth	Container	5	Fully Cellular	Auxiliary	0	Distillate	395819	6.021	0.07314	0.07950	0.07950	0.18510	299.15
SC	SC	Long Beach	At Berth	Container	5	Fully Cellular	Auxiliary	1	Distillate	1438701	19.348	0.26585	0.28897	0.28897	0.67281	1087.34
SC	SC	Long Beach	At Berth	Container	5	Fully Cellular	Auxiliary	2	Distillate	308100	3.566	0.05693	0.06188	0.06188	0.14408	232.86
SC	SC	Long Beach	At Berth	Container	5	Fully Cellular	Boiler	-	Distillate	2291103	5.038	0.38090	0.41402	0	1.48124	2393.30
SC	SC	Long Beach	At Berth	Container	6	Fully Cellular	Auxiliary	1	Distillate	49965	0.672	0.00923	0.01004	0.01004	0.02337	37.76
SC	SC	Long Beach	At Berth	Container	6	Fully Cellular	Boiler	-	Distillate	105165	0.231	0.01748	0.01900	0	0.06799	109.86
SC	SC	Long Beach	At Berth	Container	7	Fully Cellular	Auxiliary	1	Distillate	344082	4.627	0.06358	0.06911	0.06911	0.16091	260.05
SC	SC	Long Beach	At Berth	Container	7	Fully Cellular	Boiler	-	Distillate	285334	0.627	0.04744	0.05156	0	0.18447	298.06
SC	SC	Long Beach	At Berth	Container	8	Fully Cellular	Auxiliary	1	Distillate	2968325	39.918	0.54851	0.59621	0.59621	1.38813	2243.40
SC	SC	Long Beach	At Berth	Container	8	Fully Cellular	Auxiliary	2	Distillate	1924073	22.270	0.35554	0.38646	0.38646	0.89979	1454.17
SC	SC	Long Beach	At Berth	Container	8	Fully Cellular	Boiler	-	Distillate	11448184	25.176	1.90329	2.06879	0	7.40147	11958.84
SC	SC	Long Beach	At Berth	Container	9	Fully Cellular	Auxiliary	1	Distillate	1166580	15.688	0.21557	0.23431	0.23431	0.54555	881.68
SC	SC	Long Beach	At Berth	Container	9	Fully Cellular	Auxiliary	2	Distillate	1185894	13.726	0.21914	0.23819	0.23819	0.55458	896.27
SC	SC	Long Beach	At Berth	Container	9	Fully Cellular	Boiler	-	Distillate	2886051	6.347	0.47981	0.52154	0	1.86589	3014.79
SC	SC	Long Beach	At Berth	Container	10	Fully Cellular	Auxiliary	1	Distillate	2152162	28.942	0.39769	0.43227	0.43227	1.00646	1626.56
SC	SC	Long Beach	At Berth	Container	10	Fully Cellular	Auxiliary	2	Distillate	2993549	34.648	0.55317	0.60127	0.60127	1.39993	2262.46
SC	SC	Long Beach	At Berth	Container	10	Fully Cellular	Boiler	-	Distillate	3407565	7.494	0.56652	0.61578	0	2.20305	3559.56
SC	SC	Long Beach	At Berth	Container	11	Fully Cellular	Auxiliary	1	Distillate	1974117	26.548	0.36479	0.39651	0.39651	0.92319	1492.00
SC	SC	Long Beach	At Berth	Container	11	Fully Cellular	Auxiliary	2	Distillate	553213	6.403	0.10223	0.11112	0.11112	0.25871	418.11
SC	SC	Long Beach	At Berth	Container	11	Fully Cellular	Boiler	-	Distillate	5904460	12.984	0.98163	1.06699	0	3.81734	6167.83
SC	SC	Long Beach	At Berth	Container	13	Fully Cellular	Auxiliary	2	Distillate	1643025	19.017	0.30361	0.33001	0.33001	0.76836	1241.76
SC	SC	Long Beach	At Berth	Container	13	Fully Cellular	Boiler	-	Distillate	1532448	3.370	0.25477	0.27693	0	0.99076	1600.80
SC	SC	Long Beach	At Berth	Container	17	Fully Cellular	Auxiliary	2	Distillate	142000	1.644	0.02624	0.02852	0.02852	0.06641	107.32
SC	SC	Long Beach	At Berth	Container	17	Fully Cellular	Boiler	-	Distillate	91874	0.202	0.01527	0.01660	0	0.05940	95.97
SC	SC	Long Beach	At Berth	Cruise	-	Cruise	Auxiliary	0	Distillate	7281718	110.768	1.34557	1.46258	1.46258	3.40529	5503.37
SC	SC	Long Beach	At Berth	Cruise	-	Cruise	Auxiliary	1	Distillate	1451677	19.522	0.26825	0.29158	0.29158	0.67887	1097.15
SC	SC	Long Beach	At Berth	Cruise	-	Cruise	Boiler	-	Distillate	2061828	4.534	0.34278	0.37259	0	1.33301	2153.80
SC	SC	Long Beach	At Berth	General	-	General	Auxiliary	0	Distillate	117658	1.790	0.02174	0.02363	0.02363	0.05502	88.92
SC	SC	Long Beach	At Berth	General	-	General	Auxiliary	1	Distillate	282247	3.796	0.05216	0.05669	0.05669	0.13199	213.32
SC	SC	Long Beach	At Berth	General	-	General	Auxiliary	2	Distillate	421718	4.881	0.07793	0.08470	0.08470	0.19722	318.73
SC	SC	Long Beach	At Berth	General	-	General	Boiler	-	Distillate	198880	0.437	0.03306	0.03594	0	0.12858	207.75

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SC	SC	Long Beach	At Berth	Reefer	-	Reefer	Auxiliary	1	Distillate	5400	0.073	0.00100	0.00108	0.00108	0.00253	4.08
SC	SC	Long Beach	At Berth	Reefer	-	Reefer	Boiler	-	Distillate	1824	0.004	0.00030	0.00033	0	0.00118	1.91
SC	SC	Long Beach	At Berth	Ro-ro	-	Ro-ro	Auxiliary	0	Distillate	46926	0.714	0.00867	0.00943	0.00943	0.02194	35.47
SC	SC	Long Beach	At Berth	Ro-ro	-	Ro-ro	Boiler	-	Distillate	17094	0.038	0.00284	0.00309	0	0.01105	17.86
SC	SC	Long Beach	At Berth	Tanker	Aframax	Crude	Auxiliary	1	Distillate	2914824	39.199	0.53862	0.58546	0.58546	1.36311	2202.96
SC	SC	Long Beach	At Berth	Tanker	Aframax	Crude	Auxiliary	2	Distillate	1984484	22.969	0.36671	0.39860	0.39860	0.92804	1499.83
SC	SC	Long Beach	At Berth	Tanker	Aframax	Crude	Boiler	-	Distillate	34038010	74.853	5.65889	6.15098	0	22.00621	35556.30
SC	SC	Long Beach	At Berth	Tanker	Panamax	Crude	Auxiliary	1	Distillate	2287038	30.756	0.42262	0.45937	0.45937	1.06953	1728.49
SC	SC	Long Beach	At Berth	Tanker	Panamax	Crude	Auxiliary	2	Distillate	113142	1.310	0.02091	0.02273	0.02273	0.05291	85.51
SC	SC	Long Beach	At Berth	Tanker	Panamax	Crude	Boiler	-	Distillate	11663260	25.649	1.93904	2.10766	0	7.54052	12183.51
SC	SC	Long Beach	At Berth	Tanker	Panamax	Products	Auxiliary	1	Distillate	504234	6.781	0.09318	0.10128	0.10128	0.23580	381.09
SC	SC	Long Beach	At Berth	Tanker	Panamax	Products	Boiler	-	Distillate	2450238	5.388	0.40736	0.44278	0	1.58412	2559.53
SC	SC	Long Beach	At Berth	Tanker	Seawaymax	Crude	Auxiliary	1	Distillate	56448	0.759	0.01043	0.01134	0.01134	0.02640	42.66
SC	SC	Long Beach	At Berth	Tanker	Seawaymax	Crude	Boiler	-	Distillate	167472	0.368	0.02784	0.03026	0	0.10827	174.94
SC	SC	Long Beach	At Berth	Tanker	Seawaymax	Products	Auxiliary	0	Distillate	43120	0.656	0.00797	0.00866	0.00866	0.02017	32.59
SC	SC	Long Beach	At Berth	Tanker	Seawaymax	Products	Auxiliary	1	Distillate	2619344	35.225	0.48402	0.52611	0.52611	1.22493	1979.64
SC	SC	Long Beach	At Berth	Tanker	Seawaymax	Products	Auxiliary	2	Distillate	813792	9.419	0.15038	0.16345	0.16345	0.38057	615.05
SC	SC	Long Beach	At Berth	Tanker	Seawaymax	Products	Boiler	-	Distillate	10313484	22.680	1.71464	1.86374	0	6.66786	10773.52
SC	SC	Long Beach	At Berth	Tanker	Seawaymax	Chemical	Auxiliary	1	Distillate	26656	0.358	0.00493	0.00535	0.00535	0.01247	20.15
SC	SC	Long Beach	At Berth	Tanker	Seawaymax	Chemical	Boiler	-	Distillate	79084	0.174	0.01315	0.01429	0	0.05113	82.61
SC	SC	Long Beach	At Berth	Tanker	Suezmax	Crude	Auxiliary	1	Distillate	5296499	71.228	0.97873	1.06383	1.06383	2.47690	4002.98
SC	SC	Long Beach	At Berth	Tanker	Suezmax	Crude	Auxiliary	2	Distillate	1405040	16.262	0.25963	0.28221	0.28221	0.65706	1061.90
SC	SC	Long Beach	At Berth	Tanker	Suezmax	Crude	Boiler	-	Distillate	15606653	34.320	2.59464	2.82026	0	10.08999	16302.80
SC	SC	Long Beach	At Berth	Tanker	ULCC	Crude	Auxiliary	1	Distillate	392285	5.275	0.07249	0.07879	0.07879	0.18345	296.48
SC	SC	Long Beach	At Berth	Tanker	ULCC	Crude	Auxiliary	2	Distillate	672154	7.780	0.12421	0.13501	0.13501	0.31433	508.00
SC	SC	Long Beach	At Berth	Tanker	ULCC	Crude	Boiler	-	Distillate	5454000	11.994	0.90674	0.98559	0	3.52611	5697.28
SC	SC	Long Beach	At Berth	Tanker	VLCC	Crude	Auxiliary	1	Distillate	721336	9.701	0.13329	0.14488	0.14488	0.33733	545.17
SC	SC	Long Beach	At Berth	Tanker	VLCC	Crude	Auxiliary	2	Distillate	637024	7.373	0.11771	0.12795	0.12795	0.29790	481.45
SC	SC	Long Beach	At Berth	Tanker	VLCC	Crude	Boiler	-	Distillate	6960000	15.306	1.15712	1.25774	0	4.49977	7270.46
SC	SC	Los Angeles	At Berth	Auto	-	Auto	Auxiliary	0	Distillate	220210	3.350	0.04069	0.04423	0.04423	0.10298	166.43
SC	SC	Los Angeles	At Berth	Auto	-	Auto	Auxiliary	1	Distillate	995581	13.389	0.18397	0.19997	0.19997	0.46558	752.44

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SC	SC	Los Angeles	At Berth	Auto	-	Auto	Auxiliary	2	Distillate	859978	9.954	0.15891	0.17273	0.17273	0.40217	649.95
SC	SC	Los Angeles	At Berth	Auto	-	Auto	Boiler	-	Distillate	562374	1.237	0.09350	0.10163	0	0.36359	587.46
SC	SC	Los Angeles	At Berth	Bulk	-	Bulk	Auxiliary	0	Distillate	20900	0.318	0.00386	0.00420	0.00420	0.00977	15.80
SC	SC	Los Angeles	At Berth	Bulk	-	Bulk	Auxiliary	1	Distillate	506920	6.817	0.09367	0.10182	0.10182	0.23706	383.12
SC	SC	Los Angeles	At Berth	Bulk	-	Bulk	Auxiliary	2	Distillate	756580	8.757	0.13981	0.15196	0.15196	0.35381	571.81
SC	SC	Los Angeles	At Berth	Bulk	-	Bulk	Boiler	-	Distillate	845000	1.858	0.14048	0.15270	0	0.54631	882.69
SC	SC	Los Angeles	At Berth	Container	2	Fully Cellular	Auxiliary	0	Distillate	3325294	50.584	0.61447	0.66791	0.66791	1.55507	2513.19
SC	SC	Los Angeles	At Berth	Container	2	Fully Cellular	Auxiliary	1	Distillate	2015742	27.108	0.37248	0.40487	0.40487	0.94266	1523.45
SC	SC	Los Angeles	At Berth	Container	2	Fully Cellular	Auxiliary	2	Distillate	356919	4.131	0.06595	0.07169	0.07169	0.16691	269.75
SC	SC	Los Angeles	At Berth	Container	2	Fully Cellular	Boiler	-	Distillate	2420505	5.323	0.40241	0.43741	0	1.56490	2528.47
SC	SC	Los Angeles	At Berth	Container	3	Fully Cellular	Auxiliary	1	Distillate	669054	8.997	0.12363	0.13438	0.13438	0.31288	505.66
SC	SC	Los Angeles	At Berth	Container	3	Fully Cellular	Auxiliary	2	Distillate	163011	1.887	0.03012	0.03274	0.03274	0.07623	123.20
SC	SC	Los Angeles	At Berth	Container	3	Fully Cellular	Boiler	-	Distillate	739620	1.626	0.12296	0.13366	0	0.47818	772.61
SC	SC	Los Angeles	At Berth	Container	4	Fully Cellular	Auxiliary	0	Distillate	238082	3.622	0.04399	0.04782	0.04782	0.11134	179.94
SC	SC	Los Angeles	At Berth	Container	4	Fully Cellular	Auxiliary	1	Distillate	3580015	48.144	0.66154	0.71907	0.71907	1.67419	2705.70
SC	SC	Los Angeles	At Berth	Container	4	Fully Cellular	Auxiliary	2	Distillate	447244	5.176	0.08265	0.08983	0.08983	0.20915	338.02
SC	SC	Los Angeles	At Berth	Container	4	Fully Cellular	Boiler	-	Distillate	3939543	8.663	0.65496	0.71191	0	2.54699	4115.27
SC	SC	Los Angeles	At Berth	Container	5	Fully Cellular	Auxiliary	0	Distillate	1676950	25.509	0.30988	0.33683	0.33683	0.78422	1267.40
SC	SC	Los Angeles	At Berth	Container	5	Fully Cellular	Auxiliary	1	Distillate	1701317	22.879	0.31438	0.34172	0.34172	0.79562	1285.82
SC	SC	Los Angeles	At Berth	Container	5	Fully Cellular	Auxiliary	2	Distillate	1542664	17.855	0.28506	0.30985	0.30985	0.72142	1165.91
SC	SC	Los Angeles	At Berth	Container	5	Fully Cellular	Boiler	-	Distillate	5261952	11.571	0.87481	0.95088	0	3.40195	5496.66
SC	SC	Los Angeles	At Berth	Container	6	Fully Cellular	Auxiliary	1	Distillate	2977758	40.045	0.55025	0.59810	0.59810	1.39254	2250.53
SC	SC	Los Angeles	At Berth	Container	6	Fully Cellular	Auxiliary	2	Distillate	153110	1.772	0.02829	0.03075	0.03075	0.07160	115.72
SC	SC	Los Angeles	At Berth	Container	6	Fully Cellular	Boiler	-	Distillate	6589725	14.491	1.09556	1.19082	0	4.26038	6883.66
SC	SC	Los Angeles	At Berth	Container	7	Fully Cellular	Auxiliary	1	Distillate	2969771	39.938	0.54878	0.59650	0.59650	1.38881	2244.49
SC	SC	Los Angeles	At Berth	Container	7	Fully Cellular	Boiler	-	Distillate	2462719	5.416	0.40943	0.44504	0	1.59219	2572.57
SC	SC	Los Angeles	At Berth	Container	8	Fully Cellular	Auxiliary	1	Distillate	3188423	42.878	0.58918	0.64041	0.64041	1.49106	2409.74
SC	SC	Los Angeles	At Berth	Container	8	Fully Cellular	Auxiliary	2	Distillate	2119335	24.530	0.39163	0.42568	0.42568	0.99110	1601.75
SC	SC	Los Angeles	At Berth	Container	8	Fully Cellular	Boiler	-	Distillate	12420124	27.313	2.06487	2.24443	0	8.02984	12974.13
SC	SC	Los Angeles	At Berth	Container	9	Fully Cellular	Auxiliary	1	Distillate	93260	1.254	0.01723	0.01873	0.01873	0.04361	70.48
SC	SC	Los Angeles	At Berth	Container	9	Fully Cellular	Auxiliary	2	Distillate	1887829	21.850	0.34885	0.37918	0.37918	0.88284	1426.78

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SC	SC	Los Angeles	At Berth	Container	9	Fully Cellular	Boiler	-	Distillate	2430430	5.345	0.40406	0.43920	0	1.57132	2538.84
SC	SC	Los Angeles	At Berth	Container	10	Fully Cellular	Auxiliary	2	Distillate	2786492	32.251	0.51491	0.55968	0.55968	1.30310	2105.97
SC	SC	Los Angeles	At Berth	Container	10	Fully Cellular	Boiler	-	Distillate	1845256	4.058	0.30678	0.33345	0	1.19299	1927.56
SC	SC	Los Angeles	At Berth	Container	11	Fully Cellular	Auxiliary	1	Distillate	279311	3.756	0.05161	0.05610	0.05610	0.13062	211.10
SC	SC	Los Angeles	At Berth	Container	11	Fully Cellular	Auxiliary	2	Distillate	375684	4.348	0.06942	0.07546	0.07546	0.17569	283.93
SC	SC	Los Angeles	At Berth	Container	11	Fully Cellular	Boiler	-	Distillate	1530230	3.365	0.25440	0.27653	0	0.98932	1598.49
SC	SC	Los Angeles	At Berth	Container	12	Fully Cellular	Auxiliary	2	Distillate	95986	1.111	0.01774	0.01928	0.01928	0.04489	72.54
SC	SC	Los Angeles	At Berth	Container	12	Fully Cellular	Boiler	-	Distillate	813700	1.789	0.13528	0.14704	0	0.52607	850.00
SC	SC	Los Angeles	At Berth	Container	13	Fully Cellular	Auxiliary	1	Distillate	546582	7.350	0.10100	0.10978	0.10978	0.25561	413.09
SC	SC	Los Angeles	At Berth	Container	13	Fully Cellular	Auxiliary	2	Distillate	2022942	23.414	0.37381	0.40632	0.40632	0.94603	1528.90
SC	SC	Los Angeles	At Berth	Container	13	Fully Cellular	Boiler	-	Distillate	2396592	5.270	0.39844	0.43309	0	1.54944	2503.49
SC	SC	Los Angeles	At Berth	Container	14	Fully Cellular	Auxiliary	1	Distillate	6000	0.081	0.00111	0.00121	0.00121	0.00281	4.53
SC	SC	Los Angeles	At Berth	Container	14	Fully Cellular	Boiler	-	Distillate	68544	0.151	0.01140	0.01239	0	0.04431	71.60
SC	SC	Los Angeles	At Berth	Container	17	Fully Cellular	Auxiliary	2	Distillate	62000	0.718	0.01146	0.01245	0.01245	0.02899	46.86
SC	SC	Los Angeles	At Berth	Container	17	Fully Cellular	Boiler	-	Distillate	40114	0.088	0.00667	0.00725	0	0.02593	41.90
SC	SC	Los Angeles	At Berth	Cruise	-	Cruise	Auxiliary	0	Distillate	279966	4.259	0.05173	0.05623	0.05623	0.13093	211.59
SC	SC	Los Angeles	At Berth	Cruise	-	Cruise	Auxiliary	1	Distillate	3499580	47.063	0.64668	0.70291	0.70291	1.63657	2644.91
SC	SC	Los Angeles	At Berth	Cruise	-	Cruise	Boiler	-	Distillate	892296	1.962	0.14835	0.16125	0	0.57689	932.10
SC	SC	Los Angeles	At Berth	General	-	General	Auxiliary	0	Distillate	804437	12.237	0.14865	0.16158	0.16158	0.37619	607.98
SC	SC	Los Angeles	At Berth	General	-	General	Auxiliary	1	Distillate	590934	7.947	0.10920	0.11869	0.11869	0.27635	446.62
SC	SC	Los Angeles	At Berth	General	-	General	Auxiliary	2	Distillate	821623	9.510	0.15183	0.16503	0.16503	0.38423	620.97
SC	SC	Los Angeles	At Berth	General	-	General	Boiler	-	Distillate	536640	1.180	0.08922	0.09698	0	0.34695	560.58
SC	SC	Los Angeles	At Berth	Reefer	-	Reefer	Auxiliary	0	Distillate	918900	13.978	0.16980	0.18457	0.18457	0.42972	694.49
SC	SC	Los Angeles	At Berth	Reefer	-	Reefer	Auxiliary	1	Distillate	121500	1.634	0.02245	0.02440	0.02440	0.05682	91.83
SC	SC	Los Angeles	At Berth	Reefer	-	Reefer	Auxiliary	2	Distillate	121500	1.406	0.02245	0.02440	0.02440	0.05682	91.83
SC	SC	Los Angeles	At Berth	Reefer	-	Reefer	Boiler	-	Distillate	392464	0.863	0.06525	0.07092	0	0.25374	409.97
SC	SC	Los Angeles	At Berth	Ro-ro	-	Ro-ro	Auxiliary	2	Distillate	1070055	12.385	0.19773	0.21493	0.21493	0.50041	808.72
SC	SC	Los Angeles	At Berth	Ro-ro	-	Ro-ro	Boiler	-	Distillate	389795	0.857	0.06480	0.07044	0	0.25201	407.18
SC	SC	Los Angeles	At Berth	Tanker	Panamax	Crude	Auxiliary	1	Distillate	2183706	29.367	0.40352	0.43861	0.43861	1.02121	1650.40
SC	SC	Los Angeles	At Berth	Tanker	Panamax	Crude	Auxiliary	2	Distillate	425100	4.920	0.07855	0.08538	0.08538	0.19880	321.28
SC	SC	Los Angeles	At Berth	Tanker	Panamax	Crude	Boiler	-	Distillate	12677042	27.878	2.10759	2.29086	0	8.19595	13242.51

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SC	SC	Los Angeles	At Berth	Tanker	Panamax	Products	Auxiliary	1	Distillate	423138	5.690	0.07819	0.08499	0.08499	0.19788	319.80
SC	SC	Los Angeles	At Berth	Tanker	Panamax	Products	Boiler	-	Distillate	2056166	4.522	0.34184	0.37157	0	1.32935	2147.88
SC	SC	Los Angeles	At Berth	Tanker	Seawaymax	Crude	Auxiliary	0	Distillate	222656	3.387	0.04114	0.04472	0.04472	0.10412	168.28
SC	SC	Los Angeles	At Berth	Tanker	Seawaymax	Crude	Auxiliary	1	Distillate	204624	2.752	0.03781	0.04110	0.04110	0.09569	154.65
SC	SC	Los Angeles	At Berth	Tanker	Seawaymax	Crude	Boiler	-	Distillate	1267670	2.788	0.21075	0.22908	0	0.81957	1324.22
SC	SC	Los Angeles	At Berth	Tanker	Seawaymax	Products	Auxiliary	0	Distillate	729904	11.103	0.13488	0.14661	0.14661	0.34134	551.65
SC	SC	Los Angeles	At Berth	Tanker	Seawaymax	Products	Auxiliary	1	Distillate	2907072	39.094	0.53719	0.58390	0.58390	1.35949	2197.10
SC	SC	Los Angeles	At Berth	Tanker	Seawaymax	Products	Auxiliary	2	Distillate	1996848	23.112	0.36899	0.40108	0.40108	0.93382	1509.18
SC	SC	Los Angeles	At Berth	Tanker	Seawaymax	Products	Boiler	-	Distillate	16714636	36.757	2.77884	3.02049	0	10.80633	17460.20
SC	SC	Los Angeles	At Berth	Tanker	Seawaymax	Chemical	Auxiliary	1	Distillate	47824	0.643	0.00884	0.00961	0.00961	0.02236	36.14
SC	SC	Los Angeles	At Berth	Tanker	Seawaymax	Chemical	Boiler	-	Distillate	141886	0.312	0.02359	0.02564	0	0.09173	148.21
SCC	Ven	Hueneme	At Berth	Auto	-	Auto	Auxiliary	0	Distillate	1262151	19.200	0.23323	0.25351	0.25351	0.59024	953.91
SCC	Ven	Hueneme	At Berth	Auto	-	Auto	Auxiliary	1	Distillate	2422310	32.575	0.44761	0.48654	0.48654	1.13279	1830.73
SCC	Ven	Hueneme	At Berth	Auto	-	Auto	Auxiliary	2	Distillate	895907	10.369	0.16555	0.17995	0.17995	0.41897	677.11
SCC	Ven	Hueneme	At Berth	Auto	-	Auto	Boiler	-	Distillate	1240928	2.729	0.20631	0.22425	0	0.80228	1296.28
SCC	Ven	Hueneme	At Berth	Container	1	Fully Cellular	Auxiliary	1	Distillate	1058678	14.237	0.19563	0.21264	0.21264	0.49509	800.13
SCC	Ven	Hueneme	At Berth	Container	1	Fully Cellular	Boiler	-	Distillate	603876	1.328	0.10040	0.10913	0	0.39042	630.81
SCC	Ven	Hueneme	At Berth	Container	2	Fully Cellular	Auxiliary	1	Distillate	107000	1.439	0.01977	0.02149	0.02149	0.05004	80.87
SCC	Ven	Hueneme	At Berth	Container	2	Fully Cellular	Auxiliary	2	Distillate	24477	0.283	0.00452	0.00492	0.00492	0.01145	18.50
SCC	Ven	Hueneme	At Berth	Container	2	Fully Cellular	Boiler	-	Distillate	67868	0.149	0.01128	0.01226	0	0.04388	70.90
SCC	Ven	Hueneme	At Berth	General	-	General	Auxiliary	2	Distillate	261095	3.022	0.04825	0.05244	0.05244	0.12210	197.33
SCC	Ven	Hueneme	At Berth	General	-	General	Boiler	-	Distillate	63200	0.139	0.01051	0.01142	0	0.04086	66.02
SCC	Ven	Hueneme	At Berth	Reefer	-	Reefer	Auxiliary	1	Distillate	2147048	28.874	0.39675	0.43125	0.43125	1.00406	1622.69
SCC	Ven	Hueneme	At Berth	Reefer	-	Reefer	Boiler	-	Distillate	1074336	2.363	0.17861	0.19414	0	0.69458	1122.26
SCC	Ven	Hueneme	At Berth	Tanker	Seawaymax	Products	Auxiliary	0	Distillate	206192	3.137	0.03810	0.04141	0.04141	0.09643	155.84
SCC	Ven	Hueneme	At Berth	Tanker	Seawaymax	Products	Auxiliary	1	Distillate	259504	3.490	0.04795	0.05212	0.05212	0.12136	196.13
SCC	Ven	Hueneme	At Berth	Tanker	Seawaymax	Products	Auxiliary	2	Distillate	28224	0.327	0.00522	0.00567	0.00567	0.01320	21.33
SCC	Ven	Hueneme	At Berth	Tanker	Seawaymax	Products	Boiler	-	Distillate	1465380	3.223	0.24362	0.26481	0	0.94740	1530.74
SD	SD	San Diego	At Berth	Auto	-	Auto	Auxiliary	0	Distillate	1141615	17.366	0.21096	0.22930	0.22930	0.53387	862.81
SD	SD	San Diego	At Berth	Auto	-	Auto	Auxiliary	1	Distillate	4267438	57.389	0.78857	0.85714	0.85714	1.99566	3225.24
SD	SD	San Diego	At Berth	Auto	-	Auto	Auxiliary	2	Distillate	1850923	21.423	0.34203	0.37177	0.37177	0.86558	1398.89

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SD	SD	San Diego	At Berth	Auto	-	Auto	Boiler	-	Distillate	1966896	4.325	0.32700	0.35544	0	1.27164	2054.63
SD	SD	San Diego	At Berth	Bulk	-	Bulk	Auxiliary	1	Distillate	41230	0.554	0.00762	0.00828	0.00828	0.01928	31.16
SD	SD	San Diego	At Berth	Bulk	-	Bulk	Auxiliary	2	Distillate	22990	0.266	0.00425	0.00462	0.00462	0.01075	17.38
SD	SD	San Diego	At Berth	Bulk	-	Bulk	Boiler	-	Distillate	42250	0.093	0.00702	0.00763	0	0.02732	44.13
SD	SD	San Diego	At Berth	Container	1	Fully Cellular	Auxiliary	0	Distillate	64114	0.975	0.01185	0.01288	0.01288	0.02998	48.46
SD	SD	San Diego	At Berth	Container	1	Fully Cellular	Auxiliary	1	Distillate	14574	0.196	0.00269	0.00293	0.00293	0.00682	11.01
SD	SD	San Diego	At Berth	Container	1	Fully Cellular	Auxiliary	2	Distillate	114228	1.322	0.02111	0.02294	0.02294	0.05342	86.33
SD	SD	San Diego	At Berth	Container	1	Fully Cellular	Boiler	-	Distillate	823914	1.812	0.13698	0.14889	0	0.53268	860.67
SD	SD	San Diego	At Berth	Container	3	Fully Cellular	Auxiliary	2	Distillate	29253	0.339	0.00541	0.00588	0.00588	0.01368	22.11
SD	SD	San Diego	At Berth	Container	3	Fully Cellular	Boiler	-	Distillate	20580	0.045	0.00342	0.00372	0	0.01331	21.50
SD	SD	San Diego	At Berth	Cruise	-	Cruise	Auxiliary	0	Distillate	1621368	24.664	0.29961	0.32566	0.32566	0.75823	1225.40
SD	SD	San Diego	At Berth	Cruise	-	Cruise	Auxiliary	1	Distillate	2399461	32.268	0.44339	0.48195	0.48195	1.12210	1813.46
SD	SD	San Diego	At Berth	Cruise	-	Cruise	Boiler	-	Distillate	604044	1.328	0.10042	0.10916	0	0.39053	630.99
SD	SD	San Diego	At Berth	General	-	General	Auxiliary	1	Distillate	120302	1.618	0.02223	0.02416	0.02416	0.05626	90.92
SD	SD	San Diego	At Berth	General	-	General	Auxiliary	2	Distillate	478564	5.539	0.08843	0.09612	0.09612	0.22380	361.69
SD	SD	San Diego	At Berth	General	-	General	Boiler	-	Distillate	144960	0.319	0.02410	0.02620	0	0.09372	151.43
SD	SD	San Diego	At Berth	Ro-ro	-	Ro-ro	Auxiliary	2	Distillate	134379	1.555	0.02483	0.02699	0.02699	0.06284	101.56
SD	SD	San Diego	At Berth	Ro-ro	-	Ro-ro	Boiler	-	Distillate	48951	0.108	0.00814	0.00885	0	0.03165	51.13
SD	SD	San Diego	At Berth	Tanker	Seawaymax	Products	Auxiliary	1	Distillate	192080	2.583	0.03549	0.03858	0.03858	0.08983	145.17
SD	SD	San Diego	At Berth	Tanker	Seawaymax	Products	Auxiliary	2	Distillate	1455104	16.842	0.26888	0.29227	0.29227	0.68048	1099.74
SD	SD	San Diego	At Berth	Tanker	Seawaymax	Products	Boiler	-	Distillate	4886926	10.747	0.81246	0.88311	0	3.15949	5104.91
SF	BA	Avon	At Berth	Bulk	-	Bulk	Auxiliary	2	Distillate	190	0.002	0.00004	0.00004	0.00004	0.00009	0.14
SF	BA	Avon	At Berth	Bulk	-	Bulk	Boiler	-	Distillate	125	0.000	0.00002	0.00002	0	0.00008	0.13
SF	BA	Avon	At Berth	Tanker	Panamax	Crude	Auxiliary	1	Distillate	100716	1.354	0.01861	0.02023	0.02023	0.04710	76.12
SF	BA	Avon	At Berth	Tanker	Panamax	Crude	Auxiliary	2	Distillate	63438	0.734	0.01172	0.01274	0.01274	0.02967	47.95
SF	BA	Avon	At Berth	Tanker	Panamax	Crude	Boiler	-	Distillate	797678	1.754	0.13262	0.14415	0	0.51571	833.26
SF	BA	Avon	At Berth	Tanker	Panamax	Products	Auxiliary	1	Distillate	99408	1.337	0.01837	0.01997	0.01997	0.04649	75.13
SF	BA	Avon	At Berth	Tanker	Panamax	Products	Boiler	-	Distillate	483056	1.062	0.08031	0.08729	0	0.31230	504.60
SF	BA	Avon	At Berth	Tanker	Seawaymax	Crude	Auxiliary	0	Distillate	18032	0.274	0.00333	0.00362	0.00362	0.00843	13.63
SF	BA	Avon	At Berth	Tanker	Seawaymax	Crude	Boiler	-	Distillate	53498	0.118	0.00889	0.00967	0	0.03459	55.88
SF	BA	Avon	At Berth	Tanker	Seawaymax	Products	Auxiliary	0	Distillate	105056	1.598	0.01941	0.02110	0.02110	0.04913	79.40

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SF	BA	Avon	At Berth	Tanker	Seawaymax	Products	Auxiliary	1	Distillate	1614256	21.709	0.29829	0.32423	0.32423	0.75490	1220.02
SF	BA	Avon	At Berth	Tanker	Seawaymax	Products	Auxiliary	2	Distillate	864752	10.009	0.15980	0.17369	0.17369	0.40440	653.56
SF	BA	Avon	At Berth	Tanker	Seawaymax	Products	Boiler	-	Distillate	7666496	16.859	1.27457	1.38541	0	4.95653	8008.46
SF	BA	Benicia	At Berth	Auto	-	Auto	Auxiliary	0	Distillate	905179	13.769	0.16727	0.18181	0.18181	0.42331	684.11
SF	BA	Benicia	At Berth	Auto	-	Auto	Auxiliary	1	Distillate	1714161	23.052	0.31676	0.34430	0.34430	0.80162	1295.53
SF	BA	Benicia	At Berth	Auto	-	Auto	Auxiliary	2	Distillate	576023	6.667	0.10644	0.11570	0.11570	0.26938	435.35
SF	BA	Benicia	At Berth	Auto	-	Auto	Boiler	-	Distillate	865698	1.904	0.14392	0.15644	0	0.55969	904.31
SF	BA	Benicia	At Berth	Bulk	-	Bulk	Auxiliary	1	Distillate	179360	2.412	0.03314	0.03603	0.03603	0.08388	135.56
SF	BA	Benicia	At Berth	Bulk	-	Bulk	Auxiliary	2	Distillate	310460	3.593	0.05737	0.06236	0.06236	0.14519	234.64
SF	BA	Benicia	At Berth	Bulk	-	Bulk	Boiler	-	Distillate	322250	0.709	0.05357	0.05823	0	0.20834	336.62
SF	BA	Benicia	At Berth	Tanker	Aframax	Crude	Auxiliary	1	Distillate	146972	1.976	0.02716	0.02952	0.02952	0.06873	111.08
SF	BA	Benicia	At Berth	Tanker	Aframax	Crude	Auxiliary	2	Distillate	626260	7.248	0.11572	0.12579	0.12579	0.29287	473.31
SF	BA	Benicia	At Berth	Tanker	Aframax	Crude	Boiler	-	Distillate	5372040	11.814	0.89311	0.97078	0	3.47312	5611.66
SF	BA	Benicia	At Berth	Tanker	Panamax	Crude	Auxiliary	1	Distillate	221052	2.973	0.04085	0.04440	0.04440	0.10337	167.07
SF	BA	Benicia	At Berth	Tanker	Panamax	Crude	Auxiliary	2	Distillate	18966	0.220	0.00350	0.00381	0.00381	0.00887	14.33
SF	BA	Benicia	At Berth	Tanker	Panamax	Crude	Boiler	-	Distillate	1166326	2.565	0.19390	0.21077	0	0.75405	1218.35
SF	BA	Benicia	At Berth	Tanker	Panamax	Products	Auxiliary	1	Distillate	22236	0.299	0.00411	0.00447	0.00447	0.01040	16.81
SF	BA	Benicia	At Berth	Tanker	Panamax	Products	Boiler	-	Distillate	108052	0.238	0.01796	0.01953	0	0.06986	112.87
SF	BA	Benicia	At Berth	Tanker	Seawaymax	Products	Auxiliary	1	Distillate	98784	1.328	0.01825	0.01984	0.01984	0.04620	74.66
SF	BA	Benicia	At Berth	Tanker	Seawaymax	Products	Auxiliary	2	Distillate	36064	0.417	0.00666	0.00724	0.00724	0.01687	27.26
SF	BA	Benicia	At Berth	Tanker	Seawaymax	Products	Boiler	-	Distillate	400072	0.880	0.06651	0.07230	0	0.25865	417.92
SF	BA	Benicia	At Berth	Tanker	Suezmax	Crude	Auxiliary	1	Distillate	1354860	18.220	0.25036	0.27213	0.27213	0.63360	1023.97
SF	BA	Benicia	At Berth	Tanker	Suezmax	Crude	Boiler	-	Distillate	3155220	6.939	0.52456	0.57018	0	2.03991	3295.96
SF	BA	Crockett	At Berth	Bulk	-	Bulk	Auxiliary	1	Distillate	320720	4.313	0.05927	0.06442	0.06442	0.14998	242.39
SF	BA	Crockett	At Berth	Bulk	-	Bulk	Auxiliary	2	Distillate	228380	2.643	0.04220	0.04587	0.04587	0.10680	172.60
SF	BA	Crockett	At Berth	Bulk	-	Bulk	Boiler	-	Distillate	361250	0.794	0.06006	0.06528	0	0.23355	377.36
SF	BA	Crockett	At Berth	General	-	General	Auxiliary	1	Distillate	271671	3.653	0.05020	0.05457	0.05457	0.12705	205.32
SF	BA	Crockett	At Berth	General	-	General	Auxiliary	2	Distillate	183097	2.119	0.03383	0.03678	0.03678	0.08563	138.38
SF	BA	Crockett	At Berth	General	-	General	Boiler	-	Distillate	110080	0.242	0.01830	0.01989	0	0.07117	114.99
SF	BA	Martinez	At Berth	Tanker	Aframax	Crude	Auxiliary	1	Distillate	1258312	16.922	0.23252	0.25274	0.25274	0.58845	951.01
SF	BA	Martinez	At Berth	Tanker	Aframax	Crude	Auxiliary	2	Distillate	993328	11.497	0.18355	0.19952	0.19952	0.46453	750.74

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SF	BA	Martinez	At Berth	Tanker	Aframax	Crude	Boiler	-	Distillate	15643300	34.401	2.60073	2.82689	0	10.11369	16341.08
SF	BA	Martinez	At Berth	Tanker	Panamax	Crude	Auxiliary	1	Distillate	1286418	17.300	0.23771	0.25838	0.25838	0.60159	972.25
SF	BA	Martinez	At Berth	Tanker	Panamax	Crude	Auxiliary	2	Distillate	115104	1.332	0.02127	0.02312	0.02312	0.05383	86.99
SF	BA	Martinez	At Berth	Tanker	Panamax	Crude	Boiler	-	Distillate	6810454	14.977	1.13225	1.23071	0	4.40309	7114.24
SF	BA	Martinez	At Berth	Tanker	Panamax	Products	Auxiliary	1	Distillate	148458	1.996	0.02743	0.02982	0.02982	0.06943	112.20
SF	BA	Martinez	At Berth	Tanker	Panamax	Products	Boiler	-	Distillate	721406	1.586	0.11994	0.13036	0	0.46640	753.58
SF	BA	Martinez	At Berth	Tanker	Seawaymax	Products	Auxiliary	0	Distillate	46256	0.704	0.00855	0.00929	0.00929	0.02163	34.96
SF	BA	Martinez	At Berth	Tanker	Seawaymax	Products	Auxiliary	1	Distillate	385728	5.187	0.07128	0.07748	0.07748	0.18039	291.52
SF	BA	Martinez	At Berth	Tanker	Seawaymax	Products	Auxiliary	2	Distillate	402976	4.664	0.07446	0.08094	0.08094	0.18845	304.56
SF	BA	Martinez	At Berth	Tanker	Seawaymax	Products	Boiler	-	Distillate	2477190	5.448	0.41184	0.44765	0	1.60155	2587.69
SF	BA	Martinez	At Berth	Tanker	Suezmax	Crude	Auxiliary	1	Distillate	1056289	14.205	0.19519	0.21216	0.21216	0.49397	798.32
SF	BA	Martinez	At Berth	Tanker	Suezmax	Crude	Auxiliary	2	Distillate	2250573	26.048	0.41588	0.45204	0.45204	1.05248	1700.94
SF	BA	Martinez	At Berth	Tanker	Suezmax	Crude	Boiler	-	Distillate	7701074	16.935	1.28032	1.39165	0	4.97889	8044.59
SF	BA	Oakland	At Berth	Bulk	-	Bulk	Auxiliary	0	Distillate	55480	0.844	0.01025	0.01114	0.01114	0.02595	41.93
SF	BA	Oakland	At Berth	Bulk	-	Bulk	Auxiliary	1	Distillate	59850	0.805	0.01106	0.01202	0.01202	0.02799	45.23
SF	BA	Oakland	At Berth	Bulk	-	Bulk	Auxiliary	2	Distillate	331550	3.837	0.06127	0.06659	0.06659	0.15505	250.58
SF	BA	Oakland	At Berth	Bulk	-	Bulk	Boiler	-	Distillate	294000	0.647	0.04888	0.05313	0	0.19008	307.11
SF	BA	Oakland	At Berth	Container	1	Fully Cellular	Auxiliary	0	Distillate	2046133	31.125	0.37810	0.41098	0.41098	0.95687	1546.42
SF	BA	Oakland	At Berth	Container	1	Fully Cellular	Auxiliary	1	Distillate	458830	6.170	0.08479	0.09216	0.09216	0.21457	346.77
SF	BA	Oakland	At Berth	Container	1	Fully Cellular	Auxiliary	2	Distillate	123355	1.428	0.02279	0.02478	0.02478	0.05769	93.23
SF	BA	Oakland	At Berth	Container	1	Fully Cellular	Boiler	-	Distillate	1099371	2.418	0.18277	0.19867	0	0.71076	1148.41
SF	BA	Oakland	At Berth	Container	2	Fully Cellular	Auxiliary	0	Distillate	880344	13.392	0.16268	0.17682	0.17682	0.41169	665.35
SF	BA	Oakland	At Berth	Container	2	Fully Cellular	Auxiliary	1	Distillate	410347	5.518	0.07583	0.08242	0.08242	0.19190	310.13
SF	BA	Oakland	At Berth	Container	2	Fully Cellular	Auxiliary	2	Distillate	84332	0.976	0.01558	0.01694	0.01694	0.03944	63.74
SF	BA	Oakland	At Berth	Container	2	Fully Cellular	Boiler	-	Distillate	482657	1.061	0.08024	0.08722	0	0.31205	504.19
SF	BA	Oakland	At Berth	Container	3	Fully Cellular	Auxiliary	0	Distillate	391735	5.959	0.07239	0.07868	0.07868	0.18319	296.07
SF	BA	Oakland	At Berth	Container	3	Fully Cellular	Auxiliary	1	Distillate	391374	5.263	0.07232	0.07861	0.07861	0.18303	295.79
SF	BA	Oakland	At Berth	Container	3	Fully Cellular	Auxiliary	2	Distillate	240457	2.783	0.04443	0.04830	0.04830	0.11245	181.73
SF	BA	Oakland	At Berth	Container	3	Fully Cellular	Boiler	-	Distillate	1190700	2.618	0.19796	0.21517	0	0.76981	1243.81
SF	BA	Oakland	At Berth	Container	4	Fully Cellular	Auxiliary	0	Distillate	288312	4.386	0.05328	0.05791	0.05791	0.13483	217.90
SF	BA	Oakland	At Berth	Container	4	Fully Cellular	Auxiliary	1	Distillate	3406034	45.805	0.62939	0.68412	0.68412	1.59283	2574.21

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SF	BA	Oakland	At Berth	Container	4	Fully Cellular	Auxiliary	2	Distillate	340789	3.944	0.06297	0.06845	0.06845	0.15937	257.56
SF	BA	Oakland	At Berth	Container	4	Fully Cellular	Boiler	-	Distillate	3117672	6.856	0.51832	0.56339	0	2.01563	3256.74
SF	BA	Oakland	At Berth	Container	5	Fully Cellular	Auxiliary	0	Distillate	1037079	15.776	0.19164	0.20830	0.20830	0.48499	783.80
SF	BA	Oakland	At Berth	Container	5	Fully Cellular	Auxiliary	1	Distillate	1449493	19.493	0.26785	0.29114	0.29114	0.67785	1095.50
SF	BA	Oakland	At Berth	Container	5	Fully Cellular	Auxiliary	2	Distillate	637428	7.378	0.11779	0.12803	0.12803	0.29809	481.75
SF	BA	Oakland	At Berth	Container	5	Fully Cellular	Boiler	-	Distillate	2692929	5.922	0.44771	0.48664	0	1.74103	2813.05
SF	BA	Oakland	At Berth	Container	6	Fully Cellular	Auxiliary	1	Distillate	1354534	18.216	0.25030	0.27207	0.27207	0.63345	1023.73
SF	BA	Oakland	At Berth	Container	6	Fully Cellular	Auxiliary	2	Distillate	181411	2.100	0.03352	0.03644	0.03644	0.08484	137.11
SF	BA	Oakland	At Berth	Container	6	Fully Cellular	Boiler	-	Distillate	1952625	4.294	0.32463	0.35286	0	1.26241	2039.72
SF	BA	Oakland	At Berth	Container	7	Fully Cellular	Auxiliary	1	Distillate	898146	12.078	0.16597	0.18040	0.18040	0.42002	678.80
SF	BA	Oakland	At Berth	Container	7	Fully Cellular	Boiler	-	Distillate	781865	1.719	0.12999	0.14129	0	0.50549	816.74
SF	BA	Oakland	At Berth	Container	8	Fully Cellular	Auxiliary	1	Distillate	1938070	26.063	0.35813	0.38927	0.38927	0.90634	1464.75
SF	BA	Oakland	At Berth	Container	8	Fully Cellular	Auxiliary	2	Distillate	1376228	15.929	0.25431	0.27642	0.27642	0.64359	1040.12
SF	BA	Oakland	At Berth	Container	8	Fully Cellular	Boiler	-	Distillate	4251820	9.350	0.70687	0.76834	0	2.74888	4441.48
SF	BA	Oakland	At Berth	Container	9	Fully Cellular	Auxiliary	1	Distillate	85889	1.155	0.01587	0.01725	0.01725	0.04017	64.91
SF	BA	Oakland	At Berth	Container	9	Fully Cellular	Auxiliary	2	Distillate	927604	10.736	0.17141	0.18631	0.18631	0.43379	701.06
SF	BA	Oakland	At Berth	Container	9	Fully Cellular	Boiler	-	Distillate	1477891	3.250	0.24570	0.26707	0	0.95548	1543.81
SF	BA	Oakland	At Berth	Container	10	Fully Cellular	Auxiliary	1	Distillate	245718	3.304	0.04541	0.04935	0.04935	0.11491	185.71
SF	BA	Oakland	At Berth	Container	10	Fully Cellular	Auxiliary	2	Distillate	1455234	16.843	0.26891	0.29229	0.29229	0.68054	1099.83
SF	BA	Oakland	At Berth	Container	10	Fully Cellular	Boiler	-	Distillate	880796	1.937	0.14643	0.15917	0	0.56945	920.08
SF	BA	Oakland	At Berth	Container	11	Fully Cellular	Auxiliary	1	Distillate	1172653	15.770	0.21669	0.23553	0.23553	0.54839	886.27
SF	BA	Oakland	At Berth	Container	11	Fully Cellular	Auxiliary	2	Distillate	553922	6.411	0.10236	0.11126	0.11126	0.25904	418.64
SF	BA	Oakland	At Berth	Container	11	Fully Cellular	Boiler	-	Distillate	2462430	5.415	0.40938	0.44498	0	1.59201	2572.27
SF	BA	Oakland	At Berth	Container	12	Fully Cellular	Auxiliary	2	Distillate	96634	1.118	0.01786	0.01941	0.01941	0.04519	73.03
SF	BA	Oakland	At Berth	Container	12	Fully Cellular	Boiler	-	Distillate	218830	0.481	0.03638	0.03954	0	0.14148	228.59
SF	BA	Oakland	At Berth	Container	13	Fully Cellular	Auxiliary	1	Distillate	172085	2.314	0.03180	0.03456	0.03456	0.08048	130.06
SF	BA	Oakland	At Berth	Container	13	Fully Cellular	Auxiliary	2	Distillate	1351063	15.637	0.24966	0.27137	0.27137	0.63182	1021.10
SF	BA	Oakland	At Berth	Container	13	Fully Cellular	Boiler	-	Distillate	1164636	2.561	0.19362	0.21046	0	0.75296	1216.59
SF	BA	Oakland	At Berth	Container	14	Fully Cellular	Auxiliary	1	Distillate	49575	0.667	0.00916	0.00996	0.00996	0.02318	37.47
SF	BA	Oakland	At Berth	Container	14	Fully Cellular	Boiler	-	Distillate	22032	0.048	0.00366	0.00398	0	0.01424	23.01
SF	BA	Oakland	At Berth	Container	17	Fully Cellular	Auxiliary	2	Distillate	57000	0.660	0.01053	0.01145	0.01145	0.02666	43.08

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SF	BA	Oakland	At Berth	Container	17	Fully Cellular	Boiler	-	Distillate	36879	0.081	0.00613	0.00666	0	0.02384	38.52
SF	BA	Oakland	At Berth	Ro-ro	-	Ro-ro	Auxiliary	0	Distillate	23463	0.357	0.00434	0.00471	0.00471	0.01097	17.73
SF	BA	Oakland	At Berth	Ro-ro	-	Ro-ro	Boiler	-	Distillate	8547	0.019	0.00142	0.00154	0	0.00553	8.93
SF	BA	Oleum	At Berth	Tanker	Aframax	Crude	Auxiliary	1	Distillate	15928	0.214	0.00294	0.00320	0.00320	0.00745	12.04
SF	BA	Oleum	At Berth	Tanker	Aframax	Crude	Auxiliary	2	Distillate	120184	1.391	0.02221	0.02414	0.02414	0.05620	90.83
SF	BA	Oleum	At Berth	Tanker	Aframax	Crude	Boiler	-	Distillate	945640	2.080	0.15721	0.17089	0	0.61137	987.82
SF	BA	Oleum	At Berth	Tanker	Panamax	Crude	Auxiliary	1	Distillate	520584	7.001	0.09620	0.10456	0.10456	0.24345	393.45
SF	BA	Oleum	At Berth	Tanker	Panamax	Crude	Auxiliary	2	Distillate	88944	1.029	0.01644	0.01786	0.01786	0.04159	67.22
SF	BA	Oleum	At Berth	Tanker	Panamax	Crude	Boiler	-	Distillate	2961896	6.513	0.49242	0.53524	0	1.91492	3094.01
SF	BA	Oleum	At Berth	Tanker	Panamax	Products	Auxiliary	1	Distillate	15042	0.202	0.00278	0.00302	0.00302	0.00703	11.37
SF	BA	Oleum	At Berth	Tanker	Panamax	Products	Boiler	-	Distillate	73094	0.161	0.01215	0.01321	0	0.04726	76.35
SF	BA	Oleum	At Berth	Tanker	Seawaymax	Crude	Auxiliary	0	Distillate	33712	0.513	0.00623	0.00677	0.00677	0.01577	25.48
SF	BA	Oleum	At Berth	Tanker	Seawaymax	Crude	Boiler	-	Distillate	100018	0.220	0.01663	0.01807	0	0.06466	104.48
SF	BA	Oleum	At Berth	Tanker	Seawaymax	Products	Auxiliary	0	Distillate	26656	0.405	0.00493	0.00535	0.00535	0.01247	20.15
SF	BA	Oleum	At Berth	Tanker	Seawaymax	Products	Auxiliary	1	Distillate	972944	13.084	0.17979	0.19542	0.19542	0.45500	735.33
SF	BA	Oleum	At Berth	Tanker	Seawaymax	Products	Auxiliary	2	Distillate	457856	5.299	0.08461	0.09196	0.09196	0.21412	346.04
SF	BA	Oleum	At Berth	Tanker	Seawaymax	Products	Boiler	-	Distillate	4324034	9.509	0.71888	0.78139	0	2.79557	4516.91
SF	BA	Oleum	At Berth	Tanker	Suezmax	Crude	Auxiliary	1	Distillate	1959529	26.352	0.36210	0.39358	0.39358	0.91637	1480.97
SF	BA	Oleum	At Berth	Tanker	Suezmax	Crude	Auxiliary	2	Distillate	143013	1.655	0.02643	0.02873	0.02873	0.06688	108.09
SF	BA	Oleum	At Berth	Tanker	Suezmax	Crude	Boiler	-	Distillate	4896434	10.768	0.81404	0.88483	0	3.16564	5114.84
SF	BA	Redwood City	At Berth	Bulk	-	Bulk	Auxiliary	0	Distillate	38760	0.590	0.00716	0.00779	0.00779	0.01813	29.29
SF	BA	Redwood City	At Berth	Bulk	-	Bulk	Auxiliary	1	Distillate	115710	1.556	0.02138	0.02324	0.02324	0.05411	87.45
SF	BA	Redwood City	At Berth	Bulk	-	Bulk	Auxiliary	2	Distillate	99940	1.157	0.01847	0.02007	0.02007	0.04674	75.53
SF	BA	Redwood City	At Berth	Bulk	-	Bulk	Boiler	-	Distillate	167375	0.368	0.02783	0.03025	0	0.10821	174.84
SF	BA	Redwood City	At Berth	Bulk	-	Self-discharging	Auxiliary	0	Distillate	42960	0.653	0.00794	0.00863	0.00863	0.02009	32.47
SF	BA	Redwood City	At Berth	Bulk	-	Self-discharging	Auxiliary	2	Distillate	124942	1.446	0.02309	0.02510	0.02510	0.05843	94.43
SF	BA	Redwood City	At Berth	Bulk	-	Self-discharging	Boiler	-	Distillate	123816	0.272	0.02058	0.02237	0	0.08005	129.34
SF	BA	Richmond	At Berth	Auto	-	Auto	Auxiliary	0	Distillate	713944	10.860	0.13193	0.14340	0.14340	0.33387	539.58
SF	BA	Richmond	At Berth	Auto	-	Auto	Auxiliary	1	Distillate	1245925	16.755	0.23023	0.25025	0.25025	0.58266	941.64
SF	BA	Richmond	At Berth	Auto	-	Auto	Auxiliary	2	Distillate	463600	5.366	0.08567	0.09312	0.09312	0.21680	350.38
SF	BA	Richmond	At Berth	Auto	-	Auto	Boiler	-	Distillate	656574	1.444	0.10916	0.11865	0	0.42449	685.86

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SF	BA	Richmond	At Berth	Bulk	-	Bulk	Auxiliary	0	Distillate	18430	0.280	0.00341	0.00370	0.00370	0.00862	13.93
SF	BA	Richmond	At Berth	Bulk	-	Bulk	Auxiliary	1	Distillate	334020	4.492	0.06172	0.06709	0.06709	0.15620	252.45
SF	BA	Richmond	At Berth	Bulk	-	Bulk	Auxiliary	2	Distillate	433580	5.018	0.08012	0.08709	0.08709	0.20276	327.69
SF	BA	Richmond	At Berth	Bulk	-	Bulk	Boiler	-	Distillate	517125	1.137	0.08597	0.09345	0	0.33433	540.19
SF	BA	Richmond	At Berth	Bulk	-	Self-discharging	Auxiliary	0	Distillate	21659	0.329	0.00400	0.00435	0.00435	0.01013	16.37
SF	BA	Richmond	At Berth	Bulk	-	Self-discharging	Auxiliary	2	Distillate	82161	0.951	0.01518	0.01650	0.01650	0.03842	62.10
SF	BA	Richmond	At Berth	Bulk	-	Self-discharging	Boiler	-	Distillate	76560	0.168	0.01273	0.01384	0	0.04950	79.98
SF	BA	Richmond	At Berth	Tanker	Aframax	Crude	Auxiliary	1	Distillate	842736	11.333	0.15573	0.16927	0.16927	0.39410	636.92
SF	BA	Richmond	At Berth	Tanker	Aframax	Crude	Auxiliary	2	Distillate	203444	2.355	0.03759	0.04086	0.04086	0.09514	153.76
SF	BA	Richmond	At Berth	Tanker	Aframax	Crude	Boiler	-	Distillate	3557590	7.823	0.59146	0.64289	0	2.30005	3716.28
SF	BA	Richmond	At Berth	Tanker	Panamax	Crude	Auxiliary	1	Distillate	913638	12.287	0.16883	0.18351	0.18351	0.42726	690.51
SF	BA	Richmond	At Berth	Tanker	Panamax	Crude	Boiler	-	Distillate	3548380	7.803	0.58993	0.64122	0	2.29409	3706.66
SF	BA	Richmond	At Berth	Tanker	Panamax	Products	Auxiliary	1	Distillate	261600	3.518	0.04834	0.05254	0.05254	0.12234	197.71
SF	BA	Richmond	At Berth	Tanker	Panamax	Products	Boiler	-	Distillate	1016000	2.234	0.16891	0.18360	0	0.65686	1061.32
SF	BA	Richmond	At Berth	Tanker	Seawaymax	Crude	Auxiliary	0	Distillate	455504	6.929	0.08417	0.09149	0.09149	0.21302	344.26
SF	BA	Richmond	At Berth	Tanker	Seawaymax	Crude	Auxiliary	1	Distillate	48608	0.654	0.00898	0.00976	0.00976	0.02273	36.74
SF	BA	Richmond	At Berth	Tanker	Seawaymax	Crude	Boiler	-	Distillate	952283	2.094	0.15832	0.17209	0	0.61567	994.76
SF	BA	Richmond	At Berth	Tanker	Seawaymax	Products	Auxiliary	0	Distillate	3090528	47.012	0.57109	0.62075	0.62075	1.44528	2335.76
SF	BA	Richmond	At Berth	Tanker	Seawaymax	Products	Auxiliary	1	Distillate	4632656	62.300	0.85606	0.93050	0.93050	2.16646	3501.26
SF	BA	Richmond	At Berth	Tanker	Seawaymax	Products	Auxiliary	2	Distillate	1467648	16.987	0.27120	0.29479	0.29479	0.68634	1109.22
SF	BA	Richmond	At Berth	Tanker	Seawaymax	Products	Boiler	-	Distillate	17361763	38.180	2.88643	3.13743	0	11.22471	18136.20
SF	BA	Richmond	At Berth	Tanker	Seawaymax	Chemical	Auxiliary	1	Distillate	283024	3.806	0.05230	0.05685	0.05685	0.13236	213.90
SF	BA	Richmond	At Berth	Tanker	Seawaymax	Chemical	Boiler	-	Distillate	534641	1.176	0.08889	0.09661	0	0.34566	558.49
SF	BA	Richmond	At Berth	Tanker	Suezmax	Crude	Auxiliary	1	Distillate	2002182	26.925	0.36998	0.40215	0.40215	0.93632	1513.21
SF	BA	Richmond	At Berth	Tanker	Suezmax	Crude	Auxiliary	2	Distillate	3700775	42.833	0.68386	0.74332	0.74332	1.73066	2796.97
SF	BA	Richmond	At Berth	Tanker	Suezmax	Crude	Boiler	-	Distillate	9073816	19.954	1.50854	1.63972	0	5.86639	9478.56
SF	BA	San Francisco	At Berth	Auto	-	Auto	Auxiliary	0	Distillate	1159	0.018	0.00021	0.00023	0.00023	0.00054	0.88
SF	BA	San Francisco	At Berth	Auto	-	Auto	Auxiliary	1	Distillate	127490	1.714	0.02356	0.02561	0.02561	0.05962	96.35
SF	BA	San Francisco	At Berth	Auto	-	Auto	Auxiliary	2	Distillate	74176	0.859	0.01371	0.01490	0.01490	0.03469	56.06
SF	BA	San Francisco	At Berth	Auto	-	Auto	Boiler	-	Distillate	54950	0.121	0.00914	0.00993	0	0.03553	57.40
SF	BA	San Francisco	At Berth	Bulk	-	Bulk	Auxiliary	0	Distillate	190	0.003	0.00004	0.00004	0.00004	0.00009	0.14

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SF	BA	San Francisco	At Berth	Bulk	-	Bulk	Auxiliary	1	Distillate	1710	0.023	0.00032	0.00034	0.00034	0.00080	1.29
SF	BA	San Francisco	At Berth	Bulk	-	Bulk	Auxiliary	2	Distillate	1330	0.015	0.00025	0.00027	0.00027	0.00062	1.01
SF	BA	San Francisco	At Berth	Bulk	-	Bulk	Boiler	-	Distillate	2125	0.005	0.00035	0.00038	0	0.00137	2.22
SF	BA	San Francisco	At Berth	Bulk	-	Self-discharging	Auxiliary	0	Distillate	25060	0.381	0.00463	0.00503	0.00503	0.01172	18.94
SF	BA	San Francisco	At Berth	Bulk	-	Self-discharging	Auxiliary	1	Distillate	179	0.002	0.00003	0.00004	0.00004	0.00008	0.14
SF	BA	San Francisco	At Berth	Bulk	-	Self-discharging	Auxiliary	2	Distillate	47793	0.553	0.00883	0.00960	0.00960	0.02235	36.12
SF	BA	San Francisco	At Berth	Bulk	-	Self-discharging	Boiler	-	Distillate	53856	0.118	0.00895	0.00973	0	0.03482	56.26
SF	BA	San Francisco	At Berth	Container	1	Fully Cellular	Auxiliary	0	Distillate	709	0.011	0.00013	0.00014	0.00014	0.00033	0.54
SF	BA	San Francisco	At Berth	Container	1	Fully Cellular	Auxiliary	1	Distillate	1418	0.019	0.00026	0.00028	0.00028	0.00066	1.07
SF	BA	San Francisco	At Berth	Container	1	Fully Cellular	Boiler	-	Distillate	819	0.002	0.00014	0.00015	0	0.00053	0.86
SF	BA	San Francisco	At Berth	Container	2	Fully Cellular	Auxiliary	0	Distillate	21756	0.331	0.00402	0.00437	0.00437	0.01017	16.44
SF	BA	San Francisco	At Berth	Container	2	Fully Cellular	Auxiliary	1	Distillate	1036	0.014	0.00019	0.00021	0.00021	0.00048	0.78
SF	BA	San Francisco	At Berth	Container	2	Fully Cellular	Boiler	-	Distillate	7942	0.017	0.00132	0.00144	0	0.00513	8.30
SF	BA	San Francisco	At Berth	Container	3	Fully Cellular	Auxiliary	0	Distillate	3582	0.054	0.00066	0.00072	0.00072	0.00168	2.71
SF	BA	San Francisco	At Berth	Container	3	Fully Cellular	Auxiliary	1	Distillate	1791	0.024	0.00033	0.00036	0.00036	0.00084	1.35
SF	BA	San Francisco	At Berth	Container	3	Fully Cellular	Auxiliary	2	Distillate	597	0.007	0.00011	0.00012	0.00012	0.00028	0.45
SF	BA	San Francisco	At Berth	Container	3	Fully Cellular	Boiler	-	Distillate	4200	0.009	0.00070	0.00076	0	0.00272	4.39
SF	BA	San Francisco	At Berth	Container	4	Fully Cellular	Auxiliary	0	Distillate	1153	0.018	0.00021	0.00023	0.00023	0.00054	0.87
SF	BA	San Francisco	At Berth	Container	4	Fully Cellular	Auxiliary	1	Distillate	16142	0.217	0.00298	0.00324	0.00324	0.00755	12.20
SF	BA	San Francisco	At Berth	Container	4	Fully Cellular	Boiler	-	Distillate	7155	0.016	0.00119	0.00129	0	0.00463	7.47
SF	BA	San Francisco	At Berth	Container	5	Fully Cellular	Auxiliary	0	Distillate	1007	0.015	0.00019	0.00020	0.00020	0.00047	0.76
SF	BA	San Francisco	At Berth	Container	5	Fully Cellular	Auxiliary	1	Distillate	4028	0.054	0.00074	0.00081	0.00081	0.00188	3.04
SF	BA	San Francisco	At Berth	Container	5	Fully Cellular	Auxiliary	2	Distillate	3021	0.035	0.00056	0.00061	0.00061	0.00141	2.28
SF	BA	San Francisco	At Berth	Container	5	Fully Cellular	Boiler	-	Distillate	4632	0.010	0.00077	0.00084	0	0.00299	4.84
SF	BA	San Francisco	At Berth	Container	7	Fully Cellular	Auxiliary	1	Distillate	4652	0.063	0.00086	0.00093	0.00093	0.00218	3.52
SF	BA	San Francisco	At Berth	Container	7	Fully Cellular	Boiler	-	Distillate	1246	0.003	0.00021	0.00023	0	0.00081	1.30
SF	BA	San Francisco	At Berth	Container	8	Fully Cellular	Auxiliary	1	Distillate	5706	0.077	0.00105	0.00115	0.00115	0.00267	4.31
SF	BA	San Francisco	At Berth	Container	8	Fully Cellular	Auxiliary	2	Distillate	2853	0.033	0.00053	0.00057	0.00057	0.00133	2.16
SF	BA	San Francisco	At Berth	Container	8	Fully Cellular	Boiler	-	Distillate	6012	0.013	0.00100	0.00109	0	0.00389	6.28
SF	BA	San Francisco	At Berth	Container	9	Fully Cellular	Auxiliary	2	Distillate	1946	0.023	0.00036	0.00039	0.00039	0.00091	1.47
SF	BA	San Francisco	At Berth	Container	9	Fully Cellular	Boiler	-	Distillate	1354	0.003	0.00023	0.00024	0	0.00088	1.41

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SF	BA	San Francisco	At Berth	Container	10	Fully Cellular	Auxiliary	2	Distillate	4488	0.052	0.00083	0.00090	0.00090	0.00210	3.39
SF	BA	San Francisco	At Berth	Container	10	Fully Cellular	Boiler	-	Distillate	2324	0.005	0.00039	0.00042	0	0.00150	2.43
SF	BA	San Francisco	At Berth	Container	11	Fully Cellular	Auxiliary	1	Distillate	1500	0.020	0.00028	0.00030	0.00030	0.00070	1.13
SF	BA	San Francisco	At Berth	Container	11	Fully Cellular	Boiler	-	Distillate	790	0.002	0.00013	0.00014	0	0.00051	0.83
SF	BA	San Francisco	At Berth	Container	13	Fully Cellular	Auxiliary	2	Distillate	990	0.011	0.00018	0.00020	0.00020	0.00046	0.75
SF	BA	San Francisco	At Berth	Container	13	Fully Cellular	Boiler	-	Distillate	612	0.001	0.00010	0.00011	0	0.00040	0.64
SF	BA	San Francisco	At Berth	Cruise	-	Cruise	Auxiliary	0	Distillate	2616340	39.799	0.48347	0.52551	0.52551	1.22353	1977.37
SF	BA	San Francisco	At Berth	Cruise	-	Cruise	Auxiliary	1	Distillate	5251639	70.624	0.97044	1.05482	1.05482	2.45592	3969.08
SF	BA	San Francisco	At Berth	Cruise	-	Cruise	Boiler	-	Distillate	1015920	2.234	0.16890	0.18359	0	0.65681	1061.24
SF	BA	San Francisco	At Berth	General	-	General	Auxiliary	1	Distillate	661	0.009	0.00012	0.00013	0.00013	0.00031	0.50
SF	BA	San Francisco	At Berth	General	-	General	Auxiliary	2	Distillate	1322	0.015	0.00024	0.00027	0.00027	0.00062	1.00
SF	BA	San Francisco	At Berth	General	-	General	Boiler	-	Distillate	480	0.001	0.00008	0.00009	0	0.00031	0.50
SF	BA	San Francisco	At Berth	Tanker	Aframax	Crude	Auxiliary	1	Distillate	2896	0.039	0.00054	0.00058	0.00058	0.00135	2.19
SF	BA	San Francisco	At Berth	Tanker	Aframax	Crude	Auxiliary	2	Distillate	2896	0.034	0.00054	0.00058	0.00058	0.00135	2.19
SF	BA	San Francisco	At Berth	Tanker	Aframax	Crude	Boiler	-	Distillate	40240	0.088	0.00669	0.00727	0	0.02602	42.03
SF	BA	San Francisco	At Berth	Tanker	Panamax	Crude	Auxiliary	1	Distillate	3270	0.044	0.00060	0.00066	0.00066	0.00153	2.47
SF	BA	San Francisco	At Berth	Tanker	Panamax	Crude	Boiler	-	Distillate	15890	0.035	0.00264	0.00287	0	0.01027	16.60
SF	BA	San Francisco	At Berth	Tanker	Panamax	Products	Auxiliary	1	Distillate	654	0.009	0.00012	0.00013	0.00013	0.00031	0.49
SF	BA	San Francisco	At Berth	Tanker	Panamax	Products	Boiler	-	Distillate	3178	0.007	0.00053	0.00057	0	0.00205	3.32
SF	BA	San Francisco	At Berth	Tanker	Seawaymax	Crude	Auxiliary	0	Distillate	784	0.012	0.00014	0.00016	0.00016	0.00037	0.59
SF	BA	San Francisco	At Berth	Tanker	Seawaymax	Crude	Boiler	-	Distillate	2326	0.005	0.00039	0.00042	0	0.00150	2.43
SF	BA	San Francisco	At Berth	Tanker	Seawaymax	Products	Auxiliary	0	Distillate	3136	0.048	0.00058	0.00063	0.00063	0.00147	2.37
SF	BA	San Francisco	At Berth	Tanker	Seawaymax	Products	Auxiliary	1	Distillate	10976	0.148	0.00203	0.00220	0.00220	0.00513	8.30
SF	BA	San Francisco	At Berth	Tanker	Seawaymax	Products	Auxiliary	2	Distillate	6272	0.073	0.00116	0.00126	0.00126	0.00293	4.74
SF	BA	San Francisco	At Berth	Tanker	Seawaymax	Products	Boiler	-	Distillate	60476	0.133	0.01005	0.01093	0	0.03910	63.17
SF	BA	San Francisco	At Berth	Tanker	Suezmax	Crude	Auxiliary	1	Distillate	12545	0.169	0.00232	0.00252	0.00252	0.00587	9.48
SF	BA	San Francisco	At Berth	Tanker	Suezmax	Crude	Auxiliary	2	Distillate	7527	0.087	0.00139	0.00151	0.00151	0.00352	5.69
SF	BA	San Francisco	At Berth	Tanker	Suezmax	Crude	Boiler	-	Distillate	46744	0.103	0.00777	0.00845	0	0.03022	48.83
SF	BA	Selby	At Berth	Tanker	Seawaymax	Products	Auxiliary	0	Distillate	25872	0.394	0.00478	0.00520	0.00520	0.01210	19.55
SF	BA	Selby	At Berth	Tanker	Seawaymax	Products	Auxiliary	1	Distillate	836528	11.250	0.15458	0.16802	0.16802	0.39120	632.23
SF	BA	Selby	At Berth	Tanker	Seawaymax	Products	Auxiliary	2	Distillate	161504	1.869	0.02984	0.03244	0.03244	0.07553	122.06

AB	DIS	Arrival Port	Mode	Vessel Type	Size bin	Vessel Subtype	Engine type	tier ID	Fuel type	Energy Used (kWh)	NOx (tpy)	PM2.5 (tpy)	PM 10 (tpy)	DPM (tpy)	SOx (tpy)	CO2eq (tpy)
SF	BA	Selby	At Berth	Tanker	Seawaymax	Products	Boiler	-	Distillate	3037756	6.680	0.50503	0.54895	0	1.96397	3173.26
SJV	SJU	Stockton	At Berth	Bulk	-	Bulk	Auxiliary	0	Distillate	111340	1.694	0.02057	0.02236	0.02236	0.05207	84.15
SJV	SJU	Stockton	At Berth	Bulk	-	Bulk	Auxiliary	1	Distillate	738530	9.932	0.13647	0.14834	0.14834	0.34537	558.17
SJV	SJU	Stockton	At Berth	Bulk	-	Bulk	Auxiliary	2	Distillate	1135060	13.137	0.20974	0.22798	0.22798	0.53081	857.85
SJV	SJU	Stockton	At Berth	Bulk	-	Bulk	Boiler	-	Distillate	1305875	2.872	0.21710	0.23598	0	0.84427	1364.12
SJV	SJU	Stockton	At Berth	Bulk	-	Self-discharging	Auxiliary	2	Distillate	13962	0.162	0.00258	0.00280	0.00280	0.00653	10.55
SJV	SJU	Stockton	At Berth	Bulk	-	Self-discharging	Boiler	-	Distillate	10296	0.023	0.00171	0.00186	0	0.00666	10.76
SJV	SJU	Stockton	At Berth	General	-	General	Auxiliary	0	Distillate	320585	4.877	0.05924	0.06439	0.06439	0.14992	242.29
SJV	SJU	Stockton	At Berth	General	-	General	Auxiliary	1	Distillate	482530	6.489	0.08917	0.09692	0.09692	0.22565	364.69
SJV	SJU	Stockton	At Berth	General	-	General	Auxiliary	2	Distillate	1555333	18.002	0.28741	0.31240	0.31240	0.72735	1175.49
SJV	SJU	Stockton	At Berth	General	-	General	Boiler	-	Distillate	570880	1.255	0.09491	0.10316	0	0.36908	596.34
SJV	SJU	Stockton	At Berth	Tanker	Seawaymax	Products	Auxiliary	0	Distillate	787920	11.986	0.14560	0.15826	0.15826	0.36847	595.49
SJV	SJU	Stockton	At Berth	Tanker	Seawaymax	Products	Auxiliary	1	Distillate	1200304	16.142	0.22180	0.24109	0.24109	0.56132	907.16
SJV	SJU	Stockton	At Berth	Tanker	Seawaymax	Products	Auxiliary	2	Distillate	285376	3.303	0.05273	0.05732	0.05732	0.13346	215.68
SJV	SJU	Stockton	At Berth	Tanker	Seawaymax	Products	Boiler	-	Distillate	6745400	14.834	1.12144	1.21896	0	4.36103	7046.28
SJV	SJU	Stockton	At Berth	Tanker	Seawaymax	Chemical	Auxiliary	1	Distillate	116816	1.571	0.02159	0.02346	0.02346	0.05463	88.29
SJV	SJU	Stockton	At Berth	Tanker	Seawaymax	Chemical	Boiler	-	Distillate	346574	0.762	0.05762	0.06263	0	0.22407	362.03
SJV	SJU	Stockton	At Berth	Tanker	Seawaymax	LPG	Auxiliary	1	Distillate	243040	3.268	0.04491	0.04882	0.04882	0.11366	183.68
SJV	SJU	Stockton	At Berth	Tanker	Seawaymax	LPG	Boiler	-	Distillate	721060	1.586	0.11988	0.13030	0	0.46618	753.22
SV	YS	Sacramento	At Berth	Bulk	-	Bulk	Auxiliary	1	Distillate	185630	2.496	0.03430	0.03728	0.03728	0.08681	140.30
SV	YS	Sacramento	At Berth	Bulk	-	Bulk	Auxiliary	2	Distillate	307990	3.565	0.05691	0.06186	0.06186	0.14403	232.77
SV	YS	Sacramento	At Berth	Bulk	-	Bulk	Boiler	-	Distillate	324750	0.714	0.05399	0.05869	0	0.20996	339.24
SV	YS	Sacramento	At Berth	General	-	General	Auxiliary	0	Distillate	238621	3.630	0.04409	0.04793	0.04793	0.11159	180.34
SV	YS	Sacramento	At Berth	General	-	General	Auxiliary	1	Distillate	389329	5.236	0.07194	0.07820	0.07820	0.18207	294.25
SV	YS	Sacramento	At Berth	General	-	General	Auxiliary	2	Distillate	673559	7.796	0.12447	0.13529	0.13529	0.31499	509.06
SV	YS	Sacramento	At Berth	General	-	General	Boiler	-	Distillate	315040	0.693	0.05238	0.05693	0	0.20368	329.09
SV	YS	Sacramento	At Berth	Tanker	Seawaymax	Products	Auxiliary	1	Distillate	784	0.011	0.00014	0.00016	0.00016	0.00037	0.59
SV	YS	Sacramento	At Berth	Tanker	Seawaymax	Products	Boiler	-	Distillate	2326	0.005	0.00039	0.00042	0	0.00150	2.43

Appendix C: Growth Factors

Avon

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Bulk		1.000	1.010	1.021	1.031	1.042	1.164	1.282	1.422	1.618	1.807	2.018
Tanker	Seawaymax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Panamax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465

Benicia

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Auto		1.000	1.033	1.067	1.103	1.139	1.289	1.458	1.663	1.929	2.192	2.491
Bulk		1.000	1.010	1.021	1.031	1.042	1.164	1.282	1.422	1.618	1.807	2.018
Tanker	Seawaymax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Panamax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Aframax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Suezmax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465

Crockett

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Bulk		1.000	1.010	1.021	1.031	1.042	1.164	1.282	1.422	1.618	1.807	2.018
General		1.000	1.058	1.119	1.183	1.252	1.656	2.155	2.835	3.897	4.635	5.514

El Segundo

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Tanker	Seawaymax	1.000	0.986	0.972	0.959	0.945	0.962	1.037	1.158	1.324	1.479	1.654
Tanker	Panamax	1.000	0.986	0.972	0.959	0.945	0.962	1.037	1.158	1.324	1.479	1.654

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Tanker	Aframax	1.000	0.986	0.972	0.959	0.945	0.962	1.037	1.158	1.324	1.479	1.654
Tanker	Suezmax	1.000	0.986	0.972	0.959	0.945	0.962	1.037	1.158	1.324	1.479	1.654

Eureka

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Bulk		1.000	1.034	1.070	1.106	1.144	1.420	1.677	1.995	2.543	3.108	3.798

Hueneme

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Auto		1.000	1.020	1.040	1.061	1.082	1.195	1.319	1.457	1.608	1.776	1.961
Container	1	1.000	1.020	1.040	1.061	1.082	1.195	1.319	1.457	1.608	1.776	1.961
Container	2	1.000	1.020	1.040	1.061	1.082	1.195	1.319	1.457	1.608	1.776	1.961
General		1.000	1.020	1.040	1.061	1.082	1.195	1.319	1.457	1.608	1.776	1.961
Reefer		1.000	1.020	1.040	1.061	1.082	1.195	1.319	1.457	1.608	1.776	1.961
Tanker	Seawaymax	1.000	1.020	1.040	1.061	1.082	1.195	1.319	1.457	1.608	1.776	1.961

Long Beach

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Auto		1.000	1.060	1.124	1.191	1.263	1.603	1.835	2.035	2.367	2.788	3.284
Bulk		1.000	1.033	1.068	1.103	1.140	1.204	1.229	1.242	1.253	1.265	1.276
Container	1	1.000	0.930	0.861	0.794	0.702	0.603	0.594	0.750	0.750	0.750	0.750
Container	2	1.000	0.930	0.861	0.794	0.702	0.603	0.594	0.750	0.750	0.750	0.750
Container	3	1.000	1.288	1.579	1.876	2.105	0.966	0.238	0.300	0.300	0.300	0.300
Container	4	1.000	1.001	1.005	1.010	0.983	1.521	1.746	2.204	2.204	2.204	2.204
Container	5	1.000	0.906	0.813	0.721	0.607	-	-	-	-	-	-
Container	6	1.000	0.858	0.718	0.577	0.421	0.579	0.570	0.720	0.720	0.720	0.720
Container	7	1.000	0.960	0.921	0.884	0.819	0.634	0.416	0.525	0.525	0.525	0.525
Container	8	1.000	1.102	1.206	1.314	1.376	1.419	0.898	1.134	1.134	1.134	1.134
Container	9	1.000	0.930	0.861	0.794	0.702	0.724	0.356	0.450	0.450	0.450	0.450

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Container	10	1.000	1.335	1.675	2.021	2.293	3.717	3.659	4.619	4.619	4.619	4.619
Container	11	1.000	-	-	-	-	-	-	-	-	-	-
Container	13	1.000	1.233	1.469	1.710	1.890	3.509	5.373	6.783	6.783	6.783	6.783
Container	16	-	-	-	-	1.000	2.064	7.109	8.974	8.974	8.974	8.974
Container	17	1.000	1.049	1.101	1.156	1.213	1.543	1.928	2.433	2.433	2.433	2.433
Container	18	-	-	-	-	-	-	4.960	6.262	6.262	6.262	6.262
Container	20	-	-	-	-	-	-	4.960	6.262	6.262	6.262	6.262
Cruise		1.000	1.037	1.075	1.115	1.156	1.384	1.659	1.987	2.381	2.770	3.163
General		1.000	1.046	1.094	1.145	1.198	1.467	1.771	2.143	2.574	3.084	3.696
Reefer		1.000	1.046	1.094	1.145	1.198	1.467	1.771	2.143	2.574	3.084	3.696
Ro-ro		1.000	1.060	1.124	1.191	1.263	1.603	1.835	2.035	2.367	2.788	3.284
Tanker	Seawaymax	1.000	1.014	1.028	1.042	1.057	1.100	1.133	1.163	1.193	1.223	1.254
Tanker	Panamax	1.000	1.014	1.028	1.042	1.057	1.100	1.133	1.163	1.193	1.223	1.254
Tanker	Aframax	1.000	1.014	1.028	1.042	1.057	1.100	1.133	1.163	1.193	1.223	1.254
Tanker	Suezmax	1.000	1.014	1.028	1.042	1.057	1.100	1.133	1.163	1.193	1.223	1.254
Tanker	VLCC	1.000	1.014	1.028	1.042	1.057	1.100	1.133	1.163	1.193	1.223	1.254
Tanker	ULCC	1.000	1.014	1.028	1.042	1.057	1.100	1.133	1.163	1.193	1.223	1.254

Los Angeles

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Auto		1.000	1.060	1.124	1.191	1.263	1.603	1.835	2.035	2.367	2.788	3.284
Bulk		1.000	1.033	1.068	1.103	1.140	1.204	1.229	1.242	1.253	1.265	1.276
Container	2	1.000	0.930	0.861	0.794	0.702	0.603	0.594	0.750	0.750	0.750	0.750
Container	3	1.000	1.288	1.579	1.876	2.105	0.966	0.238	0.300	0.300	0.300	0.300
Container	4	1.000	1.001	1.005	1.010	0.983	1.521	1.746	2.204	2.204	2.204	2.204
Container	5	1.000	0.906	0.813	0.721	0.607	-	-	-	-	-	-
Container	6	1.000	0.858	0.718	0.577	0.421	0.579	0.570	0.720	0.720	0.720	0.720
Container	7	1.000	0.960	0.921	0.884	0.819	0.634	0.416	0.525	0.525	0.525	0.525
Container	8	1.000	1.102	1.206	1.314	1.376	1.419	0.898	1.134	1.134	1.134	1.134

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Container	9	1.000	0.930	0.861	0.794	0.702	0.724	0.356	0.450	0.450	0.450	0.450
Container	10	1.000	1.335	1.675	2.021	2.293	3.717	3.659	4.619	4.619	4.619	4.619
Container	11	1.000	-	-	-	-	-	-	-	-	-	-
Container	12	1.000	1.049	1.101	1.156	1.213	1.543	1.928	2.433	2.433	2.433	2.433
Container	13	1.000	1.233	1.469	1.710	1.890	3.509	5.373	6.783	6.783	6.783	6.783
Container	14	1.000	1.076	1.154	1.235	1.274	1.752	2.156	2.722	2.722	2.722	2.722
Container	16	-	-	-	-	1.000	2.064	7.109	8.974	8.974	8.974	8.974
Container	17	1.000	1.049	1.101	1.156	1.213	1.543	1.928	2.433	2.433	2.433	2.433
Container	18	-	-	-	-	-	-	4.960	6.262	6.262	6.262	6.262
Container	20	-	-	-	-	-	-	4.960	6.262	6.262	6.262	6.262
Cruise		1.000	1.037	1.075	1.115	1.156	1.384	1.659	1.987	2.381	2.770	3.163
General		1.000	1.046	1.094	1.145	1.198	1.467	1.771	2.143	2.574	3.084	3.696
Reefer		1.000	1.046	1.094	1.145	1.198	1.467	1.771	2.143	2.574	3.084	3.696
Ro-ro		1.000	1.060	1.124	1.191	1.263	1.603	1.835	2.035	2.367	2.788	3.284
Tanker	Seawaymax	1.000	1.014	1.028	1.042	1.057	1.100	1.133	1.163	1.193	1.223	1.254
Tanker	Panamax	1.000	1.014	1.028	1.042	1.057	1.100	1.133	1.163	1.193	1.223	1.254

Martinez

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Tanker	Seawaymax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Panamax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Aframax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Suezmax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465

Oakland

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Bulk		1.000	1.010	1.021	1.031	1.042	1.164	1.282	1.422	1.618	1.807	2.018
Container	1	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604

Container	2	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	3	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	4	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	5	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	6	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	7	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	8	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	9	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	10	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	11	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	12	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	13	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	14	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	17	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Ro-ro		1.000	1.056	1.114	1.176	1.241	1.583	1.997	2.534	3.289	4.037	4.954

Oleum

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Tanker	Seawaymax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Panamax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Aframax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Suezmax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465

Redwood City

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Bulk		1.000	1.010	1.021	1.031	1.042	1.164	1.282	1.422	1.618	1.807	2.018

Richmond

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Auto		1.000	1.033	1.067	1.103	1.139	1.289	1.458	1.663	1.929	2.192	2.491
Bulk		1.000	1.010	1.021	1.031	1.042	1.164	1.282	1.422	1.618	1.807	2.018
Tanker	Seawaymax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Panamax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Aframax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Suezmax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465

Sacramento

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Bulk		1.000	1.010	1.021	1.031	1.042	1.164	1.282	1.422	1.618	1.807	2.018
General		1.000	1.058	1.119	1.183	1.252	1.656	2.155	2.835	3.897	4.635	5.514
Tanker	Seawaymax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465

San Diego

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Auto		1.000	1.032	1.065	1.099	1.134	1.269	1.418	1.597	1.827	2.084	2.377
Bulk		1.000	0.942	0.888	0.836	0.788	0.823	0.879	0.943	0.998	1.045	1.095
Container	1	1.000	1.040	1.082	1.125	1.171	1.404	1.657	1.977	2.446	2.943	3.541
Container	3	1.000	1.040	1.082	1.125	1.171	1.404	1.657	1.977	2.446	2.943	3.541
Cruise		1.000	1.037	1.075	1.115	1.156	1.384	1.659	1.987	2.381	2.770	3.163
General		1.000	1.046	1.095	1.146	1.199	1.471	1.782	2.178	2.742	3.356	4.107
Ro-ro		1.000	1.052	1.107	1.164	1.225	1.595	2.003	2.540	3.413	4.115	4.961
Tanker	Seawaymax	1.000	1.044	1.090	1.138	1.189	1.508	1.826	2.240	2.979	3.530	4.182

San Francisco

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Auto		1.000	1.033	1.067	1.103	1.139	1.289	1.458	1.663	1.929	2.192	2.491
Bulk		1.000	1.010	1.021	1.031	1.042	1.164	1.282	1.422	1.618	1.807	2.018
Container	1	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	2	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	3	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	4	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	5	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	6	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	7	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	8	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	9	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	10	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	11	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	12	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Container	13	1.000	1.050	1.102	1.158	1.215	1.571	1.976	2.513	3.380	3.945	4.604
Cruise		1.000	1.037	1.075	1.115	1.156	1.384	1.659	1.987	2.381	2.770	3.163
General		1.000	1.058	1.119	1.183	1.252	1.656	2.155	2.835	3.897	4.635	5.514
Ro-ro		1.000	1.056	1.114	1.176	1.241	1.583	1.997	2.534	3.289	4.037	4.954
Tanker	Seawaymax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Panamax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Aframax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465
Tanker	Suezmax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465

Selby

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Tanker	Seawaymax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465

Stockton

Vessel Type	Vessel Size	2016	2017	2018	2019	2020	2025	2030	2035	2040	2045	2050
Bulk		1.000	1.010	1.021	1.031	1.042	1.164	1.282	1.422	1.618	1.807	2.018
General		1.000	1.058	1.119	1.183	1.252	1.656	2.155	2.835	3.897	4.635	5.514
Tanker	Seawaymax	1.000	0.993	0.987	0.980	0.973	1.006	1.077	1.162	1.258	1.357	1.465