Appendix A

Methods and Data Differences Between Recalibrated 2006 Baseline, Recalibrated 2016 CAP Inventory, and 2022 CAP Inventory

Category	Recalibrated 2006 Baseline		Recalibrated 2016 CAP Inventory		2022 CAP Inventory	
	Method	**Data Used**	**Method**	**Data Used**	**Method**	**Data Used**
Electricity						
Activity						
Tenant SDG&E	Aggregated energy consumption for all tenants within the Port boundary for 2006, assuming 55% of electricity consumption is obtained through SDG&E	166,699 MWh	Aggregated energy consumption for all tenants within the Port boundary for 2016, assuming 55% of electricity consumption is obtained through SDG&E	177,281 MWh	Aggregated energy consumption for all tenants within the Port boundary provided by SDG&E for 2022 by provider. Shore power electricity usage for ocean-going vessels is included in the maritime category	Confidential
Tenant Direct Access	Aggregated energy consumption for all tenants within the Port boundary for 2006, assuming 45% of electricity consumption is obtained through Direct Access	144,615 MWh	Aggregated energy consumption for all tenants within the Port boundary for 2016, assuming 45% of electricity consumption is obtained through Direct Access	150,243 MWh	Aggregated energy consumption for all tenants within the Port boundary provided by SDG&E for 2022 by provider	Confidential
Tenant SDCP	N/A	N/A	N/A	N/A	Aggregated energy consumption for all tenants within the Port boundary provided by SDG&E for 2022 by provider	Confidential
Port Operations SDG&E	Consumption provided by SDG&E	10,052 MWh	Consumption provided by SDG&E	6,350 MWh	Consumption provided by SDG&E	3,500 MWh
Port Operations SDCP	N/A	N/A	N/A	N/A	Consumption provided by SDG&E	2,405 MWh
Emission Factor						
Tenant SDG&E	SDG&E reporting (for CO_2) and California Climate Action Registry (CCAR; for CH_4 and N_2O); same as CAP, except for change in GWP.	0.355 MT/MWh	SDG&E CPUC filing for 2016, filed November 2017. Rate provided for CO_2e.	0.267 MT/MWh	CEC's 2022 Power Source Disclosure data, which discloses retail sales (in MWh) and GHG emissions (in pounds CO_2e per MWh) for each electricity provider in the state	0.230 MT/MWh
Tenant Direct Access	Based on CPUC Decision 15-08-006; converted from 0.379 $MTCO_2e$/MWh.	0.379 MT/MWh	Based on CPUC Decision 15-08-006; converted from 0.379 $MTCO_2e$/MWh.	0.379 MT/MWh	CEC's 2022 Power Source Disclosure data, based on a weighted average emission factor of all DA providers in the state	0.291 MT/MWh
Tenant and Port SDCP	N/A	N/A	N/A	N/A	CEC's 2022 Power Source Disclosure data for SDCP's PowerOn power mix	0.170 MT/MWh
Activity =	*321,366*	*MWh*	*339,090*	*MWh*	*Confidential*	
Emissions =	*117,526*	*$MTCO_2e$*	*101,381*	*$MTCO_2e$*	*68,320*	*$MTCO_2e$*

Category	Recalibrated 2006 Baseline		Recalibrated 2016 CAP Inventory		2022 CAP Inventory	
	Method	**Data Used**	**Method**	**Data Used**	**Method**	**Data Used**
Natural Gas						
Activity						
Tenant SDG&E	Aggregated energy consumption for all tenants within the Port boundary for 2006, assuming 9% of natural gas consumption is obtained through SDG&E (same as 2016)	2,687,962 therms	No change	2,293,013 therms	Aggregated energy consumption for all tenants within the Port boundary provided by SDG&E for 2022 by provider	Confidential
Tenant Direct Access	Aggregated energy consumption for all tenants within the Port boundary for 2006, assuming 91% of natural gas consumption is obtained through Direct Access (same as 2016). Assumes stationary sources (CP Kelco and Solar Turbines) are on direct access	9,790,046 therms	No change	1,877,417 therms	Aggregated energy consumption for all tenants within the Port boundary provided by SDG&E for 2022 by provider	Confidential
Port Operations SDG&E	Consumption provided by SDG&E	61,524 therms	Consumption provided by SDG&E	27,319 therms	Consumption provided by SDG&E	28,298 therms
Emission Factor						
All Natural Gas	Based on same but updated General Reporting Protocol - US Weighted Average CO_2 rate (Table 12.1) and Commercial sector CH_4 and N_2O (Table 12.9.2) from the Climate Registry's (TCR's) 2017 emission factor update	11.73 lbs/therm	Based on same but updated General Reporting Protocol - US Weighted Average CO_2 rate (Table 12.1) and Commercial sector CH_4 and N_2O (Table 12.9.2) from TCR's 2017 emission factor update	11.73 lbs/therm	Based on EPA and TCR emission factors for stationary source natural gas combustion	11.71 lbs/therm
Activity =	*12,539,532*	*therms*	*4,197,748*	*therms*	*Confidential*	
Emissions =	*66,723*	*$MTCO_2e$*	*22,336*	*$MTCO_2e$*	*30,368*	*$MTCO_2e$*
Non-Maritime On-Road Transportation						
Activity						
	Scaled down to 2006 based on regional VMT from EMFAC and the Port of SD to Regional VMT ratio from Series 14 activity-based modeling	172,900,164 VMT	Total Port of SD Origin-Destination VMT provided by SANDAG Series 14 Activity-Based Model for years 2016 and 2022. GHG emissions from non-maritime on-road transportation revised based on this revised VMT estimate.	194,837,204 VMT	Total Port of SD Origin-Destination VMT provided by SANDAG Series 14 Activity-Based Model for years 2016 and 2025. The 2022 values were linearly interpolated between the 2016 and 2025 values.	207,068,375 VMT
Emission Factor						
	Based on Port-specific speeds from Series 14 and San Diego region emission factors by speed from EMFAC2021 for CY2006	523.66 g/VMT	Based on Port-specific speeds from Series 14 and San Diego region emission factors by speed from EMFAC2021 for CY2016	454.70 g/VMT	Based on Port-specific speeds from Series 14 and San Diego region emission factors by speed from EMFAC2021 for CY2022	417.42 g/VMT
Activity =	172,900,164	VMT	194,837,204	VMT	207,068,375	VMT
Emissions =	90,541	$MTCO_2e$	*88,592*	$MTCO_2e$	*86,435*	$MTCO_2e$

Category	Recalibrated 2006 Baseline		Recalibrated 2016 CAP Inventory		2022 CAP Inventory	
	Method	**Data Used**	**Method**	**Data Used**	**Method**	**Data Used**
Off-Road Equipment						
Activity						
Shipyards	Aggregated fuel consumption obtained from shipyards	194,835 gallons of diesel, 15,244 gallons of propane, and 916 gallons of gasoline	No change	168,927 gallons of diesel, 12,449 gallons of propane, and 901 gallons of gasoline	Aggregated fuel consumption obtained from shipyards	369,957 gallons of diesel, 278,134 gallons of RD99, 15,752 gallons of gasoline, and 3,436 gallons of propane
Boatyards	Same as CAP, but minor change in emissions due to update to emission factor	57,670 gallons of diesel and 16,809 gallons of propane	No Change	47,774 gallons of diesel and 13,983 gallons of propane	Aggregated fuel consumption was obtained from several boatyards. Consumption for those that did not provide information estimated based on leasehold square footage.	9,667 gallons of diesel, 309 gallons of gasoline, and 891 gallons of propane
Yacht Clubs, Marinas, Fishing, and Other Commercial	Same as CAP	114,747 gallons of gasoline, 39,966 gallons of diesel, and 12,174 gallons of LPG	No Change	109,040 gallons of gasoline, 22,698 gallons of diesel, and 7,025 gallons of LPG	Aggregated fuel consumption was obtained from several marinas and yacht clubs. Consumption for those that did not provide information estimated based on leasehold square footage.	2,039 gallons of diesel, 106,974 gallons of gasoline, and 816 gallons of propane
Lumber Yard	Same as CAP	39,966 gallons of diesel	No Change	39,966 gallons of diesel	Aggregated fuel consumption obtained from lumber yards	28,764 gallons of diesel and 8,762 gallons of LPG
Event Generators	Same as CAP	75,517 gallons of diesel	No Change	75,695 gallons of diesel	Activity data obtained from Parks & Recreation Department	3,312 gallons of gasoline
Emission Factor						
	Updated based on DOE's GREET (diesel and gasoline's CO_2 factors), TCR Tables 13.1 (propane's CO_2 factor) and 13.7 (gasoline and diesel's CH_4 and N_2O factors), and ICLEI Table TR.6.C.1 (LPG and propane's CH_4 and N_2O factors)	lbs/gallon: diesel=22.77 gasoline=19.16 propane=12.78 LPG = 12.92	*No Change*	lbs/gallon: diesel=22.77 gasoline=19.16 propane=12.78 LPG = 12.92	EPA CO_2, CH_4, and N_2O emission factors for mobile combustion	lbs/gallon: diesel=22.73 RD99 = 0.23 gasoline=19.43 propane=12.66 LPG = 12.58
Activity = *Emissions =*	*515,704* *5,064*	*gallons of fuel* *$MTCO_2e$*	*451,464* *4,404*	*gallons of fuel* *$MTCO_2e$*	*828,813* *5,453*	*gallons of fuel* *$MTCO_2e$*
Recreational Boating						
Activity						
	Fuel dock sales minus fueling from other CHC	4,420,412 gallons of diesel and 1,357,941 gallons of gasoline	No Change	3,960,169 gallons of diesel and 1,627,106 gallons of gasoline	Fuel dock sales minus fueling from other CHC (commercial fishing, sport fishing, and Port fleet)	4,274,910 gallons of diesel and 2,631,759 gallons of gasoline
Emission Factor						
	Based on GREET (diesel and gasoline CO_2 factors) and TCR Table 13.7 for Ship and Boat CH_4 and N_2O factors	lbs/gallon: diesel=22.87 gasoline=19.16	No Change	lbs/gallon: diesel=22.87 gasoline =19.16	EPA CO_2, CH_4, and N_2O emission factors for mobile diesel and gasoline combustion	lbs/gallon: diesel=22.73 gasoline =19.43
Activity = *Emissions =*	*5,778,352* *57,662*	*gallons* *$MTCO_2e$*	*5,587,275* *55,227*	*gallons* *$MTCO_2e$*	*6,906,668* *67,266*	*gallons* *$MTCO_2e$*

Category	Recalibrated 2006 Baseline		Recalibrated 2016 CAP Inventory		2022 CAP Inventory	
	Method	**Data Used**	**Method**	**Data Used**	**Method**	**Data Used**
Maritime Off-Road Equipment						
Activity and Carbon Intensity						
Ocean-Going Vessels	Same as CAP, but emissions revised per updated methods in 2012 maritime inventory	Same as CAP	No Change	420 calls, 28.1 hours of hoteling per call	Activity for each sector obtained from various sources	410 calls, 35.6 hours of hoteling per call
	Emission factors vary by ship type and activity, but OGV emissions per call for disclosure here only	74 $MTCO_2e$ per call	No Change	54 $MTCO_2e$ per call	Emission factors vary by ship type and activity, but OGV emissions per call for disclosure here only	79 $MTCO_2e$ per call
Harbor Craft	Same as CAP, but emissions revised per updated methods in 2012 maritime inventory	Same as CAP	No Change	169 vessels, 76,979 main engine hours, 222,747 auxiliary engine hours	Activity obtained from tenants through the Port with operational hours filled in with AIS data	154 vessels, 56,536 main engine hours, 50,481 auxiliary engine hours
	Varies by fuel and type	43 $MTCO_2e$ per OGV call	No Change	61 $MTCO_2e$ per OGV call	Varies by fuel and type	31 $MTCO_2e$ per OGV call
Cargo Handling Equipment	Same as CAP	Same as CAP	No Change	134 pieces, 1,154 million hp-hrs of activity	Activity obtained primarily from tenants through the Port	171 pieces, 2,550 million hp-hrs of activity
	Varies by fuel and type	Same as CAP	No Change	5 $MTCO_2e$ per OGV call	Varies by fuel and type	5 $MTCO_2e$ per OGV call
Rail	Same as CAP	Same as CAP	No Change	194,791 gallons line-haul, 3,225 hours of switching	Activity obtained primarily through the Port	161,249 gallons line-haul, 1,362 hours of switching
	Same as CAP	Same as CAP	No Change	496 g/hp-hr for line-haul, 684 g/hp-hr for switcher, overall 6 $MTCO_2e$ per OGV call	Based on EPA 2009 Locomotive Summary, 2022 EPA Emission Factors, and 2022 San Pedro Ports Methodology	496 g/hp-hr for line-haul, 674 g/hp-hr for switcher, 530 g/hp-hr for rail pusher, overall 6 $MTCO_2e$ per OGV call
Activity =	*530*	*calls*	*420*	*calls*	*410*	*calls*
Emissions =	*102,056*	*$MTCO_2e$*	*67,431*	*$MTCO_2e$*	*65,129*	*$MTCO_2e$*
Maritime On-Road Transportation						
Activity						
Terminal Trucks	Same as CAP	135,225 trips and 15,987,000 VMT	No Change	72,759 trips and 6,649,080 VMT	Truck counts estimated based on terminal gate counts by cargo and truck type; VMT estimated based on destination data provided by maritime staff	101,229 trips and 9,077,6870 VMT
Emission Factor						
	Same as CAP	Same as CAP	San Diego region drayage trucks ("T7 Other Port"), emission factors by speed (terminal and surface street travel) and by aggregate for (freeway travel) from EMFAC2017 for CY2016	2,033 g/VMT	San Diego Region Drayage trucks ("T7 Other Port") and car carrier ("T7 Tractor") emission factors from EMFAC2021 for CY2022	1,754 g/VMT for TAMT, 1,643 g/VMT for NCMT
Activity =	*135,225*	*Truck Counts*	*72,759*	*Truck Counts*	*101,229*	*Truck Counts*
	15,987,000	*Truck VMT*	*6,649,080*	*Truck VMT*	*9,077,687*	*Truck VMT*
Emissions =	*29,947*	*$MTCO_2e$*	*14,325*	*$MTCO_2e$*	*15,572*	*$MTCO_2e$*

Category	Recalibrated 2006 Baseline		Recalibrated 2016 CAP Inventory		2022 CAP Inventory	
	Method	**Data Used**	**Method**	**Data Used**	**Method**	**Data Used**
Water						
Activity						
	Indoor water consumption rates were obtained from CalEEMod by land use type; outdoor water consumption for golf courses and parks estimated using the Maximum Applied Water Allowance (MAWA) methodology provided in CalEEMod; land use square footage and outdoor acreage provided for 2006 in the CAP.	943 million gallons indoor, 175 million gallons outdoor	Indoor water consumption rates were obtained from CalEEMod by land use type; outdoor water consumption for golf courses and parks estimated using the Maximum Applied Water Allowance (MAWA) methodology provided in CalEEMod; land use square footage and outdoor acreage provided by Port for 2016.	1,033 million gallons indoor, 175 million gallons outdoor	Indoor water consumption rates were obtained from CalEEMod by land use type; outdoor water consumption for golf courses and parks estimated using the Maximum Applied Water Allowance (MAWA) methodology provided in CalEEMod; land use square footage and outdoor acreage provided by Port.	1,048 million gallons indoor, 175 million gallons outdoor
Emission Factor						
	Same as SDG&E electricity	0.355 MT/MWh	Same as SDG&E electricity	0.267 MT/MWh	Average emission factor from the CAMX region	0.234 MT/MWh
Activity =	*1,118*	*million gallons*	*1,208*	*million gallons*	*1,223*	*million gallons*
Emissions =	*2,606*	*$MTCO_2e$*	*1,926*	*$MTCO_2e$*	*1,886*	*$MTCO_2e$*
Tenant Waste						
Activity						
	Consumption estimated based on methods in CalEEMod, the Commercial Buildings Energy Consumption Survey (CBECS), and land use data obtained from the Port for 2006	12,816 tons	Consumption estimated based on methods in CalEEMod, the Commercial Buildings Energy Consumption Survey (CBECS), and land use data obtained from the Port for 2016	14,699 tons	Consumption estimated based on methods in CalEEMod, the Commercial Buildings Energy Consumption Survey (CBECS), and land use data obtained from the Port for 2022	15,115 Tons
Emission Factor						
	CH_4 emissions estimated based on Equation SW.4.1 from the U.S. Community Protocol, assuming a 0.67 landfill gas collection efficiency	0.48 MT/ton	CH_4 emissions estimated based on Equation SW.4.1 from the U.S. Community Protocol, assuming a 0.75 landfill gas collection efficiency	0.36 MT/ton	CH_4 emissions estimated based on Equation SW.4.1 from the U.S. Community Protocol, assuming a 0.75 landfill gas collection efficiency	0.36 MT/ton
Activity =	*12,816*	*tons*	*14,699*	*tons*	*15,115*	*tons*
Emissions =	*6,116*	*$MTCO_2e$*	*5,358*	*$MTCO_2e$*	*5,509*	*$MTCO_2e$*

Appendix B

Summary of Data and Methods for Recalibrated 2006 and 2016 CAP Inventories

The Port of San Diego (Port) adopted its Climate Action Plan (CAP) in 2013, which established a plan and framework for achieving a 10 percent decrease in greenhouse gas (GHG) emissions from a 2006 baseline by 2020 and a 25 percent decrease in GHG emissions by 2035. Emissions were estimated for the 2006 baseline based on a set of methodologies and data sets that were available at the time of analysis. In 2018, the Port produced a comprehensive GHG emissions inventory for calendar year 2016 as well as some revisions to the CAP's 2006 baseline emissions inventory and presented results in the *Overview of Methods and Results for the Recalibrated 2006 Baseline Greenhouse Gas Inventory and 2016 Greenhouse Gas Inventory Progress Report* (Appendix C), which is referred to hereafter as the 2016 Progress Report.

As part of the 2022 CAP Inventory, 2006 and 2016 emissions estimates were revisited for sectors for which better (or more exact) data was available or the methods for estimating emissions have changed. These sectors include the following: on-road transportation, solid waste, and water.

The revisions to both the 2006 and 2016 inventories in this report replace those included in the 2016 Progress Report. This approach is consistent with the California Air Resources Board (CARB), which states in its most recent GHG emissions inventory that it is good practice to recalculate historic emissions when methods are changed or refined, new sources are introduced, or errors are discovered, so as to maintain a consistent time series of estimates within the emissions inventory (CARB 2024a). Therefore, to maintain consistency between years, the Recalibrated 2006 Baseline and the Recalibrated 2016 CAP Inventory are based on more locally specific or comprehensive datasets to improve upon the accuracy of each GHG inventory sector and to provide an accurate comparison over time.

The sections below summarize the data collection and emission estimation methodologies for the revised emission sectors in 2006 and 2016. For the most part, the revised inventories replicate the methods used in development of the 2022 CAP Inventory.

On-Road Transportation

Emissions associated with on-road transportation are affected over time by changes in both vehicle miles traveled (VMT) and emission factors. The methods for estimating on-road transportation VMT and emission rates were the same for 2006 and 2016 as they were for 2022, with a few exceptions.

Staff from the San Diego Association of Governments (SANDAG) provided Port visitor VMT estimates for 2016 and 2025. No processing of the 2016 VMT was necessary. However, 2006 VMT data is not available from SANDAG. CARB's EMFAC model provides historic annual VMT by vehicle type down to the sub-regional (e.g., county and air basin) level based on a combination of fuel sales, vehicle registration, and inter-regional travel assumptions from Caltrans. While EMFAC does provide region-wide (i.e., San Diego County) VMT estimates, EMFAC does not provide VMT for specific jurisdictions such as the Port. However, EMFAC's region-wide VMT can be used to estimate San Diego County VMT for past years. To provide a defensible comparison between the 2016 VMT results and a 2006 baseline for VMT, the Port utilized CARB's EMFAC model, which provides VMT estimates for each year between 2000 and 2050 that CARB uses to help compile its emissions inventory.

To account for changes in VMT, 2006 VMT was estimated based on VMT data for San Diego County from EMFAC and VMT provided by SANDAG, utilizing the following method:

1. VMT for San Diego County in EMFAC for year 2006 is 0.89 of VMT in EMFAC for year 2016:
    a. Annual VMT in EMFAC for 2006 = 28,258,634,297
    b. Annual VMT in EMFAC for 2016 = 31,844,031,001
2. Port visitor VMT provided by SANDAG for year 2016 was 561,491 average daily, which is equal to 194,837,204 annually.
3. In order to estimate Port visitor VMT for 2006, the following steps were employed:
    a. 2016 Annual VMT (from SANDAG) assigned to the Port is 194,837,204.
    b. 2006 Annual VMT was estimated based on multiplying this 2016 VMT estimate by the 0.89 ratio of VMT from EMFAC data.
    c. The resultant estimated annual VMT assigned to the Port in 2006 is 172,900,164.

These VMT estimates for each year are summarized in **Table B-1**.

Vehicle emission rates were obtained from the most recent version of EMFAC that was available at the time of analysis. The most recent version of EMFAC available at the time of this inventory process began was EMFAC2021 (CARB 2024c). Emission factors from EMFAC2021 were used in this analysis.

SANDAG's Series 14 activity-based model (ABM3) presents VMT by speed bin (e.g., 0–5 mph) within the Port's jurisdictional boundary. Speed bin data was provided for 2016 and 2025. These values were used to linearly interpolate VMT by speed bin values for 2006. The 2006 VMT by speed bin was then mapped to CARB's EMFAC2021 model data, which contains emission factors by speed bin for San Diego County for each year. The weighted average emission factors and emission estimates for each year in the analysis are shown in Table B-1.

Table B-1. Summary of On-Road Transportation Activity and Emission Calculation

Year	Annual VMT	EMFAC Emission Factor (g CO_2e/VMT)	On-Road Transportation Emissions ($MTCO_2e$)
2006	172,900,164	523.66	90,541
2016	194,837,204	454.70	88,592
2022	207,068,375	417.42	86,435

Notes: g CO_2e/VMT = grams carbon dioxide equivalent per vehicle mile traveled.

Source: Compiled by Ascent in 2025.

Solid Waste

The methods for estimating solid waste disposal rates and land use square footage were the same for 2006 and 2016 as they were for 2022, with a few exceptions.

Land use square footage estimates for 2006 are based primarily on the square footage estimates assumed for 2006 in the CAP and are supplemented with square footage estimates for 2022. The number of hotel rooms for 2016 was estimated by interpolating between the 2006 hotel room quantity (from the CAP) and the 2022 estimate. The landfill gas collection efficiency was assumed to be the same in 2016 as in 2022 (0.75 collection efficiency), but the landfill gas collection efficiency for 2006 was assumed to be 0.67 to match the assumption used in the original 2006 baseline emissions inventory presented in the CAP.

Table B-2 lists the calculated solid waste tonnage for 2016, and **Table B-3** lists the calculated solid waste tonnage for 2006. **Table B-4** shows the solid waste emission calculations for each year.

Table B-2. Calculation of 2016 Solid Waste Disposal Tonnage

Tenant Type	Quantity	Units	Solid Waste Disposal (tons per unit)	Total Solid Waste Disposed (tons)
Retail	89	1,000 sq ft	1.05	94
Office	105	1,000 sq ft	0.93	98
Restaurant	344	1,000 sq ft	11.90	4,097
Hotel/Lodging	7,219	Rooms	0.55	4,528
Warehouse/Storage	116	1,000 sq ft	0.94	109
Museums	29	1,000 sq ft	0.92	27
Industrial	2,570	1,000 sq ft	1.24	3,186
Boatyards	81	1,000 sq ft	1.24	100
Rental Car	58	1,000 sq ft	3.82	223
Yacht Clubs	99	1,000 sq ft	5.70	565
Marinas	126	1,000 sq ft	11.90	1,502
Sportfishing	11	1,000 sq ft	11.90	130
Commercial Fishing	35	1,000 sq ft	1.05	36
Excursions	3	1,000 sq ft	11.90	34
Ship/Boat Petroleum	17	1,000 sq ft	3.01	52
Open Space	227	Acres	0.09	20
Golf Course	100	Acres	0.93	93
			Total Solid Waste Disposed	**14,894**

Source: Compiled by Ascent in 2025.

Table B-3. Calculation of 2006 Solid Waste Disposal Tonnage

Tenant Type	Quantity	Units	Solid Waste Disposal (tons per unit)	Total Solid Waste Disposed (tons)
Retail	78	1,000 sq ft	1.05	82
Office	93	1,000 sq ft	0.93	86
Restaurant	256	1,000 sq ft	11.90	3,041
Hotel/Lodging	4,793	Rooms	0.55	2,624
Warehouse/Storage	116	1,000 sq ft	0.94	109
Museums	29	1,000 sq ft	0.92	27
Industrial	2,153	1,000 sq ft	1.24	2,670
Boatyards	497	1,000 sq ft	1.24	617
Rental Car	58	1,000 sq ft	3.82	223
Yacht Clubs	103	1,000 sq ft	5.70	589
Marinas	203	1,000 sq ft	11.90	2,413
Sportfishing	8	1,000 sq ft	11.90	100
Commercial Fishing	35	1,000 sq ft	1.05	36
Excursions	3	1,000 sq ft	11.90	34
Ship/Boat Petroleum	17	1,000 sq ft	3.01	52
Open Space	227	Acres	0.09	20
Golf Course	100	Acres	0.93	93
			Total Solid Waste Disposed	**12,816**

Source: Compiled by Ascent in 2025.

Table B-4. Solid Waste Emission Calculation

Year	CH_4 GWP	Control Efficiency	Oxidation Rate	Solid Waste Tonnage	Mixed Waste Emission Factor (MT CH_4 /short ton)	Total Emissions ($MTCO_2e$)
2006	27	67%	10%	12,816	0.060	6,166
2016	27	75%	10%	14,699	0.060	5,358
2022	27	75%	10%	15,115	0.060	5,509

Source: Compiled by Ascent in 2025.

Water

The methods for estimating water consumption and land use square footage were the same for 2006 and 2016 as they were for 2022, with a few exceptions. Water consumption is based on the same land use square footage estimates used for solid waste, the same water consumption rates (gallons of water per unit), and the water energy intensity factor (in kilowatt-hours per gallon used) assumed for 2022.

The emission factor assigned to this electricity was sourced from EPA (2022), assuming an average emission factor from the CAMX region, which covers the majority of California.

The emission factors assigned to this electricity were sourced from the values assumed in the 2016 Progress Report, which are equal to 0.242 metric tons per MWh for 2016 and 0.355 metric tons per MWh for 2006.

Table B-5 and **Table B-6** show the calculated total water volumes and the calculated emissions for 2016, respectively. **Table B-7** and **Table B-8** below show the calculated total water volumes and the calculated emissions for 2006, respectively.

Table B-5. Calculation of Water Volume Consumed in 2016

Indoor or Outdoor	Tenant Types	Quantity	Units	Water Consumption Rates (gallons per unit)	Total Water Consumption (gallons)
Indoor	Retail	89	1,000 sq ft	74,073	6,598,773
Indoor	Office	105	1,000 sq ft	177,734	18,696,026
Indoor	Restaurant	344	1,000 sq ft	303,534	104,514,154
Indoor	Hotel/Lodging	8,271	Rooms	25,367	209,808,555
Indoor	Warehouse/Storage	116	1,000 sq ft	231,250	26,817,600
Indoor	Museums	29	1,000 sq ft	31,289	919,894
Indoor	Industrial	2,570	1,000 sq ft	231,250	594,244,050
Indoor	Boatyards	81	1,000 sq ft	231,250	18,728,706
Indoor	Rental Car	7	1,000 sq ft	94,081	679,077
Indoor	Yacht Clubs	99	1,000 sq ft	59,143	5,857,774
Indoor	Marinas	126	1,000 sq ft	303,534	38,299,884
Indoor	Sportfishing	11	1,000 sq ft	303,534	3,308,517
Indoor	Commercial Fishing	35	1,000 sq ft	74,073	2,566,983
Indoor	Excursions	3	1,000 sq ft	303,534	862,339
Indoor	Ship/Boat Petroleum	17	1,000 sq ft	74,073	1,288,343
Outdoor	Open Space	227	Acres	534,743	121,582,144
Outdoor	Golf Course	100	Acres	534,743	53,495,661
				Total Indoor Water Used	**1,033,190,676**
				Total Outdoor Water Used	**175,077,804**

Note: NA = not applicable.

Source: Compiled by Ascent in 2025.

Table B-6. Total Emissions from Indoor and Outdoor Water Usage in 2016

Area	Water Consumption (million gallons)	Energy Intensity (megawatt-hours per million gallons)	Electricity Emission Factor ($MTCO_2e$ per MWh)	Total Emissions ($MTCO_2e$)
Indoor	1,033	6.81	0.242	1,701
Outdoor	175	5.31	0.242	225
			Total	**1,926**

Source: Compiled by Ascent in 2025.

Table B-7. Calculation of Water Volume Consumed in 2006

Indoor or Outdoor	Tenant Types	Quantity	Units	Water Consumption Rates (gallons per unit)	Total Water Consumption (gallons)
Indoor	Retail	78	1,000 sq ft	74,073	5,756,716
Indoor	Office	93	1,000 sq ft	177,734	16,491,897
Indoor	Restaurant	256	1,000 sq ft	303,534	77,579,125
Indoor	Hotel/Lodging	4,793	Rooms	25,367	121,585,136
Indoor	Warehouse/Storage	116	1,000 sq ft	231,250	26,817,600
Indoor	Museums	29	1,000 sq ft	31,289	919,894
Indoor	Industrial	2,153	1,000 sq ft	231,250	497,943,780
Indoor	Boatyards	497	1,000 sq ft	231,250	115,028,976
Indoor	Rental Car	58	1,000 sq ft	94,081	5,498,100
Indoor	Yacht Clubs	103	1,000 sq ft	59,143	6,106,647
Indoor	Marinas	203	1,000 sq ft	303,534	61,539,807
Indoor	Sportfishing	8	1,000 sq ft	303,534	2,549,683
Indoor	Commercial Fishing	35	1,000 sq ft	74,073	2,566,983
Indoor	Excursions	3	1,000 sq ft	303,534	862,339
Indoor	Ship/Boat Petroleum	17	1,000 sq ft	74,073	1,288,343
Outdoor	Open Space	227	Acres	534,743	121,582,144
Outdoor	Golf Course	100	Acres	534,743	53,495,661
				Total Indoor Water Used	**942,535,027**
				Total Outdoor Water Used	**175,077,804**

Note: NA = not applicable.

Source: Compiled by Ascent in 2025.

Table B-8. Total Emissions from Indoor and Outdoor Water Usage in 2006

Area	Water Consumption (million gallons)	Energy Intensity (megawatt-hours per million gallons)	Electricity Emission Factor ($MTCO_2e$ per MWh)	Total Emissions ($MTCO_2e$)
Indoor	943	6.81	0.355	2,277
Outdoor	175	5.31	0.355	330
			Total	**2,606**

Source: Compiled by Ascent in 2025.

Appendix C

2016 Progress Report

PORT of SAN DIEGO Environment

climate action plan

Overview of Methods and Results for the Recalibrated 2006 Baseline Greenhouse Gas Inventory and 2016 Greenhouse Gas Inventory Progress Report

Overview of Methods and Results for the Recalibrated 2006 Baseline Greenhouse Gas Inventory and 2016 Greenhouse Gas Inventory Progress Report

Overview

The San Diego Unified Port District (Port) adopted a Climate Action Plan (CAP) in 2013 that established a plan and framework for achieving a 10% decrease in greenhouse gas (GHG) emissions from a 2006 baseline by 2020. The CAP also established a longer-term GHG reduction goal to reduce GHG emissions 25% from a 2006 baseline by 2035. The CAP contains a suite of GHG reduction strategies to help achieve these goals.

Emissions were estimated for the 2006 baseline based on a set of methodologies and data sets that were available at the time of analysis. Where accurate data representing sources of GHG emissions could not be collected, activity was modeled using the best available guidance. For example, to estimate energy consumption in the original 2006 CAP baseline, the Port utilized the California Energy Commission's (CEC) Commercial End-Use Survey.[1] Since the adoption of the CAP, more refined data and updated methodologies have become available to estimate GHG emissions from various sources. The Port conducted its first comparison to baseline conditions in 2015 using better quality energy data provided by San Diego Gas and Electric (SDG&E) representing electricity and natural gas consumption Port-wide (including Port tenants). The results of the progress report were summarized in a *Climate Action Plan, GHG Inventory Update* memorandum prepared by Ramboll Environ (*CAP Memo*).[2] The memo indicated that better quality energy data compared to the modeled energy data used in the original 2006 CAP baseline led to different and more accurate GHG emission results.

In 2017, the Port commenced another inventory based on calendar year 2016 operations to track progress toward the Port's 2020 GHG emissions target. In developing the 2016 GHG inventory, ICF reviewed various emissions inventory documents and reporting protocols to acquire an understanding of the current emission estimation practices and methodologies. To the extent possible, the data collection process and emission estimation methodologies for all emission sectors aimed to replicate the methods used in development of the CAP. However, given the current state of the practice as well as access to better (or more exact) quality data, a recalibration of the 2006 baseline was deemed vital to track progress toward 2020 goals. This approach is consistent with the California Air Resources Board (CARB), which states in its most recent inventory that it is good practice to recalculate historic emissions when methods are changed or refined, new sources are introduced, or errors are discovered, so as to maintain a consistent time-series of estimates within the emissions inventory.[3] Therefore, to maintain consistency between years, the recalibrated 2006 baseline and 2016 inventory update are based on more locally specific or comprehensive datasets to improve upon the accuracy of each GHG inventory sector and to provide an accurate comparison over time.

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[1] *California Commercial End-Use Survey*. Prepared by Itron Inc., for California Energy Commission. Available from: http://www.energy.ca.gov/ceus/.

[2] The *2016 CAP Memo* is presented in Attachment C of this report.

[3] See the *2000–2015 Inventory Updates Documentation* report, available at: https://www.arb.ca.gov/cc/inventory/data/data.htm.

Sources of Greenhouse Gas Emissions

Sources of emissions on Port of San Diego tidelands include tenant facilities (e.g., hotels, marinas, boatyards), maritime activity (e.g., the movement of goods and people associated with marine terminal operations), and Port operations (e.g., Port-owned building and outdoor energy consumption and fleet activity). A brief introduction to the methods and data sources used to estimate each emissions sector for 2006 and 2016 is presented below.

- **Electricity and Natural Gas**—emissions from electricity and natural gas consumption for all tenant, maritime, and Port operations, distinguished by procurement of electricity from SDG&E or Direct Access. Direct Access refers to electricity purchased from an electric Service Provider instead of a regulated electric utility. Emissions are based on aggregated consumption information from SDG&E as well as electricity emission rates from SDG&E and the California Public Utilities Commission (PUC).
- **On-road transportation**—emissions from on-road transportation include both non-maritime and maritime sources. Emissions from on-road transportation are based on vehicle miles traveled (VMT) calculated by speed obtained from the San Diego Association of Governments (SANDAG) for non-maritime sources, truck trip counts and arrival and destination information for maritime tenants, and vehicle and truck emissions factors from CARB's Emissions Factor Model (EMFAC). Emissions generated by Port-owned vehicles are included in the On-Road Transportation category and are based on fuel consumption obtained from the Port for each fleet vehicle and emission factors from The Climate Registry (TCR).
- **Off-road transportation**—emissions from off-road transportation include vehicles and equipment which do not operate on the road and are therefore not included in the SANDAG models to estimate VMT. Emissions from off-road transportation are based on equipment activity and fuel consumption associated with non-maritime tenants, activity associated with freight movement (e.g., ocean-going vessels [OGVs], commercial harbor craft [CHC], freight rail, and cargo handling equipment [CHE]), and emission factors from a variety of sources, including TCR, CARB emission databases, and relevant maritime inventory studies at other ports. Emissions generated by Port-owned equipment and vessels are included in the Off-Road Transportation category and are based on fuel consumption obtained from the Port for each piece of equipment and vessel and emission factors from TCR.
- **Solid waste**—emissions from waste generation are based on the same assumptions used in the original 2006 CAP baseline, and are based on a combination of waste disposal rates, profiles, and densities derived from the California Integrated Waste Management Board Statewide Waste Characterization Study[4] and waste decomposition and collection metrics developed by the Intergovernmental Panel on Climate Change (IPCC) [5] and used in the County of San Diego's GHG inventory.[6]

[4] California Integrated Waste Management Board (2009). California 2008 Waste Characterization Study. Prepared by Cascadia Consulting Group. Available from: http://www.calrecycle.ca.gov/publications/documents/general/2009023.pdf

[5] Intergovernmental Panel on Climate Change (IPCC). 2006. *Guidelines for National Greenhouse Gas Inventories*. Volume 5, Chapter 2. Available from: https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

[6] Energy Policy Initiatives Center (EPIC). 2011. *San Diego County Greenhouse Gas Inventory*. Available from: www.sandiego.edu/epic/resources/reports.php#accordion1

- **Water Use**—emissions from water consumption are based on the same assumptions used in the original 2006 CAP baseline, except minor adjustments and were made based on SDG&E's current power and renewable mix.

Global Warming Potential

The most commonly accepted method to compare GHG emissions is the global warming potential (GWP) methodology defined in the IPCC reference documents. IPCC defines the GWP of various GHG emissions on a normalized scale that recasts all GHG emissions in terms of carbon dioxide equivalent (CO_2e), which compares the gas in question to that of the same mass of carbon dioxide (CO_2) (which has a GWP of 1 by definition). Of note is that the GWP values used in this report are based on the IPCC Fourth Assessment Report (AR4) and United Nations Framework Convention on Climate Change reporting guidelines. While the Port's 2006 GHG inventory is based on the IPCC Second Assessment Report (SAR), the GWP values have since been updated based on the best available science. The United Nations Framework Convention on Climate Change reporting guidelines for national inventories require the use of GWP values from the IPCC AR4. Both the U.S. Environmental Protection Agency (EPA) and CARB use AR4 GWP values in their most recent GHG inventories. CARB also uses AR4 GWP values in the GHG forecasts within the 2017 Scoping Plan Update. To reflect the state of the science and for purposes of comparison, emissions from the CAP were adjusted for AR4. All emissions are presented in metric tons of CO_2e ($MTCO_2e$). Emissions were converted from pounds to metric tons assuming 2204.62262 pounds per metric ton, or from grams to metric tons assuming 1,000,000 grams per metric ton.

Summary of Results

Table 1 provides a comparison of emissions between the original and recalibrated 2006 CAP baseline inventories. Total GHG emissions in the recalibrated 2006 baseline were estimated to be 581,750 $MTCO_2e$, which is 30% (or 244,679$MTCO_2e$) below the original 2006 CAP baseline.

TABLE 1. COMPARISON OF ORIGINAL 2006 CAP AND RECALIBRATED 2006 BASELINE EMISSIONS ($MTCO_2E$ PER YEAR)

Sector	ORIGINAL 2006 CAP	Recalibrated 2006 CAP	*Difference*
Electricity	173,192	117,526	*-55,666*
Natural Gas[1]	135,516	162,556	*+27,040*
On-Road Transportation[2]	314,870	137,664	*-177,206*
Off-Road Transportation[3]	172,929	131,597	*-41,332*
Water Use	13,166	13,169	*+3*
Waste	16,757	19,239	*+2,482*
Total Emissions	826,429	581,750	*-244,679*
2020 Emission Target (10% below 2006)	*745,695*	*523,575*	*-222,120*

[1] Natural Gas emissions include stationary source consumption

[2] On-Road Transportation includes passenger car activity for all Port of San Diego-wide uses, heavy-duty terminal trucks, and new car offloading at National City Marine Terminal.

[3] Off-Road Transportation includes all other maritime uses (e.g., vessels, harbor craft, cargo handling, and rail) as well as mobile and stationary equipment at industrial tenants (e.g., boatyards and shipyards).

The differences between the Original 2006 CAP baseline and the Recalibrated CAP baseline are due to the following:

- On-road vehicle emission estimates were reduced 177,273 $MTCO_2e$ due to more refined VMT estimates.
- Electricity consumption decreased 176,903,447 kWh reducing emissions 55,666 $MTCO_2e$ due to more refined consumption provided by SDG&E.
- Natural gas emissions increased 27,040 $MTCO_2e$, as refined data related to natural gas consumption demonstrated an increase from 25.5 million therms presented in the original 2006 CAP baseline to 30.5 million therms in the recalibrated 2006 baseline.
- Off-road emissions were changed 41,332 $MTCO_2e$ due to the following: (1) refined recreational boating fuel consumption estimates, which reduced emissions 22,483 $MTCO_2e$ due to a decrease in fuel consumption from an estimated 11 million gallons in the original 2006 CAP baseline to 5.8 million gallons in the recalibrated 2006 baseline; (2) maritime off-road emissions are down 14,841 $MTCO_2e$ due to refinements in estimating maritime emissions, as presented in the *2012 Maritime Emissions Inventory Report*[7]; and (3) non-maritime off-road emissions are down 4,007 $MTCO_2e$ due mainly to refined fuel estimates from shipyard tenants.

Table 2 provides a comparison of the recalibrated 2006 baseline and emissions generated during 2016. Total GHG emissions produced Port-wide in 2016 were estimated to be 504,554 $MTCO_2e$, which is 13% (or 77,195 $MTCO_2e$) below the recalibrated 2006 baseline.

TABLE 2. COMPARISON OF RECALIBRATED 2006 BASELINE AND CALENDAR YEAR 2016 EMISSIONS ($MTCO_2E$ PER YEAR)

Sector	Recalibrated 2006 CAP	2016 CAP Inventory	*Difference*
Electricity	117,526	101,381	*-16,145*
Natural Gas[1]	162,556	137,183	*-25,373*
On-Road Transportation[2]	136,664	121,728	*-15,935*
Off-Road Transportation[3]	131,597	113,175	*-18,422*
Water Use	13,169	9,741	*-3,428*
Waste	19,239	21,346	*+2,108*
Total Emissions	581,750	504,554	*-77,195*
Percent Change from Recalibrated 2006 Baseline	-	-	*13%*
2016 Emissions from 2020 Emissions Target (see Table 1)	-	-	*-19,020*

[1] Natural Gas emissions include stationary source consumption.
[2] On-Road Transportation includes passenger car activity for all Port of San Diego-wide uses, heavy duty terminal trucks, and new car offloading at National City Marine Terminal.
[3] Off-Road Transportation includes all other maritime uses (e.g., vessels, harbor craft, cargo handling, and rail) as well as mobile and stationary equipment at industrial tenants (e.g., boatyards and shipyards).

[7] The *Port of San Diego 2012 Maritime Air Emissions Inventory*. June 2014.

The major components of changes in emissions since 2006 include the following:

- Total maritime-related emissions are down 31,072 $MTCO_2e$ due to reduced OGV calls (110 fewer vessel calls) and berthing duration (12.9 fewer hoteling hours per call), use of shore power allowing vessels to eliminate emissions from auxiliary engines while vessels are at berth, and increased on-road vehicle fuel economy. Of this reduction, 15,450 $MTCO_2e$ is from off-road sources and 15,622 $MTCO_2e$ is from on-road sources.
- Overall, off-road emissions representing maritime and non-maritime tenants were reduced 18,422 $MTCO_2e$ due to the 15,450 $MTCO_2e$ reduction in maritime off-road emissions (e.g., vessels, harbor craft, terminal equipment, and rail); decrease in recreational boating fuel consumption from 5.8 million gallons in 2006 to 5.6 million gallons in 2016, resulting in a 2,435 $MTCO_2e$ decrease in recreational boating emissions; and reduced fuel consumption from specific operations (e.g., shipyards, yacht clubs) that decreased emissions 536 $MTCO_2e$.
- Natural gas consumption decreased from 30.5 million therms in the recalibrated 2006 baseline to 25.8 million therms in the 2016 inventory, resulting in a 25,373 $MTCO_2e$ decrease in emissions.
- The SDG&E electricity emission factor decreased from 782.27 pounds per megawatt-hour (MWh) in 2006 to 533.52 pounds per MWh in 2016, resulting in a decrease of 16,145 $MTCO_2e$ in electricity emissions even though total consumption, not including shore power, has increased from 321,365,741 kilowatt-hours (kWh) in 2006 to 333,873,577 kWh in 2016.

For context, the Port of San Diego's inventory for 2016 is approximately 1.5% of total countywide GHG emissions (relative to the most recent year 2012 inventory).[8]

Description of Sector Results and Methodological Changes

A description of the emissions, results, and methodological changes between the CAP and the recalibrated analysis for each sector is included below. For reference, a detailed description of the methods employed in the original 2006 CAP baseline is contained within Appendix B of the Port's CAP document.

Electricity

GHG emissions produced from electricity consumption were estimated to be 173,192 $MTCO_2e$ in the original 2006 CAP baseline. Table 3 presents electricity consumption and emissions for the original 2006 CAP baseline, the recalibrated 2006 CAP baseline, and the 2016 inventory. Utilizing better quality data from SDG&E, emissions from electricity consumption are estimated to be 117,526 $MTCO_2e$ in the recalibrated 2006 baseline. In 2016, emissions from electricity consumption decreased to 101,381 $MTCO_2e$.

[8] San Diego Countywide GHG emissions in 2012 were 34.67 million metric tons of CO_2e (Energy Policy Initiatives Center. 2015. *2012 Greenhouse Gas Emissions Inventory and Projections for the San Diego Region*. See Appendix D from: http://www.sdforward.com/previous-plan-dropdown/chapters-and-appendices.

TABLE 3. COMPARISON OF ELECTRICITY CONSUMPTION AND EMISSIONS ESTIMATES

Activity	Source	Original 2006 CAP	Recalibrated 2006 CAP	2016 CAP Inventory
Consumption (kWh)	Tenant SDG&E	478,165,752	166,699,440	177,280,931
	Tenant Direct Access	-	144,614,583	150,243,110
	Port SDG&E	10,051,718	10,051,718	6,349,537
	Total Consumption	*488,217,470*	*321,365,741*	*333,873,577*
GHG Emissions ($MTCO_2e$)	Tenant SDG&E	169,625	59,150	42,902
	Tenant Direct Access	-	54,809	56,942
	Port SDG&E	3,567	3,567	1,537
	Total Emissions	*173,192*	*117,526*	*101,381*

Below is a summary of key factors that influenced the methodological changes and results.

- Consumption/Activity:

  Original 2006 CAP Baseline: The original 2006 CAP baseline estimated emissions associated with electricity based on a combination of tenant feedback and industry standard assumptions and emission factors. Energy consumption was estimated for land uses Port-wide based on assumptions found within the CEC Commercial End-Use Survey[9] (e.g., kWh per square foot). Where the CEC survey did not have energy consumption tied to specific land use types, energy consumption were informed by tenant input (e.g., boatyards, marinas).

  Recalibrated 2006 Cap Baseline: Since the CAP was adopted, the Port has worked with SDG&E to obtain aggregated energy consumption for all tenants. To obtain more accurate energy consumption, a geographic information system (GIS) analysis was conducted whereby location-specific SDG&E account information was determined within the Port's geographic boundary. The data was then summarized to obtain a Port-wide electricity consumption total. The data and methods to revise the 2006 electricity data are summarized in the *CAP Memo*[10]. The recalibrated baseline (321,365,741 kWh) electricity consumption is 166,851,729 kWh, or 34%, lower than the original 2006 CAP baseline (488,217,470 kWh).

  2016 CAP Inventory: The process for determining electricity consumption Port-wide, as described for the recalibrated 2006 CAP baseline, was repeated to calculate 2016 electricity consumption. Due to privacy requirements, the 2016 consumption data provided by SDG&E included a proxy consumption estimate for those customers that did not meet the aggregation standard and did not provide consent to release their data, consistent with the *Energy Data Access Decision* (D.14-05-016). Per SDG&E, the proxy methodology is based on publicly available information on energy intensity by industry type

[9] *California Commercial End-Use Survey*. Prepared by Itron Inc., for California Energy Commission. Available from: http://www.energy.ca.gov/ceus/.

[10] The *2016 CAP Memo* is presented in Attachment C of this report.

that yields a reasonable result.[11] Additionally, electricity associated with shore power consumption at Tenth Avenue Marine Terminal (TAMT) was removed from the "Tenant SDG&E" category and shore power consumption at Cruise Ship Terminal (CST) was removed from "Port SDG&E access" category. Shorepower are presented in the maritime emissions category. The 2016 Port-wide electricity consumption is 333,873,577 kWh, which includes 327,524,041 kWh from tenants and 6,349,537 from Port operations.

SDG&E also informed the Port that approximately 45% of electricity consumption for Port tenants is obtained through Direct Access and 55% of electricity is obtained through SDG&E.[12] This proportion of procured electricity is roughly the same between 2006 and 2016. This was a change from the original CAP 2006 baseline, which did not include separate emission calculations for Direct Access. Therefore, both the recalibrated 2006 CAP baseline and the 2016 inventory utilize this distribution of Direct Access and the SDG&E electricity procurement to determine GHG emissions.

- Emission Factors: The original 2006 CAP baseline estimated SDG&E's electricity emission factor to be 782.07 pounds CO_2e per MWh in 2006 (354.74 grams per kWh), based on SDG&E's reporting for year 2006 and historic statewide methane (CH_4) and nitrous oxide (N_2O) emission factors from the California Climate Action Registry's General Reporting Protocol, version 3.1. CO_2e was estimated using GWP from the SAR. As part of this update, the CO_2, CH_4, and N_2O rates for 2006 remain unchanged, but CO_2e was adjusted based on the change in GWP to the AR4 (as described previously). As a result, the adjusted emission factor utilized in the recalibrated 2006 baseline is 782.27 pounds CO_2e per MWh (354.83 grams per kWh).

  Based on Sempra's filings in November 2017, SDG&E's electricity emission factor decreased from 782.27 pounds CO_2e per MWh (354.83 grams per kWh) in 2006 to 533.52 pounds CO_2e per MWh (242.00 grams per kWh) in 2016.[13] This decrease is mostly attributable to the increase in SDG&E's renewable power portfolio from approximately 6% in 2006 to 43% in 2016.[14]

  The Direct Access emission factor is higher than SDG&E emission factors for all years in this analysis. The Direct Access emission factor is 835.55 pounds CO_2e per MWh (379.00 grams per kWh), as taken from the PUC's 2011 direction. The PUC has not updated this emission factor since 2011.[15] Because this emission factor is higher than the SDG&E 2006 emission factor, emissions during 2006 for consumption provided through Direct Access (45% of total electricity consumption) are approximately 9.4% higher than shown in the *2016 CAP Memo* (855.55 pounds per MWh is 9.4% higher than 782.07 pounds per MWh). It was assumed that the Direct Access portion of total consumption has remained constant over time. Note that because the Direct Access emission factor

[11] Personal communication between Cory Illeman of Sempra and Port staff on April 5, 2017. In this case, the proxy estimate is a 25% markup of total tenant consumption.

[12] Personal communication between Cory Illeman of Sempra and Port staff on June 6, 2017.

[13] See Template D-5 of the SDG&E 2018 Forecast Application, available at: https://www.sdge.com/regulatory-filing/21006/2018-erra-forecast

[14] Renewables Portfolio Standard Procurement for the three largest investor-owned utilities is summarized on the CPUC's website at: http://www.cpuc.ca.gov/RPS_Homepage.

[15] CPUC's Decision 15-08-006 is available at: http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M154/K188/154188197.PDF. 835.55 pounds CO_2e/MWh converted from 0.379 $MTCO_2e$/MWh presented for "all inventory-owned utilities."

is given in terms of CO_2e, no adjustment for CO_2e using GWP is required, and does not allow for adjustments using AR4.

Natural Gas

GHG emissions produced from natural gas consumption were estimated to be 135,516 $MTCO_2e$ in the original 2006 CAP baseline, including 95,833 $MTCO_2e$ from CARB regulated sources (CP Kelco only). Utilizing better quality data from SDG&E, emissions from natural gas consumption are estimated to be 162,556 $MTCO_2e$ under the recalibrated 2006 baseline. In 2016, emissions from natural gas consumption were estimated to be 137,183 $MTCO_2e$. Natural gas consumption and associated emissions for the original 2006 CAP baseline, the recalibrated 2006 CAP baseline, and the 2016 inventory are presented in Table 4.

TABLE 4. COMPARISON OF NATURAL GAS CONSUMPTION AND EMISSIONS ESTIMATES

Activity	Source	Original 2006 CAP	Recalibrated 2006 CAP	Inventory 2016 CAP
Consumption (therms)	Tenant-SDG&E	7,435,787	2,687,962	2,293,013
	Tenant- Direct Access	-	9,790,046	1,877,417
	CARB Regulated Sources [1]	18,010,310	18,010,310	21,583,715
	Port Operations- SDG&E	61,524	61,524	27,319
	Total Consumption	*25,507,621*	*30,549,842*	*25,781,464*
GHG Emissions ($MTCO_2e$)	Tenant- SDG&E	39,356	14,303	12,201
	Tenant- Direct Access	-	52,093	9,990
	CARB Regulated Sources [1]	95,833	95,833	114,847
	Port Operations- SDG&E	327	327	145
	Total Emissions	135,516	162,556	137,183

[1] CARB Regulated Sources refer to those facilities regulated by CARB under the Cap and Trade Program requiring annual reporting of emissions. In 2006, this included only CP Kelco. In 2016, this included both CP Kelco and Solar Turbines. All CARB Regulated Sources consumption is through Direct Access.

Note that natural gas consumption and emissions are broken out between CARB regulated sources and non-regulated tenant and Port Operations sources. Regulated sources are those major sources that are required to comply with CARB's Cap-and-Trade program.[16] The only two Cap-and-Trade Regulated Sources within the Port's jurisdiction is CP Kelco and Solar Turbines. The majority of natural gas consumption is attributed to these two sources (CP Kelco and Solar Turbines). Solar Turbines did not begin reporting GHG emissions to CARB per Cap and Trade until emissions year 2012, and CP Kelco began reporting GHG emissions in year 2008. As such, the only CARB regulated source included in both the original 2006 baseline and recalibrated 2006 baseline is CP Kelco. In the recalibrated 2006 CAP baseline, CARB regulated sources (tenants plus Port operations) account for 95,833 $MTCO_2e$ and non-regulated sources account for 66,723 $MTCO_2e$. In 2016, CARB regulated sources, which now include

[16] Cap-and-Trade is a market based regulation that is designed to reduce GHG emissions from large sources. Cap-and-Trade sets a firm limit, or cap, on GHGs to achieve requisite share of 2020 and 2030 reductions. The statewide cap declines through 2030.

both CP Kelco and Solar Turbines, account for 114,847 $MTCO_2e$, and the portion of consumption attributed to non-regulated sources, which no longer include Solar Turbines, reduced for 22,336 $MTCO_2e$.

Below is a summary of key factors that influenced these methodological changes and results.

- Consumption/Activity:

  Original 2006 Cap Baseline: Similar to electricity, the original 2006 CAP baseline estimated emissions associated with natural gas based on a combination of tenant feedback and industry standard assumptions and emission factors. The original 2006 CAP baseline estimated natural gas consumption for each land use type based on default metrics (e.g., therms per square foot) for most land uses (e.g., hotels, offices, restaurants), along with some tenant feedback for atypical land uses (e.g., boatyards, marinas). For CARB regulated sources, the original 2006 CAP included consumption and emissions from one stationary source (CP Kelco) based on its reporting to CARB and one other unidentified source based on information provided by the Port.

  Recalibrated 2006 Cap Baseline: As described for electricity data, the Port has worked with SDG&E to obtain aggregated energy consumption for all tenants. To obtain more accurate natural gas use Port-wide, a geographic information system (GIS) analysis was conducted whereby location-specific SDG&E account information was determined within the Port's geographic boundary. The data was then summarized to obtain a Port-wide natural gas consumption total. The data and methods to revise the 2006 natural gas data are summarized in the *CAP Memo*.[17] As stated above, the majority of natural gas consumption in 2006 is attributed to CP Kelco which reports to CARB under the Cap and Trade program. The recalibrated 2006 baseline (*30,549,842* therms) natural gas consumption is 5,042,221 therms, or approximately 17%, lower than the original 2006 CAP baseline (*25,507,621* therms).

  2016 CAP Inventory: Consistent with the methods to determine electricity consumption Port-wide for the 2016 inventory , SDG&E provided aggregated natural gas consumption based on accounts located within the Port's jurisdictional boundary. However, unlike the electricity data, the 2016 natural gas consumption data was complete and no proxy consumption estimates were included. SDG&E informed the Port that approximately 91% of natural gas consumption is obtained through Direct Access and 9% of natural gas is obtained through SDG&E. As noted below, for the most part natural gas emission factors do not vary by procurement type or year aside from minor changes based on which GWP values are used, so the only change in emissions is due to consumption changes.

  For 2016, both CP Kelco and Solar Turbines are included in the CARB regulated source category based on reporting for emissions year 2015, because emissions year 2016 was not available at the time of analysis. CP Kelco and Solar Turbines consumption is assumed to be procured through Direct Access. Further discussion of this is contained within the *Limitations and Uncertainties* section at the end of this report.

- Emission Factors: The original CAP estimated the natural gas emission factor to be 11.71 pounds CO_2e per therm, based on information from the General Reporting Protocol v3.1. As part of this update, the emission factor is estimated to be 11.73 pounds CO_2e per therm based on natural gas rates for CO_2, CH_4, and N_2O in TCR's 2017 default emission factor update, which show a slightly

[17] The *2016 CAP Memo* is presented in Attachment C of this report.

different emission rate for CH_4 than used in the CAP.[18] This 11.73 pounds CO_2e per therm rate is the same for both the recalibrated 2006 baseline and the 2016 inventory and is the same for both Direct Access and SDG&E access. Table 4 presents the original 2006 CAP baseline natural gas consumption, the recalibrated 2006 baseline, and 2016 natural gas consumption and emissions.

On-Road Transportation

On-road transportation includes non-maritime activities (e.g., passenger vehicles), maritime-related activity and Port fleet operations. Maritime-related activity is defined as activity related to the movement of goods, services, and people associated with marine terminal operations. For on-road transportation, maritime-related activity includes drayage and heavy-duty truck operations to and from the Port's marine terminals, and new car offloading at NCMT.

Non-maritime Activity

Vehicle miles traveled (VMT) is a common metric used for determining GHG emissions. Table 5 demonstrates a comparison of VMT for non-maritime on-road transportation for the original 2006 CAP baseline, the recalibrated 2006 CAP baseline, and the 2016 inventory. For non-maritime and non-Port activities, GHG emissions produced from on-road transportation sources primarily composed of passenger vehicles were estimated to be 280,719 $MTCO_2e$ in the original 2006 CAP baseline. Utilizing new methods and better quality transportation data from SANDAG and CARB, emissions from on-road transportation were estimated to be 106,672 $MTCO_2e$ under the recalibrated 2006 CAP baseline. In 2016, emissions from on-road transportation were estimated to be 106,414 $MTCO_2e$.

TABLE 5. COMPARISON OF NON-MARITIME ON-ROAD TRANSPORTATION ACTIVITY AND EMISSIONS

Activity	Original 2006 CAP	Recalibrated 2006 CAP	2016 CAP Inventory
Annual VMT	501,926,317	213,589,748	242,896,591
GHG Emissions ($MTCO_2e$)	280,719	106,672	106,414

Below is a summary of key factors that influenced these methodological changes and results.

- Consumption/Activity:

  Original 2006 Cap Baseline: The original 2006 CAP baseline estimated emissions from on-road transportation by calculating a generated quantity of VMT using trip-generation rates and trip lengths based on land use types, specific to the San Diego Region. Trip generation rates for the Port were based on the City of San Diego's trip generation for downtown.[19] Trip lengths are from SANDAG (Not so) Brief Guide of Vehicular Traffic Generation Rates for the San Diego Region and represent

[18] TCR's default emission factor update is available at: https://www.theclimateregistry.org/wp-content/uploads/2017/05/2017-Climate-Registry-Default-Emission-Factors.pdf.

[19] City of San Diego. 2003. San Diego Municipal Code, Land Development Code, Trip Generation Manual. May 2003. Available at: https://www.sandiego.gov/development-services/industry/information/transportation

average weighted trip lengths for all trips to and from the general land use site.[20] Using this method, VMT for the original 2006 CAP baseline was estimated to be 501,926,317.

Recalibrated 2006 Cap Baseline: In 2013, California adopted Senate Bill (SB) 743, which directed the Governor's Office of Planning and Research to develop a new approach to analyze transportation impacts under the California Environmental Quality Act (CEQA). The Governor's Office of Planning and Research has since proposed changes to the State CEQA Guidelines that identify VMT as the most appropriate metric to evaluate a project's transportation impacts. One of the intents of SB 743 is that the analysis of transportation in CEQA better promotes the State's goals of reducing GHG emissions, citing in particular SB 375. Under SB 375, CARB sets regional targets for GHG emissions reductions from passenger vehicle use. In order to apportion VMT to different jurisdictions, CARB developed the Regional Targets Advisory Committee method, which incorporates an analysis of VMT through an "origin-destination" transportation method whereby vehicle trips that originate and/or end in a geographic area are more accurately tracked and counted. SANDAG utilizes the "origin-destination" method in its recently updated Activity Based Model (Series 13) to better reflect driver behavior and transportation mode choices (e.g., public transit) throughout the region. Because this new method for determining VMT will become the standard in the environmental review process once the State CEQA Guidelines are adopted (most likely in 2018), it is appropriate to be used to estimate vehicle activity associated with the Port's GHG inventory and the CAP. Since SANDAG's model cannot backcast VMT beyond its base year of 2012, the process which was used to develop VMT for the recalibrated 2006 CAP baseline will be described below.

2016 CAP Inventory: As part of CAP progress report, SANDAG (Series 13) origin-destination VMT data was obtained for year 2016. Consistent with the Regional Targets Advisory Committee methodology, daily VMT was provided by SANDAG for the following three types of vehicle trips in 5 mile per hour (mph) speed increments:

1. Vehicle trips that originated and terminated within the Port's jurisdictional boundary.
2. Vehicle trips that either originated or terminated (but not both) within the Port's jurisdictional boundary.
3. Vehicle trips that neither originated nor terminated within the Port's jurisdictional boundary. These trips are commonly called pass-through trips.

Using the "accounting rules" established by the Regional Targets Advisory Committee, VMT from the trips of types 1, 2, and 3 were weighted by 1, 0.5, and 0, respectively, toward jurisdiction-generated VMT. In other words, 100% of vehicle trips that originate and terminate within the Port's jurisdictional boundary are included in the VMT analysis; 50% of trips that originate or terminate within the Port's jurisdictional boundary are included in the VMT analysis; and 0% of pass-through trips are used to calculate VMT in the Port's inventory. Note that this analysis prevents double-counting of GHG emissions between two jurisdictions where a vehicle trip originates in one jurisdiction and then terminates in another. In this case, each jurisdiction is attributed with 50% of a round trip.

The Series 13 model provided two key pieces of information for this analysis. First, region-wide (i.e., San Diego County) *daily* VMT in 2016 was provided, and was estimated to be 79,463,626. Second, total Port-wide (i.e., within the Port's jurisdictional boundary) *daily* VMT in 2016 was estimated to be 699,990, consistent with the above-mentioned "accounting rules." Based on the model output, the

[20] SANDAG. 2002. *SANDAG (Not so) Brief Guide of Vehicular Traffic Generation Rates for the San Diego Region*. April 2002. Available at: http://www.sandag.org/uploads/publicationid/publicationid_1140_5044.pdf.

Port's portion of the region-wide VMT is 0.88% (699,990/79,463,626). Daily VMT was converted to annual VMT using a factor of 347 to account for reduced weekend and holiday mileage, consistent with the method employed by CARB in the Scoping Plan.

Although SANDAG's Activity Based Model (Series 13) can be used to estimate current and future VMT, it cannot estimate VMT for years in the past. CARB's EMFAC model provides historic year VMT by vehicle type down to the sub-regional (e.g., county and air basin) level based on a combination of fuel sales, vehicle registration, and inter-regional travel assumptions from Caltrans. While EMFAC does provide region-wide (i.e., San Diego County) daily VMT, EMFAC does not provide VMT at the jurisdictional (i.e., Port's jurisdictional) boundary. However, EMFAC's region-wide VMT can be used to estimate region-wide VMT for years in the past. To provide a defensible comparison between the 2016 VMT results and a 2006 baseline for VMT, the Port utilized CARB's EMFAC model, which provides VMT estimates for each year between 2000 and 2050 that CARB uses to help compile its emissions inventory. VMT estimates do differ between EMFAC and the Series 13 model because of the difference in methods. CARB's latest release, EMFAC2017, was used for this analysis.

To account for changes in EMFAC versus Series 13 methods, 2006 VMT from EMFAC was adjusted based on the following methods:

1. Series 13 regional VMT for 2016 is significantly lower (16.5%) than projected VMT for San Diego County from EMFAC2017 for year 2016.
    - 2016 daily VMT for San Diego County from EMFAC = 95,190,562
    - 2016 daily VMT for San Diego County from Series 13 (region-wide) = 79,463,626, or 16.5% lower than EMFAC
2. In order to adjust regional VMT for 2006, the following steps were employed:
    - 2006 daily VMT for San Diego County from EMFAC = 83,705,284
    - Using the adjustment factor of -16.5%, 2006 regional VMT is adjusted downward 16.5% from 83,705,284 to 69,875,892
3. In order to estimate the Port of San Diego's portion of regional VMT in 2006, the following steps were employed:
    - The adjusted 2006 VMT of 69,875,892 was multiplied by the Port's portion of VMT in Series 13 for 2016 of 0.88%
    - Port daily VMT in 2006 = 615,532, and Port annual VMT in 2006 = 213,589,748

Annual VMT for both the 2006 and 2016 scenarios is provided in Table 5.

- Emission Factors: Vehicle emission rates are obtained from the most recent version of the EMFAC that is available at the time of analysis. For the original CAP, EMFAC2007 was employed, and because specific vehicle travel speeds were not available, emission factors for all but terminal trucks were based on the fleet average speed from EMFAC. For the 2016 inventory, EMFAC2017 was used to estimate CO_2, CH_4, and N_2O emissions.

  Moreover, the Series 13 model presents VMT by speed bin (e.g., 0–5 mph) within the Port's jurisdictional boundary, and because emissions vary by speed, EMFAC emission factors were obtained for each speed (in 5 mph increments). Speed bin data and emission factors by speed for the entire vehicle fleet is presented in Table 6. As shown, vehicle-related emission rates are trending downward as the federal and state governments implement emission reduction and fuel economy regulations. As a result, the 2016 vehicle emission factor is lower than the 2006 vehicle emission factor.

Emissions over time are affected by both the change in VMT and the change in emission factors. Speed bin data was only obtained for 2016 VMT, and no speed bin data was available for 2006 conditions. EMFAC does provide VMT by speed bin, but this is only provided at the county-wide level and is not reflective of conditions within the Port boundary. Thus, for comparison to the 2006 baseline, it was assumed that the 2006 speed bin distribution was the same as 2016 speed bin distribution from SANDAG.

TABLE 6. VMT AND EMISSION FACTOR BREAKDOWN BY SPEED BIN

Bin Range	Bin Name [1]	VMT % by bin [2]	Weighted Emission Factors (g/VMT)	
			2006	2016
1 mph - 5 mph	5	0.54%	1,917	1,739
5 mph - 10 mph	10	1.86%	1,317	1,276
10 mph - 15 mph	15	1.36%	902	855
15 mph - 20 mph	20	3.70%	671	616
20 mph - 25 mph	25	9.62%	501	433
25 mph - 30 mph	30	24.27%	451	391
30 mph - 35 mph	35	21.06%	411	353
35 mph - 40 mph	40	6.82%	409	349
40 mph - 45 mph	45	9.10%	431	362
45 mph - 50 mph	50	6.29%	488	424
50 mph - 55 mph	55	2.75%	545	485
55 mph - 60 mph	60	8.27%	618	563
60 mph - 65 mph	65	4.37%	444	382

[1] Bin name is the max speed in each bin range and is used for assigning emission factors from EMFAC

[2] VMT percent by bin is based on the Speed Bin Report within SANDAG's Series 13 VMT run and is specific to travel within the Port of San Diego jurisdiction.

Maritime Activity, Car Movements, and Cruise Ship Passengers

Maritime activity refers to operations directly related to goods movement (e.g., goods carried by ship, truck, or rail), goods movement services (e.g., tugs that assist vessels, commercial and charter fishing), and people movement operations (e.g., cruise ships that carry passengers over water to the Port, and vehicle that carry passenger over land to the cruise ship terminal). Maritime truck and car movement activity is covered in detail in the *2016 Maritime Air Emissions Inventory*. Emissions are presented separately in Table 7 below for heavy duty trucks (terminal trucks) and light duty vehicles (car offloading and CST passenger travel).

As shown in Table 6, emissions from combined maritime operations (sum of trucks, car offloading, and CST passenger travel) were estimated to be 33,777 $MTCO_2e$ in the original 2006 CAP baseline.[21] For the

[21] Includes the 29,343 $MTCO_2e$ shown under Heavy-Duty Vehicles, 3,830 $MTCO_2e$ allotted to CST passenger travel under Ocean-Going Vessels, and 604 $MTCO_2e$ allotted to new car offloading under Cargo Handling Equipment in the *2006 Air Emissions Inventory* and as summarized in Table A-11 of the CAP.

recalibrated 2006 CAP baseline, CST passenger travel was removed from the original 2006 CAP baseline because CST vehicle travel is accounted for in Series 13 and EMFAC VMT modeling, resulting in a new total of 29,974 $MTCO_2e$ (29,343 $MTCO_2e$ from trucks plus 604 $MTCO_2e$ from car offloading). In 2016, emissions from maritime trucks and car movement vehicle activity were estimated to be 14,325 $MTCO_2e$ (13,929 $MTCO_2e$ from trucks and 397 $MTCO_2e$ from car offloading).

TABLE 7. COMPARISON OF MARITIME ON-ROAD ACTIVITY AND EMISSIONS

Activity	Original CAP 2006[1]	Recalibrated 2006[2]	Inventory 2016[2]
Terminal Trucks			
Truck Counts	133,225	133,225	72,759
GHG Emissions ($MTCO_2e$)	29,343	29,343	13,929
Car Offloading and CST Passengers			
Cars offloaded at NCMT	375,000	375,000	430,356
CST Passengers	502,169	-	-
GHG Emissions ($MTCO_2e$)	4,434	604	397
Total Maritime GHG Emissions ($MTCO_2e$)	33,777	29,947	14,325

[1] Maritime on-road emissions under the 2006 CAP baseline include the 3,830 $MTCO_2e$ associated with CST vehicle travel and 604 $MTCO_2e$ associated with New Car Offloading contained within the CHE category, as shown in Table B-11 of the CAP.

[2] Maritime on-road emissions under the recalibrated 2006 baseline and the 2016 inventory do not include emissions associated with CST vehicle travel because it is assumed these vehicle trips are now included in regional VMT estimates from SANDAG and EMFAC.

A summary of activity and methods employed to estimate emission from maritime trucks is provided below.

- Consumption/Activity:

  Original and Recalibrated 2006 Cap Baseline: The method employed in estimating maritime truck activity is similar in both the CAP and as employed as part of this update. Maritime truck activity in the CAP was based on activity and emission estimates within the *2006 Maritime Emissions Inventory*. In 2006, there were an estimated 97,090 truck entries at TAMT and 36,135 truck entries at NCMT. It was assumed each truck traveled 120 miles per round trip; therefore, annual VMT was estimated to be 15,970,800. As part of the update, no changes were made to original 2006 CAP baseline emission estimates.

  2016 CAP Inventory: In 2016, there were 57,219 truck entries at TAMT and 15,540 truck entries at NCMT. Based on trip distribution provided by Port staff, average trip length was estimated to be approximately 91 miles per round trip; therefore, annual VMT was estimated to be 6,649,080, which is approximately 58% lower than in 2006. In addition, there were an estimated 375,000 cars offloaded from vessels at NCMT in 2006. In 2016, there were 430,356 cars offloaded.

  For car offloading, both the 2006 and 2016 inventories assume each new car travels 1.5 miles to the parking location at an average speed of 10 mph. CST vehicle activity in the CAP was based on 167 passenger ship calls, 3,007 passengers per ship, and VMT that varied by trip type (e.g., taxis, shuttle buses). Because regional VMT estimates are assumed to include CST vehicle activity, CST travel in the recalibrated 2006 baseline and 2016 inventory are not included. A summary of terminal truck on-road activity and NCMT car offloading and CST passenger travel activity (for the original 2006 CAP baseline only) for both the 2006 and 2016 scenarios is provided in Table 7.

- Emission Factors: Vehicle emission rates are obtained from the most recent version of the EMFAC that is available at the time of analysis. For the original CAP, EMFAC2007 was employed, and truck emissions were estimated assuming a 12 mph travel speed within the terminal boundaries and a 44 mph travel speed on the regional network. For the 2016 inventory, EMFAC2017 was used to estimate CO_2, CH_4, and N_2O emissions from trucks assuming a 10 mph travel speed within the terminal boundaries (note: EMFAC only provides emission factors in 5 mph increments), travel speeds that match the posted limit on surface streets between the terminal and the freeway, and EMFAC's aggregated (or average) drayage truck speed for truck travel on the regional freeway network. For offloaded cars, EMFAC2017 was used to estimate GHG emissions from new light-duty cars and trucks assuming a 10 mph travel speed. The 2016 inventory also assumes each vehicle cold starts prior to being offloaded. A summary of emission factors from maritime on-road sources is provided in the *2016 Maritime Air Emissions Inventory*.

Port-Owned On-Road Fleet

The Port-owned vehicle fleet includes various passenger cars, light-duty trucks, and heavy-duty trucks that are owned and operated by the Port. GHG emissions produced by the Port's fleet were estimated to be 978 $MTCO_2e$ in the original 2006 CAP baseline. This total was revised in the recalibrated 2006 CAP baseline to include refrigerants from vehicle air conditioning units, which were not included in the Original 2006 CAP baseline. For 2016, emissions were calculated with more recent published guidance from TCR. Both the Revised 2006 CAP and 2016 estimates includes hydrofluorocarbon emissions from vehicle air conditioning unit usage. GHG emissions from the Port-owned vehicle fleet were estimated to be 1,045 $MTCO_2e$ in recalibrated 2006 CAP inventory and 988 $MTCO_2e$ in 2016. Table 8 summarizes fuel usage, refrigerants, and GHG emissions from the Port's fleet for the 2006 baseline and the 2016 inventory.

TABLE 8. COMPARISON OF PORT OPERATIONS ON-ROAD FLEET TRANSPORTATION ACTIVITY AND EMISSIONS

Activity	Original 2006 CAP	Recalibrated 2006 CAP	2016 CAP Inventory
Gallons of Gasoline	100,691	100,691	94,211
Gallons of Diesel	7,787	7,787	5,302
Gallons-equivalent of Natural Gas	882	882	3,301
Refrigerants	--	228	288
GHG Emissions ($MTCO_2e$)	978	1,045	988

- Consumption/Activity:
  Original 2006 Cap Baseline: The original 2006 CAP baseline estimated emissions from the Port's on-road fleet based on fuel consumption by vehicle. During development of the original 2006 CAP baseline, 2006 fuel usage was not available; therefore, Port staff relied on the average fuel use and GHG emissions from the 2008 and 2009 Port GHG inventories. However refrigerants were not included.

  Recalibrated 2006 Cap Baseline: The recalibrated 2006 CAP Baseline utilized the same fuel usage as the original CAP baseline; however, refrigerants were included.

  2016 CAP Inventory: Fuel use data for each fleet vehicle collected from Port fuel receipts and refrigerants for 2016 were utilized to estimate emissions.

- Emission Factors: Emissions from on-road sources are based on gallons consumed for each vehicle, the assumed fuel economy for each vehicle, and GHG emission factors from TCR for gasoline, diesel, and compressed natural gas (CNG) engines. Fuel economy for each vehicle was obtained from EMFAC except for heavy-duty trucks, which follow guidance in TCR's General Reporting Protocol (5.8 miles per gallon), and for alternative CNG and hybrids, which are based on EPA's fueleconomy.gov website. Emission factors from TCR are based on CO_2 factors from TCR Table 13.1 and CH_4 and N_2O factors from TCR Table 13.5, which are based on vehicle type (e.g., passenger car, light-duty truck) and model year.

  Port fleet emissions also include fugitive emissions from the use of hydrofluorocarbons as refrigerants in fleet vehicles. Emissions are based on Equation 16e from TCR's General Reporting Protocol, Version 2.1, and default for mobile air conditioning units in the 2017 Climate Registry Default Emission Factors, Table 16.2.

Off-Road Transportation

Off-road transportation includes recreational boating, mobile (e.g., forklifts) and stationary (e.g., generators) off-road equipment at various tenants (such as marinas, boatyards, and shipyards), and off-road equipment associated with maritime-related activity. Maritime-related activity is defined as activity related to the movement of goods, services, and people associated with marine terminal operations. For off-road transportation, maritime-related activity includes ocean-going vessels that visit the Port's marine terminals, commercial harbor craft operations (e.g., tug boat, tow-boats, commercial fishing, sport fishing, and excursion vessels), cargo handling equipment (e.g.,, forklifts, yard trucks), and rail operations.

Recreational Boating

Recreational boating emissions were estimated to be 80,145 $MTCO_2e$ in the original 2006 CAP baseline. The Port decided to update the methods to calculate emissions from recreational boating using fuel use data collected from sales of fuel from fuel docks located in San Diego Bay. Sales of fuel from fuel docks provide the Port with a consistent measurement to estimate emissions from year to year. As such, emissions from recreational boating were estimated to be 57,662 $MTCO_2e$ in the recalibrated 2006 CAP baseline. Using the same method in 2016, emissions from recreational boating were estimated to be 55,227 $MTCO_2e$.

Below is a summary of the methods and results.

- Consumption/Activity:

  Original 2006 Cap Baseline: The original 2006 CAP baseline estimated boating activity and emissions from recreational boating using CARB's OFFROAD2007 model, which presents emissions at the state and county levels. GHG emissions attributed to boating at the Port of San Diego were estimated by scaling down county-wide boating emissions from the OFFROAD model by the percentage of boating days that are estimated to occur in the ocean[22] and by the boat slip area present within the Port versus the slip area present within the entire county as a whole. A limitation of this approach is that it may minimize boating activity within other water bodies of San Diego County, including Mission Bay and inland lakes, since activity in those locations is high but boat slip area is low relative to the Port.

[22] Percentage of boating days in the ocean and fueling location assumptions were based on the State of California Division of Boating and Waterways *California Boater Survey.* July 2011. See Table 46, available at: http://dbw.parks.ca.gov/pages/28702/files/FinalCABoatersReport_July2011_DG.pdf.

Recalibrated 2006 Cap Baseline: The new method for estimating emissions from recreational boating involves collecting fuel sale data from fuel docks in San Diego Bay. The Port leases land and water space to three fuel docks, two located in Shelter Island and one located in Harbor Island. As the Port collects annual fuel sale data from the fuel docks, there is a historical record of fuel sales for comparison between 2006 and 2016. As a result, fuel sale data from the three fuel docks within San Diego Bay was collected for 2006 and 2016. Total fuel sales at the fuel docks are summarized in Table 9.

Various types of vessels likely use these fuel docks, including commercial and charter fishing vessels, Port-owned vessels, and recreational boats. To obtain an estimate of fuel sales directly attributed to recreational boating activity, fuel consumption from commercial and charter fishing vessels as well as Port-owned vessels (e.g., Harbor Police vessels) were removed from the fuel sale data. GHG emissions from commercial and charter fishing vessels are calculated within the Port's *2016 Maritime Air Emissions Inventory*. Fuel consumption from fishing vessels was estimated based on the sum of commercial fishing (1,945 metric tons of CO_2 from diesel, 28.3 $MTCO_2e$ from gasoline) and sport fishing (4,877 metric tons of CO_2 from diesel) CO_2 emissions, assuming 8.61 kilograms per gallon of gasoline and 10.24 kilograms per gallon of diesel. Fuel consumption from the Port's vessel fleet was directly obtained from the Port (52,899 gallons of diesel, 11,918 gallons of gasoline).

San Diego Bay contains four boat launch access points, which allow boaters to launch boats that are not docked at slips. Based on the California Division of Boating and Waterways *California Boater Survey*, most operators of recreational boats do not use marina-based fuel docks. Instead they either fuel up at a gas station prior to launching their boats or they fuel with a pre-filled gas can at some point during the activity. Based on this, it is assumed in the *California Boater Survey* that fuel dock sales in San Diego Bay represent only 37.2% of fuel consumption in the Bay from recreational boats. Therefore, to estimate fuel sales in the Bay from recreational boating, sales of gasoline from fuel docks was divided by 0.372.

Fuel sales were obtained for both gasoline and diesel. It was assumed that because diesel fuel consumption only occurs in larger recreational boats (i.e., yachts), which are not regularly launched from boat launch facilities, diesel fuel dock sales are assumed to reflect all diesel recreational boating in the Bay. Consequently, this scaling does not occur for diesel fuel. A summary of fuel dock sales, fuel that was removed, accounting for boat launching, and total fuel attributed to recreational boating is provided in Table 9.

- Emission Factors: The CAP estimated GHG emissions from recreational boating based on activity and emissions levels in the OFFROAD2007 model. The OFFROAD2007 model is outdated and has since been superseded by various sector-specific models developed by CARB. The method employed herein for recreational boating is fuel-based, because fuel consumption has been estimated. For this update, emissions from gasoline and diesel boats were estimated using CO_2 emission factors from GREET[23] 2016 and CH_4 and N_2O emission factors for gasoline and diesel ships and boats from TCR. A summary of emission factors is presented in Attachment A.

[23] GREET is a life-cycle analysis tool that provides properties for California-specific fuel types. The model is available at: https://greet.es.anl.gov/index.php?content=greetdotnet.

TABLE 9. RECREATIONAL BOATING FUEL ESTIMATES (GALLONS)

Year	Total Fuel Sales		Fuel from Fishing and Port Fleet Removed		Fuel Markup for Boat Launch Use		Total Fuel Use Attributed to Recreational Boating[1]	
	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas
2006	5,154,093	517,460	733,682[2]	12,433[2]	-	37.2%[3]	4,420,412	1,357,941
2016	4,617,462	620,029	657,292	14,897	-	37.2%[3]	3,960,169	1,627,106

[1] Total fuel is based on Total Fuel Sales (-) Fuel from Fishing and Port Fleet Removed (/) 0.372. For example, the equation for estimating recreational boating gasoline in 2006 is: 517,460 – 12,433 / 0.372 = 1,357,941 gallons
[2] Fishing and Port fleet fuel consumption for 2006 was not available. Therefore, it was assumed that the percentage of diesel (14.2%) and gasoline (2.4%) removed from fuel sales in 2016 was consistent for 2006.
[3] Markup assuming fuel sales only represent 37.2% of fuel consumption associated with recreational boating.

Mobile and Stationary Off-Road Equipment at Non-Maritime Tenants

Mobile (e.g., forklifts) and stationary (e.g., generators) off-road equipment emissions at non-maritime tenants were estimated to be 9,071 $MTCO_2e$ in the original 2006 CAP baseline. Utilizing refined fuel consumption data for the shipyards, along with minor changes in emission factors, emissions from off-road equipment were estimated to be 4,854 $MTCO_2e$ under the recalibrated 2006 baseline. In 2016, emissions from off-road equipment were estimated to be 4,405 $MTCO_2e$. Table 10 provides a summary of land use and fuel consumption metrics used to estimate fuel consumption. Table 11 provides a summary of fuel consumption and emissions generated by off-road equipment from non-freight maritime activities.

Below is a summary of key the methods and results.

- Consumption/Activity:

  Original 2006 Cap Baseline: In the original 2006 CAP baseline, equipment activity at tenant types, which include yacht clubs, marinas, fishing, lumberyards, boatyards, and other commercial and industrial tenants, and shipyards, was estimated based on information provided by participating representative tenants. Various tenants provided fuel usage for equipment (gallons/year), and then a metric (gallons per year per slip or per square foot) was calculated for use in the original 2006 CAP baseline based on the land use information available at the time. For the most part, information used to estimate emissions in the CAP was carried over to this inventory.

TABLE 10. OFF-ROAD TRANSPORATION COMPSUMPTION METRICS

Tenant Type	Metric	Activity			Method for Estimating Fuel
		Original 2006 CAP[1]	Recalibrated 2006 CAP[1]	2016 CAP Inventory	
Yacht Clubs, Marinas, fishing, etc.[2]	Slips	7,771	7,771	7,210	14 gallons of gasoline per slip. Same for each scenario; no change from CAP
Lumber Yards	SF	954,603	954,603	540,368	0.042 gallons of diesel per SF 0.013 gallons of propane per SF Same for each scenario; no change from CAP
Shipyards	SF	4,639,831	4,639,831	4,639,831	CAP 2006 = 0.129 gallons of diesel per SF Recalibrated 2006 and 2016 Inventory = based on actual fuel from all three tenants
Boatyards	SF	1,392,465	1,392,465	1,165,223	0.041 gallons of diesel per SF 0.012 gallons of propane per SF Same for each scenario; no change from CAP
Generator Sets	gallons	75,517	75,517	75,695	Based on actual diesel fuel for 2006. Port events and "other commercial" usage increases through 2020 per CAP

[1] Original 2006 CAP and Recalibrated 2006 CAP land uses (slips, SF) and generator fuel consumption taken from CAP. 2016 land uses (slips, SF) based on GIS and land use data from Port staff. 2016 generator fuel consumption estimated based on interpolating between 2006 and 2020 data in the CAP.

[2] The Yacht Clubs, Marinas, fishing, etc. category for each scenario also includes 8,100 gallons of gasoline from "other commercial tenants".

TABLE 11. COMPARISON OF OFF-ROAD TRANSPORTATION CONSUMPTION AND EMISSIONS

Metric	Tenant Type	Fuel	Original 2006 CAP	Recalibrated 2006 CAP	2016 CAP Inventory
Consumption (gallons)	Yacht Clubs, Marinas, fishing, etc.	Gasoline	114,747	114,747	109,040
	Lumber Yards	Diesel	39,966	39,966	22,695
		LPG	12,174	12,174	7,025
	Shipyards	Diesel	596,477	194,835	168,927
		Propane	-	15,244	12,449
		Gasoline	-	916	901
	Boatyards	Diesel	57,670	39,966	47,774
		Propane	16,809	12,174	13,983
	Generator Sets	Diesel	75,517	75,517	75,695
GHG Emissions ($MTCO_2e$)	Yacht Clubs, Marinas, fishing, etc.	Gasoline	1,020	997	948
	Lumber Yards	Diesel	409	413	234
		LPG	72	71	41
	Shipyards	Diesel	6,110	2,013	1,745
		Propane	-	88	72
		Gasoline	-	8	8
	Boatyards	Diesel	591	413	494
		Propane	99	71	81
	Generator Sets	Diesel	770	780	782
Total $MTCO_2e$			9,071	4,854	4,405

Recalibrated 2006 CAP Baseline and 2016 CAP Inventory: The original 2006 CAP baseline was changed based on the following:

1) Square footage and boating slip counts for each tenant type for 2016 was different than the data used in the original 2006 CAP baseline. Because the same emission metric (gallons per year per slip or per square foot) was used in this update, changing the slip counts or square footage would result in different emissions assumed in 2006. For example, the metric used to estimate non-boating off-road emissions for yacht clubs, marina, sport fishing, and charter fishing (14 gallons of gasoline per slip per year) continued to be utilized, but revised slip counts resulted in a change in emissions relative to the CAP. Similarly, the metric used to estimate boatyard emissions (0.041 gallon of diesel and 0.012 gallon of propane per square foot of leased space per year) was continued to be utilized, but revised square footage estimates based on GIS resulted in a change in emissions relative to the CAP.
2) Fuel consumption for the shipyards was revised based on fuel consumption received from the three shipyard tenants. Fuel consumption representative of activity in both 2006 and 2016 was received. Due to annual changes in fuel activity, two of the shipyards provided fuel usage over a

3-year a period from 2007 to 2009 to represent a baseline for 2006. One of the shipyard tenants did not have fuel records dating back to 2006, therefore, fuel consumption was provided from a single year in 2010. Fuel consumption from the three shipyards was lower than presented in the original 2006 CAP baseline and include diesel, gasoline, and propane consumption. .

Fuel consumption and emissions associated with general stationary combustion from other commercial and industrial tenants are similar to the original CAP.[24]

2016 CAP Inventory: The methods employed to determine emissions for the Recalibrated 2006 CAP baseline were used to determine emissions for the 2016 CAP Inventory, with the following exceptions:

- For 2016, the three shipyard tenants provided a 3-year average of fuel use from 2014 to 2016.
- The original CAP projected increases in some stationary combustion sources—Port Events and Other Commercial—between 2006 and 2020. For these categories, estimated fuel combustion in 2016 was based on interpolating between 2006 and 2020. For "Other Industrial" no change in consumption between 2006 and 2020 was projected in the CAP. Thus, estimated fuel combustion in 2016 was based on 2006 activity.

- Emission Factors: The CAP estimated GHG emissions based on fuel estimates and fuel-based emission factors from TCR. For this update, emissions from gasoline and diesel boats and equipment were estimated using CO_2 emission factors from GREET 2016 and CH_4 and N_2O emission factors for construction equipment from TCR. A summary of emissions by tenant type and fuel type is provided in Table 10.

Maritime Off-Road Activity

Emissions from maritime off-road activity associated with maritime freight and passenger movement, which includes OGVs, CHC, CHE, and rail activity, are described in the Port's *Maritime Air Emissions Inventory* report. GHG emissions produced from maritime off-road activity were estimated to be 83,121 $MTCO_2e$ in the original 2006 CAP baseline.[25] Adjustments were made to the original 2006 CAP baseline in the *2012 Maritime Air Emissions Inventory*, which adjusted off-road emissions to 68,280 $MTCO_2e$. In 2016, emissions from maritime off-road activity were estimated to be 52,829 $MTCO_2e$. A detailed description of the methods used to estimate maritime-related emissions can be found in the Port's *Maritime Air Emissions Inventory* reports. Therefore, only a brief summary of activity and methods employed to estimate emissions from maritime off-road activity is provided below.

- Consumption/Activity: Various methods were employed to estimate emissions associated with maritime and goods movement activity. The method employed in estimating maritime activity is similar in both the CAP and as employed as part of this update. Data for estimating emissions came from Port staff and ICF research.
    - For OGVs, vessel call data was obtained from the Port, which included hoteling time stamps, vessel type, shore power consumption, and cargo type. ICF purchased Automatic

[24] Includes stationary source data found the Appendix B of the CAP document in Tables A-4 and C-4 as well as the "other industrial" category shown in Table A-9.

[25] Includes the sum of the off-road categories (OGV, CHC, CHE, and rail) minus the 3,830 $MTCO_2e$ allotted to CST vehicles under Ocean-Going Vessels in the *2006 Air Emissions Inventory* and as summarized in Table A-11 of the CAP.

Identification System data, which provide vessel positioning data, so that the time and travel speed for each call could be estimated. Lloyd's database was used to gather vessel information, including keel lay date, engine size, and others, so that emissions could be calculated for each individual vessel.

- For CHC, Port staff provided CHC information obtained from tenants, including names and types of CHC that operate in the Bay, an estimate of operating hours, and engine retrofit information, among other pieces. Many CHC pieces are shown in the Automatic Identification System data, which were used to fill any data gaps in terms of main and auxiliary engine operating hours. Where data were missing, CARB defaults or internet research was used to fill missing data.
- For CHE, Port staff provided CHE information obtained from tenants, including names and types of CHE that operate at the three marine terminals, an estimate of operating hours, and engine retrofit information, among other pieces. Where data was missing, CARB defaults or internet research was used to fill missing data.
- For rail, Port staff provided a summary of cargo tonnage that was moved by rail.

A summary of maritime activity by off-road sources is provided in Table 12.

- Emission Factors: Emission factors were obtained from a variety of sources, including CARB, EPA, and air emissions studies at other California ports. The sources generally follow the same methodology employed in previous air emission inventories. In general, GHG emission factors (e.g., grams per horsepower-hour, grams per gallon) are relatively unchanged since 2006 because the majority of regulations to date affecting off-road emission sources are aimed at reducing criteria pollutant emissions.

TABLE 12. COMPARISON OF MARITIME OFF-ROAD TRANSPORTATION ACTIVITY AND EMISSIONS

Activity	Original 2006 CAP	Recalibrated 2006 CAP	2016 CAP Inventory
Vessel Calls	530	530	420
Hotel Duration	41.0	41.0	28.1
CHC Engine Hours (Main/Auxiliary)	200,746 / 128,415	200,746 / 128,415	75,946 / 204,899
CHE horsepower-hours (in millions)	1,952.3	1,952.3	1,154.1
Rail Line-Haul Gallons	235,297	235,297	194,791
Rail Switching Hours	3,510	3,510	3,225
GHG Emissions ($MTCO_2e$)	83,121	68,280	52,829

Port-owned Off-Road

- The Port-owned and -operated off-road fleet includes various boats and off-road equipment. GHG emissions produced by the Port's fleet were estimated to be 591 $MTCO_2e$ in the original 2006 CAP baseline. This total was unchanged in the recalibrated 2006 CAP baseline. Similar methods were used for the 2016 inventory, albeit with more recent published guidance from TCR. GHG emissions from the Port-owned vehicle fleet were estimated to be 715 $MTCO_2e$ in 2016. A summary of Port-owned off-road fleet activity and emissions for both the 2006 and 2016 scenarios is provided in Table 13.

TABLE 13. COMPARISON OF PORT OPERATIONS FLEET OFF-ROAD TRANSPORTATION ACTIVITY AND EMISSIONS

Activity	Original 2006 CAP	Recalibrated 2006 CAP	2016 CAP Inventory
Gallons of Diesel	42,151	42,151	55,601
Gallons of Gasoline	17,155	17,155	15,833
Gallons of Propane	1,109	1,109	0
GHG Emissions ($MTCO_2e$)	591	591	715

- Consumption/Activity:

  Original 2006 Cap Baseline: The original 2006 CAP baseline estimated emissions from the Port's off-road fleet based on fuel consumption by vehicle. During development of the original 2006 CAP baseline, 2006 fuel usage was not available; therefore, Port staff relied on the average fuel use and GHG emissions from the 2008 and 2009 Port GHG inventories.

  Recalibrated 2006 Cap Baseline: The recalibrated 2006 CAP Baseline utilized the same fuel usage as the original CAP baseline.

  2016 CAP Inventory: Fuel use data for each fleet vehicle, vessel, or piece of equipment was collected from Port fuel receipts to estimate emissions. The CAP estimated emissions from the Port's off-road equipment based on fuel consumption by vehicle.
- Emission Factors: Emissions from off-road equipment are based CO_2 emission factors from TCR Table 13.1 as well as CH_4 and N_2O emission factors for construction equipment in Table 13.7. Emissions from gasoline and diesel ships and boats are based on CO_2 emission factors from TCR Table 13.1 and CH_4 and N_2O emission factors for gasoline and diesel ships and boats on TCR Table 13.7.

Solid Waste

Waste-related emissions were estimated to be 21,346 $MTCO_2e$ in 2016. Emissions from solid waste are dominated by CH_4 emissions. The GWP for CH_4 increased from 21 in SAR, which was assumed in the CAP, to 25 in AR4, which is assumed herein. Thus, because the GWP increased, emissions under the recalibrated 2006 baseline increased from 16,757 $MTCO_2e$ to 19,239 $MTCO_2e$ due solely to the change in GWP. Below is an analysis of key factors that may have influenced these results.

- Consumption/Activity: The CAP estimated waste generation and resulting emissions from a combination of CalRecycle, CalEEMod (version 2013.1), AP-42, CARB's Local Government Operations Protocol (version 1.1), IPCC guidelines (2006), and collection efficiencies from the San Diego County emissions inventory.[26] As part of this update, we used the same method for estimating waste disposal and generation (tons) as well as the same variables for estimating emissions (e.g., collection efficiency). The only change in emissions versus the original 2006 CAP baseline is in adjusting the GWP for CH_4, as discussed below.

[26] Energy Policy Initiatives Center (EPIC). 2011. *San Diego County Greenhouse Gas Inventory*. Available from: http://www.sandiego.edu/epic/resources/reports.php#accordion1.

- Emission Factors: The CAP estimated emissions of CH_4 from decomposition of waste as well as emissions of CO_2 from the combustion of CH_4 through collection and destruction. Total CH_4 emissions were not revised as part of this update. However, the CAP estimated total GHG emissions using the GWPs associated with IPCC's SAR. GHG emissions as part of this update are based on GWPs associated with IPCC's AR4. The GWP for CH_4 in SAR is 21, which was assumed in the CAP, while the GWP for CH_4 in AR4 is 25, which is used herein. Therefore, the only change in emissions relative to the CAP is in multiplying total CH_4 emissions, which are unchanged, by 25 instead of 21. A summary of the change is shown in Table 14.

TABLE 14. ADJUSTMENTS TO WASTE EMISSIONS

	Year	Method	Metric Tons CO_2	Metric Tons CH_4	CH_4 GWP	$MTCO_2e$
Original 2006 CAP Baseline	2006	SAR (from CAP)	7,266	479	21	16,757
	2020		11,264	437	21	20,441
	2016*		10,122	449	21	19,551
Recalibrated 2006 CAP Baseline	2006	AR4	7,266	479	25	19,239
	2020		11,264	437	25	22,189
	2016		10,122	449	25	21,346

* CAP 2016 estimate based on interpolating between 2006 (Table A-10 of the CAP) and 2020 estimates (Table C-10 of the CAP).

Water Use

- Consumption/Activity: The original 2006 CAP baseline estimated indoor and outdoor water consumption through a combination of tenant input and the 2003 *Waste Not Want Not* report. As part of this update, we used the same method for estimating water consumption. The 2006 water consumption presented in the recalibrated 2006 CAP is unchanged, and 2016 water consumption was estimated by interpolating between water emissions for 2006 and 2020 as presented in the CAP. Energy associated with water consumption was estimated using the same energy intensity factors (kWh per gallon) for indoor and outdoor water consumption used in the CAP.
- Emission Factors: The original 2006 CAP baseline estimated water-related energy emissions using the same SDG&E emission (782.07 pounds CO_2e per MWh) discussed above under *Electricity*. As part of this update, water-related energy emissions for the recalibrated 2006 baseline (782.27 pounds CO_2e per MWh) and 2016 (533.52 pounds CO_2e per MWh) are discussed above under *Electricity*. Using the same method as in the CAP, electricity emission factors are multiplied by water-related energy consumption for 2006 and 2016.

Summary of Results

Table 15 provides a comparison of emissions broken down into more specific sectors than shown above for the original 2006 CAP baseline, recalibrated 2006 CAP baseline, and 2016 inventories. In addition, Figure 1, Figure 2, and Figure 3 show the relative contribution of each source category for the CAP 2006 baseline, recalibrated 2006 baseline, and 2016 inventories, respectively. Lastly, Table 15 provides a breakdown of emissions by sector and subsector for the original CAP 2006 CAP baseline, recalibrated 2006 CAP baseline, and 2016 inventories.

Table 16 provides a summary of activity and emission factors for emissions sources.

TABLE 15. COMPARISON OF RECALIBRATED 2006 BASELINE AND CALENDAR YEAR 2016 EMISSIONS ($MTCO_2E$ PER YEAR)

Sector[1]	Original 2006 CAP[2]	Recalibrated 2006CAP[2]	2016 CAP Inventory[2]
Electricity	173,192	117,526	101,381
Natural Gas (non-stationary)	39,683	66,723	22,336
CARB Regulated Sources	95,833	95,833	114,847
Non-Maritime On-Road	281,697	107,716	107,403
Maritime On-road	33,777	29,947	14,325
Maritime Off-Road	83,121	68,280	52,829
Recreational Boating	80,145	57,662	55,227
Non-Maritime Off-Road	9,662	5,655	5,119
Water Use	13,166	13,169	9,144
Waste	16,757	19,239	21,346
Total Emissions	**826,429**	**581,750**	**504,554**
Difference between 2016 Emissions and 2020 Emissions Target (see Table 1)	-	-	*-19,020*

[1] Electricity, natural gas (non-stationary), non-maritime on-road, and non-maritime off-road categories include Port-operations= consumption and emissions.
[2] Totals may not add exactly due to rounding.

FIGURE 1. ORIGINAL 2006 CAP BASELINE EMISSIONS BY GHG SOURCE

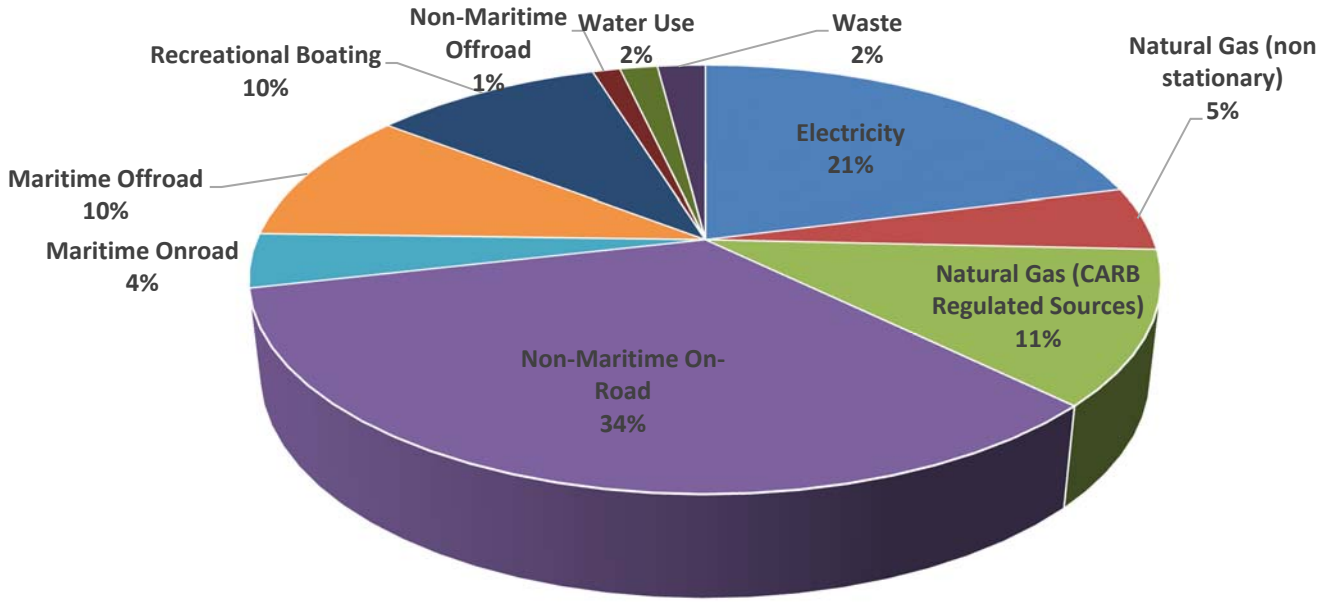

FIGURE 2. RECALIBRATED 2006 CAP BASELINE EMISSIONS BY GHG SOURCE

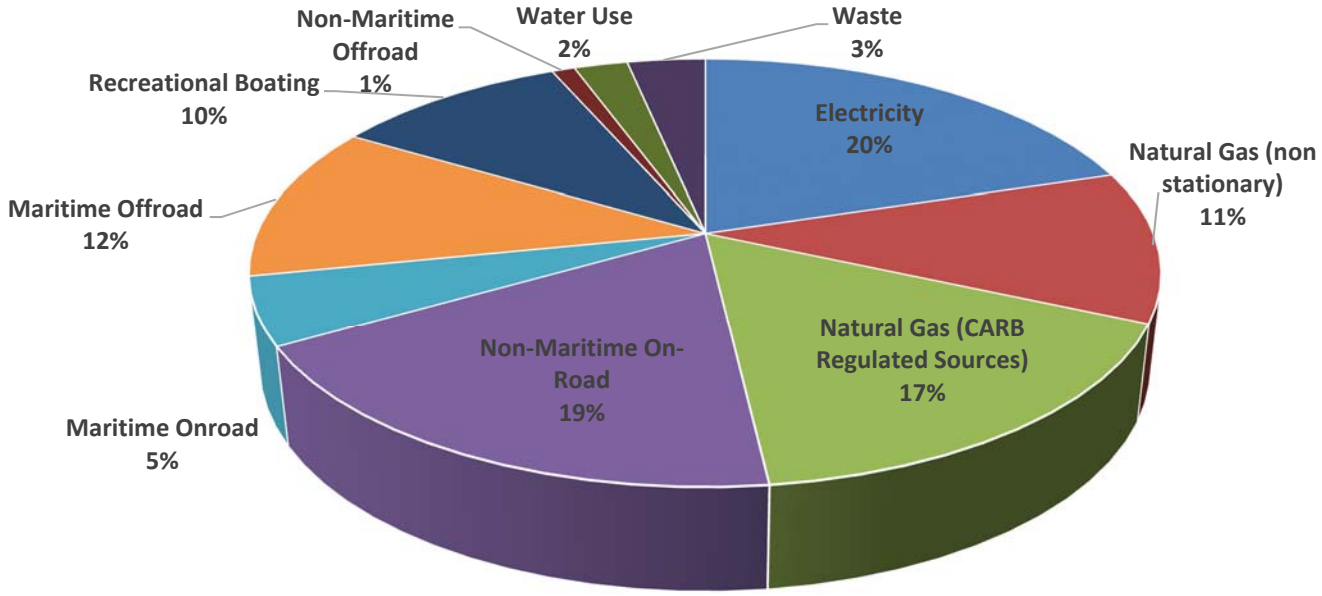

FIGURE 3. 2016 CAP INVENTORY EMISSIONS BY GHG SOURCE

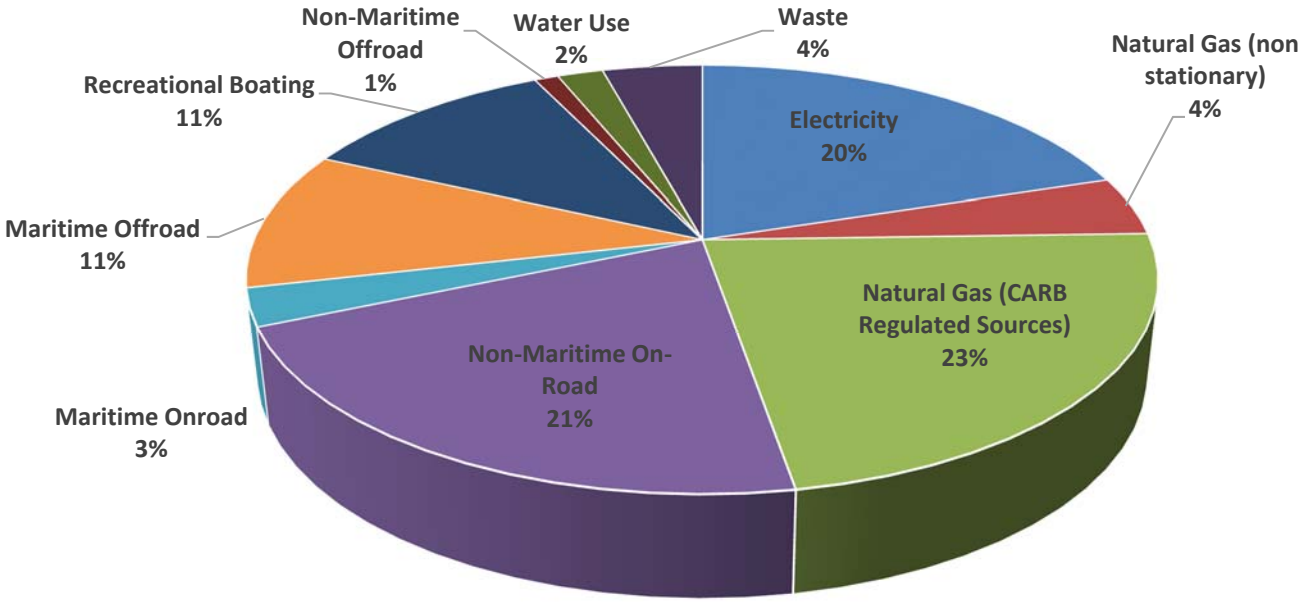

FIGURE 4. COMPARISON BETWEEN ORIGINAL 2006 CAP BASELINE, RECALIBRATED 2006 BASELINE, 2016 INVENTORY BY GENERAL CATEGORY

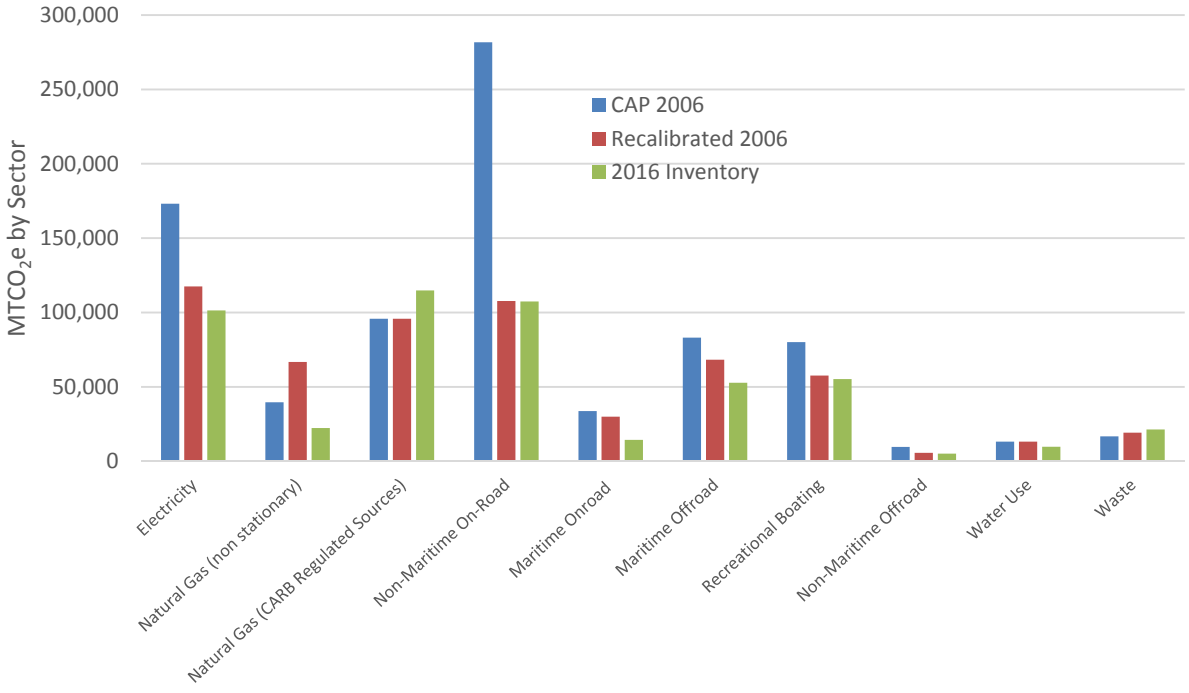

TABLE 16. PORT OF SAN DIEGO EMISSIONS BY SECTOR BY YEAR ($MTCO_2E$/YEAR)

Sector	Subsector	Original 2006 CAP	% of 2006 Inventory	Recal. 2006 CAP	% of 2006 Inventory	2016 CAP Inventory	% of 2016 Inventory
Electricity	Tenants- SDG&E	173,349	21.0%	59,150	10.2%	42,902	8.5%
	Tenants- Direct Access	0	-	54,809	9.4%	56,942	11.3%
	Port Operations	0	-	3,567	0.6%	1,537	0.3%
Building Natural Gas	Tenants- SDG&E	26,040	3.2%	14,303	2.5%	12,201	2.4%
	Tenants- Direct Access	0	-	52,093	9.0%	9,990	2.0%
	Port Operations	0	-	327	0.1%	145	0.0%
CARB Regulated Sources Natural Gas*	Direct Access	95,833	11.6%	95,833	16.5%	114,847	22.8%
Non-Maritime On-Road	Passenger Vehicles	279,741	33.8%	106,672	18.3%	106,414	21.1%
	Port Operations	978	0.1%	1,045	0.2%	988	0.2%
On-Road Maritime	Terminal Trucks and car offloading	29,947	3.6%	29,947	5.2%	14,325	2.8%
	CST passengers and deliveries	3,830	0.5%	-	-	-	-
Off-Road Maritime	OGVs (not including Shore Power)	55,162	6.7%	38,975	6.7%	20,766	4.1%
	Harbor Craft	20,835	2.5%	22,785	3.9%	25,500	5.1%
	CHE	4,039	0.5%	3,435	0.6%	2,183	0.4%
	Rail	3,085	0.4%	3,084	0.5%	2,646	0.5%
	OGV Shore Power	-	-	-	-	1,734	0.3%
Off-Road Equipment	Yacht Clubs & Lumber Yards	1,564	0.2%	1,545	0.3%	1,286	0.3%
	Shipbuilding	6,110	0.7%	2,109	0.4%	1,825	0.4%
	Boatyards	690	0.1%	693	0.1%	575	0.1%
	Generators	707	0.1%	717	0.1%	718	0.1%
	Port Operations	591	0.1%	591	0.1%	715	0.1%
Recreational Boating	-	80,145	9.7%	57,662	9.9%	55,227	10.9%
Solid Waste	Waste	13,166	1.6%	13,169	2.3%	9,741	1.9%
Water	Water Pumping and Treatment	16,757	2.0%	19,239	3.3%	21,346	4.2%
Total Emissions		826,429	100%	581,750	100%	504,554	100%
2020 Goal		**745,695**	**-**	**523,575**	**-**	**523,575**	**-**
Reductions Necessary to Hit Target		***80,734***	**-**	***58,175***	**-**	***-19,020***	**-**

Limitations and Uncertainties

For the most part, emissions are estimated by multiplying activity (or fuel consumption) by an emission factor. As discussed in the TCR General Reporting Protocol (v2.1), preparing a GHG inventory is inherently both an accounting and a scientific exercise. Uncertainty arises any time activity is estimated or emissions are quantified. For purposes of compiling an emissions inventory, uncertainty can arise from the modeling methods employed, from the emission factor that is chosen, and from which parameters or datasets are chosen and how those data are assembled. Some data sets are more certain than others. For instance, emissions associated with Port operations are primarily based on fuel receipts for vehicles, vessels, and equipment, and utility records for electricity and natural gas for Port meters, which is more certain than estimating trip lengths and VMT for visitors to Port tidelands from other parts of the region. Each activity and emission factor estimate contained within this inventory is based on the best available science, method, or data that are available at the time of analysis.

Obtaining accurate data regarding all forms of activity that are used to calculate emissions is not possible at this time. Models themselves are used to estimate or replicate real-world conditions, because tracking every person's travel behavior is impractical and infeasible. As a result, estimating activity levels increases the uncertainty of emissions. For example, estimating VMT for vehicles included in a GHG inventory is extremely complex, involving multiple community-related factors such as land uses, travel behavior, and modes of transportation as well as socioeconomic and employment data. SANDAG's Series 13 Transportation Demand Model was used to estimate Port of San Diego-wide VMT in 2016. The results of the 2016 Series 13 model helped to develop a metric to determine a comparable 2006 VMT result. Series 13 was developed using travel behavior information from surveys, socioeconomic and employment data, and traffic and transit observations. The model uses land use data to estimate trip generation, trip distribution, mode choice (auto, transit, or non-motorized), and network assignment (most efficient path based on mode selected) in order to estimate VMT both regionally and within a specified study area. Because VMT is estimated based on a set of assumption about travel behavior, VMT estimates are inherently uncertain because it is uncertain if those travel behaviors apply to the population that, in this case, visits or works within the Port's jurisdiction, or if those observed travel behaviors remain relevant.

Although model results are uncertain, SANDAG has worked to ensure the viability and accuracy of model results by conducting multiple validations of model runs. In SANDAG's 2016 model calibration and validation report, daily VMT from Series 13 was underestimated by only 0.21% relative to Highway Performance Monitoring System data for analysis year 2012.[27] Thus, while SANDAG will continue to calibrate and adjust its modeling, Series 13 currently provides a defensible estimate of regional VMT. Most of the jurisdictions in San Diego County developing inventories of GHG emissions utilize SANDAG's models to estimate VMT, and the jurisdiction-specific VMT estimates from Series 13 are a common practice in the region.

However, while the VMT results from SANDAG may include some level of uncertainty, its modeling does represent the best available method for estimating the emissions contribution of motor vehicles within the Port's jurisdiction. Similarly, each activity and emission factor estimate contained within this inventory is based on the best available science, method, or data that are available at the time of analysis.

[27] *Activity-Based Travel Model Calibration and Validation for Base Year* 2012 available at: http://www.sandag.org/uploads/publicationid/publicationid_2097_21613.pdf.

As stated above, the limitations regarding calculations of VMT extend to other sources of emissions summarized in this report. Many assumptions were made to estimate emissions from, and not limited to, recreational boating, commercial harbor craft, and cargo handling equipment. It is the Port's intent to utilize best available methods, science, and understanding of operations to determine emissions from sources within the Port's jurisdiction. Where empirical data is not available, the Port will strive to gain the best available data or assumptions through discussions with tenants and operators of equipment, vessels, vehicles, buildings and infrastructure. It is common practice that if assumptions change or new data becomes available that was not available for previous inventories of GHGs, than the new information shall be utilized and the past inventories shall be updated using the most recent state of practice. The Port will continue to use the best available science and recalibrate past inventories of GHGs as applicable.

TABLE 17. ACTIVITY AND EMISSION FACTORS FOR PORT OF SAN DIEGO'S 2006 AND 2016 GHG INVENTORIES

Sector and Parameters	Units	Original 2006 CAP	Recalibrated 2006 CAP	2016 CAP Inventory
Building Energy				
Electricity				
Consumption- SDG&E (Tenants)	Kilowatt-hours (kWh)	478,165,752	166,699,440	177,280,931
SDG&E Emissions factor	Grams (g) CO_2e / kilowatt hour (kWh)	354.74	354.83	242.00
Consumption- Direct Access (Tenants)	Kilowatt-hours (kWh)	-	144,614,583	150,243,110
Direct Access Emissions factor	g CO_2e / kWh	-	379.00	379.00
Port Operations SDG&E Access	Kilowatt-hours (kWh)	10,051,718	10,051,718	6,349,537
SDG&E Emissions factor	g CO_2e / kWh	357.74	354.83	242.00
Natural Gas				
Consumption SDG&E Access	Therms	7,435,787	2,687,962	2,293,013
SDG&E Emissions factor	lbs CO_2e/therm	11.71	11.73	11.73
Consumption Direct Access (non-stationary)	Therms	-	9,790,046	1,877,417
Consumption Direct Access (CARB Regulated Sources)	Therms	18,010,310	18,010,310	21,583,715
Direct Access Emissions factor	lbs CO_2e/therm	11.71	11.73	11.73
Port Operations SDG&E Access	Therms	61,524	61,524	27,319
SDG&E Emissions factor	lbs CO_2e/therm	11.71	11.73	11.73
On-Road Transportation				
Tenant Non-Maritime				
Vehicle Miles Traveled (VMT)	VMT	501,926,317	213,589,748	242,896,591
Emissions factor	g CO_2e/VMT	500.31	499.42	438.11
Maritime				
Terminal Truck Counts	Number of Vehicles	133,225	133,225	72,759
Terminal Truck VMT	VMT	15,987,000	15,987,000	6,649,080
Cars offloaded at NCMT	Number of Vehicles	375,000	375,000	430,356
Cars offloaded at NCMT VMT	VMT	562,500	562,500	645,534
CST Passengers Trips	Number of Passengers	502,169	-	-
CST Passengers VMT	VMT	11,757,802	-	-
Emission factor	Varies by type, speed, etc.			
Port Operations				

Sector and Parameters	Units	Original 2006 CAP	Recalibrated 2006 CAP	2016 CAP Inventory
Gasoline	Gallons	100,691	100,691	94,211
Diesel	Gallons	7,787	7.787	5,302
CNG	Gallons	882	882	3,301
Diesel Emission factor	lbs CO_2/gallon (CH_4 and N_2O varies by Model Year)	22.51	22.51	22.51
Gasoline Emission factor	lbs CO_2/gallon (CH_4 and N_2O varies by Model Year)	19.36	19.36	19.36
CNG Emission factor	lbs CO_2/gallon (CH_4 and N_2O varies by Model Year)	16.05	16.05	16.05
Off-Road Transportation (non-maritime)				
Recreational Boating				
Diesel Fuel Consumption	Gallons	297,053	4,420,412	3,960,169
Diesel Fuel Emissions factor	lbs CO_2e/gallon	21.66	22.87	22.87
Gasoline Fuel Consumption	Gallons	10,684,612	1,357,941	1,627,106
Gasoline Fuel Emissions factor	lbs CO_2e/gallon	15.93	19.16	19.16
Offroad Equipment (at non-maritime tenants)				
Gasoline Fuel Consumption (gallons) - Yacht Clubs, Marinas, fishing, other commercial	Gallons	114,747	114,747	109,040
Diesel Fuel Consumption - Lumber	Gallons	39,966	39,966	22,695
LPG Fuel Consumption - Lumber	Gallons	12,174	12,174	7,025
Diesel Fuel Consumption - Shipyards	Gallons	596,477	194,835	168,927
Propane Fuel Consumption - Shipyards	Gallons	-	15,244	12,449
Gasoline Fuel Consumption - Shipyards	Gallons	-	916	901
Diesel Fuel Consumption - Boatyards	Gallons	57,670	39,966	47,774
Propane Fuel Consumption – Boatyards	Gallons	16,809	12,174	13,983
Diesel Fuel Consumption - Gen Sets	Gallons	75,517	75,517	75,695
Diesel Fuel Emissions factor	lbs CO_2e/gallon	22.58	22.77	22.77
Gasoline Fuel Emissions factor	lbs CO_2e/gallon	19.60	19.16	19.16
Propane Fuel Emissions factor	lbs CO_2e/gallon	12.94	12.78	12.78
LPG Fuel Emissions factor	lbs CO_2e/gallon	13.05	12.92	12.92
Maritime				
Vessel Calls	Calls	530	530	420
Hotel Duration	Hours	41.0	41.0	28.1
CHC Main Hours	Engine Hours	200,746	200,746	75,946

Sector and Parameters	Units	Original 2006 CAP	Recalibrated 2006 CAP	2016 CAP Inventory
CHC Auxiliary Hours	Engine Hours	128,415	128,415	204,899
CHE Hp-Hrs (in millions)	Horsepower-Hours	1,952	1,952	1,154
Rail Line-Haul Fuel	Gallons	235,297	235,297	194,791
Rail Switching Hours	Hours	3,510	3,510	3,225
OGV and CHC Emission Factor	g CO_2e/ hp-hr	varies by type, engine speed, and fuel		
CHE Emission Factor	g CO_2e/ hp-hr	varies by type, engine speed, and fuel		
Rail Line-Haul Diesel Emission Factor	g CO_2e/ hp-hr	496	496	496
Rail Switcher Diesel Emission Factor	g CO_2e/ hp-hr	496	496	684
Port Operations				
Diesel	Gallons	42,151	42,151	55,601
Gasoline	Gallons	17,155	17,155	15,833
Propane	Gallons-Equivalent	1,109	1,109	0
Diesel Emissions factor	lbs CO2e/gallon	22.58	22.58	22.70
Gasoline Emissions factor	lbs CO2e/gallon	19.6	19.6	19.52
Propane Emissions factor	lbs CO2e/gallon	12.94	12.94	12.86
Water use				
Water Consumption - Indoor	Million Gallons	2,692	2,692	2,859
Water Consumption - Outdoor	Million Gallons	244	244	272
Electricity consumption	MWh	37,763	37,763	40,252
Emissions factor	lbs CO_2e/kWh	782.07	782.27	533.52
Solid Waste				
Waste Generation	Tons	16,629	16,629	22,001
Emissions factor	MTCO_2e/ton waste	1.01	1.16	0.97

Attachment A: *Methods and Data Differences Between 2006 CAP Baseline, Recalibrated 2006 Baseline, and 2016 CAP Inventory*

Attachment A

Methods and Data Differences Between CAP 2006 Baseline, Recalibrated 2006 Baseline, and 2016 CAP Inventory

		CAP 2006 Baseline		Recalibrated 2006 Baseline		2016 CAP Inventory	
Category	**Detail**	**Method**	**Data Used**	**Method**	**Data Used**	**Method**	**Data Used**
Electricity							
Tenant SDG&E Access	Activity	Combination of default consumption for buildings and consumption information from participating representative tenants	478,166 MWh	Aggregated energy consumption for all tenants within the tidelands for 2006 and 2016 assuming 55% of electricity consumption is obtained through SDG&E	166,699 MWh	Aggregated energy consumption for all tenants within the tidelands for 2006 and 2016 assuming 55% of electricity consumption is obtained through SDG&E	180,150 MWh
	Emission Factor	SDG&E reporting (for CO_2) and California Climate Action Registry (CCAR) (for CH_4 and N_2O)	782.07 lbs/MWh	SDG&E reporting (for CO_2) and California Climate Action Registry (CCAR) (for CH_4 and N_2O); Same as CAP except change in GWP	782.27 lbs/MWh	SDG&E PUC Filing, for 2016, November 2017. Rate provided in CO_2e.	533.52 lbs/MWh
Tenant Direct Access	Activity (kwh)	N/A	N/A	Aggregated energy consumption for all tenants within the tidelands for 2006 and 2016 assuming 45% of electricity consumption is obtained through Direct Access	144,615	Aggregated energy consumption for all tenants within the tidelands for 2006 and 2016 assuming 45% of electricity consumption is obtained through Direct Access	152,590
	Emission Factor	N/A	N/A	Based on CPUC Decision: 15-08-006, converted from 0.379 $MTCO_2e/MWh$ – Does not change over time	835.55 lbs/MWh	Based on CPUC Decision: 15-08-006, converted from 0.379 $MTCO_2e/MWh$ – Does not change over time	835.55 lbs/MWh
Port SDG&E Access	Activity	Consumption provided by SDG&E	10,052 MWh	Consumption provided by SDG&E	10,052 MWh	Consumption provided by SDG&E	6,350 MWh
	Emission Factor	Same as Tenant SDG&E Access	782.07 lbs/MWh	Same as Tenant SDG&E Access	782.27 lbs/MWh	Same as Tenant SDG&E Access	533.52 lbs/MWh
Total Activity= Total Emissions=		*488,217 Megawatt-hours 173,192 $MTCO_2e$*		*321,366 Megawatt-hours 117,526 $MTCO_2ee$*		*339,090 Megawatt-hours 102,965 $MTCO_2e$*	
Natural Gas							
Tenant SDG&E Access	Activity	Combination of default consumption for buildings and consumption information from participating representative tenants	7,435,787 Therms	Aggregated energy consumption for all tenants within the tidelands for 2006 and 2016 assuming 9% of natural gas consumption is obtained through SDG&E (same as 2016)	2,687,962 Therms	Aggregated energy consumption for all tenants within the tidelands for 2006 and 2016 assuming 9% of natural gas consumption is obtained through SDG&E (same as 2006)	2,293,013 Therms
	Emission Factor	Based on 2009 General Reporting Protocol, page 60	11.71 lbs/therm	Based on same but updated General Reporting Protocol - US Weighted Average CO_2 rate (Table 12.1) and Commercial sector CH_4 and N_2O (Table	11.73 lbs/therm	Based on same but updated General Reporting Protocol - US Weighted Average CO_2 rate (Table 12.1) and Commercial sector CH_4 and N_2O (Table	11.73 lbs/therm

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Category	Detail	CAP 2006 Baseline		Recalibrated 2006 Baseline		2016 CAP Inventory	
		Method	**Data Used**	**Method**	**Data Used**	**Method**	**Data Used**
				12.9.2) from TCR's 2017 emission factor update		12.9.2) from TCR's 2017 emission factor update	
Tenant Direct Access	Activity	N/A	N/A	Aggregated energy consumption for all tenants within the tidelands for 2006 and 2016 assuming 91% of natural gas consumption is obtained through Direct Access (same as 2016). Assumes stationary sources (CP Kelco and Solar Turbines) are on direct access	9,790,046 Therms	Aggregated energy consumption for all tenants within the tidelands for 2006 and 2016 assuming 91% of natural gas consumption is obtained through Direct Access (same as 2006). Assumes stationary sources (CP Kelco and Solar Turbines) are on direct access	1,877,417 Therms
CARB Regulated Sources	Activity	Based on CP Kelco Cap & Trade Emissions Reporting for 2008; consumption estimated based on natural gas emission factor. Solar Turbines' first reporting was 2012	18,010,310 Therms	Same as CAP	18,010,310 Therms	Based on CP Kelco and Solar Turbines Cap & Trade Emissions Reporting for 2015; consumption estimated based on natural gas emission factor	21,583,715 Therms
	Emission Factor	Same as SDG&E access	11.7 lbs/therm	Same as SDG&E access	11.7 lbs/therm	Same as SDG&E access	11.7 lbs/therm
Port SDG&E Access	Activity	Consumption provided by SDG&E	61,524 Therms	Consumption provided by SDG&E	61,524 Therms	Consumption provided by SDG&E	27,319 Therms
	Emission Factor	Same as Tenant SDG&E Access	11.7 lbs/therm	Same as Tenant SDG&E Access	11.7 lbs/therm	Same as Tenant SDG&E Access	11.7 lbs/therm
Total Activity=		*25,507,621 Therms*		*30,549,842 Therms*		*25,781,464 Therms*	
Total Emissions=		*135,516 $MTCO_2e$*		*162,556 $MTCO_2e$*		*137,182 $MTCO_2e$*	
Non-Maritime On-Road Transportation							
	Activity	Estimated based on trip generation rates and trip lengths by land use type	501,926,317 VMT	Scaled down to 2006 based on regional VMT from EMFAC and the Port of SD to Regional VMT ratio from Series 13 study	213,589,748 VMT	Total Port of SD Origin-Destination VMT provided by SANDAG Series 13 Activity Based Model; Port of SD portion of regional VMT is 0.88%	242,896,591 VMT
	Emission Factor	San Diego region aggregated emission factor (average of all speeds) from EMFAC2007 for CY 2006	561.23 g/VMT	Based on Port-specific speeds from Series 13 and San Diego region emission factors by speed from EMFAC2017 for CY 2006	499.42 g/VMT	Based on Port-specific speeds from Series 13 and San Diego region emission factors by speed from EMFAC2017 for CY 2016	438.11 g/VMT
Total Activity=		*501,926,317 VMT*		*213,589,748 VMT*		*242,896,591 VMT*	
Total Emissions=		*281,697 $MTCO_2e$*		*106,672 $MTCO_2e$*		*106,414 $MTCO_2e$*	
Maritime On-Road Transportation							
Terminal Trucks	Activity	Estimated based on terminal gate counts and all trips assumed to start or end at air basin boundary	135,225 trips and 15,987,000 VMT	Same as CAP	135,225 trips and 15,987,000 VMT	Estimated based on terminal gate counts and origin/destination which varies by cargo type	72,759 trips and 6,649,080 VMT

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Category	Detail	CAP 2006 Baseline		Recalibrated 2006 Baseline		2016 CAP Inventory	
		Method	**Data Used**	**Method**	**Data Used**	**Method**	**Data Used**
	Emission Factor	San Diego Region heavy duty trucks, emission factors by speed for terminal travel, surface street travel, and freeway travel, from EMFAC2007 for CY 2006	Hard to decipher idling emission factor, but regional off-port average is 1,835 g/VMT	Same as CAP	Same as CAP	San Diego Region Drayage trucks ("T7 Other Port") , emission factors by speed (terminal and surface street travel) and by aggregate for (freeway travel) from EMFAC2007 for CY 2006	7,323 g/idle-hour, 2,033 g/vmt aggregate speed, rates by speed vary
Cars offloaded at NCMT	Activity	Estimated based on cars process and 1.5 miles driven from vessel to parking location	375,000 cars and 562,500 VMT	Same as CAP	375,000 cars and 562,500 VMT	Same as CAP but based on 2016 activity	430,356 trips and 645,53 4VMT
	Emission Factor	San Diego region for new light duty autos and trucks 10 mph travel speed from EMFAC 2007 in CY 2006 plus one cold start (e.g., >720 soak time)	789.6 g/VMT for travel, 209.0 g/start	Same as CAP	Same as CAP	San Diego region for new light duty autos and trucks 10 mph travel speed from EMFAC 2017 in CY 2016 plus one cold start (e.g., >720 soak time)	473.3 g/VMT for travel, 126.3 g/start
Passenger Cruise Ship Terminal	Activity	Estimated based personal vehicles, for-hire taxis, and shuttle buses based on assumed trip lengths (population centroid for all trips)	167 calls, 11,757,802 VMT	Not included	N/A	Not included	N/A
	Emission Factor	San Diego regional aggregated rates for light duty autos (for taxis and personal vehicles), medium duty vehicles (for shuttles), and motor coaches (for buses) from EMFAC 2007 in CY 2006	Varies, but overall average is 325.71 g/VMT	Not included	N/A	Not included	N/A
Total Activity=		*28,307,302 VMT*		*16,549,500 VMT*		*7,294,614 VMT*	
Total Emissions=		*33,777 $MTCO_2e$*		*29,947 $MTCO_2e$*		*14,325 $MTCO_2e$*	
Port On-Road Transportation							
	Activity	Fuel consumption provided by District	100,691 gallons of gasoline, 7,787 gallons of diesel, 882 gallons-equivalent of CNG	Same as CAP	Same fuel as CAP, but CAP did not include HFCs from air conditioning; air conditioning refrigerants based on TCR assumption of 1.5 kg per vehicle (prior to losses)	Fuel consumption and number of vehicles for refrigerants provided by Por;	94,211 gallons of gasoline, 5,302 gallons of diesel, 3,301 gallons-equivalent of CNG; air conditioning refrigerants based on TCR assumption of 1.5 kg per vehicle (prior to losses)

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Category	Detail	CAP 2006 Baseline		Recalibrated 2006 Baseline		2016 CAP Inventory	
		Method	**Data Used**	**Method**	**Data Used**	**Method**	**Data Used**
	Emission Factor	Based on 2009 General Reporting Protocol	CO_2 lbs/gallon (CO_2 only; CH_4 and N_2O vary by speed): Diesel = 22.51 Gas =19.36 CNG = 16.05	TCR Tables 13.1 (for all CO_2) and various tables for CH_4 and N_2O	lbs/gallon (CO_2 only; CH_4 and N_2O vary by speed): Diesel=22.51 Gas=19.36 CNG=16.05	TCR Tables 13.1 (for all CO_2) and various tables for CH_4 and N_2O	lbs/gallon (CO2 only; CH4 and N2O vary by speed): Diesel=22.51 Gas=19.36 CNG=16.05
Total Activity= Total Emissions		*109,360 gallons, 228 kg of refrigerants 1,045 $MTCO_2e$*		*109,360 gallons, 228 kg of refrigerants 1,045 $MTCO_2e$*		*102,814 gallons, , 288 kg of refrigerants 988 $MTCO_2e$*	
Recreational Boating Off-Road							
	Activity	Based on Countywide fuel and emission estimated from OFFROAD 2007, scaled down to Port/SD Bay	297,503 gallons of diesel, 10,684,612 gallons of gasoline	Fuel dock sales minus fueling from other CHC	4,420,412 gallons of diesel, 1,357,941 gallons of gasoline	Fuel dock sales minus fueling from other CHC	3,960,169 gallons of diesel, 1,627,106 gallons of gasoline
	Emission Factor	Based on OFFROAD emissions output	--	Based on GREET (for diesel and gasoline CO_2) and TCR Table 13.7 for Ship and Boat CH_4 and N_2O	lbs/gallon: Diesel=22.87 Gas=19.16	Same as Revised 2006	lbs/gallon: Diesel=22.87 Gas=19.16
Total Activity= Total Emissions=		*10,981,665 gallons of fuel 80,145 $MTCO_2e$*		*5,778,352 gallons of fuel 57,662 $MTCO_2e$*		*5,587,275 gallons of fuel 55,227 $MTCO_2e$*	
Non-Maritime and Non-Recreational Boating Off-Road Transportation							
Yacht Clubs, Lumber, Marinas, etc.	Activity	Fuel based on metrics for gallons per slip and gallons per SF for lumber	114,747 gallons of gasoline, 39,966 gallons of diesel, 12,174 gallons of LPG	Same as CAP	114,747 gallons of gasoline, 39,966 gallons of diesel, 12,174 gallons of LPG	Minor change due to reduce slip counts and reduced lumber yard SF	109,040 gallons of gasoline, 22,698 gallons of diesel, 7,025 gallons of LPG
Shipyards	Activity	Fuel Usage (0.129 gal/dsl/SF) based on 4,639,831 SF	596,477 gallons of diesel	Aggregated fuel consumption obtained from shipyards	194,835 gallons of diesel, 15,244 gallons of propane, 916 gallons of gasoline	Aggregated fuel consumption obtained from shipyards	168,927 gallons of diesel, 12,449 gallons of propane, 901 gallons of gasoline
Boatyards	Activity	Fuel Usage (0.041 gal/dsl/SF and 0.012 gal/propane/SF) based on 1,392,465 SF	57,670 gallons of diesel, 16,809 gallons of propane	Same as CAP, but minor change in emissions due to update to emission factor	57,670 gallons of diesel, 16,809 gallons of propane	Same as CAP; fuel usage (0.041 gal/dsl/SF and 0.012 gal/propane/SF) based on change in SF (1,165,223 SF) plus update to emission factor	47,774 Gallons of diesel,13,983 gallons of propane
Event Generators	Activity	Based on tenant feedback	75,517 Gallons of diesel	Same as CAP	75,517 Gallons of diesel	2016 interpolated between 2006 and 2020 CAP numbers	75,695 Gallons of diesel

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Category	Detail	CAP 2006 Baseline		Recalibrated 2006 Baseline		2016 CAP Inventory	
		Method	**Data Used**	**Method**	**Data Used**	**Method**	**Data Used**
	Emission Factor	Based on 2009 General Reporting Protocol	lbs/gallon: Diesel=22.58 Gas=19.6 Propone=12.94 LPG = 13.05	Updated based on GREET (for diesel and gasoline CO_2), TCR Tables 13.1 (for propane CO_2) and 13.7 (for gasoline and diesel CH_4 and N_2O), and ICLEI Table TR.6.C.1 (for LPG and Propane CH_4 and N_2O)	lbs/gallon: Diesel=22.77 Gas=19.16 Propane=12.78 LPG = 12.92	Same as Recalibrated 2006	lbs/gallon: Diesel=22.77 Gas=19.16 Propane=12.78 LPG = 12.92
Total Activity= *Total Emissions=*		*913,360 gallons of fuel* *9,071 $MTCO_2e$*		*527,878 gallons of fuel* *5,064 $MTCO_2e$*		*458,489 gallons of fuel* *4,405 $MTCO_2e$*	
Maritime Off-Road Transportation							
Vessels	Activity	Activity for each sector obtained from various sources	530 calls, 41.0 hours of hoteling per call	Same as CAP, but emission revised per updated methods in 2012 maritime inventory	Same as CAP	Activity for each sector obtained from various sources	420 calls, 28.1 hours of hoteling per call
	Emission Factor	Emission factors vary by ship type and activity, but OGV emissions per call for disclosure here only	104 $MTCO_2e$ per call	Emission factors vary by ship type and activity, but OGV emissions per call for disclosure here only	74 $MTCO_2e$ per call	Emission factors vary by ship type and activity, but OGV emissions per call for disclosure here only	54 $MTCO_2e$ per call
Harbor Craft	Activity	Activity obtained primarily from tenants through the Port	107 pieces, 200,746 main engine hours, 128,415 aux engine hours	Same as CAP, but emission revised per updated methods in 2012 maritime inventory	Same as CAP	Activity obtained primarily from tenants through the Port with operational hours filled in with AIS data	169 pieces, 76,979 main engine hours, 222,747 aux engine hours
	Emission Factor	Varies by fuel and type	39 $MTCO_2e$ per call	Varies by fuel and type	43 $MTCO_2e$ per call	Varies by fuel and type	61 $MTCO_2e$ per call
Cargo Handling Equipment	Activity	Activity obtained primarily from tenants through the Port	126 pieces, 1,952 million hp-hrs of activity	Same as CAP	Same as CAP	Activity obtained primarily from tenants through the Port	134 pieces, 1,154 million hp-hrs of activity
	Emission Factor	Varies by fuel and type	6 $MTCO_2e$ per call	Varies by fuel and type	Same as CAP	Varies by fuel and type	5 $MTCO_2e$ per call
Rail	Activity	Activity obtained primarily through the Port	235,297 gallons line-haul, 3,510 hours of switching	Same as CAP	Same as CAP		194,791 gallons line-haul, 3,225 hours of switching
	Emission Factor	Based on 2005 EPA Emission Facts and 2003 EPA GHG Inventory	496 g/hp-hr for line-haul and switching, 6 $MTCO_2e$ per call	Same as CAP	Same as CAP	Based on EPA 2009 Locomotive Summary, 2017 TCR Emission Factors, and 2013 POLB inventory	496 g/hp-hr for line-haul, 684 g/hp-hr for switcher, overall 6 $MTCO_2e$ per call
Total Activity= *Total Emissions=*		*530 calls* *82,517 $MTCO_2e$*		*530 calls* *68,280 $MTCO_2e$*		*420 calls* *52,829 $MTCO_2e$*	
Port Off-Road Transportation							
	Activity	Fuel consumption provided by Port	42,151 gallons of diesel, 17,155 gallons	Same as CAP	Same as CAP	Fuel consumption provided by Port	55,601 gallons of diesel,

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Category	Detail	CAP 2006 Baseline		Recalibrated 2006 Baseline		2016 CAP Inventory	
		Method	**Data Used**	**Method**	**Data Used**	**Method**	**Data Used**
			of gasoline, 1,109 gallons of propane				15,833 gallons of gasoline
	Emission Factor	Based on 2009 General Reporting Protocol	lbs/gallon: Diesel=22.58 Gasoline=19.6 Propane=12.94	TCR Tables 13.1 (for all CO_2) and Table 13.7 for both construction equipment and boats CH_4 and N_2O	Same as CAP	TCR Tables 13.1 (for all CO_2) and Table 13.7 for both construction equipment and boats CH_4 and N_2O	lbs/gallon-offroad: Diesel =22.70 Gas=19.52 Propane=12.86 lbs/gallon-ships: Diesel =22.78 Gas=19.52
Total Activity= *Total Emissions=*		61,769 *gallons* *591 $MTCO_2e$*		61,769 *gallons* *591 $MTCO_2e$*		71,434 *gallons* *715 $MTCO_2e$*	
Water							
	Activity	Combination of default consumption by land use and information from participating representative tenants	2,692 Million Gallons indoor, 244 Million Gallons outdoor	Same as CAP	Same as CAP	No change from CAP; 2016 estimated by interpolating between CAP's 2006 and 2020 consumption and adjusting emissions for RPS	2,859 Million Gallons, 272 Million Gallons outdoor
	Emission Factor	Same as SDG&E electricity	782.07 lbs/MWh	Same as SDG&E electricity	782.27 lbs/MWh	Same as SDG&E electricity	533.52 lbs/MWh
Total Activity= *Total Emissions=*		*2,936 million gallons* *13,166 $MTCO_2e$*		*2,936 million gallons* *13,169 $MTCO_2e$*		*3,131 million gallons* *9,741 $MTCO_2e$*	
Waste							
	Activity	Combination of default consumption by land use and information from participating representative tenants	16,629 tons	No change in consumption or emissions, but adjusted CO_2e emissions to update for AR4 (CAP used SAR);	16,629 tons	2016 estimated by interpolating between CAP's 2006 and 2020 consumption and emissions	22,001 tons
	Emission Factor	Methods taken from CalEEMod, using guidance from IPCC, ARB, and collection efficiency of 67% for 2006 and 80% for 2020	1.01 MT/ton	Same as CAP	1.16 MT/ton	No change from CAP; 2016 estimated by interpolating between CAP's 2006 and 2020 emission factor, which reduce over time due to the increase in collection efficiency assumed for 2020	0.97 MT/ton
Total Activity= *Total Emissions=*		*16,629 tons* *16,757 $MTCO_2e$*		*16,629 tons* *19,239 $MTCO_2e$*		*22,001 tons* *21,346 $MTCO_2e$*	

Attachment B: *Acronyms and Abbreviations*

Attachment B
Acronyms and Abbreviations

AR4	IPCC Fourth Assessment Report
ARB	Air Resources Board
CalEEMod	California Emission Estimator Model
CAP	Climate Action Plan
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CH_4	Methane
CHC	Commercial Harbor Craft
CHE	Cargo Handling Equipment
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CPUC	California Public Utilities Commission
CST	Cruise Ship Terminal
EMFAC	Emission Factor Model
EPA	Environmental Protection Assessment
GHG	Greenhouse Gas
GIS	Geographic Information System
GWP	Global Warming Potential
IPCC	International Panel on Climate Change
KWh	Kilowatt hour
MWh	Megawatt hour
N_2O	Nitrous oxide
NCMT	National City Marine Terminal
OGV	Ocean Going Vessel
SANDAG	San Diego Association of Governments
SAR	IPCC Second Assessment Report
SDG&E	San Diego Gas and Electric
TAMT	Tenth Avenue Marine Terminal
TCR	The Climate Registry
VMT	Vehicle Miles Traveled

Attachment C: *June 2016 Climate Action Plan, GHG Inventory Update*

RAMBOLL ENVIRON

ENVIRONMENT & HEALTH

MEMO

Date: June 28, 2016

To: Port of San Diego

From: Ramboll Environ US Corporation

Subject: **CLIMATE ACTION PLAN, GHG INVENTORY UPDATE**

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PURPOSE OF INVENTORY UPDATE

The Port of San Diego (POSD or "the Port") Climate Action Plan (CAP) establishes an implementation framework and corresponding timeline for evaluating performance and progress against the greenhouse gas (GHG) reduction goals of 10% less than 2006 levels by 2020 and 25% less than 2006 levels by 2035. This timeline incorporates periodic progress reports and GHG inventory updates to allow the Port to ensure the CAP remains current and effective at reducing GHG emissions. In support of such ongoing monitoring, Ramboll Environ US Corporation ("Ramboll Environ") prepared an updated GHG inventory for District-wide 2013 operations and corresponding progress reports for affected reduction categories.

UPDATED BASELINE INVENTORY

Additionally, an updated baseline GHG inventory (for 2006) was prepared to incorporate refined data, as available. This step was conducted to allow for accurate progress reporting. When evaluating progress, it is important to understand changes in methodology or significant changes in sources of data. When such changes occur, comparisons should be made to a modified baseline, reflecting the same changes in methodology and/or data sources, when possible. In this way, reductions and/or increases that are seen are reflective of changes in activity, operations, or other tenant initiatives, and are not washed out by any impact due to changes in methodology and/or data sources.

REFINED DATA ELEMENTS

The updated GHG inventories presented in this memorandum incorporate the following refined data elements:

1. District-wide 2013 electricity and natural gas data provided by San Diego Gas & Electric (SDG&E);
2. 2006 electricity and natural gas data provided by SDG&E, or otherwise extrapolated from refined 2013 data;
3. 2012 maritime air emissions (assumed representative of 2013 operations); and
4. Updated 2006 maritime air emissions, due to the availability of more current

data and methods.

Emissions associated with non-maritime on-road transportation, non-maritime off-road equipment, recreational boating, water use, and waste remained consistent with the CAP, as refined activity data were not available.

Tenant Reconciliation Efforts

To enable the use of refined SDG&E electricity and natural gas data, the Port, Ramboll Environ, and SDG&E performed a reconciliation of Port tenants with available SDG&E records. To maintain data confidentiality, all reconciliation efforts involving the Port were completed without the use or access to tenant-specific electricity or natural gas data. Tenant reconciliation included both Master Tenants and sub-tenants, as applicable. The overall process undertaken is outlined below (with responsible entities shown in parentheses):

- The Port provided SDG&E with geographic information system (GIS) data representing the Port's jurisdictional boundaries (Port).
- SDG&E pulled available electricity and natural gas accounts within the geographic boundary defined above (SDG&E).
- SDG&E accounts were reviewed and matched to Port tenants based on Account/Customer name and/or address (Ramboll Environ).
- Matched accounts were then compared to the original tenant list in the CAP to determine if tenants were excluded from SDG&E records (Ramboll Environ).
- Unmatched SDG&E accounts were reviewed to determine if they were outside of the Port's jurisdiction or should otherwise be excluded (e.g., any residential accounts were removed) (SDG&E).
- Unmatched tenants from the original CAP or unmatched SDG&E accounts which appeared to be in the Port's jurisdiction were reviewed by Port and SDG&E staff. Tenants and/or accounts familiar to District staff were kept in the inventory. Those accounts unfamiliar to Port staff were removed from the inventory.

Methodology for Incorporating Refined Data in Inventory Update

Electricity and Natural Gas Data

Refined electricity and natural gas data provided by SDG&E for tenants across Port tidelands were incorporated into the 2013 (updated) and 2006 (baseline) inventories as follows.

<u>2013 Electricity and Natural Gas data:</u>

1. SDG&E data reflecting 2013 District-wide operations were used when available[1]; or
2. Assumptions and methods consistent with the CAP inventory development were otherwise used.[2]

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[1] For subtenants under a Master Tenant, SDG&E data was used directly when available, otherwise the Master Tenant total was allocated between subtenants based on the original breakdown in the CAP.

[2] Assumptions and methods used in the original CAP inventory development are documented in Appendix B of the CAP: https://www.portofsandiego.org/public-documents/doc_view/5528-port-of-san-diego-climate-action-plan-appendices-combined.html. For example, this may include using the California Energy Commission (CEC) Commercial End-use Survey (CEUS) data, which provides energy intensities on a square footage basis for given land use types within a designated climate zone.

Of the 2013 totals, only 1% of electricity usage and <0.5% of natural gas usage (equating to <0.5% of the total emissions) were derived using the method in Step 2 above.

2006 Electricity and Natural Gas data:

1. SDG&E data reflecting 2006 District-wide operations were used when available and deemed complete (including tenant-provided data, as provided during the original CAP development)[3];
2. In cases where 2006 SDG&E data or tenant-provided data were not available or incomplete or invalid[4] and corresponding 2013 SDG&E data were available, calculated trends by tenant type (e.g., retail, office, hotel, etc.) were used to back cast 2013 usage to 2006[5]; or
3. Assumptions and methods consistent with the CAP inventory development were otherwise used.

Table 1 presents the trends used to back cast 2013 usage to 2006, per Step 2 above. The % change shown in Table 1 represents an average of calculated trends for the given tenant type.

Table 1: Electricity and Natural Gas Trends, SDG&E Data

Tenant Type [1]	Electricity	Natural Gas
	% Change from 2006 to 2013 (% of Total Revised 2006 Inventory using Trends)	
Retail	-21% (<1%)	No trend available (<1%)
Office	-9% (<1%)	5% (<1%)
Restaurant	-4% (<1%)	-7% (<1%)
Lodging	-2% (17%)	5% (4%)
Museums	No trend available (1%)	No trend available (not used)
Rental Car	0.4% (<1%)	81% (<1%)
Yacht Club	21% (<1%)	11% (<1%)
Marina	-4% (1%)	-8% (<1%)
Sportfishing	-10% (<1%)	56% (not used)
Commercial Fishing	-9% (not used)	No trend available (<1%)
Excursions	No trend available (<1%)	No trend available (<1%)
Petroleum	27% (<1%)	No trend available (<1%)
Boatyard	-17% (<1%)	-46% (<1%)

[3] For subtenants under a Master Tenant, SDG&E data was used directly when available and deemed complete, otherwise the Master Tenant total was allocated between subtenants based on the original breakdown in the CAP.

[4] 2006 records were deemed incomplete or invalid when there was greater than 100% absolute change between years 2006 and 2013, excluding cases where data was received directly from the tenant.

[5] For example, if a lodging tenant in 2006 did not have available electricity or natural gas data or was considered incomplete/invalid but there was 2013 electricity and natural gas data available, then 2006 data was back cast as follows: 2006 data = 2013 data / (1 + % shown in Table 1). [% shown in Table 1 is expressed as a decimal in the latter formula.] Therefore if a hotel had 100 kWh of usage in 2013, 2006 usage would be estimated as 102 kWh. If Table 1 indicates "No trend available" (i.e., valid data was not available in both 2006 and 2013 for the given tenant type), 2006 usage was assumed equivalent to 2013 usage.

Table 1: Electricity and Natural Gas Trends, SDG&E Data		
Tenant Type [1]	**Electricity**	**Natural Gas**
	% Change from 2006 to 2013 (% of Total Revised 2006 Inventory using Trends)	
Terminal Tenant	-4% (<1%)	-53% (<1%)
Ship Building	25% (18%)	73% (1%)
Industrial	-0.2% (<1%)	2% (not used)
Other	6% (<1%)	28% (not used)

Notes:
[1] Tenant types presented here are consistent with those presented in Appendix B of the CAP.

Tables 2a through 2d present the electricity and natural gas usage totals (in kWh and therms, respectively), for the original 2006 inventory (for comparison), the revised 2006 inventory, and the updated 2013 inventory. Totals are characterized by tenant types, both using the original CAP categories (Tables 2a and 2b) and consistent with categories currently being considered for aggregation under the Utility Usage Reporting Ordinance (Ordinance #2844) (Tables 2c and 2d).

Table 2a: Summary of Electricity Usage (Original CAP Categories)			
Tenant Category	**Electricity (kWh)**		
	2006 (Original)	**2006 (Revised)**	**2013**
Retail	1,030,350	1,234,096	1,776,716
Office	880,272	654,067	660,951
Restaurant	10,870,521	10,521,361	9,979,875
Lodging	102,616,720	106,618,499	112,968,064
Warehouse/Storage	526,412	4,091,622	4,517,056
Museums	501,639	2,472,971	2,472,971
Rental Car	838,346	3,160,320	2,868,163
Yacht Club	7,201,941	2,828,011	3,136,010
Marina	17,576,780	11,626,562	11,690,827
Sportfishing	295,990	543,248	544,798
Commercial Fishing	669,814	476,968	527,001
Excursions	89,190	1,548,879	1,466,521
Petroleum	271,286	360,639	459,106
Boatyard	3,686,085	2,569,467	2,002,551
Terminal Tenant	16,539,033	15,817,563	10,066,943
Ship Building	263,367,151	83,215,870	103,667,934

Table 2a: Summary of Electricity Usage (Original CAP Categories)			
Tenant Category	**Electricity (kWh)**		
	2006 (Original)	**2006 (Revised)**	**2013**
Industrial	30,341,154	27,808,722	37,888,917
Other	20,863,068	35,765,156	26,842,351
Port Owned/Operated	10,051,718	10,051,718	7,315,304
Total	**488,217,470**	**321,365,741**	**340,852,059**

Table 2b: Summary of Natural Gas Usage (Original CAP Categories)			
Tenant Category	**Natural Gas (therms)**		
	2006 (Original)	**2006 (Revised)**	**2013**
Retail	1,624	1,907	1,890
Office	12,998	23,085	23,527
Restaurant	439,542	621,077	581,390
Lodging	3,736,469	2,937,797	3,599,425
Warehouse/Storage	2,416	0	0
Museums	12,939	0	0
Rental Car	1,278	1,973	3,571
Yacht Club	21,694	59,649	66,499
Marina	60,885	68,137	74,297
Sportfishing	3,359	3,688	5,745
Commercial Fishing	5,444	645	0
Excursions	2,859	2,854	5
Petroleum	872	107	107
Boatyard	6,545	2,135	1,037
Terminal Tenant	93,961	78,935	39,276
Ship Building	5,265	364,306	533,712
Industrial	20,794,573	26,092,731	19,098,498
Other	243,375	229,293	275,797
Port Owned/Operated	61,524	61,524	40,336
Total	**25,507,621**	**30,549,842**	**24,345,113**

Table 2c. Summary of Electricity Usage (Utility Usage Reporting Ordinance Categories)

Tenant Category	Electricity (kWh)		
	2006 (Original)	2006 (Revised)	2013
Hotel (High Rise) with/without marina	87,981,366	97,125,131	103,445,765
Hotel (Low Rise) with/without marina	19,683,921	13,319,618	12,999,300
Commercial	31,114,835	50,894,010	41,555,010
Maritime Commercial	22,008,923	13,884,914	14,685,236
Maritime Industrial	314,315,189	133,907,161	158,672,245
Other	2,538,867	2,179,909	2,179,199
Port Owned/Operated	10,574,370	10,054,998	7,315,304
Total	**488,217,470**	**321,365,741**	**340,852,059**

Table 2d. Summary of Natural Gas Usage (Utility Usage Reporting Ordinance Categories)

Tenant Category	Natural Gas (therms)		
	2006 (Original)	2006 (Revised)	2013
Hotel (High Rise) with/without marina	3,133,336	2,436,387	3,085,897
Hotel (Low Rise) with/without marina	613,100	506,009	517,660
Commercial	605,774	785,325	790,489
Maritime Commercial	119,403	152,955	165,997
Maritime Industrial	20,904,078	26,538,631	19,673,113
Other	67,271	68,961	71,620
Port Owned/Operated	64,659	61,572	40,336
Total	**25,507,621**	**30,549,842**	**24,345,113**

Of the revised 2006 totals, approximately 40% of electricity usage and 5% of natural gas usage (equating to approximately 19% of the total emissions) were derived using methods in Steps 2 and 3 above. This represents a significant improvement in the use of refined data as compared to estimates in the original baseline inventory of the CAP.

When calculating GHG emissions associated with the refined electricity and natural gas usages, emission factors were kept consistent with the CAP inventory development with the following update:

1. 2013 electricity CO_2 emission factor was updated to account for the 2013 SDG&E Renewables Portfolio Standard (RPS) procurement percentage of 23.6%.[6]

Total electricity and natural gas use and corresponding GHG emission factors for 2006 and 2013 are shown in Table 3.

Table 3. 2006 and 2013 Electricity Use, Natural Gas Use, and Emission Factors

Year	Sector	Usage	Units	Emission Factor (EF) (lbs CO_2e/Unit)	EF Source
2006 (Original)	Electricity	488,217	MWh	782	SDG&E[1]
	Natural Gas	25,507,621	therm	11.7	CCAR GRP[2]
2006 (Revised)	Electricity	321,366	MWh	782	SDG&E[1]
	Natural Gas	30,549,842	therm	11.7	CCAR GRP[2]
2013	Electricity	340,852	MWh	634	SDG&E[3]
	Natural Gas	24,345,113	therm	11.7	CCAR GRP[2]

Notes:

[1] See Appendix B of the CAP for additional details regarding the derivation of this emission factor. As shown in Table EF-2 of Appendix B of the CAP, the % of total energy from renewables in 2006 was 6%.

[2] California Climate Action Registry (CCAR). 2009. General Reporting Protocol (GRP), Version 3.1. See Appendix B of the CAP for additional details.

[3] Methods for calculating the emission factor are consistent with the CAP, with the RPS procurement percentage updated to 23.6% for 2013 operations.

Maritime Activity Data

The maritime emissions inventory includes the following source categories: ocean-going vessels (OGVs), harbor craft, cargo handling equipment, rail locomotives, and on-road vehicles. Updates to the 2012 and 2006 maritime air emissions, and related methodology are described in detail in the 2012 Maritime Air Emissions Inventory Report (June, 2014).[7] The updated 2006 inventory accounts for a revised calculation of OGV and harbor craft source categories to incorporate more current data and methods.

To account for the increase in electricity use associated with 2012 shorepower operations at the Cruise Ship Terminal, corresponding GHG emissions were calculated and added to the OGV category. An electricity emission factor for such shorepower usage was developed specific to 2012 operations, using a SDG&E RPS procurement percentage of 20.31%.

---

[6] The RPS percentage is combined with the non-renewable energy emission factors developed from the 2006-2008 Power/Utility Protocol (PUP) Reports (California Climate Action Registry Database: San Diego Gas and Electric Company), consistent with CAP methods. 2013 RPS procurement percentage is available online here: http://www.cpuc.ca.gov/General.aspx?id=3856 [San Diego Gas & Electric 2013 Preliminary Annual 33% RPS Compliance Report. July 29, 2014]

[7] 2012 Maritime Air Emissions Inventory. Available online at: https://www.portofsandiego.org/environment.html?start=12.

Summary of GHG Inventory Update

Table 4 shows the original 2006 inventory (for comparison) as well as the updated inventories for 2006 and 2013, incorporating the refined data elements discussed above. The 2012 Maritime Air Emissions Inventory was assumed to be representative of 2013 operations, for purposes of representing a complete inventory.

In cases where refined data were not available, the following methodology was used:

1. 2006: Emissions were kept consistent with the CAP.[8]
2. 2013: Emissions, as estimated in the CAP, were assumed to progress linearly from 2006 to 2020. This correlation was then used to interpolate 2013 emissions for non-refined categories.

Table 4. 2006 and 2013 Inventories

Sector	2006 (Original)	2006 (Revised)	2013
	(metric tons CO_2e/year)		
Electricity	173,192	114,002	98,006
Natural Gas	135,516	162,513	129,506
Transportation: Onroad[1]	314,870	314,870	292,704
Transportation: Offroad Vehicles, Vessels, Equipment, Locomotives[2]	172,929	158,691	148,741
Water Use[3]	13,166	13,166	11,786
Waste[3]	16,757	16,757	18,598
Total Emissions	**826,429**	**780,000**	**699,341**

Notes:
[1] Methods 1 and 2 were used for emissions from non-maritime based on-road activity.
[2] Methods 1 and 2 were used for emissions from non-maritime based off-road activity.
[3] Methods 1 and 2 were used for all emissions from the water and waste categories.

Progress Report Summary

As presented and discussed in the CAP, proposed policies and measures were evaluated by sector to help the Port reach the overall GHG emission reduction targets (10% less than 2006 by 2020 and 25% less than 2006 by 2035). Sectors that were targeted include Transportation and Land Use, Energy Conservation and Efficiency, Alternative Energy Generation, Water Conservation and Recycling, Waste Reduction and Recycling, and Miscellaneous.

As refined data were evaluated for electricity, natural gas, and maritime operations, a progress summary was prepared for the (1) Transportation and Land Use category and the (2) Energy Conservation and Efficiency category.

[8] See Appendix B of the CAP for additional details of the methods used in the original baseline (2006) inventory development. https://www.portofsandiego.org/public-documents/doc_view/5528-port-of-san-diego-climate-action-plan-appendices-combined.html

Transportation and Land Use

Based on the refined 2006 and 2012 maritime emissions inventories, summarized in Table 5, the total reduction in emissions was compared against the targeted reduction for the Transportation and Land Use category, as identified in the CAP. This comparison, and the remaining reduction, are shown in Table 6.

Table 5. Comparison of 2006 and 2012 Maritime Emissions

Maritime Sector	2006 Emissions (Revised)	2012 Emissions
	(metric tons CO_2e)/year	
Ocean Going Vessels	38,975	20,458
Commercial Harbor Craft	22,785	21,216
Cargo Handling Equipment	4,039	1,524
Locomotive	3,084	2,896
Heavy Duty Vehicles	33,173	13,220
Cruise Terminal Transportation		
Shorepower	N/A	253
Total	**102,056**	**59,567**
Reduction from 2006[1]	**42,000**	

Notes:

[1] Reduction is rounded to the nearest thousand. This is represented as Progress in Table 6.

Table 6. Transportation and Land Use Progress Report

Sector	GHG Reduction Target[1]	Progress[2]	Remaining Reduction Target
	(metric tons CO_2e)/year[4]		
Transportation and Land Use	62,000	42,000	20,000

Notes:

[1] GHG reductions to meet the 2020 goal is roughly comprised of 62,000 MT from the Transportation and Land Use Source Category. Although this target is useful for planning purposes, overachievement of GHG emissions may be realized elsewhere (i.e., Energy Conservation and Efficiency or Alternative Energy Generation) thereby decreasing specific source category targets. The final measurement of whether the CAP goal is achieved will be an overall summary of greenhouse gas emissions reduction across all sectors equaling or exceeding 109,830 MT CO_2e/yr during CY 2020.

[2] Progress shown here represents the difference between the 2012 maritime emissions inventory (accounting for activity and regulation at that time) and the revised 2006 maritime emissions inventory. As this is being compared to the overall reduction target which is based on 2020 emissions, this assumes the level of maritime activity will remain constant through 2020.

[4] Values are rounded to the nearest thousand.

While the progress shown above is reflective of 2012 maritime operations, it is important to note that the CAP goals are set with reference to year 2020. As such, there may be operational changes, such as growth in maritime business, which may influence the progress determination moving forward.

Energy Conservation and Efficiency

Using the refined electricity and natural gas data for 2013 and 2006 operations, the total reduction in emissions was compared against the targeted reduction for the Energy Conservation and Efficiency category, as identified in the CAP. Additionally, since the GHG reduction target is defined for year 2020, energy associated with new development projects anticipated for completion between 2014 and 2020 (referred to as "Future Projects (2014 – 2020)") were incorporated in the total electricity and natural gas use,[9] for comparison with 2006 levels. A list of future projects, including those identified for completion between 2014 and 2020 are shown in Table 7.

Table 7. Future Projects

Future Project	Completed before or during 2013?	Future Project (2014-2020)	Notes
Chula Vista Bayfront Master Plan	Master Plan complete, No construction	Yes (construction portion)	1
South Bay Power Plant Decommissioning	Yes	--	1
Dole	N/A (Assumed to stay)	--	1
TAMT Redevelopment	Demolition complete, No construction	Yes (construction portion)	1
Pier 32 Marina	Yes	--	1
National City Aquatic Center	No	Yes	1
Convention Center Expansion	No	Yes	1
Hilton San Diego Bayfront Hotel	Yes	--	1
San Diego Marriott Expansion/Redevelopment	No	Yes	1
Ferry Landing Restaurants (Candela's)	Yes	--	1
Coronado Ferry Landing Restaurant Pad	No	Yes	1
Coronado Yacht Club Redevelopment	No	Yes	1
North Embarcadero Visionary Plan	No	Yes	1
Lane Field	No	Yes	1
Broadway Pier Cruise Terminal	Yes	--	1
Grape St. Parking Lot/Redevelopment	No	Yes	1
Bay Café Redevelopment	No	Yes	1

[9] The incorporation of projects anticipated for completion prior to 2020 is consistent with the development of future inventories in the CAP, and includes both the addition of new land uses and the removal of existing land uses. See Appendix B of the CAP for additional details of the methods used.

Table 7. Future Projects

Future Project	Completed before or during 2013?	Future Project (2014-2020)	Notes
Convis Redevelopment	No	Yes	[1]
Ruocco Park	Yes	--	[1]
Palm St Intermodal Site Redevelopment	No	Yes	[1]
Tom Ham's Lighthouse Renovation	Yes	--	[1]
ACH Parking Structure	No	Yes	[1]
Atlas Kona Kai Resort Expansion/Remodel	No	Yes	[1]
Island Palms Expansion	Yes	--	[1]
Jimmy's Famous American Tavern	Yes	--	[1]
Point Loma Marina Expansion	Yes	--	[1]
Point Loma Seafoods Redevelopment	Yes	--	[1]
Removal of Bay Café	No	Yes	[2]
Removal of Harbor Excursion Shack	No	Yes	[2]
Removal of Marine Terminals Corp	No	Yes	[2]

Notes:

[1] Refer to the "Future Project List" excel file for additional details on these projects. The timeline and status of these future projects was assumed at the time of writing.

[2] Removal of these tenants were not incorporated in the original CAP, but were identified during this progress report update.

The combined electricity and natural gas totals are shown in Table 8. Corresponding emissions are shown in Table 9, for comparison with 2006 levels. This comparison, and the remaining reduction, are shown in Table 10. Total 2013 emissions and the emissions estimated from future projects are used to develop the progress report in Table 10.

Table 8. 2013, Future Projects (2014-2020), and 2013 + Future Projects (2014-2020), Electricity Use, Natural Gas Use, and Emission Factors

Year	Sector	Usage	Units	Emission Factor[1]	Units	EF Source
2013	Electricity	340,852	MWh	634	lb/MWh	SDG&E
	Natural Gas	24,345,113	therm	11.7	lb/therm	CCAR GRP
Future Projects (2014-2020)[2]	Electricity	76,343	MWh	634	lb/MWh	SDG&E
	Natural Gas	2,479,551	therm	11.7	lb/therm	CCAR GRP
2013 + Future Projects (2014-2020)	Electricity	417,195	MWh	634	lb/MWh	SDG&E
	Natural Gas	26,824,664	therm	11.7	lb/therm	CCAR GRP

Notes:

[1] Emission factors from 2013 are used to assess current progress.

[2] Future Projects (2014-2020) includes both projects anticipated for completion between 2014 and 2020 as of the time of writing and removal of tenants identified as leaving the Port's jurisdiction between 2014 and 2020.

Table 9. Comparison of 2006, 2013, and 2013 + Future Projects (2014-2020) Electricity and Natural Gas Emissions

Sector	2006 Emissions (Revised)	2013 Emissions	2013 + Future Projects (2014-2020) Emissions
	(metric tons CO_2e)/year		
Electricity	114,002	98,006	119,957
Natural Gas	162,513	129,506	142,696
Total	**276,515**	**227,512**	**262,653**
Reduction from 2006[1]	**--**	**49,000**	**14,000**

Notes:

[1] Reduction is rounded to the nearest thousand. This is represented as Progress in Table 10.

Table 10. Energy Progress Report

Sector	GHG Reduction Target[1]	Progress[2]	Remaining Reduction Target[3]
	(metric tons CO_2e)/year[4]		
Energy Conservation & Efficiency	22,000	14,000	8,000

Notes:

[1] GHG reductions to meet the 2020 goal is roughly comprised of 22,000 MT from the Energy Conservation and Efficiency Source Category. Although this target is useful for planning purposes, overachievement of GHG emissions may be realized elsewhere (i.e., Transportation and Land Use or Alternative Energy Generation) thereby decreasing specific source category targets. The final measurement of whether the CAP goal is achieved will be an overall summary of greenhouse gas emissions reduction across all sectors equaling or exceeding 109,830 MT CO_2e/yr during CY 2020.

[2] Progress here represents the difference between the 2013 + future projects (2014-2020) electricity and natural gas emissions inventory and the revised 2006 electricity and natural gas emissions inventory. As this is being compared to the overall reduction target which is based on 2020 emissions, it accounts for future projects anticipated for completion between 2014 and 2020, but conservatively does not account for further impacts of regulation (beyond 2013).

[3] The Remaining Reduction Target shows the difference between the GHG Reduction Target and the Progress shown.

[4] Values are rounded to the nearest thousand.

Similar to what is discussed above for maritime operations, an important consideration when interpreting these progress reports is that results may be driven by changes in operation that are not related to permanent reductions, but could instead reflect other circumstances such as economic conditions.

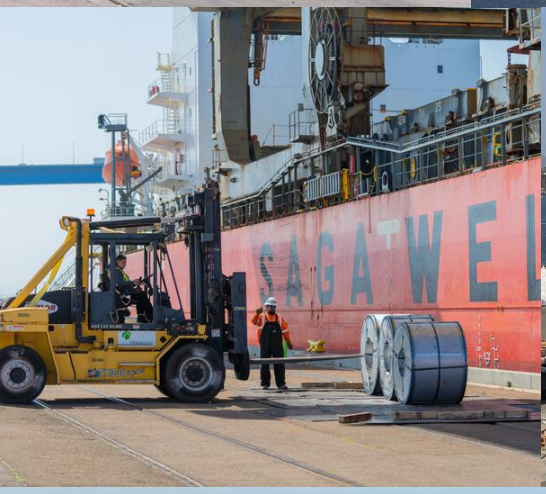
Ongoing Monitoring

As discussed and demonstrated above, due to ongoing changes in operations within the Port tidelands, changing economic conditions, implementation of CAP measures, and other factors, continual tracking of progress towards CAP goals is an important step to ensuring the Port is on track. Accordingly, the implementation timeline in the CAP incorporates both future Port-wide inventory updates and additional interim progress reports.

Appendix D

2022 Maritime Air Emissions Inventory





Port of San Diego

2022 Maritime Air Emissions Inventory

June 2025

Prepared for:

PORT of SAN DIEGO Environment

Prepared by:

ASCENT

Assistance from:

ICF

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Metron Inc.
National Oceanic and Atmospheric Administration
Pacific Maritime Group
The Pasha Group
R.E. Staite Engineering
San Diego Bay Pilots Association
San Diego Mooring Company
San Diego Working Waterfront
Searles Valley Minerals
Sportfishing Association of California
SSA Marine
Terminalift

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ACRONYMS AND ABBREVIATIONS

AIS	Automatic Identification System
AR6	IPCC Sixth Assessment Report
bhp-hr	brake horsepower-hour
BNSF	Burlington Northern Santa Fe Railway
CAP	Climate Action Plan
CARB	California Air Resources Board
CH_4	methane
CHC	commercial harbor craft
CHE	cargo handling equipment
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CST	Cruise Ship Terminals
DPM	diesel particulate matter
EPA	U.S. Environmental Protection Agency
g	gram
g/gal	grams per gallon
g/hp-hr	grams per horsepower-hour
g/kWh	grams per kilowatt-hour
GHG	greenhouse gas
GIS	geographic information system
GT	gas turbine
GTM	gross-ton miles
GVWR	Gross Vehicle Weight Rating
GWP	global warming potential
hp	horsepower
hp-hr	horsepower-hour
I-	Interstate
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
kW	kilowatt
kWh	kilowatt-hour
MOU	Memorandum of Understanding
MSD	medium-speed diesel
MT	metric tons
MW	megawatts
MWh	megawatt-hours
N_2O	nitrous oxide
NCMT	National City Marine Terminal
nm	nautical mile
NO_x	nitrogen oxides
OGV	ocean-going vessel
PM10	particulate matter 10 micrometers or less in diameter
PM2.5	particulate matter 2.5 micrometers or less in diameter
Port	Port of San Diego
ppm	parts per million
ROG	reactive organic gas
RSD	Regulatory Support Document
SB	Senate Bill

SO_2	sulfur dioxide
SSD	slow-speed diesel
TAC	toxic air contaminant
TAMT	Tenth Avenue Marine Terminal
VMT	vehicle miles traveled
VOC	volatile organic compound
VSR	vessel speed reduction

1 EXECUTIVE SUMMARY

The Port of San Diego (Port) has prepared this maritime air emissions inventory for the purpose of identifying and quantifying the air emissions from maritime-related activities during calendar year 2022. The Port has conducted maritime air emissions inventories based on activity in calendar years 2006, 2012, 2016, and 2019. Emissions from this 2022 inventory are compared to activity and emissions in previous inventories herein.

This Executive Summary presents an overview of the results of the 2022 Maritime Air Emissions Inventory, as well as a comparison to previous maritime air emissions inventories in terms of activity and emissions over time.

In summary, emissions have decreased since 2006 because of a decrease in cargo activity as well as implementation of various regulations and new technologies that have acted to reduce emissions. However, since 2016, cargo throughput has varied year to year, but emissions are relatively flat, consistent with other West Coast ports. More discussion related to emission trends is provided below.

1.1 INTRODUCTION

The inventory includes emissions from the following Port-related source categories:

- Ocean-going vessels (OGVs)
- Commercial harbor craft (CHC)
- Cargo handling equipment (CHE)
- Freight rail
- Heavy-duty trucks

This inventory includes emissions of the following criteria pollutants:

- Particulate matter 10 micrometers or less in diameter (PM10) and 2.5 micrometers or less in diameter (PM2.5)
- Nitrogen oxides (NO_x)
- Sulfur dioxide (SO_2)
- Reactive organic gases (ROG)
- Carbon monoxide (CO)

This inventory includes emissions of the following toxic air contaminant: diesel particulate matter (DPM).

Additionally, the inventory includes emissions of the following greenhouse gases (GHGs):

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)

The emissions inventory update includes OGV, CHC, CHE, freight rail, and heavy-duty truck sources associated with activity at and related to the four marine terminals: Cruise Ship Terminals (CST; B Street Cruise Ship Terminal and Port Pavilion on Broadway Pier [Broadway Pavilion]), Tenth Avenue Marine Terminal (TAMT), and National City Marine Terminal (NCMT).

As noted above, the GHG inventory only includes the three GHG pollutants that are associated with mobile source fuel combustion. Moreover, all GHG emissions are reported as total carbon dioxide equivalent (CO_2e) values. This metric aggregates the three pollutants based on their century-long global warming potential (GWP), as determined by the Intergovernmental Panel on Climate Change's Sixth Assessment Report.[1] While all pollutant emissions are reported in short tons per year, GHG emissions are also presented in metric tons per year to be consistent with the Port's Climate Action Plan (CAP) as well as the Maritime Clean Air Strategy (MCAS).

1.2 SUMMARY OF 2022 INVENTORY

A summary of maritime emissions from all sectors in 2022 is provided in **Table 1**. Emission estimation methods are presented in Appendix A of this report. The emission estimation methodology is generally similar to those of previous maritime air emissions inventories, except for various revised methods as well as updated emission and

[1] For more information, see Table 7.15 of "Climate Change 2021: The Physical Science Basis," available at: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_FullReport_small.pdf.

load factors. These changes are discussed in Appendix A. Emission summaries from each sector are provided below.

Table 1. Summary of 2022 Maritime Air Emissions Inventory (tons)

Sector	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Ocean-Going Vessels	19.6	45.5	530.0	8.8	8.1	7.3	21.4	35,598	32,294
Harbor Craft	15.8	93.1	163.4	5.1	4.9	5.1	0.2	13,939	12,645
Cargo Handling Equipment	2.9	33.7	9.1	0.2	0.2	0.2	0.02	2,390	2,168
Freight Rail	1.8	7.0	28.9	1.1	1.1	1.1	0.5	2,701	2,450
Heavy-Duty Trucks	0.5	2.1	28.3	1.5	0.6	0.2	0.2	17,165	15,572
Total Emissions	**40.6**	**181.4**	**759.7**	**16.8**	**15.0**	**13.9**	**22.2**	**71,792**	**65,129**

1.3 EMISSIONS TRENDS

Since 2006, the first year in which the Port quantified emissions from its maritime activities, pollutants have been reduced across all sectors. **Table 2** summarizes the results of previous maritime inventories along with the 2022 inventory, and **Table 3** summarizes the percent change for each inventory year relative to the 2022 inventory. **Figure 1** shows the trend in emissions over time for each pollutant.

Table 2. Summary of Maritime Air Emissions Inventories (tons)

Year	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
2022	40.6	181.4	759.7	16.8	15.0	13.9	22.2	71,792	65,129
2019[1]	50.7	253.2	685.6	17.5	16.2	15.5	14.5	68,502	62,143
2016	58.6	260.7	652.9	17.4	16.5	15.9	17.9	74,330	67,431
2012	67.7	202.0	836.0	28.6	26.6	27.6	42.0	65,383	59,314
2006	108.7	436.0	1686.0	119.9	111.6	109.5	686.0	112,498	102,056

[1] Values for 2019 include adjustments to reflect revised OGV auxiliary engine loads, as described in Section 1.3.2, as well as revised CHE emission factors, as described in Section 3.3.

Table 3. Percent Change by Inventory Year Relative to 2022 Inventory

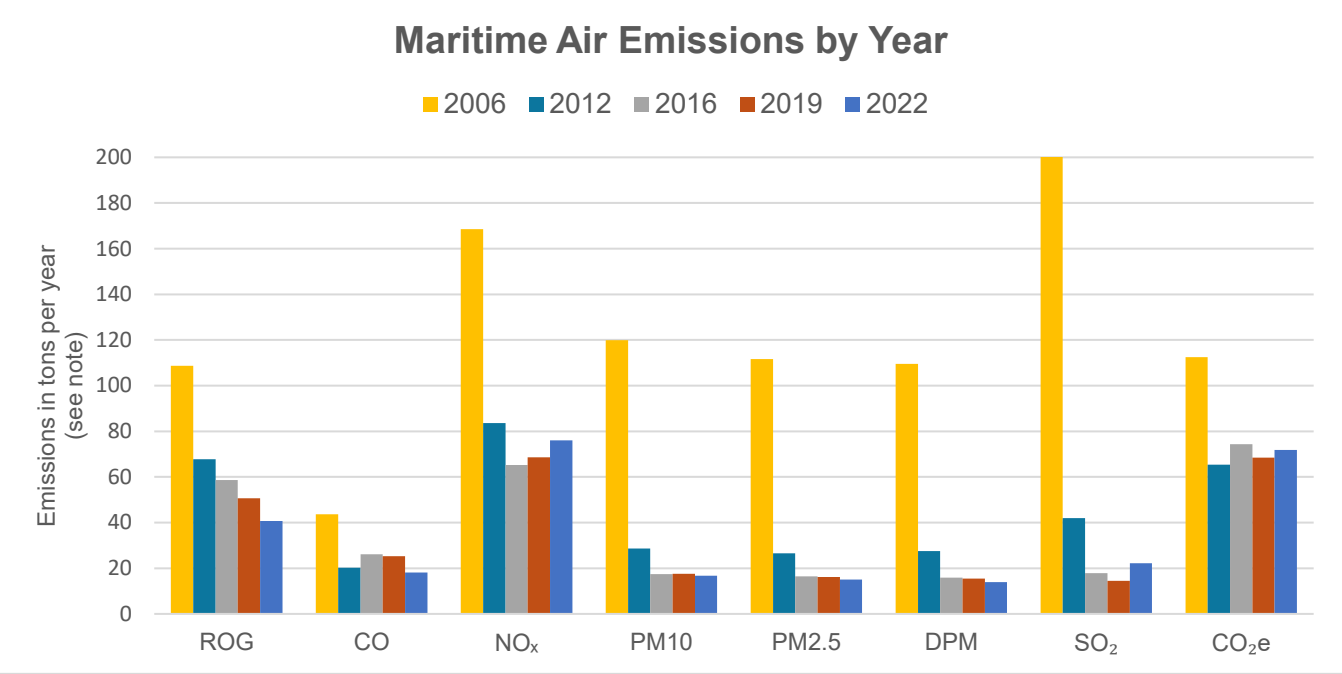
Year	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
2022	-	-	-	-	-	-	-	-	-
2019	-20%	-28%	+11%	-4%	-7%	-10%	+53%	+5%	+5%
2016	-31%	-30%	+16%	-4%	-9%	-13%	+24%	-3%	-3%
2012	-40%	-10%	-9%	-41%	-44%	-49%	-47%	+10%	+10%
2006	-63%	-58%	-55%	-86%	-87%	-87%	-97%	-36%	-36%

Emissions were highest in the 2006 inventory and have generally trended downward. While there has been variability between inventory years, emissions of every pollutant type have decreased substantially since 2006. Between 2006 and 2022, this includes a 55% reduction in NO_x, an 87% reduction in DPM, a 97% reduction in SO_2, and a 36% reduction in CO_2e emissions.

The reduction in pollutants is due to the Port's efforts to implement cleaner technologies and operations; regulations at the international, federal, state, and local levels; and varying activity levels. For instance, statewide regulations that require the use of low sulfur fuel in all marine and off-road engines as well as regulations that require the replacement or retrofit of CHC, CHE, and truck engines that operate at or near ports have led to cleaner engines and a reduction in emissions. In addition, the Port has implemented various programs to reduce emissions, including its Vessel Speed Reduction (VSR) Program, and has worked with tenants to replace their equipment with zero-emission equipment. As shown in Figure 1**,** since 2016, emissions have plateaued as technologies and fuels have been introduced to comply with regulations that largely went into effect in the mid-

2000's and early 2010's. Variations since 2016 appear to be a result of, in part, demonstration of new zero-emission equipment and annual changes in activity levels. This is consistent with emissions reporting from other ports in the region, such as the Port of Los Angeles.[2] As will be discussed, with the introduction of new regulations focused on maritime vessels, cargo handling equipment, and trucks, as well as the implementation of the Port's MCAS, emissions from maritime activity are expected to decrease following 2022 and throughout the 2020s.

Figure 1. Comparison of Maritime Air Emissions Inventories



Note: For presentation purposes, ROG, PM10, PM2.5, and DPM emissions are shown in tons per year; CO and NO_x emissions are shown in tons per year divided by 10; and CO_2e emissions are shown in tons per year divided by 1,000.

Table 4 summarizes the emissions by sector for each maritime inventory. As shown, emissions for each sector have decreased since 2006.

The trend in emissions over time is the result of changes in activity levels and the emissions profiles of the various activity types. It is important to note that activity levels are not static. The majority of cargo at the Port arrives by vessel. The number of vessel calls varies year to year, which in turn creates a cascading effect of different levels of activity for other maritime sources of emissions. Although activity levels play a significant role in the amounts of emissions generated from the maritime sector, regulations and new technologies that reduce criteria pollutant emissions have led to reductions of most emissions.

The NO_x, DPM, and GHG emissions trend charts in **Figure 2**, **Figure 3**, and **Figure 4**, respectively, show the relative proportions of emissions by source category for each year for which an emissions inventory has been prepared. The major sources of NO_x and DPM emissions are ocean-going vessels and commercial harbor craft, while the major sources of GHG emissions are ocean-going vessels, commercial harbor craft, and trucks. Notably, DPM emissions have decreased every year since 2006. Discussion of these trends is provided below.

Emissions have decreased since 2006. While the emissions for most categories vary year to year based on cargo throughput, 2022 emissions for each category are lower than they were in 2006. However, overall emissions have been relatively flat since 2016, although this varies by source type. This is consistent with reporting for other ports in the region, such as the Port of Los Angeles.[2] Emissions have decreased since 2006 because of various factors, including regulations implemented at the state level, programs implemented by the Port, and new technologies, all of which have acted to reduce emissions over time.

Cargo activity has decreased since 2006 but has been relatively flat since 2016. Table 5 summarizes maritime activity by year. As shown, activity was highest in 2006 and has been relatively flat in recent years. Compared to 2019, 2022 saw marginally higher cargo tonnage and a marginally lower number of OGV calls, while

[2] Port of Los Angeles. 2023. *Inventory of Air Emissions 2022*. https://kentico.portoflosangeles.org/getmedia/409590b5-0e6a-4c15-8d9b-fcdb02624933/2022_Air_Emissions_Inventory.

other indicators, such as hoteling hours on auxiliary engines for OGVs, increased relative to 2019. This data demonstrates that while some of the emissions trends can be explained by changes in activity levels, a full explanation requires further review. Overall, NO_x, SO_2, and GHG emissions are higher than in previous years, which is due primarily to activity at the Port's cruise terminals.

Table 4. Summary of Emissions by Sector for Each Inventory Year (tons)

Year	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
OGV									
2022	20	46	530	9	8	7	21	35,598	32,294
2019	13	31	327	5	5	4	13	23,923	21,703
2016	20	32	323	8	7	6	15	24,802	22,500
2012	21	31	368	9	9	8	41	22,551	20,458
2006	31	61	726	82	76	72	681	42,963	38,975
CHC									
2022	16	93	163	5	5	5	0.2	13,939	12,645
2019	34	200	284	9	9	9	0.4	25,495	23,128
2016	29	183	235	8	8	8	0.5	28,109	25,500
2012	40	136	362	15	14	15	0.2	23,387	21,216
2006	55	150	528	24	23	24	0.2	25,116	22,785
CHE									
2022	2.9	33.7	9.1	0.2	0.2	0.20	0.02	2,390	2,168
2019	1.2	11.3	8.3	0.3	0.3	0.30	0.01	2,274	2,063
2016	4.3	26.1	13.7	0.6	0.5	0.52	1.6	2,407	2,183
2012	1.1	10.0	12.0	0.3	0.3	0.27	<0.01	1,680	1,524
2006	4.0	43.0	33.0	1.0	0.9	0.90	<0.01	4,452	4,039
Rail									
2022	1.8	7.0	28.9	1.1	1.1	1.1	0.5	2,701	2,450
2019	1.9	7.5	30.3	1.2	1.2	1.2	0.5	2,916	2,646
2016	1.9	7.5	30.3	1.2	1.2	1.2	0.5	2,916	2,646
2012	1.9	6.0	32.0	1.1	1.1	1.1	<0.1	3,192	2,896
2006	3.4	9.0	61.0	2.1	2.0	2.1	4.1	3,400	3,084
Trucks									
2022	0.5	2.1	28.3	1.5	0.6	0.2	0.2	17,165	15,572
2019	1.0	3.6	36.2	1.5	0.8	0.5	0.1	13,894	12,604
2016	3.1	12.3	51.4	0.3	0.3	0.3	0.1	16,095	14,601
2012	3.7	18.0	62.0	3.1	2.4	3.1	<0.1	14,573	13,220
2006	15.5	174.0	338.0	10.6	9.8	10.5	0.2	36,567	33,173

Cruise ship activity is increasing. Table 6 summarizes maritime activity by year at CST. Cruise ship call and passenger activity peaked in 2006 and declined significantly for several years, but activity has begun to increase. The total number of OGV hours at berth and the number of OGVs running on auxiliary engines increased in 2022 to its highest level since 2006, while the number of hours that OGVs plugged into shore power decreased slightly relative to 2019. Shore power was installed at the B Street Cruise Ship Terminal in 2010, and the construction of an additional shore power transformer and associated equipment at both the Broadway Pavilion and the B Street Cruise Ship Terminal was initiated in 2022 and completed in January 2023. The project doubled the electrical capacity of the shore power system, allowing two cruise ships to connect to shore power simultaneously. However, because of construction activities during 2022, there were multiple occasions when vessels calling at B

Street Cruise Ship Terminal were unable to plug in to shore power. Therefore, the number of shore power hours was lower in 2022 than in 2019 despite the increase in total hotel hours. This increased the total number of hours that the cruise ships ran on their auxiliary engines, which consequently increased emissions of all pollutants associated with cruise ship activity relative to previous years. With the additional infrastructure and capacity installed at CST, the number of hours cruise ships will utilize shore power is expected to increase.

Figure 2. NO_x Emissions Trend by Source Category

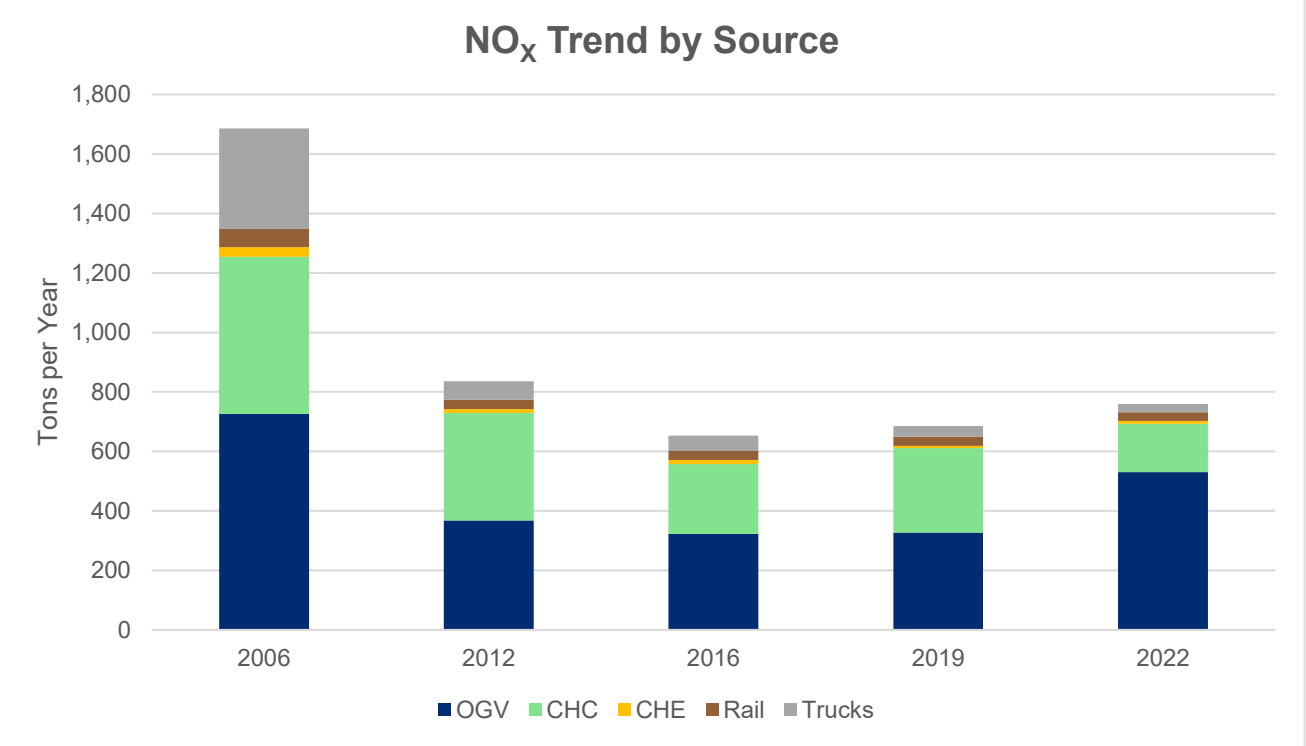


Figure 3. DPM Emissions Trend by Source Category

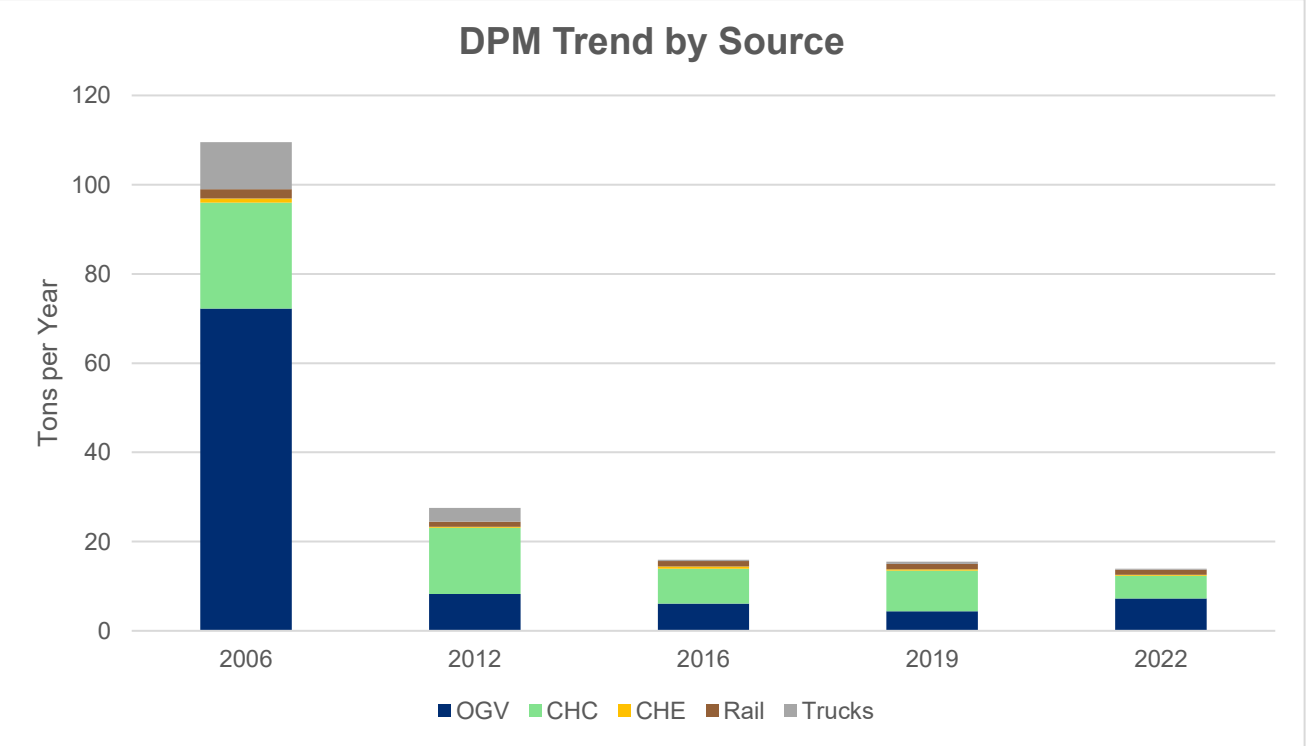


Figure 4. GHG Emissions Trend by Source Category

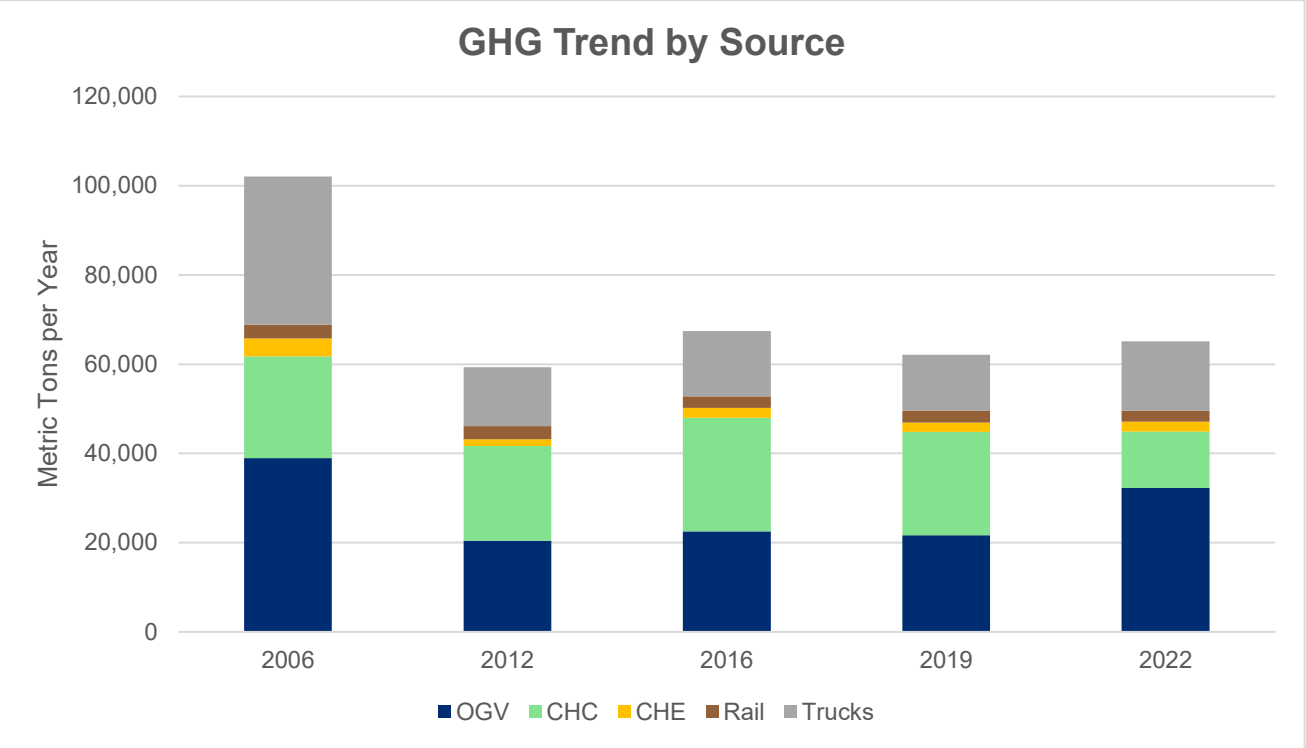


Table 5. Summary of Maritime Activity and Throughput by Year

Year	Cargo Tonnage	OGV Calls	OGV Hours At Berth		
			Total Hours at Berth	Hours on Shore Power[1]	Hours on Auxiliary Engines
2022	2,085,156	410	14,597	3,550	11,047
2019	1,981,329	424	11,128	3,391	7,736
2016	1,948,581	420	11,734	3,398	8,336
2012	1,368,346	411	10,481	120	10,361
2006	2,900,000	530	21,730	NA	21,730
Change since 2019	+5%	-3%	+31%	+5%	+43%
Change since 2006	-28%	-23%	-33%	NA	-49%

[1] Shore power infrastructure was installed at CST in 2010 and at TAMT in 2014.

Table 6. Summary of Maritime Activity and Throughput by Year at CST

Year	No. of Cruise Ship Calls	No. of Cruise Passengers	OGV Hours At Berth		
			Total Hours at Berth	Hours on Shore Power*	Hours on Auxiliary Engines
2022	126	331,425	1,692	445	1,247
2019	95	349,521	1,279	513	766
2016	74	192,700	892	264	628
2012	87	259,123	1,088	120	968
2006	167	526,886	2,204	-	2,204

2 DISCUSSION BY EMISSION SECTOR

A summary of emissions for each sector is provided in this section. Detailed methods, including emission estimation methods, formulas, and emission factor sources are presented in Appendix A to this report.

2.1 OCEAN-GOING VESSELS

The scope of the inventory includes OGVs that called at the Port's marine terminals (CST, TAMT, and NCMT) in 2022. OGVs are defined as vessels that move cargo and passengers over the open ocean and have a Category 3 propulsion engine and two or more Category 2 auxiliary engines.[3] Category 1 and 2 harbor craft are discussed in Section A.2 of Appendix A. OGVs vary in speed and engine sizes based on ship type. Vessel types have been categorized by the cargo they carry. OGV types (e.g., auto carriers and bulk carriers) and location definitions (e.g., at berth and in transit within VSR zone) used in this inventory match those in previous inventories, except that travel within the 40-nautical-mile (40 nm) zone is now included to match the Port's current VSR zone.

Table 7. Summary of 2022 Ocean-Going Vessel Emissions by Vessel Type (tons)

Vessel Type	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Auto Carriers	3.8	7.3	83.4	1.2	1.1	1.0	2.9	4,898	4,443
Bulk Carriers	0.6	1.5	13.9	0.3	0.3	0.2	0.8	1,280	1,161
Container Ships	0.6	1.0	11.1	0.4	0.4	0.1	1.3	2,096	1,901
General Cargo	2.1	5.3	56.5	1.0	0.9	0.8	2.4	3,976	3,607
Passenger Ships	11.8	29.3	345.9	5.6	5.2	4.9	13.3	22,137	20,082
Reefers	0.3	0.7	7.9	0.1	0.1	0.1	0.3	498	452
Roll-On/Roll-Off (RoRo)	0.4	0.6	11.4	0.1	0.1	0.1	0.4	713	647
Total Emissions	**19.6**	**45.5**	**530.0**	**8.8**	**8.1**	**7.3**	**21.4**	**35,598**	**32,294**

The OGV emissions inventory was updated based on 2022 conditions. Data sources used for this analysis include vessel call data from the Port, Automatic Identification System (AIS) data, and data from Lloyd's Register of Ships. A detailed description of data collection, fleet characteristics, and emission estimation methodology is described in Appendix A. Emissions were calculated based upon the California Air Resources Board's (CARB's) OGV methodology.

A summary of OGV emissions by vessel type is shown in **Table 7**, and a summary of OGV emissions by mode is shown in **Table 8**. A summary of OGV emissions by terminal is shown in **Table 9**. The relative proportions of OGV emissions that occur both inside and outside the bay are shown in **Figure 5**.

Table 8. Summary of 2022 Ocean-Going Vessel Emissions by Mode (tons)

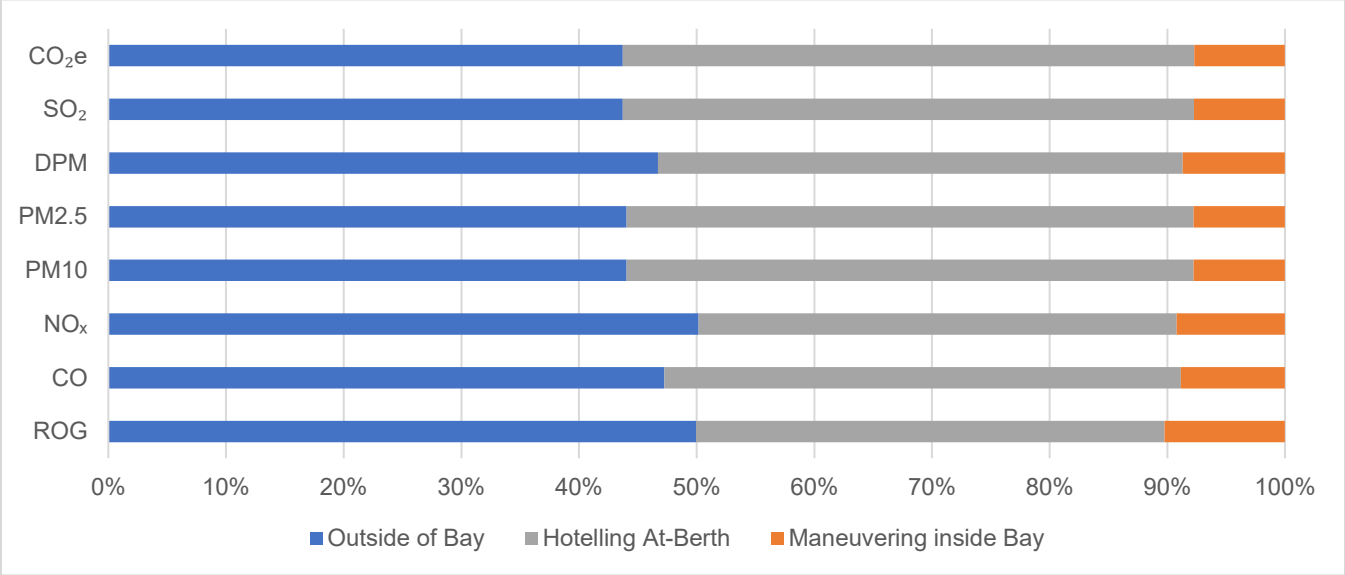
Vessel Mode	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Transit Outside VSR Zone	0.1	0.1	1.6	<0.1	<0.1	<0.1	<0.1	75	68
VSR 40nm	4.3	9.5	117.5	1.7	1.6	1.5	4.1	6,785	6,155
VSR 20nm	3.7	7.6	100.0	1.2	1.1	1.2	3.0	5,058	4,588
Maneuver	2.0	4.0	48.8	0.7	0.6	0.6	1.7	2,748	2,493
Hotel	7.8	20.0	215.4	4.3	3.9	3.2	10.4	17,289	15,684
Anchor	1.7	4.2	46.7	0.9	0.8	0.7	2.2	3,643	3,305
Total Emissions	**19.6**	**45.5**	**530.0**	**8.8**	**8.1**	**7.3**	**21.4**	**35,598**	**32,294**

[3] Category 1 engines have a gross engine power that is greater than or equal to 37 kW and a displacement that is less than 7 liters per cylinder, and they are typically associated with small harbor craft and recreational propulsion. Category 2 engines have a displacement greater than or equal to 7 and less than 30 liters per cylinder, and engines are typically used as OGV auxiliary engines, harbor craft engines, and smaller OGV propulsion engines. Category 3 engines have a displacement greater than or equal to 30 liters per cylinder, and engines are typically used for OGV propulsion.

Table 9. Summary of 2022 Ocean-Going Vessel Emissions by Terminal (tons)

Vessel Mode	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
TAMT	3.6	8.3	89.4	1.9	1.7	1.3	4.7	7,850	7,121
NCMT	4.2	7.9	94.7	1.3	1.2	1.1	3.4	5,612	5,091
CST	11.8	29.3	345.9	5.6	5.2	4.9	13.3	22,137	20,082
Total Emissions	**19.6**	**45.5**	**530.0**	**8.8**	**8.1**	**7.3**	**21.4**	**35,598**	**32,294**

Figure 5. Proportion of OGV Emissions Inside and Outside of the Bay in 2022



2.1.1 Revised 2019 Inventory

OGV emissions for 2019 were revised to reflect CARB's updated methodology and to ensure the emission calculations for both 2022 and 2019 are based on the same methods. A summary of total previous and total revised 2019 OGV emissions is shown in **Table 10**. Summaries of revised 2019 OGV emissions by vessel type, by mode, and by terminal are shown in **Table 11**, **Table 12**, and **Table 13**, respectively.

Table 10. Summary of Previous and Revised 2019 Ocean-Going Vessel Emissions (tons)

Vessel Type	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Previous 2019	17.5	33.5	378.3	7.5	6.9	6.7	15.8	25,770	23,378
Revised 2019	12.6	30.9	327.2	5.4	5.0	4.4	13.5	23,923	21,703

Table 11. Summary of Revised 2019 Ocean-Going Vessel Emissions by Vessel Type (tons)

Vessel Type	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Auto Carriers	6.2	15.3	155.2	2.3	2.2	1.9	5.9	9,830	8,917
Bulk Carriers	0.3	0.9	8.3	0.2	0.2	0.1	0.4	667	605
Container Ships	0.7	1.2	17.7	0.4	0.4	0.1	1.3	2,659	2,413
General Cargo	0.8	2.2	21.4	0.4	0.4	0.3	1.0	1,601	1,452
Passenger Ships	4.6	11.1	122.8	2.1	1.9	1.9	4.9	9,051	8,211
RoRo	0.1	0.1	1.7	<0.1	<0.1	<0.1	0.1	114	104
Total Emissions	**12.6**	**30.9**	**327.2**	**5.4**	**5.0**	**4.4**	**13.5**	**23,923**	**21,703**

Table 12. Summary of Revised 2019 Ocean-Going Vessel Emissions by Mode (tons)

Vessel Mode	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Transit Outside VSR Zone	1.0	2.9	26.4	0.3	0.3	0.3	0.7	1,215	1,102
VSR	3.7	9.1	95.6	1.1	1.0	1.1	2.8	4,670	4,237
Maneuver	2.1	4.0	51.4	0.6	0.6	0.7	1.6	2,715	2,463
Hotel	5.1	13.0	134.1	2.9	2.7	2.1	7.2	13,428	12,182
Anchor	0.8	1.9	19.7	0.5	0.4	0.3	1.1	1,895	1,719
Total Emissions	**12.6**	**30.9**	**327.2**	**5.4**	**5.0**	**4.4**	**13.5**	**23,923**	**21,703**

Table 13. Summary of Revised 2019 Ocean-Going Vessel Emissions by Terminal (tons)

Vessel Mode	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
TAMT	1.8	4.3	47.4	1.0	0.9	0.6	2.6	4,928	4,470
NCMT	6.3	15.4	157.0	2.4	2.2	1.9	6.0	9,944	9,021
CST	4.6	11.1	122.8	2.1	1.9	1.9	4.9	9,051	8,211
Total Emissions	**12.6**	**30.9**	**327.2**	**5.4**	**5.0**	**4.4**	**13.5**	**23,923**	**21,703**

2.2 HARBOR CRAFT

The scope of the inventory includes all commercial harbor craft (CHC) utilized by the Port and participating tenants at various locations within the bay. CHC include a variety of vessel and boat types that serve many functions within and near San Diego Bay, including crew and supply boats, charter fishing vessels, commercial fishing vessels, ferry and excursion vessels, pilot vessels, towboats or push boats, tugboats, and work boats. CHC engage in a wide variety of activities at the Port: assisting in the movement of OGVs around the harbor; moving cargo and people into and out of the port harbor area; providing fuel to OGVs; providing police, fire, pilot, and other services to harbor users; transporting crew and supplies to offshore facilities; and transporting crew and passengers to offshore fishing destinations.

Table 14. Commercial Harbor Craft Emissions by Vessel Type in 2022 (tons)

Vessel Type	Count	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Assist Tugs	4	2.7	9.5	26.4	0.8	0.8	0.8	<0.1	2,749	2,493
Tugboat/Towboats	3	0.3	1.6	1.7	<0.1	<0.1	<0.1	<0.1	216	196
Ocean-Going Tugs	4	1.6	17.4	15.8	0.5	0.5	0.5	<0.1	2,454	2,226
Ferries	2	1.5	10.6	10.9	0.3	0.2	0.3	<0.1	1,373	1,246
Excursions	13	2.6	18.6	20.4	0.5	0.4	0.5	<0.1	2,440	2,213
Research Vessels	2	3.3	14.2	51.0	1.7	1.6	1.7	<0.1	1,975	1,791
Work Boats	3	0.2	2.1	0.4	<0.1	<0.1	<0.1	<0.1	49	44
Pilot Boats	1	0.1	0.6	2.1	0.1	0.1	0.1	<0.1	161	146
Sportfishing	54	2.2	13.9	18.3	0.5	0.5	0.5	<0.1	1,818	1,649
Commercial Fishing	68	1.3	4.6	16.4	0.7	0.7	0.7	<0.1	705	639
Total	**154**	**15.8**	**93.1**	**163.4**	**5.1**	**4.9**	**5.1**	**0.2**	**13,939**	**12,645**

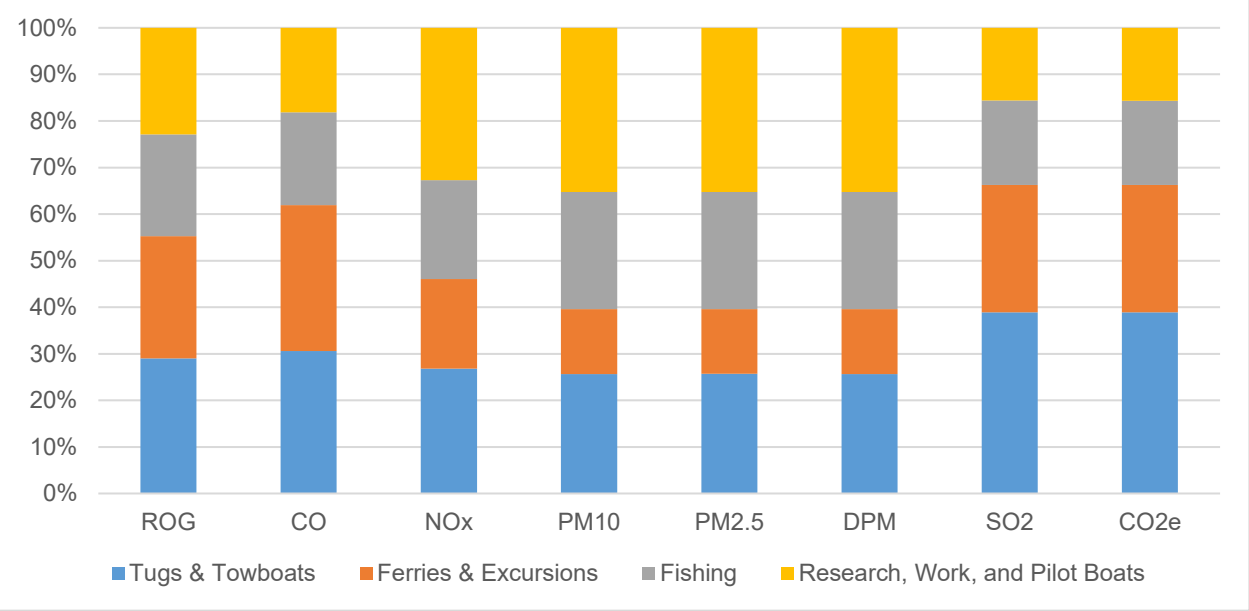
Information on the number, types, and general operating activity of CHC was obtained from equipment operators through a Port-issued survey as well as through communications with commercial fishing and sport fishing representatives. Equipment data, including engine year, horsepower, fuel type, annual operating hours, and fuel consumption, for each equipment piece were obtained from the survey results, when available. When information was missing from the survey responses, values were estimated based on category averages from CARB and

professional judgment. Detailed descriptions of data collection, fleet characteristics, and emission estimation methodology are contained in Appendix A. Emissions were calculated based upon CARB's CHC methodology.

A summary of CHC emissions by equipment type and fuel is shown in **Table 14**. **Figure 6** shows the relative contribution of each pollutant for each vessel type. As shown, approximately 26% to 39% of the Port's total harbor craft emissions are attributed to tugs and towboats, 14% to 31% to ferries and excursions, 18% to 25% to fishing, and 14% to 35% to research, work boats, and pilot boats, depending on the pollutant type.

Note that the research vessel category is comprised of two NOAA research vessels that dock at TAMT. Therefore, activity and associated emissions from these vessels are included in this inventory. However, it is worth noting that these vessels spend the majority of their time outside of the bay but within the 24 nm zone in which emissions are quantified for this inventory. For instance, one of the vessels spent 99% of its 3,811 hours outside of the bay, but within the inventory boundary. While these research vessels produce the largest share of NO_x and DPM emissions in the CHC category, 97% of these emissions occur outside of the bay.

Figure 6. Relative Contributions of Pollutants by Harbor Craft Type



2.3 CARGO HANDLING EQUIPMENT

The scope of the Inventory includes all CHE utilized by the Port and participating tenants at the Port's marine terminals (CST, TAMT, and NCMT) in 2022. Types of CHE at the terminals include container handling equipment (e.g., reach stackers), yard tractors (or yard trucks and hostlers), forklifts, construction equipment (e.g., rubber-tired loaders), and general industrial equipment. The majority of equipment is electric or diesel-powered, although some equipment is powered by gasoline or propane. CHE is only used at the marine terminals and not on public roadways.

Information on the number, types, and general operating activity of CHE was obtained from equipment operators through a Port-issued survey. Equipment data, including engine year, horsepower, fuel type, annual operating hours, and fuel consumption, for each equipment piece were obtained from the survey results, when available. In cases where information was missing from the survey responses, values were estimated based on category averages from CARB and professional judgment. The detailed description of data collection, fleet characteristics, and emission estimation methodology is described in Appendix A. Emissions were calculated based upon CARB's CHE methodology.

A summary of CHE emissions by equipment type and fuel is shown in **Table 15**. A summary of CHE emissions by terminal is shown in **Table 16**. The proportions of each terminal's emissions by pollutant are shown in **Figure 7**. The majority of CHE emissions, aside from ROG and CO emissions, occur at TAMT, which has the largest and most active diesel-powered CHE pieces.

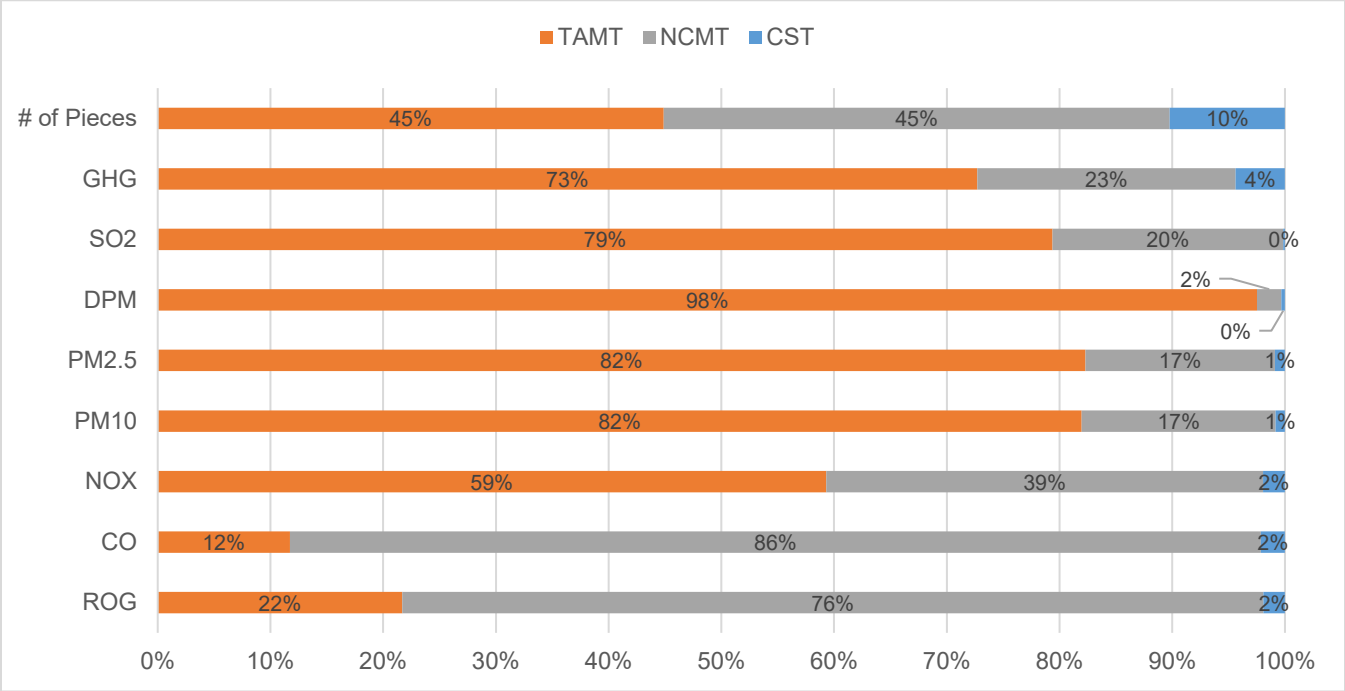
Table 15. Cargo Handling Equipment Emissions by Fuel and Equipment Type in 2022 (tons)

Fuel	Type	Count	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Diesel	Compressor	1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1	1
	Crane	3	0.04	0.11	0.63	0.02	0.02	0.02	<0.01	58	53
	Forklift	21	0.04	0.49	0.55	0.01	0.01	0.01	<0.01	146	133
	Lift	1	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	3	3
	Loader	1	0.01	0.05	0.09	<0.01	<0.01	<0.01	<0.01	9	8
	Other	1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Reach Stacker	7	0.06	0.3	0.63	0.03	0.03	0.03	<0.01	168	152
	Sweeper	1	<0.01	0.04	0.03	<0.01	<0.01	<0.01	<0.01	7	6
	Top Handler	2	0.03	0.3	0.33	<0.01	<0.01	<0.01	<0.01	176	159
	Vacuum truck	1	<0.01	<0.01	0.04	<0.01	<0.01	<0.01	<0.01	4	4
	Yard Tractor	21	0.45	2.57	3.21	0.14	0.13	0.14	0.01	1,090	989
Gasoline	ATV	15	1.41	16.4	0.68	0.02	0.01	<0.01	<0.01	214	194
	Cart	4	0.12	1.45	0.07	<0.01	<0.01	<0.01	<0.01	24	22
	Compressor	1	<0.01	0.46	0.01	<0.01	<0.01	<0.01	<0.01	1	1
	Loader	3	0.38	6	1.63	0.01	0.01	<0.01	<0.01	149	135
	Sweeper	1	0.18	2.3	0.37	<0.01	<0.01	<0.01	<0.01	23	21
Propane	Forklift	9	0.18	3.22	0.85	<0.01	<0.01	<0.01	<0.01	87	79
	Lift	1	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	3	3
	Sweeper	1	<0.01	0.08	0.03	<0.01	<0.01	<0.01	<0.01	7	6
Electric	Compressor	7	-	-	-	-	-	-	-	10	9
	Forklift	31	-	-	-	-	-	-	-	109	99
	Lift	21	-	-	-	-	-	-	-	6	5
	Other	12	-	-	-	-	-	-	-	2	2
	Reach Stacker	2	-	-	-	-	-	-	-	8	7
	Segway	2	-	-	-	-	-	-	-	0	0
	Yard Tractor	6	-	-	-	-	-	-	-	144	131
Total	**-**	**176**	**2.92**	**33.81**	**9.17**	**0.24**	**0.22**	**0.20**	**0.02**	**2,450**	**2,222**

Table 16. Summary of Cargo Handling Equipment Emissions by Terminal (tons)

Terminal	Count	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
TAMT	79	0.63	3.97	5.44	0.20	0.18	0.20	0.02	1,781	1,616
NCMT	79	2.23	29.13	3.56	0.04	0.04	<0.01	<0.01	561	509
CST	18	0.06	0.72	0.18	<0.01	<0.01	<0.01	<0.01	107	97
Total Emissions	**176**	**2.92**	**33.81**	**9.17**	**0.24**	**0.22**	**0.20**	**0.02**	**2,450**	**2,222**

Figure 7. Proportion of Cargo Handling Equipment Emissions by Terminal in 2022



2.3.1 Revised 2019 Inventory

CHE emissions for 2019 were revised to reflect CARB's updated methodology for emission factors and to ensure the emission calculations for both 2022 and 2019 are based on the same methods. A summary of total previous and total revised 2019 CHE emissions is shown in **Table 17**. A summary of revised 2019 CHE emissions by terminal is shown in **Table 18**, and a summary of revised 2019 CHE emissions by fuel type and equipment type is shown in **Table 19**.

Table 17. Summary of Previous and Revised 2019 Ocean-Going Vessel Emissions (tons)

Vessel Type	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Previous 2019	1.03	22.64	8.41	0.15	0.13	0.13	0.02	2,439	2,213
Revised 2019	1.24	11.27	8.32	0.31	0.28	0.30	0.02	2,274	2,063

Table 18. Summary of Revised 2019 Cargo Handling Equipment Emissions by Terminal (tons)

Terminal	Count	ROG	CO	NO_x	PM10	PM2.5	DPM	SO2	CO2e (tons)	CO2e (MT)
TAMT	65	0.72	3.57	6.56	0.25	0.23	0.25	0.02	1,668	1,513
NCMT	88	0.50	7.47	1.63	0.05	0.05	0.04	<0.01	502	456
CST	25	0.02	0.23	0.13	0.01	0.01	0.01	<0.01	104	94
Total Emissions	**178**	**1.24**	**11.27**	**8.32**	**0.31**	**0.28**	**0.30**	**0.02**	**2,274**	**2,063**

Table 19. Revised 2019 Cargo Handling Equipment Emissions by Fuel and Equipment Type (tons)

Fuel	Type	Count	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Diesel	Crane	1	0.02	0.05	0.30	0.01	0.01	0.01	<0.01	29	26
	Forklift	26	0.07	0.69	1.01	0.05	0.04	0.05	<0.01	203	184
	Loader	1	0.01	0.05	0.09	<0.01	<0.01	<0.01	<0.01	9	8
	Reach Stacker	4	0.05	0.28	0.63	0.03	0.03	0.03	<0.01	163	148
	Top Handler	1	0.10	0.27	1.52	0.04	0.03	0.04	<0.01	136	123
	Yard Tractor	27	0.56	3.14	3.95	0.17	0.16	0.17	0.02	1,401	1,271
	Lighting	3	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Gasoline	Cart	1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<1	<1
	Compressor	1	0.02	0.96	0.03	<0.01	<0.01	<0.01	<0.01	3	3
	Forklift	1	<0.01	0.05	0.00	<0.01	<0.01	<0.01	<0.01	2	2
	Loader	3	0.02	0.34	0.12	<0.01	<0.01	<0.01	<0.01	12	11
	Sweeper	1	0.17	2.18	0.37	<0.01	<0.01	<0.01	<0.01	23	21
	ATV	18	0.22	2.52	0.17	0.01	0.01	<0.01	<0.01	90	82
Propane	Forklift	10	0.02	0.73	0.13	<0.01	<0.01	<0.01	<0.01	31	28
Electric	Cart	10	-	-	-	-	-	-	-	10	9
	Compressor	7	-	-	-	-	-	-	-	3	3
	Forklift	18	-	-	-	-	-	-	-	87	79
	Lift	21	-	-	-	-	-	-	-	1	1
	Reach Stacker	1	-	-	-	-	-	-	-	51	47
	Yard Tractor	3	-	-	-	-	-	-	-	16	15
	Other	12	-	-	-	-	-	-	-	1	1
	Segway	2	-	-	-	-	-	-	-	<1	<1
	Signal Board (solar)	6	-	-	-	-	-	-	-	-	-
Total	**-**	**178**	**1.24**	**11.27**	**8.32**	**0.31**	**0.28**	**0.30**	**0.02**	**2,274**	**2,063**

2.4 FREIGHT RAIL

Emissions from freight rail servicing the Port's marine cargo terminals were calculated for calendar year 2022. Rail locomotives carry freight cargo between the Port and regional destinations. Activity associated with locomotives includes activity at or near the terminals to load and unload cargo as well as regional rail activity to and from the terminals. Freight rail service at the Port is provided by the Burlington Northern Santa Fe Railway (BNSF).

Rail activity is split between regional travel (or line haul) and switching (or switch duty). Line haul refers to the movement of cargo over long distances, which either initiates from or terminates at the Port. Switching includes the assembly and disassembly of trains, the sorting of the railcars of cargo trains into contiguous "fragments" for subsequent delivery to terminals, and the short-distance hauling of fully loaded and empty railcars within terminal areas and between the BNSF yard and the terminal areas. Rail activity at TAMT is limited to some dry bulk and break bulk cargo movements, which occur a few times throughout the year. Rail activity at NCMT is more frequent and occurs daily. Freight rail emissions by activity mode (regional line haul and near-terminal switching) are shown in **Table 20**. Rail emissions by terminal are shown in **Table 21**.

Table 20. Summary of Freight Rail Emissions by Activity Mode (tons)

Fuel	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
Line Haul	1.21	4.77	19.74	0.78	0.75	0.78	0.34	1,847	1,676
Switching	0.56	2.21	9.13	0.36	0.35	0.36	0.15	854	774
Total Emissions	**1.77**	**6.98**	**28.87**	**1.13**	**1.10**	**1.13**	**0.49**	**2,701**	**2,450**

Table 21. Summary of Freight Rail Emissions by Terminal (tons)

Terminal	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2e (tons)	CO_2e (MT)
NCMT	1.74	6.87	28.44	1.12	1.08	1.12	0.48	2,661	2,414
TAMT	0.03	0.11	0.43	0.02	0.02	0.02	0.01	40	37
Total Emissions	**1.77**	**6.98**	**28.87**	**1.13**	**1.10**	**1.13**	**0.49**	**2,701**	**2,450**

2.5 HEAVY-DUTY TRUCKS

Emissions from heavy-duty trucks servicing the Port's marine cargo terminals were calculated for calendar year 2022. A summary of these emissions by marine cargo terminal is provided in **Table 22**. As described in Appendix A, truck operating modes are defined as follows:

- On-Port: truck movements and idling within a marine cargo terminal boundary as trucks move into position to pick up or drop off cargo
- Local: truck trips between the Port's marine cargo terminals and locations within San Diego County
- Regional: truck trips to and from the Port's marine cargo terminals, which originate from or end outside of San Diego County.

Note that this inventory does not account for an increasing use of biofuels in the diesel fuel blend in California. As reported in the California GHG Inventory for calendar year 2022, the biofuel blend, which includes biodiesel and renewable diesel, reached 37.7% in 2022.[4] According to standard practice, CO_2 emissions produced by combustion of biofuels are reported separately. Methodologies to account for emission reductions due to this growing blend of biofuels have not been incorporated into this maritime inventory. As methodologies are updated, the results found in this section of the inventory may be revised.

Table 22. Summary of Truck Emissions by Terminal (tons)

Terminal	Mode	ROG	CO	NO_x	PM10	PM2.5	DPM	SO2	CO2e (tons)	CO2e (MT)
TAMT Trucks	On-Port	<0.01	0.01	0.11	0.01	<0.01	<0.01	<0.01	60	54
	Local	0.02	0.08	1.07	0.05	0.02	0.01	0.01	605	549
	Regional	0.40	1.53	19.44	0.93	0.40	0.15	0.10	10,955	9,938
NCMT Trucks	On-Port	<0.01	<0.01	0.05	<0.01	<0.01	<0.01	<0.01	36	33
	Local	0.01	0.04	0.64	0.04	0.02	0.01	<0.01	467	424
	Regional	0.10	0.41	6.96	0.43	0.19	0.08	0.05	5,042	4,574
Total Emissions		**0.54**	**2.08**	**28.26**	**1.46**	**0.63**	**0.25**	**0.16**	**17,165**	**15,572**

[4] CARB. 2024. *California Greenhouse Gas Emissions from 2002 to 2022: Trends of Emissions and Other Indicators*. https://ww2.arb.ca.gov/sites/default/files/2024-09/nc-2000_2022_ghg_inventory_trends.pdf.

3 UNCERTAINTIES AND LIMITATIONS

When compiling an emissions inventory, uncertainties can arise from the modeling methods employed, the choice of emission factors, and the quality of parameters and datasets. While efforts were made to obtain the most accurate and complete data and to use the best available methods to calculate emissions in the preparation of this report, the accuracy, precision, and reliability of the total emissions presented in this report cannot be easily quantified given the following:

1. The accuracy of data provided to the Port for this inventory is difficult to estimate for some emission sources, and the precision of such data varies by emission source category and data source. Data quality can be limited by several factors, such as recordkeeping, accuracy and interpretation of datasets, and methods used to estimate activity levels.
2. The development of emission formulas and emission factors generally relies on various assumptions as well as average behavior of systems observed in experimental studies, so it is uncertain how accurately these models reflect the emission sources evaluated in this report. This inventory incorporates emission formulas and emission factors developed by regulatory agencies, utility companies, and experts in the field of air quality.
3. For some emission source categories, emission calculation methods had been updated since the release of the previous emissions inventories. In order to consistently assess emission trends, the relevant categories in the previous 2019 maritime inventory (i.e., ocean-going vessels and cargo handling equipment) were revised by incorporating these updates. However, inventories for years prior to 2019 were not re-evaluated.
4. Because of the breadth of the inventory, it is possible that the inventory is missing specific pieces of equipment, vehicles, or vessels that operated in 2022.

Despite these limitations, the Port's periodic maritime air emissions inventories are a valuable tool for understanding air quality impacts due to maritime sources, informing Port policy decisions, and tracking improvements in air quality.

4 MCAS AND FUTURE PORT STRATEGIES

In October 2021, the Port adopted the MCAS, a strategic planning document that includes short- and long-term objectives aimed at reducing air emissions due to maritime sources and their associated health impacts. Achieving such objectives entails a sustained multi-year effort that involves the participation and collaboration of multiple stakeholders, including the Port, its tenants, and other government agencies. Because the MCAS was adopted in late 2021, the 2022 maritime air emissions inventory does not reflect the early progress of MCAS objectives that will lower emissions. Many of the MCAS objectives require significant timeframes to realize emission reductions.

The list below summarizes achievements and progress of selected MCAS objectives, as of the publication date. The Port will quantify emissions benefits associated with implementation of these projects based on calendar year 2024 activities in a future inventory.

1. Cargo Handling Equipment Objective 1 has targets for the reduction of emissions due to cargo handling equipment. Since the beginning of 2023, eight pieces of zero-emission CHE have been added to the marine terminals, including two fully electric mobile harbor cranes. Not only are these cranes eliminating a major source of diesel emissions, but they also increase productivity. With a combined 400 metric tons of lift capacity, they will represent the heaviest lift capability of any crane system currently in place on the West Coast. The use of this zero-emission equipment displaces the use of diesel CHE. Through periodic emissions inventories, the operations of the CHE fleet at the terminals and the emissions reductions associated with the conversion of combustion CHE to zero-emission equipment will be assessed.
2. Harbor Craft Objective 1 calls for the Port to facilitate the implementation of the first fully electric tugboat in the United States by June 30, 2026. Crowley Maritime Corporation's electric tugboat project includes the fully electric eWolf tugboat, shoreside charging and battery storage infrastructure, and solar power generation. In August 2023, Crowley broke ground on construction of shoreside charging infrastructure for the eWolf, and in June 2024, Crowley christened the eWolf, which had arrived to San Diego in February. The eWolf has been providing tug services since July 2024. The project was made possible

through support from the Port, the San Diego County Air Pollution Control District, CARB, the U.S. Environmental Protection Agency, and the U.S. Maritime Administration.

3. Harbor Craft Objective 2A furthers the state's climate goals by supporting fuel docks' transition of diesel supply to renewable diesel. In December 2023, the first of three fuel docks began selling renewable diesel, and all three fuel docks currently have renewable diesel available for purchase. Since renewable diesel is a biogenic fuel as opposed to a fossil fuel, use of renewable diesel helps to reduce GHG emissions.
4. Harbor Craft Objective 2B seeks the installation and maintenance of shore power infrastructure for facilities receiving greater than 50 CHC visits per year by 2024. Port staff have conducted outreach with operators of harbor craft facilities in furtherance of this objective. The Port plans to install additional shore power for CHC at Fish Harbor Pier and Chesapeake Wharf, facilities primarily serving commercial fishing vessels.
5. Harbor Craft Objective 2D tasks the Port with facilitating the transition of short-run ferries to zero-emission vessels. Flagship Cruises & Events, which owns and operates two ferry vessels that transport passengers between downtown San Diego and Coronado, is planning to procure two battery-electric vessels and install 350 kW DC fast chargers onshore. In November 2024, Flagship, in partnership with the San Diego County Air Pollution Control District, was awarded a grant of $15 million from CARB and the California Energy Commission for the implementation of this project.
6. Ocean-Going Vessels In-Transit Objective 1A pursues an enhanced Vessel Speed Reduction (VSR) Program with the goal of greater than 90% participation of vessel trips. When ocean-going vessels optimally reduce their speed near shore from cruising speeds on the open ocean, the result is lower emission rates. The Port's voluntary VSR program began in 2009 as part of the Port's 2007 Clean Air Plan. Participating cargo and cruise ships needed to travel at average speeds less than or equal to 12 knots and 15 knots, respectively, within a 20 nm zone centered on Point Loma. The original VSR program had a goal of 80% participation. In November 2021, the Port adopted an expanded VSR program with the 90% participation goal and an expanded 40 nm zone. At the time, preliminary analysis estimated annual emissions reductions, compared to 2019 emissions, of 4.3 tons DPM, 225.5 tons NO_x, and 9,791 tons CO_2e if 90% participation was reached within the 40 nm zone.

   In 2022, VSR participation in the 20 nm zone exceeded 90%, and in the 40 nm zone, it was 67%. The Port will continue to monitor and promote VSR participation to achieve its goal of 90% participation in the 40 nm zone.
7. Ocean-Going Vessels At-Berth Objective 2A aims to expand shore power usage at the B Street Cruise Ship Terminal at CST through the installation of an additional shore power plug, which would allow for a greater number of shore-power-capable docking configurations when two cruise ships are at berth. The Port has installed two shore power systems at the B Street Cruise Ship Terminal. Construction of a new connection location to ensure greater access to shore power at the B Street Cruise Ship Terminal is complete, with commissioning expected shortly after the publication date.
8. Ocean-Going Vessels At-Berth Objective 2B targets emission reductions of OGV visits to NCMT through the installation of either shore power infrastructure or an alternative emissions control technology. Shore power installation at NCMT will occur in two phases, the first of which is nearly complete. An additional shore power system for OGVs is also planned for TAMT.

   The METS-1, a barge-based capture and control system (or bonnet) for reducing emissions from at-berth OGVs, is now in operation at NCMT and was approved by CARB in May 2025 as an alternative emissions control strategy compliant with the 2020 At Berth Amendments.[5]
9. Truck Objective 1B seeks the development of a zero-emission truck program for short-haul truck routes and charging infrastructure for such trucks. In March 2024, the Board of Port Commissioners selected Skychargers LLC, to negotiate a proposed zero-emission truck stop project to be located in National City adjacent to the marine terminal. The proposed project is now undergoing an environmental review, which commenced in September 2024 at the direction of the Board. The proposed project is anticipated to provide necessary charging infrastructure for electric trucks and increase zero-emission truck trips to the Port's cargo marine terminals.

[5] CARB Executive Orders G-25-094 and G-25-095, available at: https://ww2.arb.ca.gov/berth-regulation-executive-orders.

Appendix A

Inventory Methodology

This appendix provides a description of the data collection, emissions estimation methodologies, including emission factors and sources of data, for each sector included in the maritime air emissions inventory. The methodology and data collection efforts are described separately for each sector.

A.1 OCEAN-GOING VESSELS

Ocean-going vessels (OGVs) are used to transport goods and passengers to and from domestic and international ports. This section describes the activity, emissions estimation methodologies, and results for OGVs that served the Port of San Diego (Port) in 2022. OGV activity and emissions estimates take into account participation in the Port's voluntary vessel speed reduction (VSR)[1] and shore power usage. OGV emissions herein include both tailpipe emissions associated with fuel combustion within each vessel's engines as well as greenhouse gas (GHG) emissions associated with electricity consumption during shore power.

SOURCE DESCRIPTION

OGVs are defined as vessels that move cargo and passengers over the open ocean and have a Category 3 propulsion engine and two or more Category 2 auxiliary engines. Engine categories are defined by the U.S. Environmental Protection Agency (EPA) based upon displacement per cylinder (see **Table A-1-1**). Category 1 and 2 harbor craft are discussed in Section A.2 of this report. OGVs vary greatly in speed and engine sizes based on ship type. Vessel types have been categorized by the cargo they carry. **Table A-1-2** lists the OGV types used in this inventory.

Table A-1-1. EPA Marine Compression-Ignition Engine Categories

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

Table A-1-2. EPA Marine Compression-Ignition Engine Categories

Category	Specification
Auto Carrier	Self-propelled dry-cargo vessel that carries containerized automobiles
Bulk Carrier	Self-propelled dry-cargo ship that carries loose cargo
Container Ship	Self-propelled dry-cargo vessel that carries containerized cargo
General Cargo	Self-propelled cargo vessel that carries a variety of dry cargo
Passenger Ship	Self-propelled cruise ship
Reefer	Self-propelled dry-cargo vessel that often carries perishable items.
Roll-on/Roll-off (RoRo)	Self-propelled vessel that handles cargo that is rolled on and off the ship, including ferries.

Emission sources from OGVs include propulsion engines, auxiliary engines, and auxiliary boilers. Propulsion engines are used to propel the ship and are usually either medium-speed diesel (MSD) or slow-speed diesel (SSD) engines. Less typical are vessels powered by gas turbines (GT); however, one passenger ship that visited the Port was propelled by a GT engine. In addition, the National Geographic Quest was treated as an ocean-going passenger ship even though it has a Category 1 propulsion engine. It is designated below as a high-speed

[1] A voluntary VSR program was established by the Port in 2009. The VSR zone included a zone of 20-nautical-mile radius centered on Point Loma, in which cargo vessel operators and cruise ship operators are encouraged to reduce speeds to 12 knots and 15 knots, respectively. In November 2021, the VSR zone was extended to a 40-nautical-mile radius.

diesel (HSD) engine. Passenger ships usually have electrically powered propulsion (ED), and all engine power is used to generate electricity. Auxiliary engines on non-passenger ships are used to power the ship's electrical needs and are assumed here to be Category 2 MSD engines. Auxiliary boilers are used to heat residual oil in the fuel tanks (operating outside the 200-nautical-mile North American Emission Control Area boundary). Auxiliary boilers also supply heat for engines as well as heat and hot water for crew or passenger needs. Average propulsion and auxiliary power by ship type for vessels that called in 2022 are listed in **Table A-1-3.**

DATA COLLECTION AND ACTIVITY

Data sources used for this analysis include vessel call data from the Port, Automatic Identification System (AIS) data, and Lloyd's Register data. Vessel call data obtained from the Port included various information, including vessel name, cargo type, last and next port of call, time stamps for berthing and de-berthing, time at berth, and electricity consumption (in kilowatt-hours [kWh]) for those passenger and container calls that used shore power while at berth.

The Port purchased AIS data from the Marine Exchange of Alaska to be processed for actual ship movements within the area of interest, an area bounded by the Orange County border, the U.S. contiguous zone boundary (24 nautical miles [nm] from the coast), and the international border. Data boundaries were defined as latitudes between 32.45° and 33.40° and longitudes between -116.97° and -118.17°. The AIS data included vessel position (latitude and longitude), International Maritime Organization (IMO) and Maritime Mobile Service Identity (MMSI) numbers, speed, direction, destination, and date/time for all cargo vessels over 100 tons calling at the Port. This data was used to determine operating mode. A data set was formulated by selecting AIS data at 6-minute intervals, which produced approximately 23 million records.

Only vessels that called at the Port's marine terminals were considered, corresponding to approximately 336,000 records. The remainder of the records were associated with vessels that passed by the Port and did not stop and with military vessels. Each AIS data was first assigned a ship type, as listed in Table A-1-2, and then assigned a location category. Location categories are defined in **Table A-1-4** and in **Figure A-1-1**. Data from locations in the Open Ocean, which were outside of the inventory boundaries, were not included in the analysis. Finally, each record was assigned an activity mode. Activity modes are listed in **Table A-1-5**.

Lloyd's Register data were purchased from IHS Global Limited, headquartered in Bracknell, England, and were used to define vessel characteristics (e.g., engine model year, engine sizes, and service speed). The list of vessel characteristics that were used in the inventory include:

- Vessel type
- Engine model year
- Propulsion power
- Propulsion engine type
- Auxiliary power
- Vessel service speed
- Vessel size

Lloyd's ship characteristics were matched to the AIS data based upon each vessel's unique IMO number.

Various OGVs plugged into shore power while at berth in 2022. Shore power infrastructure exists at TAMT and at CST. The Port provided shore power consumption information by vessel and by call. In 2022, a total of 109 calls utilized shore power, including 51 container vessel calls and 58 cruise ship calls, representing approximately 27% of the total vessel calls. In total, cruise ships at CST used shore power for 445 hours and consumed 3,342 megawatt-hours (MWh) of electricity, while container vessels used shore power for 3,105 hours and consumed 2,155 MWh of electricity.

Table A-1-3. Average Propulsion and Auxiliary Power by Ship Type

Ship Type	Engine Type	Calls	Average Power (kW)	
			Propulsion	Auxiliary
Auto Carrier	SSD	161	13,723	3,777
Bulk Carrier	SSD	13	6,507	1,919
Container Ship[1]	SSD	51	19,420	11,400
General Cargo	MSD	10	7,913	2,417
	SSD	23	9,011	2,245
Passenger Ships	GT-ED	3	53,911	
	HSD[2]	1	2,386	858
	MSD	5	10,007	7,710
	MSD-ED	117	43,510	
Reefer	SSD	1	11,004	2.560
RoRo	SSD	25	19,040	6,000

[1] Container ships include refrigerated containerized cargo vessels that call at the Tenth Avenue Marine Terminal.

[2] The National Geographic Quest is treated as an ocean-going passenger ship even though it has a Category 1 propulsion engine.

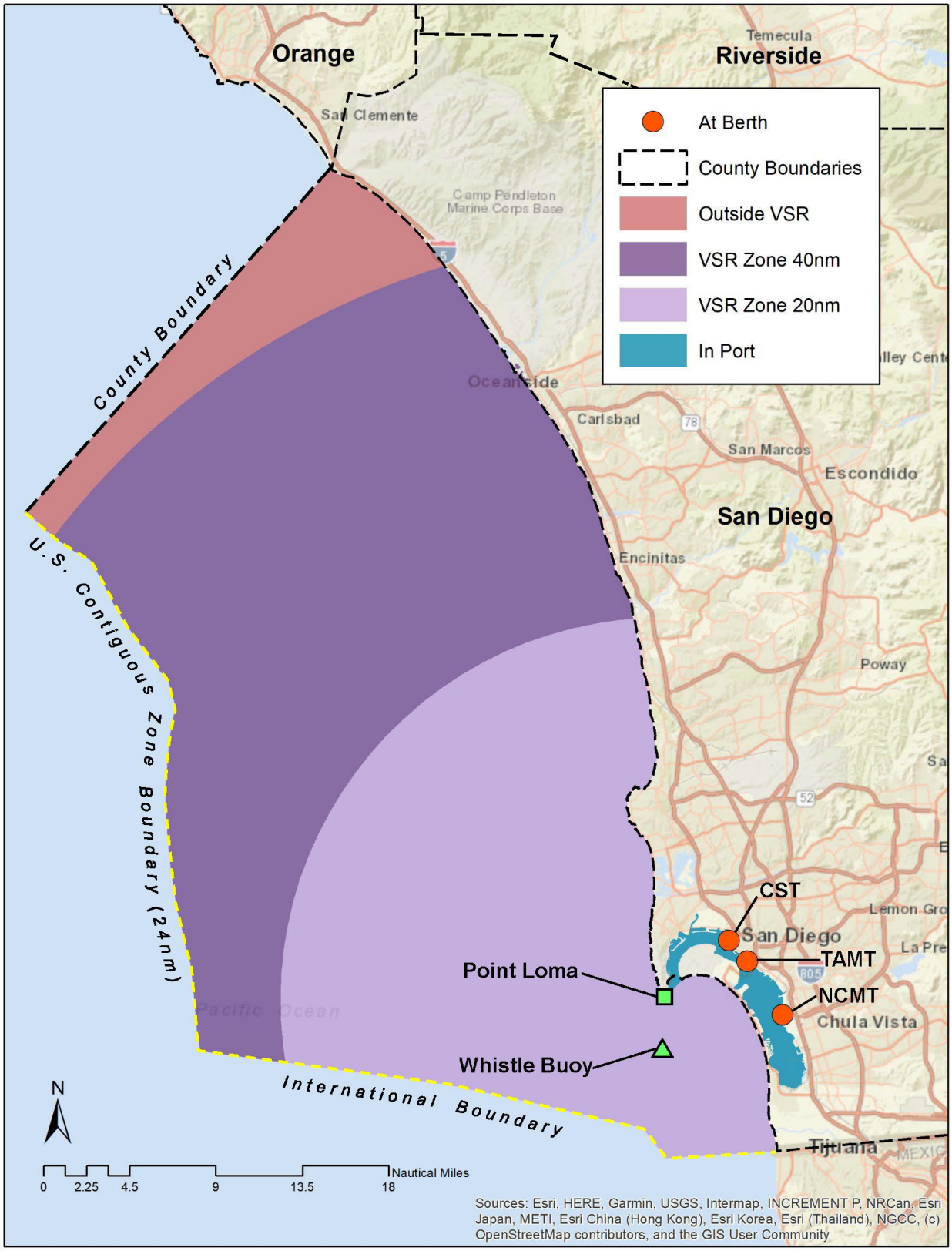
Table A-1-4. Vessel Location Categories in AIS Data

Vessel Location Category	Description
At Berth	At berth at Tenth Avenue Marine Terminal, National City Marine Terminal, or Cruise Ship Terminal
In Port	Within San Diego Bay
VSR20	Outside the bay but within the 20-nautical-mile radius of Point Loma (includes anchorage time)
VSR40	Outside the bay and the 20-nautical-mile radius of Point Loma but within the 40-nautical-mile radius of Point Loma
Outside VSR	Outside the VSR zone but within the inventory boundaries
Open Ocean	Outside the inventory boundaries

Table A-1-5. OGV Activity Modes

Vessel Activity Mode	Description
Transit	Movements in the Outside VSR zone
VSR	Movements within either of the VSR zones
Maneuvering	Movements inside the Port area
Hoteling	Stopped at berth
Anchorage	Stopped within the Port area or VSR zones but not at berth

Figure A-1-1. OGV Locations



EMISSION ESTIMATION METHODOLOGY

OGV emissions are generally calculated by using energy-based emission factors together with activity profiles for each vessel. Activity is divided into distinct modes (see Table A-1-5).

OGVs have two types of engines: main engines and auxiliary engines. The main engine is a large diesel engine used primarily to propel the vessel at sea. Auxiliary engines provide power for uses other than propulsion (except for diesel-electric vessels). Additionally, most ships have auxiliary boilers to provide steam heat for a variety of uses, including fuel heating and hot water.

Propulsion engine emissions for each mode are calculated according to the general formula:

$$E = \sum Pp \; x \; LFp \; x \; A \; x \; EF \; x \; AF \; x \; Conv$$

Where E = Emissions (grams [g])
Pp = Maximum continuous power rating for propulsion engines (kilowatts [kW])
LFp = Propulsion load factor (percent of vessel's total propulsion power)
A = Activity (hours [hr])
EF = Emission factor (grams per kilowatt-hour [g/kWh])
AF = Adjustment factor for emission factor based upon engine load
Conv = Conversion factor for grams to short tons or metric tons

Auxiliary engine emissions are calculated for each mode according to the general formula for all vessels except container ships:

$$E = \sum Pa \; x \; LFa \; x \; A \; x \; EF$$

Where E = Emissions (g)
Pa = Maximum continuous power rating for auxiliary engines (kW)
LFa = Auxiliary load factor (percent of vessel's total auxiliary power)
A = Activity (hr)
EF = Emission factor (g/kWh)

Auxiliary load is the actual power used, and it is the product of auxiliary engine power (Pa) and the engine's load factor (LFa). For these vessels, auxiliary engine emissions while hoteling are calculated according to the general formula:

$$E = \sum La \; x \; A \; x \; EF$$

Where E = Emissions (g)
L_A = Auxiliary load (vessel auxiliary power)
A = Activity (hr)
EF = Emission factor (g/kWh)

Auxiliary boiler emissions are calculated for each mode using the general formula below:

$$E = \sum Lb \; x \; A \; x \; EF$$

Where E = Emissions (g)
L_B = Boiler load (kW)
A = Activity (hr)
EF = Emission factor (g/kWh)

The emission factor is expressed in terms of emissions per unit of energy from the engine. Emission factors are multiplied by the energy consumed while in a given mode to estimate emissions.

The propulsion load factor is based on the propeller law:

$$LF = (AS/MS)^3$$

Where LF = Load factor (percent)
AS = Actual speed (knots)
MS = Maximum speed (knots)

Maximum speed was calculated as 1.066 times service speed in all cases based upon the California Air Resources Board's (CARB's) methodology.[2] For electric drive passenger ships, all engines are used to generate electricity, and propulsion is electrically driven. Because the propulsion load factor should be applied to the propulsion engine power, the total power in electrically driven ships needs to be reduced to that commonly used for propulsion. Based upon auxiliary loads during cruise and the fact that only 80% of auxiliary power might be used for auxiliary loads in passenger ships, the total power is reduced by 16.25% before applying the propulsion load factor for electrically driven passenger ships. Auxiliary loads are calculated separately. The majority (87%) of the passenger ships that called at the Port in 2022 were electrically driven.

Emission factors vary with engine load because diesel engines are less efficient at low loads and the brake-specific fuel consumption tends to increase. Thus, while mass emissions (grams per hour) decrease with low loads, the engine power tends to decrease more quickly, thereby increasing the emission factor (grams per engine power) as load decreases. Energy and Environmental Analysis, Inc., demonstrated this effect in a study prepared for EPA in 2000.[3] As such, adjustment factors were applied to propulsion engine emissions calculations. Since the 2000 EPA study, MAN-B&W, a major engine manufacturer, developed adjustment factors for their 2-stroke propulsion engines. They provided adjustment factors versus load for slide valve engines and conventional valve engines.[4] MAN-B&W employed slide valves to meet Tier I emission standards in 2002. Thus, any MAN-B&W 2-stroke engine built since 2002 uses slide valves.[5] For non-MAN-B&W engines, the EEA adjustment factors are used.[6]

Adjustment factors are not applied to diesel electric drive systems or auxiliary engines. For these vessels, several engines are used to generate power, and some can be shut down to allow others to operate at a more efficient setting. The purpose of these adjustment factors is to accurately calculate all emission types when an engine is operating less efficiently.

Auxiliary and boiler engine loads were taken from the latest CARB OGV methodology document from 2022.[7] The engine loads are broken down by operating mode and ship type, while passenger ship auxiliary engine load factors are further broken down by passenger capacity of the vessel. Auxiliary and boiler loads are shown in **Table A-1-6**.

Emission factors for propulsion engines were taken from the San Pedro Bay Emissions Inventory Methodology Report. These emission factors are listed in **Table A-1-7**. Separate emissions factors were developed for the National Geographic Quest, which is an HSD. ROG emissions were calculated based on total hydrocarbons, using CARB's conversion factor of 1.26639 for diesel engines.[8]

[2] CARB. 2011. Initial Statement of Reasons for Proposed Rulemaking: Proposed Amendments to the Regulations "Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels Within California Waters and 24 Nautical Miles of the California Baseline," Appendix D: Emissions Estimation Methodology for Ocean-Going Vessels. http://www.arb.ca.gov/regact/2011/ogv11/ogv11appd.pdf.

[3] Energy and Environmental Analysis, Inc. 2000. *Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data* (Publication No. EPA420-R-00-002). EPA. https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P1009Z2K.txt.

[4] Starcrest Consulting Group. 2013. *MAN Slide Valve Low Load Emission Test Final Report*.

[5] 2009. Slide Valves: Small Things That Mean a Lot. *Royal Belgian Institute of Marine Engineers Magazine*, 63(4), 166. https://www.gallois.be/ggmagazine_2009/gg_04_07_2009_166.pdf.

[6] Starcrest Consulting Group. 2021. *San Pedro Bay Emissions Inventory Methodology Report* (Version 3a). Port of Los Angeles and Port of Long Beach. https://kentico.portoflosangeles.org/getmedia/ad5ec383-8dc6-4652-ae0d-81b6ea4c7819/SPBP_Emissions_Inventory_Methodology_v3a.

[7] CARB. 2022. *2021 California Ocean-Going Vessels Emissions Inventory*. https://ww2.arb.ca.gov/sites/default/files/2022-03/CARB_2021_OGV_Documentation_ADA.pdf.

[8] CARB. 2000. Public Meeting to Consider Approval of Revisions to the State's On-Road Motor Vehicle Emissions Inventory: Technical Support Document, Section 4.13: Factors for Converting THC Emission Rates TOG/ROG. https://ww2.arb.ca.gov/sites/default/files/2023-03/emfac2000-ef.pdf.

Table A-1-6. Auxiliary and Boiler Engine Loads

Ship Type and Size Bin[1]	Auxiliary Loads (kW)				Boiler Loads (kW)			
	Transit	Maneuver	Hotel	Anchor	Transit	Maneuver	Hotel	Anchor
Auto Carrier	583	1,325.5	954	664	91.5	183.5	308.5	300.5
Bulk Carrier	255	282.5	522.5	260.5	58	139.5	172	172
Bulk Carrier, HL	358.5	949	211	253	35	94	125	125
Container Ship - 2000	1,420	1,944	696.5	529	252.5	246	404.5	307
General Cargo	466.5	1,104	808.5	180	93	114	148	149.5
Passenger <1500	3,994	5,268	3,069	2,289	992	784	766	867
Passenger 1500-2000	7,000	9,000	5,613	3,498	1,070	1,145	976	1,951
Passenger 2000-2500	11,000	11,350	6,900	4,707	1,382	1,773	1,506	3,005
Passenger 2500-3000	9,781	8,309	6,089	5,916	596	602	431	895
Passenger 3000-3500	8,282	10,369	8,292	7,475	697	1,199	1,068	1,984
Passenger 3500-4000	9,945	11,411	10,445	10,191	401	347	868	989
Passenger >4000	12,500	14,000	12,000	9,900	335	29	503	503
Reefer	1,164	1,250.5	1,156	1,345.5	80	149.5	229	229
RoRo	283	848.5	490	283	67	148	259	251

[1] CARB categorizes auxiliary and boiler engine loads by vessel type and size bins. The size bins for container vessels correspond to the number of standard shipping containers it can carry, while the size bins for passenger ships correspond to the number of passengers they carry.

Table A-1-7. Propulsion Engine Emission Factors

Engine Type	Tier	Model Years	Propulsion Engine Emission Factors (g/kWh)								
			NO_x	DPM	PM2.5	ROG	CO	SO_2	CO_2	CH_4	N_2O
MSD	0	Pre-2000	13.2	0.19	0.17	0.53	1.10	0.40	657	0.010	0.029
	1	2000–2010	12.2	0.19	0.17	0.53	1.10	0.40	657	0.010	0.029
	2	2011–2015	10.5	0.19	0.17	0.53	1.10	0.40	657	0.010	0.029
	3	2016+	2.6	0.19	0.17	0.53	1.10	0.40	657	0.010	0.029
SSD	0	Pre-2000	17.0	0.18	0.17	0.63	1.40	0.36	593	0.012	0.029
	1	2000–2010	16.0	0.18	0.17	0.63	1.40	0.36	593	0.012	0.029
	2	2011–2015	14.4	0.18	0.17	0.63	1.40	0.36	593	0.012	0.029
	3	2016+	3.4	0.18	0.17	0.63	1.40	0.36	593	0.012	0.029
GT	All	All	5.7	-	0.01	0.11	0.20	0.59	962	0.002	0.075
HSD	2	2011–2015	7.7	0.19	0.17	0.53	1.10	0.40	657	0.010	0.029

Emission factors for auxiliary engines and boilers are shown in **Table A-1-8**. These emission factors were taken from the San Pedro Bay Ports Emissions Inventory Methodology Report. For passenger ships, the propulsion engine load factor was used for all calculations, as engines on passenger ships are Category 3 engines. Similar to propulsion engines, ROG emissions from total hydrocarbons were calculated using CARB's conversion factor

of 1.26639 for diesel engines. Per EPA guidance, PM10 emissions from boilers are by definition not considered DPM.[9]

For the ships that used shore power (plugged into the electrical grid instead of running their auxiliary engines during hoteling) at TAMT and CST, hoteling emissions were calculated differently. Both the time during which the vessel was connected to the grid and the amount of energy (in kWh) that the ship consumed, as obtained from the Port, were used to calculate hoteling emissions from shore power electricity consumption. Normal auxiliary engine emissions were calculated for the hoteling time when the ship is not connected to the grid. In addition, electrical grid emission factors for CO_2e were calculated for the time the ship is connected to the grid. The power plant emission factor used for this inventory was 0 g CO_2e/kWh based upon guidance from Port staff.[10]

Table A-1-8. Auxiliary Engine and Boiler Emission Factors

Engine Type	Tier	Model Years	Auxiliary and Boiler Engine Emission Factors (g/kWh)								
			NO_x	DPM	PM2.5	ROG	CO	SO_2	CO_2	CH_4	N_2O
Auxiliary	0	Pre-2000	13.8	0.19	0.17	0.42	1.10	0.42	696	0.008	0.029
	1	2000–2010	12.2	0.19	0.17	0.42	1.10	0.42	696	0.008	0.029
	2	2011–2015	10.5	0.19	0.17	0.42	1.10	0.42	696	0.008	0.029
	3	2016+	2.6	0.19	0.17	0.42	1.10	0.42	696	0.008	0.029
Boiler	All	All	2.0	-	0.19	0.11	0.20	0.59	922	0.002	0.075

A.2 HARBOR CRAFT

Commercial harbor craft (CHC) include a variety of vessel and boat types that serve many functions within and near San Diego Bay, including crew and supply boats, charter fishing vessels, commercial fishing vessels, ferry and excursion vessels, pilot vessels, towboats or push boats, tug boats, and work boats. This section describes the types of CHC operating at the Port and summarizes the methods used to estimate CHC emissions in 2022. The methods used herein are consistent with the methodology used by the CARB to estimate emissions for CHC operating in California.[11]

SOURCE DESCRIPTION

CHC engage in a wide variety of activities at the Port. They assist in moving OGVs around the harbor; move cargo, crew, and passengers into and out of the harbor area; provide fuel to OGVs; provide police, fire, pilot, and other services to harbor users; transport crew and supplies to offshore facilities; and transport crew and passengers to offshore fishing destinations. Most CHC are EPA Category 1 or 2 vessels, vessels with diesel engines with displacement less than 30 liters per cylinder.[12] **Table A-2-1** lists CHC vessel types and their typical functions within the bay.[13] This inventory does not include emissions associated with Port-owned vessels operated by various departments, including the Harbor Police Department.

[9] EPA. 2022. *Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions* (Publication No. EPA-420-B-22-011). https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1014J1S.pdf.

[10] Renewable Energy Certificates were procured to offset CO_2e emissions from electricity at the Port's marine terminals as part of California's Low Carbon Fuel Standard program.

[11] CARB. 2021. Staff Report: Initial Statement of Reasons, Public Hearing to Consider the Proposed Amendments to the Commercial Harbor Craft Regulation, Appendix H: 2021 Update to the Emission Inventory for Commercial Harbor Craft: Methodology and Results. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2021/chc2021/apph.pdf.

[12] Information adapted from EPA's 2016 *National Port Strategy Assessment*, available at: https://www.epa.gov/ports-initiative/national-port-strategy-assessment-reducing-air-pollution-and-greenhouse-gases-us.

[13] Information adapted from reference in Footnote 9.

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

Vessel	Description
Assist Tugboats	Vessels that help OGVs maneuver in the harbor during arrivals, departures, and shifts from berth; and can also provide escort for OGVs
Towboats/Push Boats/Ocean-Going Tugboats	Self-propelled vessels that tow or push barges within and outside of the Port
Ferries and Excursion Vessels	Ferries transport passengers and property. Excursion boats provide harbor cruises and whale watching.
Research Boats	Vessels used for activities such as inspection, survey, and research
Crew and Supply Boats	Vessels that carry personnel and supplies to and from off-shore and in-harbor locations
Work Boats	Vessels used for activities such as utility services, spill/response, maritime pilot transport, mining, training, and construction
Commercial and Sport Fishing Vessels	Vessels that carry crew and/or passengers to fishing areas both within and outside 24 nautical miles from the Port

Tugboats, Towboats, Push Boats, and Assist Tugs

Tugboats, towboats, push boats, assist tugs, and ocean-going tugs are processed together. Assist tugs, tow boats, and push boats perform a variety of general work functions within the harbor, including assisting OGVs' maneuvering and hoteling in the harbor and pushing and pulling barges. Assist tugs ensure safe navigation for large cargo vessel movements upon arrival to and departure from the Port. Assist tugs have unique power levels, rudders, and other equipment designed and designated specifically to support the variety in size and maneuverability of the cargo vessels. Ocean-going tugs active at the Port primarily include tugs that pull fuel barges to and from the Ports of Los Angeles and Long Beach. There were four assist tugs, three tow or push boats, and four ocean-going tugs active at the Port in 2022.

Commercial and Sport Fishing

Commercial fishing includes those vessels harbored at one of the commercial fishing areas at Shelter Island or Tuna Harbor, which is located along the Embarcadero. Vessels in the commercial fishing fleet vary in size because they have size requirements specific to their geographic ranges and the type of catch. Sport fishing, or charter fishing, vessels are fishing boats that are commercially chartered by passengers. The list of vessels was provided by the Port. These vessels are operated by sport fishing operations based in north San Diego Bay, including Fisherman's Landing, H&M Landing, and Point Loma Sport Fishing. Similar to the commercial fishing fleet, vessels in the sport fishing fleet vary in size, depending on the destination type (e.g., half day, full day, and multiday) of the vessels. Generally, sport fishing vessel engines have greater power than those of commercial fishing vessels because of the demands of moving passengers and equipment.

Ferry and Excursion

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

Other Harbor Craft

Other harbor craft include boats that perform a variety of functions at the Port. In this analysis, these were broadly treated as crew and supply, pilot, work, and other vessels. Crew and supply boats are smaller boats that are used for carrying personnel and supplies. Work boats perform inspections, survey, and assist with construction. As an OGV approaches the bay, a San Diego pilot boat carries a bay pilot who then boards the OGV in the vicinity of the Whistle Buoy to ensure safe navigation to the berthing location.

DATA COLLECTION AND ACTIVITY

For all categories except for commercial fishing, information on the number, vessel types, location, operating radius, engine size, model year, and general operating activity of CHC was obtained from tenants through a Port-issued survey. For commercial fishing boats, AIS data were used to determine annual operating hours inside and outside the bay along with CARB default values for engine size and model year. For sport fishing boats, information on engine size, model year, and engine hours was obtained through a Port-issued survey and used to determine annual operating hours inside and outside the bay along with CARB default values for engine size and model year. Any vessel that operated less than 10 hours within the San Diego Bay area was not included.

In cases where information was missing, values were estimated based on a combination of vessel category averages from other vessels, Lloyd's Register data, web research on specific vessels, and default values from CARB models for CHC and barges/dredgers.[14] Average vessel characteristics from CARB were used for commercial fishing boats. Furthermore, it was assumed that all vessels were in compliance with CARB's 2010 Commercial Harbor Craft Amendments, which set forth a compliance schedule for tugboats, towboats, push boats, ferries, excursion vessels, crew and supply vessels, barges, and dredgers based on annual hours of operation and engine model year for all in-use, newly purchased, and replacement engines that operate within Regulated California Waters (e.g., 24 nm from shore) to meet the EPA's emission standards.[15] For example, a harbor craft with greater than or equal to 300 annual operating hours and a 2003 model year engine in 2017 would have needed an engine repowered or replaced to Tier 2 or higher standards by December 31, 2018.[16]

Table A-2-2 summarizes the activity metrics for the several types of vessels considered in this inventory, including the equipment counts as well as average main and auxiliary engine model years, annual hours within 24 nm from the coast, and total horsepower from all engines. As shown, there were 154 harbor craft vessels included in this inventory. All CHC are diesel powered except for one work boat, which is gasoline powered. Emission calculations were based on activity within the same region evaluated for OGVs, within 24 nm of the coast (see Figure A-1-1).

Note that the research vessel category is comprised of two research vessels that dock at TAMT. The main and auxiliary hours for these vessels were obtained from their operators. One of the vessels spent 99% of its 3,811 hours outside of the bay but within the inventory boundary. This amount of time is much higher than that of the same category in the 2019 inventory (114 main engine hours per vessel) and more than CARB's default (957 main engine hours per vessel).

EMISSION ESTIMATION METHODOLOGY

CHC emissions are estimated based on activity-based emission factors and activity profiles for each vessel. Emissions from diesel- and gasoline-powered CHC were estimated according to the general formula, which follows CARB's current approach for commercial harbor craft:

$$E = \sum EF * LF * HP * A * Conv$$

[14] Both models are available on the CARB website at: https://ww2.arb.ca.gov/our-work/programs/msei/road-categories/road-diesel-models-and-documentation.

[15] Commercial Harbor Craft Regulation documents are available at: https://www.arb.ca.gov/ports/marinevess/harborcraft.htm.

[16] This compliance schedule does not apply to dredgers, barges, and crew and supply vessels, which are subject to a different compliance schedule. The compliance dates for all CHC are described in the Final Regulation Order for the 2010 Commercial Harbor Craft Amendments, which is available at: https://www.arb.ca.gov/regact/2010/chc10/frochc931185.pdf.

Where E = Emissions, in tons per year, for each vessel
EF = Emission factor for each fuel type for each pollutant, in grams per brake horsepower-hour (g/bhp-hr; see subsection below)
LF = Main and auxiliary engine load factor for harbor craft type (see subsection below)
HP = Engine horsepower for each engine on each CHC (from Port survey)
A = Number of annual operating hours for each engine (from Port survey and AIS data)
Conv = Conversion factor for grams to short tons or metric tons

Emission factors are composed of zero-hour emission rates and deterioration rates. Zero-hour emission rates reflect the emissions generated per unit activity from a new engine. Over time, the rate of emissions increases because of wear on various parts of an engine. This is known as the "deterioration rate," which changes over time. CARB assumes that at some point during the life of a piece of equipment, the engine will be rebuilt to like-new conditions. The average lifespan before an engine is rebuilt varies by the model year and fuel type. However, CARB assumes that the cumulative lifetime hours for diesel and propane equipment are capped at (limited to) 12,000 hours.[17] Because gasoline engines are rarely rebuilt, CARB does not recommend a cumulative lifetime hour cap for gasoline-powered equipment. Emissions for each vessel are based on the sum of emissions from its main and, if applicable, auxiliary engines.

Emission factors were calculated according to the general formula:

$$EF = EF_{zh} * FCF \left(1 + D * \frac{A}{UL}\right)$$

Where EF = Deteriorated in-use emissions rate for each CHC for each criteria pollutant and GHG (g/bhp-hr)
EF_{zh} = Zero-hour engine emission factor for each CHC fuel type for each criteria pollutant and GHG (g/bhp-hr; CARB CHC model)
FCF = Fuel correction factor (as required; CARB CHC model)
D = Horsepower and pollutant-specific engine deterioration factor (CARB CHC model)
A = Engine age (hr)
UL = Vessel- and engine-specific engine useful life (hr; CARB CHC model)

The zero-hour engine emission factors and deterioration rates for ROG, CO, NO_x, and particulate matter emissions from diesel engines were obtained from CARB's CHC model. Zero-hour engine emission factors for SO_2, CH_4, and N_2O are from the San Pedro Bay Emissions Inventory Methodology Report.[6] No deterioration was assumed for a diesel engine's CO_2, SO_2, CH_4, and N_2O emissions, consistent with CARB.

In terms of activity, main and auxiliary engine hours are based on usage information provided by the Port or based on moving[18] hours taken from the AIS data. Moving hours were assigned to the main engines. For CHC with complete AIS data, auxiliary engine hours were assigned based on the sum of moving hours and stopped hours. For other CHC with incomplete AIS data, auxiliary engine hours were based on the ratio of CARB default auxiliary engine to main engine operating hours by vessel type multiplied by main engine hours. This is because stopped hours include time at berth when vessels are connected to shore power and thus not operating auxiliary engines. For commercial fishing vessels, CARB defaults were used for vessel specifications (main engine power, auxiliary power, and model years). For sport fishing vessels, engine model years, engine size, trips per year, and average time in the bay and outside the bay for each trip were obtained from data provided by the sportfishing association. The cumulative lifetime hours were determined from the reported cumulative engine hours for each piece of equipment in the Port survey. If a survey response did not include cumulative hours, cumulative hours were estimated by multiplying the 2022 annual hours by the equipment age in years. As noted above, cumulative lifetime hours were limited to 12,000 hours for diesel-powered vessels.

Load is the average operational level of an engine in a given application expressed as a fraction of the maximum rated horsepower. Because emissions are directly proportional to engine horsepower, load factors are used to adjust the maximum rated horsepower to reflect actual operating conditions. The main engine and auxiliary

[17] CARB. 2010. Staff Report: Initial Statement of Reasons for the Proposed Rulemaking, Amendments to the Regulations to Reduce Emissions from Diesel Engines on Commercial Harbor Craft Operated Within California Waters and 24 Nautical Miles of the California Baseline, Appendix C: Updates on the Emissions Inventory for Commercial Harbor Craft Operating in California. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2010/chc10/appc.pdf.

[18] A vessel is considered "moving" if it is traveling at a speed of 1 knot or greater.

engine load factors from CARB's CHC model are listed in **Table A-2-3**. The load factors were applied to engines of both fuel types.

Table A-2-2. Average Harbor Craft Activity by Type

Harbor Craft Type	Count	Main Engine			Auxiliary Engine		
		Model Year	Annual Hours within 24 nm	Total Rated hp	Model Year	Annual Hours within 24 nm	Total Rated hp
Assist Tug	4	2013	2,216	3,460	2014	1,548	342
Towboat	3	2015	396	484	2011	452	12
Ocean-Going Tug	4	2012	1,436	1,276	2011	1,025	133
Ferry	2	2017	5,259	724	1976	3,735	52
Excursion	13	2013	781	1,094	2015	709	349
Research Boats	2	1995	2,086	1,594	1995	2,260	1,053
Work Boats	3	2009	375	387	NA	NA	NA
Pilot Boat	1	2002	878	920	NA	NA	NA
Commercial Fishing	68	1995	100	691	1996	119	135
Charter Fishing	54	2009	131	1,985	2007	176	310
Averages	**154 Total**	**2003**	**367**	**1,269**	**2002**	**337**	**231**

NA = not applicable

Table A-2-3. Harbor Craft Load Factors

Vessel Type	Main Engine	Auxiliary Engine
Assist Tugs	0.163	0.338
Ocean-Going Tugs	0.334	0.370
Tow Boats	0.334	0.370
Crew and Supply	0.260	0.395
Excursion	0.268	0.403
Ferries	0.314	0.388
Work Boats	0.323	0.438
Pilot Vessels	0.333	0.322
Commercial Fishing	0.270	0.438
Sport Fishing	0.288	0.454
Others	0.333	0.322

A.3 CARGO HANDLING EQUIPMENT

Cargo handling equipment (CHE) is used to support terminal activities and move cargo onto and off of OGVs, CHC, freight rail, and heavy-duty trucks. A wide range of CHE types operate at the Port, reflecting the diversity of cargo handled at each maritime terminal, which ranges from large containers to dry bulk. This section describes the types of CHE operating at the Port and summarizes the methods used to estimate CHE emissions in 2022. The methods used herein are consistent with the methodology used by the CARB to estimate emissions for CHE operating in California.[19]

Table A-3-1. Cargo Handling Equipment Characteristics

Equipment	Fuel	Count	Average Horsepower	Average Engine Year	Average Annual Hours
ATV	G	15	16	2013	1,436
Cart	G	4	20	2010	535
Compressor	D	1	60	2006	43
	E	7	9	2003	1,560
	G	1	5	2003	600
Crane	D	3	711	2008	150
Forklift	D	21	168	2011	250
	E	31	105	2013	484
	P	9	91	2009	458
Lift	D	1	110	2007	100
	E	21	2	2008	1,560
	P	1	82	2012	100
Loader	D	1	125	1999	200
	G	3	138	2002	780
Other	D	1	0	2012	75
	E	12	3	2003	433
Reach Stacker	D	7	342	2013	263
	E	2	346	2016	100
Segway	E	2	2	NA	375
Sweeper	D	1	33	2017	464
	G	1	83	1998	479
	P	1	28	2017	464
Top Handler	D	2	331	2013	671
Vacuum Truck	D	1	320	2001	40
Yard Tractor	D	21	204	2012	649
	E	6	225	2020	931

Notes: D = Diesel, E = Electric, G = Gas, P = Propane, and S = Solar.

[19] CARB. 2022. *2022 Cargo Handling Equipment Emissions Inventory*. https://ww2.arb.ca.gov/sites/default/files/2023-08/2022CHEInventory.pdf.

SOURCE DESCRIPTION

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

DATA COLLECTION AND ACTIVITY

Information on the number, types, and general operating activity of CHE was obtained from equipment operators through a Port-issued survey. A total of 176 CHE equipment pieces were reported through the surveys in 2022. The CHE was grouped by equipment type categories consistent with CARB guidance and previous Port inventories. The majority of CHE operates at TAMT (79 pieces) and NCMT (79 pieces), with the remaining equipment located at CST (18 pieces). However, most of the equipment located at NCMT (43 of the 79 pieces) and CST (15 of the 18 pieces) are electric.

Table A-3-1 summarizes the 2022 CHE inventory and average engine operating parameters by general equipment type. Engine model year, power rating, and annual operating hours for each equipment piece were obtained from the survey results, when available. Information missing from the survey responses was estimated based on category averages from CARB and professional judgment.

Table A-3-2 presents the 2022 CHE inventory by fuel type. The majority of equipment (81 pieces) is electrically powered, followed by diesel-powered equipment (60 pieces). As shown in **Table A-3-3**, the majority of these diesel-powered pieces operate at TAMT.

Table A-3-2. Cargo Handling Equipment Count by Fuel Type

Equipment Category	Diesel	Gasoline	Propane	Electric or Solar	Total by Type
ATV	0	15	0	0	**15**
Cart	0	4	0	0	**4**
Compressor	1	1	0	7	**9**
Crane	3	0	0	0	**3**
Forklift	21	0	9	31	**61**
Lift	1	0	1	21	**23**
Loader	1	3	0	0	**4**
Other	1	0	0	12	**13**
Reach Stacker	7	0	0	2	**9**
Segway	0	0	0	2	**2**
Sweeper	1	1	1	0	**3**
Top Handler	2	0	0	0	**2**
Vacuum Truck	1	0	0	0	**1**
Yard Tractor	21	0	0	6	**27**
Total by Fuel Type	**60**	**24**	**11**	**81**	**176**

Table A-3-3. Cargo Handling Equipment Count by Fuel Type and by Terminal

Terminal	Diesel	Gasoline	Propane	Electric or Solar	Total by Terminal
TAMT	52	1	3	23	**79**
NCMT	7	23	6	43	**79**
CST	1	0	2	15	**18**

EMISSION ESTIMATION METHODOLOGY

CHE emissions are estimated based on activity-based emission factors and activity profiles for each piece of equipment. Emissions from diesel, gasoline, and propane CHE were estimated according to the general formula, which follows CARB's current approach:

$$E = \sum EF * LF * HP * A * Conv$$

Where E = Emissions for each piece of CHE (tons/year)
EF = Emission factor for each fuel type for each pollutant, in grams per brake horsepower-hour (g/bhp-hr; see subsection below)
LF = Engine load factor for each general CHE type (see subsection below)
HP = Engine horsepower for each CHE (from Port survey)
A = Number of annual operating hours for each engine (from Port survey and CARB defaults)
Conv = Conversion factor for grams to short tons or metric tons

Emission factors are composed of zero-hour emission rates and deterioration rates. Zero-hour emission rates reflect the emissions generated per unit activity from a new engine. Over time, the rate of emissions increases because of wear on various parts of an engine. This is known as the "deterioration rate," which changes over time. CARB assumes that at some point during the life of a piece of equipment, the engine will be rebuilt to like-new conditions. The average lifespan before an engine is rebuilt varies by the model year and fuel type. CARB assumes that the cumulative lifetime hours for diesel and propane equipment are capped at (limited to) 12,000. Because gasoline engines are rarely rebuilt, CARB does not recommend a cumulative lifetime hour cap for gasoline-powered or propane-powered equipment.

Emission factors were calculated according to the general formula:

$$EF = \sum EFzh + dr * CHrs * FCF * CF * RD$$

Where EF = Deteriorated in-use emissions rate for each CHE for each criteria pollutant and GHG (g/bhp-hr)
EF_{zh} = Zero-hour engine emission factor for each CHE fuel type for each criteria pollutant and GHG (g/bhp-hr; CARB CHE model)
dr = Deterioration rate for each CHE fuel type for each criteria pollutant (CARB CHE model)
CHrs = Cumulative lifetime hours for each CHE piece (hr)
FCF = Fuel correction factor (as required; CARB CHE model)
CF = Control factor for each CHE piece (based on reported controls from survey)
RD = Reduction associated with use of renewable diesel (if applicable)

The zero-hour engine emission factors (EF_{zh}) and deterioration rates (dr) for all equipment were obtained from the San Pedro Bay Emissions Inventory Methodology Report.[6] No deterioration was assumed for CO_2, SO_2, CH_4, and N_2O emissions, consistent with CARB guidance. The cumulative lifetime hours (CHrs) were determined from the reported cumulative engine hours for each piece of equipment from the Port survey. If a survey response did not include hours, cumulative hours were estimated by multiplying the annual hours for 2022 by the equipment age in years. As noted above, cumulative lifetime hours were limited to 12,000 hours for diesel and propane equipment.

Fuel correction factors were applied to the NO_x and particulate matter emission rates from diesel engines to account for differences in hydrocarbon and sulfur content in federal and California fuel standards. Fuel correction factors are not required for other pollutants or fuel types, consistent with CARB guidance.

Various emission control technologies have been installed on some CHE. These emission control technologies include diesel oxidation catalysts and diesel particulate filters. Emission control factors from CARB were applied to equipment that was reported to have emission controls in the Port survey. Additionally, some equipment use renewable diesel (R99). CARB guidance states that use of R99 reduces PM10, PM2.5, and DPM emissions by 30% and NO_x emissions by 10% for all engines except for Tier 4 engines equipped with a selective catalytic reduction (SCR) catalyst.[20] The emission reductions from R99 use in this inventory follows this guidance. No reductions for other pollutants are assumed.

Load is the average operational level of an engine in a given application expressed as a fraction of the maximum rated horsepower. Because emissions are directly proportional to engine horsepower, load factors are used to adjust the maximum rated horsepower to reflect actual operating conditions. Load factors for each of the general CHE types were obtained from CARB, except for the mobile crane, as shown in **Table A-3-4**. The load factor for the mobile crane was calculated based on the ratio of actual 2022 fuel consumption relative to the maximum fuel consumption if operating at full engine load. The load factors were applied to all fuel types.

Table A-3-4. Cargo Handling Equipment Engine Load Factors

CHE Type	Load Factor
ATV	0.72
Cart	0.58
Compressor	0.48
Crane (rented)	0.43
Crane (mobile)	0.20
Forklift	0.30
Lift	0.46
Loader	0.55
Other	0.54
Reach Stacker	0.59
Segway	0.58
Sweeper	0.68
Top Handler	0.59
Vacuum truck	0.51
Yard Tractor	0.39

[20] Durbin, Thomas D. et al. 2021. *Low Emission Diesel (LED) Study: Biodiesel and Renewable Diesel Emissions in Legacy and New Technology Diesel Engines*. CARB. https://ww2.arb.ca.gov/sites/default/files/2021-11/Low_Emission_Diesel_Study_Final_Report.pdf.

A.4 FREIGHT RAIL

Rail locomotives carry freight cargo between the Port and regional destinations. Activity associated with locomotives includes activity at or near the terminals to load and unload cargo as well as rail activity regionally to and from the terminals. This section describes the activity and emissions estimation methodologies.

SOURCE DESCRIPTION

Freight rail service at the Port is provided exclusively by Burlington Northern Santa Fe Railway (BNSF). Freight movements are made to and from both TAMT and NCMT along the north-south BNSF right-of-way. Commodities moved by rail include automobiles transported into and out of NCMT as well as dry bulk and break bulk cargo transported into and out of TAMT. Both TAMT and NCMT have on-site rail capabilities. There is no freight rail service to CST.

Rail activity is split between regional travel (or line haul) and switching (or switch duty). Line haul refers to the movement of cargo over long distances, which either initiates from or terminates at the Port. Switching refers to the assembly and disassembly of trains, the sorting of the cars of cargo trains into contiguous “fragments” for subsequent delivery to terminals, and the short-distance hauling of rail cargo within terminal areas as well as between the terminals and nearby railyards.

At NCMT, rail tracks used for auto train cars are on the terminal grounds, while the lumber yards are served by nearby tracks located off the terminal. In the case of automobile loading, trains arrive at NCMT, and the railcars are separated for vehicle loading and then reassembled upon departure. At TAMT, rail switching occurs when bulk cargo is delivered and switcher locomotives move cargo between the BNSF yard and loading areas within TAMT. Additionally, a smaller railcar pusher is used to move railcars within the TAMT terminal area. All switching at NCMT is performed by the line-haul locomotives.

DATA COLLECTION AND ACTIVITY

The methodologies to estimate regional line-haul (off-port) activity and on-site switching (on-port) activity differ, consistent with established protocols and available data. The methods used to estimate each are described below.

Regional Line Haul

Locomotives travel north-south between the Port and the Los Angeles metropolitan area along the BNSF right-of-way. For purposes of this inventory, locomotive emissions are estimated within the air basin boundary, located within San Diego County. Regional activity has been estimated using a methodology that is similar to those of the Port’s previous maritime air emissions inventories and inventories prepared by the Ports of Long Beach and Los Angeles. The approach includes estimating fuel consumption based on the gross weight (cargo, locomotives, and railcars) of all cargo movements, the distance that cargo traveled in the air basin, and the average fuel consumption for line-haul locomotive travel. Total fuel consumption is converted to total horsepower-hours (hp-hr) based on a fuel consumption conversion factor discussed below.

In summary, fuel consumption is calculated according to this general formula:

gallons of diesel = tons of cargo * distance traveled * fuel efficiency

Based on fuel consumption, horsepower-hours are calculated according to this general formula.

hp-hr = gallons of diesel * hp-hr per gallon conversion factor

A description of each of these variables is discussed below.

TONS OF CARGO

At NCMT, 154,407 automobiles were transported by rail within 17,450 railcars in 2022: 127,453 automobiles were moved outbound on 14,705 loaded railcars, and 26,954 automobiles were moved inbound on 2,745 loaded

railcars (total of 13,184 loaded railcars). To estimate gross-ton miles, it was assumed that the average automobile weighs 1.54 tons. Each empty railcar weighs 51.5 tons and each locomotive weighs 214 tons per BNSF's 2022 financial information.[21]

At TAMT, during typical years, dry bulk (soda ash) is imported into the terminal by rail, stored at the terminal, and ultimately exported by vessel. However, there were no soda ash imports to TAMT in 2022 and thus no dry bulk rail activity in 2022. Break bulk includes cargo for shipbuilding and miliary operations. In general, break bulk cargo is imported to TAMT by BNSF via rail, where it is repositioned onto vessels or trucks for transport. Smaller movements within the terminal are typically performed by a rail pusher.

To estimate regional gross-ton miles, it was assumed that break bulk cargo weighed a total of 15,200 tons and that the cargo was transported on 108 loaded railcars. As described above, each empty railcar weighs 51.5 tons, and each locomotive weighs 214 tons.

DISTANCE TRAVELED

In terms of distance traveled, the distance for NCMT cargo is 65.7 miles (from track mile 273.1 at Tidelands Ave and 19th Street to 207.4 at the Orange County boundary), while TAMT cargo is 61.9 miles (from track mile 269.3 near the southeast edge of TAMT to 207.4 at the Orange County boundary). This leads to an estimate of 159,184,844 ton-miles from NCMT and 1,947,374 ton-miles from TAMT.

Table A-4-1. Locomotive Gross Ton-Mile Estimates, Off-Port Regional Line Haul

Direction	Item	Number	Tons/Each	Total Tons	Total Ton-Miles[a]	Total Gallons[b]	Total Hp-Hr[c]
NCMT							
Loaded	Automobiles	154,407	1.54	237,787	15,622,591	15,634	325,186
	Railcars	17,450	51.5	898,675	59,042,948	59,086	1,228,986
	Locomotives	906	214	193,884	12,738,179	12,747	265,147
	Total	-	-	*1,330,346*	*87,403,718*	*87,467*	*1,819,319*
Empty	Automobiles	0	1.54	0	0	0	0
	Railcars	17,450	51.5	898,675	59,042,948	59,086	1,228,986
	Locomotives	906	214	193,884	12,738,179	12,747	265,147
	Total	-	-	*1,092,559*	*71,781,126*	71,833	1,494,132
	Total NCMT	**-**	**-**	***2,422,905***	***159,184,844***	***159,301***	***3,313,451***
TAMT							
Loaded	Break Bulk	-	-	15,200	940,880	942	19,585
	Railcars	108	51.5	5,562	344,288	345	7,166
	Locomotives	12	214	2,568	158,959	159	3,309
	Total	**-**	**-**	23,330	1,444,127	1,445	30,060
Empty	Break Bulk	-	-	0	0	0	0
	Railcars	108	51.5	5,562	344,288	345	7,166
	Locomotives	12	214	2,568	158,959	159	3,309
	Total	**-**	**-**	8,130	503,247	504	10,475
	Total TAMT	**-**	**-**	***31,460***	***1,947,374***	***1,949***	***40,535***
Total Overall				**2,454,365**	**161,132,218**	**161,249**	**3,353,986**

[a] Ton-miles estimates are based on 65.7 miles from NCMT to Orange County and 61.9 miles from TAMT to Orange County.

[b] Gallons estimates are based on ton-miles x 999.3 tons-miles per gallon.

[c] Horsepower-hours estimates are based on gallons x 20.8 hp-hr per gallon from EPA Regulatory Support Document and Technical Highlights.

[21] BNSF Surface Transportation Board Reports, available at: https://www.bnsf.com/about-bnsf/financial-information.

FUEL CONSUMPTION

Fuel consumption is derived from information annually reported by BNSF to the U.S. Surface Transportation Board. The fuel consumption rate is calculated for this inventory based on the gross tonnage and fuel consumption provided in BNSF's 2022 financial reporting. The calculated fuel efficiency in 2022 was 1.001 gallons per thousand gross ton-miles (or 999.3 ton-miles per gallon). The 2022 fuel consumption estimate is shown in **Table A-4-1**.

GALLONS PER HORSEPOWER-HOUR CONVERSION

The fuel consumption estimate was converted to hp-hr of usable power by using a fuel consumption conversion factor of 20.8 hp-hr/gallon, which is based on EPA guidance for large line-haul Class 1 railroads.[22] This multiplier is conservative: It is based on a study of locomotives manufactured in the mid-1990s, and older locomotives would be expected to produce less useful work from each gallon of fuel than newer (e.g., existing) locomotives. This conversion factor is used in other inventories, such as those of the Ports of Los Angeles and Long Beach, so it is used here for consistency. As shown in Table A-4-1, we estimate 3,313,451 hp-hr from NCMT and 40,535 hp-hr from TAMT, for a total of 3,353,986 hp-hr for line-haul activity.

On-Site Switching

Switching activity involves the loading and unloading of cargo and movements around the yard and/or terminal to position railcars. Switching activity is calculated according to this general formula:

locomotive hp-hr = hours per train * no. of active locomotives * locomotive power rating x load factor

Each variable is described below.

HOURS PER TRAIN AND NUMBER OF ACTIVE LOCOMOTIVES

Estimates of the time needed to build, spot, and load trains at both TAMT and NCMT are based on personal communication with Maritime Department staff. To determine annual activity at NCMT, it was assumed that there were 302 train-builds, based on 17,450 loaded railcars and 51.5 average railcars per train (50 railcars on weekdays and 71 railcars on Saturday). It is assumed that it takes 4.5 hours of locomotive activity for each train build.

To determine annual activity at TAMT, it was assumed that there were 12 break bulk deliveries in 2022. Each delivery was assumed to require use of a BNSF switcher to move cargo into and out of the terminal, and a rail pusher to move cargo around within the terminal.

LOCOMOTIVE POWER RATING

Freight or line-haul locomotives are the most powerful locomotives and are used to power freight train operations over long distances. Line-haul locomotives are generally equipped with 3,500 to 5,000 horsepower (hp) engines. Switch locomotives are smaller and are typically 2,000 hp or less. BNSF line-haul locomotives are equipped with 3,800 hp engines. The BNSF switcher used to move cargo into and out of TAMT is equipped with a single 3,600 hp Tier 0 engine. The railcar pusher used to move railcars around TAMT is equipped with a 300 hp Tier 3 engine.

LOAD FACTOR

A detailed description of throttle notch settings during switching activity at TAMT and NCMT is not available, so operations have been estimated based on switch-duty cycle averages from EPA's Regulatory Support Document

[22] EPA. 2009. *Emission Factors for Locomotives – Technical Highlights* (Publication No. EPA-420-F-09-025). https://nepis.epa.gov/Exe/ZyPDF.cgi/P100500B.PDF?Dockey=P100500B.PDF.

(RSD).[23] The EPA's RSD does not include power distribution by notch for idling, which is instead estimated based on the ratio of Dash 9 and ES44 engine fuel idling and notch 8 fuel consumption used in both the 2012 and 2016 maritime inventories. The resulting load factor is 9.0% for switcher movements. The railcar pusher load factor is based on the CARB average of 38% for railcar/track cars.

EMISSION ESTIMATION METHODOLOGY

Locomotive emissions are calculated by using activity-based emission factors together with the activity discussed above. Three sets of emissions factors were developed for BNSF line-haul locomotives, the switcher at TAMT, and the railcar pusher at TAMT.

Line-haul emission factors are based in part on BNSF's 1998 Memorandum of Understanding (1998 MOU) with CARB and the South Coast Air Quality Management District. BNSF compliance data is submitted annually to CARB, which summarizes the work (in MWh) and NO_x emissions rating (in grams per hp-hr [g/hp-hr]).[24] BNSF's compliance data are used to determine the fleet-average NO_x emission level each year, which is weighted by the work (in MWh) performed by locomotives in each engine tier. BNSF only estimates and submits its NO_x emission level consistent with the 1998 MOU. While emission factors for other pollutants are not provided, this compliance data can be used to assign other emission factors based on EPA locomotive emission factors. Emission factors for other pollutants are based on the same activity (sum of work by tier) assumed in the NO_x emissions calculation. The EPA only provides tier-specific emission factors for hydrocarbons (HC), particulate matter (PM), and CO, in addition to NO_x (which is already weighted per the 1998 MOU). Emission factor weightings for HC, PM, and CO emissions are provided in **Table A-4-2**.

Table A-4-2. Line-Haul Emission Factor Weighting

Tier	BNSF Agreement Locomotive Compliance Summary Information[1]			Other Emission Factor Weighting[2]		
	Sum of work (MWh)	% Work by Tier	NO_x	PM	HC	CO
Pre-Tier 0	1,335	0.65%	13.0	0.32	0.48	1.28
Tier 0	3,792	1.84%	7.5	0.32	0.48	1.28
Tier 1	81,853	39.63%	6.2	0.32	0.47	1.28
Tier 2	63,154	30.58%	4.5	0.18	0.26	1.28
Tier 3	45,449	22.00%	4.3	0.08	0.13	1.28
Tier 4	10,968	5.31%	1.2	0.015	0.04	1.28
Total	**206,554**	**100%**	**5.1**	**0.21**	**0.31**	**1.28**

[1] Based on BNSF's 2022 compliance data, available at: https://ww2.arb.ca.gov/resources/documents/rail-emission-reduction-agreements.

[2] Based on EPA Locomotive Exhaust Emissions Factors, available at: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100500B.PDF?Dockey=P100500B.PDF.

These weighted tier-specific emission factors are used to estimate emission factors for other pollutants: The ROG emission factor estimate is based on a 1.053 total HC to ROG conversion factor from the EPA rulemaking. The PM emission factor is assumed to be equal to the PM10 emission factor, and the PM2.5 emission factor is assumed to be 97% of the PM10 emission factor, per EPA guidance. The DPM emission factor is assumed to equal the PM10 emission factor. SO_2 and CO_2 emission factors are based on EPA rulemaking that estimated SO_2 (assuming ultra-low sulfur diesel at 15 parts per million) and CO_2 emission rates to be 0.09 g/hp-hr (based on 1.88 grams per gallon) and 491 g/hp-hr (based on 10,217 grams per gallon), respectively. CH_4 and N_2O emission factors are taken from the EPA default emission factors of 0.038 g/hp-hr (based on 0.8 g/gallon) for CH_4 and 0.013 g/hp-hr (based on 0.26 g/gallon) for N_2O. A summary of line-haul emission factors after weighting and after the above conversions is provided in **Table A-4-3**.

[23] EPA. 1998. *Locomotive Emission Standards: Regulatory Support Document* (Publication No. EPA-420-R-98-101). https://nepis.epa.gov/Exe/ZyPDF.cgi/P100F9QT.PDF?Dockey=P100F9QT.pdf.

[24] CARB. 1998. Memorandum of Mutual Understandings and Agreements: South Coast Locomotive Fleet Average Emissions Program. https://ww2.arb.ca.gov/sites/default/files/2021-02/1998MOU.pdf.

The emissions factors for switchers are based on Tier 0 emission rates from EPA. The ROG emission factor estimate is based on a 1.053 conversion factor from EPA rulemaking. PM emissions are equal to PM10 emissions, and DPM emissions are assumed equal to PM10 emissions. PM2.5 emissions are assumed to be 97% of PM10 emissions. SO_2 and GHG emission factors are taken from EPA. Emission factors for the railcar pusher are based on Tier 3 emission rates for a 300 hp engine. A summary of weighted switcher and railcar pusher emission factors is provided in Table A-4-3.

Table A-4-3. Summary of Locomotive Emission Factors (g/hp-hr)

	ROG	CO	NO_x	PM10	PM2.5	DPM	SO_2	CO_2	CH_4	N_2O
Line Haul	0.32	5.30	1.28	0.21	0.20	0.21	0.09	491	0.04	0.01
Switcher	1.06	12.60	1.83	0.44	0.43	0.44	0.01	671	0.03	0.01
Railcar Pusher	0.09	2.32	2.60	0.09	0.08	0.09	0.005	528	0.02	0.004

A.5 HEAVY-DUTY TRUCKS

On-road vehicles include heavy-duty trucks that are used to transport Port-related cargo between NCMT and TAMT and local and regional destinations. This section describes the activity of heavy-duty trucks and on-road vehicles that operate at the Port, including activity assumptions and methodologies that were used to develop emission estimates.

SOURCE DESCRIPTION

Heavy-duty trucks travel between NCMT and TAMT and local and regional destinations. Typical types of trucks that visit TAMT are refrigerated container trucks, dry bulk trucks, and flatbed trucks. The main type of truck that visits NCMT is auto carriers.

In order to properly account for all emissions associated with truck travel, activity for truck trips is categorized geographically:

- On-port moves, which include truck movement and idling within terminal boundaries as trucks move into position to pick up or drop off cargo
- Near-port moves, which include truck movement that occurs between terminal gates and freeway access points and between the terminal gates and local destinations or origins for trips that do not require freeway travel
- Off-port regional moves, which include truck movement on the regional freeway network between freeway access points and the cargo destination or origin

At NCMT, automobile imports arrive by vessel and are off-loaded and driven a short distance to parking areas near the terminal prior to being loaded onto trucks or rail.

DATA COLLECTION AND ACTIVITY

Information on the number of terminal truck trips and destinations by cargo type was obtained from Port staff. The emissions estimation methodology is described below,

In 2022, there were 61,478 truck visits to TAMT and 39,751 truck visits to NCMT. Truck counts are summarized in **Table A-5-1**.

Truck visit counts (one trip inbound and outbound for each gate count) and the distribution of trucks by destination were obtained from the Port and the NCMT operator, Pasha. Truck trips and vehicle miles traveled (VMT) by destination were estimated based on travel distance. At TAMT, refrigerated container and cold storage trucks primarily travel north toward Orange County along Interstate (I-) 5 or south to the National Distribution Center in National City via surface roads. A smaller portion of the refrigerated truck traffic travels north toward Riverside County along I-15 and east toward Imperial County along I-8. For dry bulk and other general cargo, trip distributions vary by cargo type. For example, all bauxite arrives to TAMT via vessel and is hauled by truck to Riverside and Imperial Counties. All trucks traveling to and from NCMT use Bay Marina Drive. A small share of

car carrier trucks travel directly from NCMT to local car dealerships located on Mile of Cars Way in National City, while the majority of trucks travel north on I-5 and I-15 for regional distribution. Additionally, a portion of auto carriers import vehicles from the Otay Mesa area to the NCMT terminal for regional distribution.

Table A-5-1. Terminal Truck Gate Counts by Type and Cargo

Terminal	Truck Type	Counts
TAMT	Containers	34,592
	Bauxite	4,793
	Sugar	5,405
	Fertilizer	471
	Car Carriers	4,056
	Break Bulk	12,143
	Other Dry Bulk	18
	Total TAMT	**61,478**
NCMT	Car Carriers	39,232
	Break Bulk	519
	Total NCMT	**39,751**

On-port distance and time duration per truck visit are taken directly from the 2012 inventory and presented in **Table A-5-2**. Near-port travel distance is based on the assumed path trucks take to access the freeway, and regional travel distance is the mileage measured from the point of freeway access to the ultimate destination.

Descriptions of the routes that trucks take between TAMT and local and regional origins and destinations are as follows:

- Trucks that move cargo between TAMT and Orange County travel on I-5 and are assumed to access I-5 and TAMT via 28th Street and Harbor Drive.
- Trucks that move cargo between TAMT and Marine Corps Air Station Miramar and Riverside County travel on I-15 and are assumed to travel between I-15 and TAMT via 32nd Street and Harbor Drive.
- Trucks that move cargo between TAMT and Imperial County travel on I-8 and are assumed to access TAMT and I-15 via 32nd Street.
- Trucks that move cargo between TAMT the National Distribution Center are assumed to travel on Harbor Drive, Tidelands Avenue, and Bay Marina Drive.
- Trucks that move cargo between TAMT and bulk facilities in National City are assumed to travel on Harbor Drive and access Main Street via 32nd Street.

Descriptions of the routes that trucks take between NCMT and local and regional origins and destinates are as follows:

- All trucks that do not move cargo between NCMT and the Mile of Cars Way are assumed to travel between NCMT and regional destinations via I-5 and I-15 via Bay Marina Drive.
- Trucks that travel between NCMT and Mile of Cars Way in National City do not access the freeway but instead travel on Bay Marina Drive and Mile of Cars Way.

The distance traveled (in miles) within each travel leg was measured with geographic information systems (GIS).

Table A-5-2. Heavy-Duty Truck Activity Assumptions at TAMT and NCMT

Cargo	Activity or Direction	Round Trip Mileage
TAMT		
All	Within Terminal	0.5
Refrigerated Containers	59% to Orange County via I-5	118
	12% to Riverside County via I-15	113
	10% to Imperial County via I-8	150
	18% to National Distribution Center via Harbor Drive	10
	1% to Otay Mesa via Harbor Drive and I-905	32.8
Bauxite	64% to Riverside County via I-15	113
	36% to Imperial County via I-8	150
Cement	70% to Riverside County via I-15	113
	30% to Imperial County via I-8	150
Other Bulk	100% of sugar to Otay Mesa via Harbor Drive and I-905	32.8
	100% of fertilizer to Barrio Logan via Harbor Drive	6
NCMT		
All	Within Terminal	0.5
Vehicle Carriers	42% from Otay Mesa Port of Entry to NCMT via I-905 and Bay Marina Drive	32
	2% of truck travel to/from Otay Mesa Yard	26
	11% to Various destinations within San Diego County	50
	38% to Orange County via I-5	124
	7% to Imperial County via I-8	156
Break Bulk	100% to various destinations within San Diego County	50

EMISSION ESTIMATION METHODOLOGY

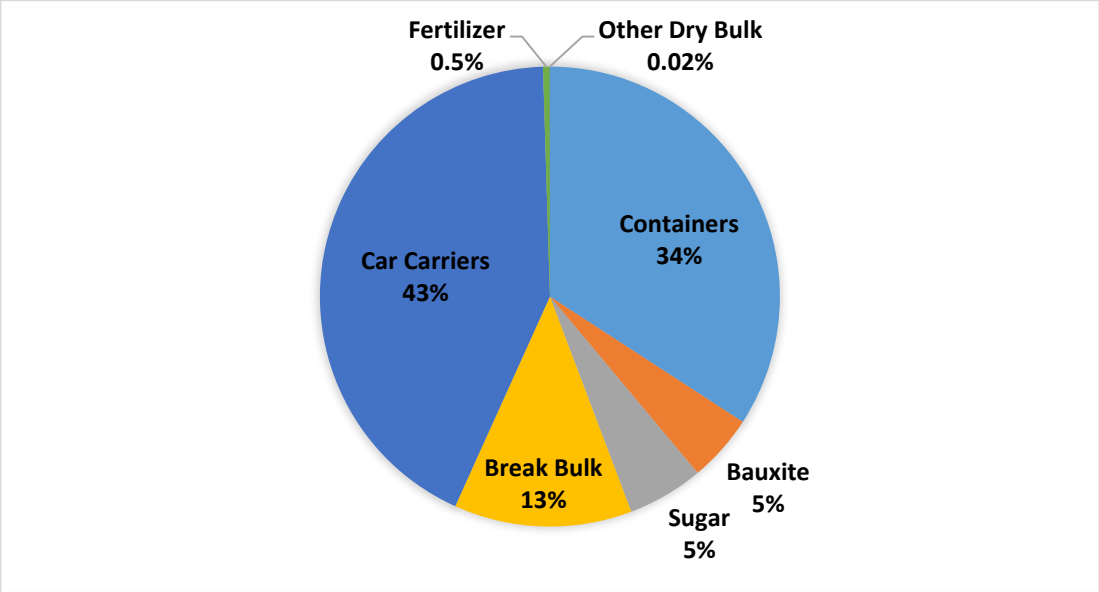
The current practice to calculate emissions from vehicles serving ports is to use activity-based emission factors and activity profiles for each vehicle type. Emissions from trucks are calculated according to the following formula:

$$E = \sum EF * T * Mi * Conv$$

Where E = Emissions from truck activity (tons or metric tons)
EF = Emission factor for each truck type for each pollutant (g/mile; see subsection below)
T = Number of truck trips
Mi = Mileage for each truck trip based on origin and destination
Conv = Conversion factor for grams to short tons or metric tons

Emissions are estimated based on emission factors from CARB's EMFAC2021 model multiplied by the truck trips and VMT assumptions shown in Table A-5-2. The relative contribution of truck trips by cargo type is shown in **Figure A-5-1**.

Figure A-5-1. Relative Contribution of Truck Trips by Cargo Type



Appendix B

Modeling Outputs

2022 Vessel Information

LR/IMO#	LLOYDNAM	MMSI	_TYPE	KEEL	MAIN_KW	DESIGN	DESIGNATIO	DISP	MAIN_ENGIN	Tier	LLAF	SPEED	Cars/TEUS/Pas	Size	T Aux Load	M Aux Load	H Aux Load	A Aux Load	T Boil Load	M Boil Load	H Boil Load	A Boil Load
9539171	ALTAIR LEADER	432817000	AUTO CARRIER	2010	14315	Mitsubishi	7UEC60LSII	650.3	SSD	1	OTH	20.65	6341	> 6000 cars	583	1326	954	664	92	184	309	301
9372327	ANDROMEDA SPIRIT	372945000	AUTO CARRIER	2006	11560	Mitsubishi	8UEC50LSII	382.9	SSD	1	OTH	19.90	3205	2000 - 4000 cars	583	1326	954	664	92	184	309	301
9728083	APOLLON HIGHWAY	353013000	AUTO CARRIER	2014	13000	MAN-B&W	7S60ME-C8	678.6	SSD	2	BSV	20.00	7625	> 6000 cars	583	1326	954	664	92	184	309	301
9008706	ARACARI ARROW	311044300	GENERAL CARGO	1992	8952	Sulzer	7RTA52	382.3	SSD	0	OTH	15.00	1688	45,000 - 90,000	467	1104	809	180	93	114	148	150
9374351	ATLANTIS FORTUNE	538007835	GENERAL CARGO	2007	7080	Mitsubishi	6UEC52LA	339.8	SSD	1	OTH	14.50	0	35,000 - 45,000	467	1104	809	180	93	114	148	150
9508419	BBC FUJI	218509000	GENERAL CARGO	2008	7000	MaK	7M43C	88.6	MSD	1	OTH	16.50	660	< 25,000	467	1104	809	180	93	114	148	150
9388883	BBC TEXAS	305063000	GENERAL CARGO	2006	5400	MaK	6M43	88.6	MSD	1	OTH	15.50	665	< 25,000	467	1104	809	180	93	114	148	150
9508471	BBC VESUVIUS	305865000	GENERAL CARGO	2008	6300	MaK	7M43C	88.6	MSD	1	OTH	16.50	660	< 25,000	467	1104	809	180	93	114	148	150
9403281	BERGAMOT ACE	319740000	AUTO CARRIER	2008	11440	MAN-B&W	8S50MC	375.0	SSD	1	BSV	20.00	4216	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9309617	BLUE BAIE	371716000	GENERAL CARGO	2004	7061	Mitsubishi	6UEC52LA	339.8	SSD	1	OTH	14.50	0	25,000 - 35,000	467	1104	809	180	93	114	148	150
9237357	CARNIVAL MIRACLE	354277000	PASSENGER 2500-3000	2000	62370	Wartsila	9L46D	96.4	MSD-ED	1	NON	22.00	2680	2500 - 3000 Pass	9781	8309	6089	5916	596	602	431	895
9189419	CELEBRITY MILLENNIUM	249055000	PASSENGER 2000-2500	1999	71242	GE Marine	LM2500+	5.3	GT-ED	0	NON	24.00	2450	2000 - 2500 Pass	11000	11350	6900	4707	1382	1773	1506	3005
9362530	CELEBRITY SOLSTICE	249409000	PASSENGER 3000-3500	2007	67200	Wartsila	16V46	96.4	MSD-ED	1	NON	24.00	3129	3000 - 3500 Pass	8282	10369	8292	7475	697	1199	1068	1984
9308883	CEPHEUS LEADER	431323000	AUTO CARRIER	2004	15540	Mitsubishi	8UEC60LSII	650.3	SSD	1	OTH	20.00	6324	> 6000 cars	583	1326	954	664	92	184	309	301
9182356	COMET ACE	351757000	AUTO CARRIER	1999	10592	Mitsubishi	8UEC52LS	392.9	SSD	0	OTH	18.90	3600	2000 - 4000 cars	583	1326	954	664	92	184	309	301
9293399	CROWN PRINCESS	310500000	PASSENGER 3500-4000	2004	67220	Wartsila	12V46	96.4	MSD-ED	1	NON	22.50	3582	3500 - 4000 Pass	9945	11411	10445	10191	401	347	868	989
9210440	CRYSTAL RAY	311039000	AUTO CARRIER	1999	15520	Sulzer	7RTA62U	649.1	SSD	0	OTH	20.50	6658	> 6000 cars	583	1326	954	664	92	184	309	301
9381249	CYGNUS LEADER	372747000	AUTO CARRIER	2006	16360	Mitsubishi	8UEC60LSII	650.3	SSD	1	OTH	19.30	6501	> 6000 cars	583	1326	954	664	92	184	309	301
9565560	DALIAN HIGHWAY	357694000	AUTO CARRIER	2010	13200	MAN-B&W	7S60ME-C8	678.6	SSD	1	BSV	20.00	6249	> 6000 cars	583	1326	954	664	92	184	309	301
9595395	DELTA	636015594	BULK CARRIER	2011	6480	MAN-B&W	6S42MC	244.4	SSD	2	BSV	13.90	0	25,000 - 35,000	255	283	523	261	58	140	172	172
9228198	DIAMOND PRINCESS	235103359	PASSENGER 3000-3500	2002	60700	Wartsila	9L46C	96.4	MSD-ED	1	NON	23.00	3026	3000 - 3500 Pass	8282	10369	8292	7475	697	1199	1068	1984
9441506	DIGNITY ACE	311002900	AUTO CARRIER	2010	14280	MAN-B&W	7S60MC-C	678.6	SSD	1	BSV	20.50	6697	> 6000 cars	583	1326	954	664	92	184	309	301
9426350	DIONYSOS LEADER	432722000	AUTO CARRIER	2008	15544	Mitsubishi	8UEC60LSII	650.3	SSD	1	OTH	20.00	6324	> 6000 cars	583	1326	954	664	92	184	309	301
9143740	DISCOVERY BAY	636022592	REEFER	1996	11004	Mitsubishi	8UEC50LSII	382.9	SSD	0	OTH	19.30	242	10,000 - 20,000	1164	1251	1156	1346	80	150	229	229
9837468	DISCOVERY PRINCESS	310812000	PASSENGER 3500-4000	2015	62400	Wartsila	12V46F	96.4	MSD-ED	2	NON	22.00	3660	3500 - 4000 Pass	9945	11411	10445	10191	401	347	868	989
9126819	DISNEY WONDER	308457000	PASSENGER 2500-3000	1997	57670	Sulzer	16ZAV40S	70.4	MSD-ED	0	NON	21.50	2834	2500 - 3000 Pass	9781	8309	6089	5916	596	602	431	895
9703069	DOLE ATLANTIC	311000415	CONTAINER SHIP - 2000	2015	19420	MAN-B&W	8L70ME-C8	908.2	SSD	2	BSV	19.50	1540	1000 - 2000 TEU	1420	1944	697	529	253	246	405	307
9703071	DOLE CARIBBEAN	311000416	CONTAINER SHIP - 2000	2015	19420	MAN-B&W	8L70ME-C8	908.2	SSD	2	BSV	19.50	1540	1000 - 2000 TEU	1420	1944	697	529	253	246	405	307
9703057	DOLE PACIFIC	311000414	CONTAINER SHIP - 2000	2015	19420	MAN-B&W	8L70ME-C8	908.2	SSD	2	BSV	19.50	1540	1000 - 2000 TEU	1420	1944	697	529	253	246	405	307
9273791	DONALD	305062000	GENERAL CARGO	2004	7200	MaK	8M43	88.6	MSD	1	OTH	17.00	675	< 25,000	467	1104	809	180	93	114	148	150
9419747	DONG-A METIS	372997000	AUTO CARRIER	2008	14280	MAN-B&W	6S60MC-C	678.6	SSD	1	BSV	20.40	6700	> 6000 cars	583	1326	954	664	92	184	309	301
9303168	DREAM BEAUTY	353642000	AUTO CARRIER	2004	11441	MAN-B&W	8S50MC	375.0	SSD	1	BSV	19.40	4075	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9325788	DREAM DIAMOND	372290000	AUTO CARRIER	2004	11441	MAN-B&W	8S50MC	375.0	SSD	1	BSV	19.40	4075	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9277486	ECO DYNAMIC	636021765	GENERAL CARGO	2004	6620	Mitsubishi	6UEC52LA	339.8	SSD	1	OTH	14.30	0	25,000 - 35,000	467	1104	809	180	93	114	148	150
9539236	EMERALD ACE	538004697	AUTO CARRIER	2010	14315	Mitsubishi	7UEC60LSII	650.3	SSD	1	OTH	20.65	6312	> 6000 cars	583	1326	954	664	92	184	309	301
9378448	EURODAM	245206000	PASSENGER 2500-3000	2007	64000	MaK	8M43C	88.6	MSD-ED	1	NON	21.90	2731	2500 - 3000 Pass	9781	8309	6089	5916	596	602	431	895
9725897	EURUS VENTURE	249832000	BULK CARRIER	2015	6050	MAN-B&W	5S50ME-B9	434.7	SSD	2	BSV	14.00	0	35,000 - 45,000	255	283	523	261	58	140	172	172
9836921	GEORGIA HARMONY	354267000	BULK CARRIER	2015	6050	MAN-B&W	6S46ME-B8	321.1	SSD	2	BSV	14.70	0	35,000 - 45,000	255	283	523	261	58	140	172	172
9441594	GLOVIS CARAVEL	311054300	AUTO CARRIER	2012	14280	MAN-B&W	7S60MC-C	678.6	SSD	2	BSV	20.50	6500	> 6000 cars	583	1326	954	664	92	184	309	301
9590589	GLOVIS CENTURY	441200000	AUTO CARRIER	2011	13570	MAN-B&W	6S60MC-C8	678.6	SSD	2	BSV	20.50	6100	> 6000 cars	583	1326	954	664	92	184	309	301
9590591	GLOVIS CHALLENGE	441190000	AUTO CARRIER	2011	13570	MAN-B&W	6S60MC-C8	678.6	SSD	2	BSV	20.50	6500	> 6000 cars	583	1326	954	664	92	184	309	301
9441582	GLOVIS CLIPPER	311054400	AUTO CARRIER	2011	14280	MAN-B&W	7S60MC-C	678.6	SSD	2	BSV	20.50	6500	> 6000 cars	583	1326	954	664	92	184	309	301
9122942	GLOVIS COMET	440269000	AUTO CARRIER	1996	14314	B&W	7S60MC	648.0	SSD	1/0	BSV	20.10	6460	> 6000 cars	583	1326	954	664	92	184	309	301
9451898	GLOVIS COUGAR	441302000	AUTO CARRIER	2009	14280	MAN-B&W	6S60MC-C	678.6	SSD	1	BSV	19.50	6700	> 6000 cars	583	1326	954	664	92	184	309	301
9706994	GLOVIS CROWN	538005981	AUTO CARRIER	2014	12560	MAN-B&W	6S60ME-C8	678.6	SSD	2	BSV	20.40	6600	> 6000 cars	583	1326	954	664	92	184	309	301
9736810	GLOVIS SIGMA	311000458	AUTO CARRIER	2014	12927	MAN-B&W	7G60ME-C9	788.9	SSD	2	BSV	19.50	7700	> 6000 cars	583	1326	954	664	92	184	309	301
9749582	GLOVIS SIRIUS	440258000	AUTO CARRIER	2015	13070	MAN-B&W	7S60ME-C8	678.6	SSD	2	BSV	20.00	7400	> 6000 cars	583	1326	954	664	92	184	309	301
9798387	GLOVIS SONIC	538007414	AUTO CARRIER	2015	13780	MAN-B&W	7S60ME-C8	678.6	SSD	2	BSV	20.00	7409	> 6000 cars	583	1326	954	664	92	184	309	301
9674165	GLOVIS SPIRIT	441151000	AUTO CARRIER	2013	13070	MAN-B&W	7S60ME-C8	678.6	SSD	2	BSV	20.00	7280	> 6000 cars	583	1326	954	664	92	184	309	301
9749594	GLOVIS SPRING	440260000	AUTO CARRIER	2015	13070	MAN-B&W	7S60ME-C8	678.6	SSD	2	BSV	20.00	7400	> 6000 cars	583	1326	954	664	92	184	309	301
9702417	GLOVIS SUMMIT	440245000	AUTO CARRIER	2013	13070	MAN-B&W	7S60ME-C8	678.6	SSD	2	BSV	20.15	7280	> 6000 cars	583	1326	954	664	92	184	309	301
9749568	GLOVIS SUN	440255000	AUTO CARRIER	2015	13070	MAN-B&W	7S60ME-C8	678.6	SSD	2	BSV	20.00	7400	> 6000 cars	583	1326	954	664	92	184	309	301
9798416	GLOVIS SUNLIGHT	538007440	AUTO CARRIER	2015	13780	MAN-B&W	7S60ME-C8	678.6	SSD	2	BSV	20.00	7409	> 6000 cars	583	1326	954	664	92	184	309	301
9702405	GLOVIS SUNRISE	440202000	AUTO CARRIER	2013	13070	MAN-B&W	7S60ME-C8	678.6	SSD	2	BSV	20.00	7280	> 6000 cars	583	1326	954	664	92	184	309	301
9674177	GLOVIS SUPREME	441133000	AUTO CARRIER	2013	13070	MAN-B&W	7S60ME-C8	678.6	SSD	2	BSV	20.00	7280	> 6000 cars	583	1326	954	664	92	184	309	301
9357315	GOLIATH LEADER	308369000	AUTO CARRIER	2007	15539	MAN-B&W	7S60ME-C	678.6	SSD	1	BSV	20.50	6658	> 6000 cars	583	1326	954	664	92	184	309	301
9279331	GRAND AURORA	351828000	AUTO CARRIER	2002	14280	B&W	7S60MC	648.0	SSD	1	BSV	19.80	6402	> 6000 cars	583	1326	954	664	92	184	309	301
9340570	GRAND CHAMPION	372613000	AUTO CARRIER	2004	14280	MAN-B&W	7S60MC	648.0	SSD	1	BSV	19.80	6402	> 6000 cars	583	1326	954	664	92	184	309	301
9303182	GRAND COSMO	371648000	AUTO CARRIER	2004	14280	MAN-B&W	7S60MC	648.0	SSD	1	BSV	19.80	6402	> 6000 cars	583	1326	954	664	92	184	309	301
9355238	GRAND DAHLIA	355222000	AUTO CARRIER	2008	14280	MAN-B&W	7S60MC	648.0	SSD	1	BSV	19.80	6402	> 6000 cars	583	1326	954	664	92	184	309	301
9303223	GRAND DIAMOND	372283000	AUTO CARRIER	2004	14280	MAN-B&W	7S60MC	648.0	SSD	1	BSV	19.80	6402	> 6000 cars	583	1326	954	664	92	184	309	301
9267663	GRAND EAGLE	357347000	AUTO CARRIER	2002	14169	Mitsubishi	8UEC60LS	622.0	SSD	1	OTH	19.80	6402	> 6000 cars	583	1326	954	664	92	184	309	301
9339806	GRAND HERO	372857000	AUTO CARRIER	2004	14280	MAN-B&W	7S60MC	648.0	SSD	1	BSV	19.80	6402	> 6000 cars	583	1326	954	664	92	184	309	301
9355240	GRAND LEGACY	371671000	AUTO CARRIER	2008	14280	MAN-B&W	7S60MC	648.0	SSD	1	BSV	19.80	6402	> 6000 cars	583	1326	954	664	92	184	309	301
9169328	GRAND PACE	357336000	AUTO CARRIER	1998	12357	Mitsubishi	7UEC60LS	622.0	SSD	0	OTH	19.20	5170	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9284764	GRAND PHOENIX	354662000	AUTO CARRIER	2004	14280	B&W	7S60MC	648.0	SSD	1	BSV	19.80	6402	> 6000 cars	583	1326	954	664	92	184	309	301
9104005	GRAND PRINCESS	310327000	PASSENGER 3000-3500	1996	69900	Sulzer	16ZAV40S	70.4	MSD-ED	0	NON	22.50	3006	3000 - 3500 Pass	8282	10369	8292	7475	697	1199	1068	1984
9184940	GRAND RACE	357983000	AUTO CARRIER	1998	12357	Mitsubishi	7UEC60LS	622.0	SSD	0	OTH	19.20	5170	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9355252	GRAND VEGA	356909000	AUTO CARRIER	2008	14280	MAN-B&W	7S60MC	648.0	SSD	1	BSV	19.80	6402	> 6000 cars	583	1326	954	664	92	184	309	301
9784051	GRANDE HALIFAX	247376400	AUTO CARRIER	2015	12200	MAN-B&W	6S60ME-C8	678.6	SSD	2	BSV	19.00	6700	> 6000 cars	583	1326	954	664	92	184	309	301
9158288	GREEN LAKE	369527000	AUTO CARRIER	1997	14123	Mitsubishi	8UEC60LS	622.0	SSD	0	OTH	19.00	5980	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9177428	GREEN RIDGE	369326000	AUTO CARRIER	1997	14123	Mitsubishi	8UEC60LS	622.0	SSD	0	OTH	18.53	6340	> 6000 cars	583	1326	954	664	92	184	309	301
9863170	HAMBURG CITY	357451000	BULK CARRIER	2015	6050	MAN-B&W	5S50ME-B9	434.7	SSD	2	BSV	14.00	0	35,000 - 45,000	255	283	523	261	58	140	172	172
9355226	HESTIA LEADER	432669000	AUTO CARRIER	2008	15540	Mitsubishi	8UEC60LSII	650.3	SSD	1	OTH	20.00	6324	> 6000 cars	583	1326	954	664	92	184	309	301
9690559	HYPERION RAY	311000322	AUTO CARRIER	2015	12927	MAN-B&W	7G60ME-C9	788.9	SSD	2	BSV	16.50	7700	> 6000 cars	583	1326	954	664	92	184	309	301
9186211	INDIANA	257548000	GENERAL CARGO	1999	11200	B&W	6S60MC	648.0	SSD	1/0	BSV	16.20	2096	35,000 - 45,000	467	1104	809	180	93	114	148	150
9156462	INSIGNIA	538001663	PASSENGER <1500	1997	18600	Wartsila	12V32	32.2	MSD-ED	0	NON	18.00	702	< 1500 Pass	3994	5268	3069	2289	992	784	766	867
9515474	IRIS ACE	352002694	AUTO CARRIER	2010	12640	MAN-B&W	8S50MC-C	392.7	SSD	1	BSV	20.00	4064	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9318503	ISTRA ACE	309955000	AUTO CARRIER	2006	12640	MAN-B&W	8S50MC-C	392.7	SSD	1	BSV	20.80	4900	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9277838	IVORY ARROW	311696000	AUTO CARRIER	2003	15519	Sulzer	7RTA62U	649.1	SSD	1	OTH	20.20	6658	> 6000 cars	583	1326	954	664	92	184	309	301
9267912	JASPER ARROW	311919000	AUTO CARRIER	2005	15540	MAN-B&W	7S60MC-C	678.6	SSD	1	BSV	20.40	6658	> 6000 cars	583	1326	954	664	92	184	309	301
9233167	JEAN ANNE	367003380	AUTO CARRIER	2000	11060	B&W	7S50MC-C	392.7	SSD	1	BCV	20.00	4300	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9088237	JIUYANG FORTUNE	477625700	AUTO CARRIER	1995	13900	B&W	7S60MC	648.0	SSD	1/0	BSV	19.90	4330	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9509401	JUPITER SPIRIT	636015173	AUTO CARRIER	2010	12210	MAN-B&W	6S60MC-C	678.6	SSD	1	BSV	20.00	5007	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9070462	K. ASIAN BEAUTY	441357000	AUTO CARRIER	1994	10519	B&W	6L60MC	549.7	SSD	0	BCV	18.00	4363	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9692557	KONINGSDAM	244830547	PASSENGER 3000-3500	2013	50400	MaK	12M43C	88.6	MSD-ED	2	NON	21.00	3152	3000 - 3500 Pass	8282	10369	8292	7475	697	1199	1068	1984
9713882	LAKE GENEVA	636016445	AUTO CARRIER	2014	12120	Mitsubishi	7UEC60LSE	678.6	SSD	2	OTH	20.00	6178	> 6000 cars	583	1326	954	664	92	184	309	301
9361809	LAPIS ARROW	308808000	AUTO CARRIER	2005	12640	MAN-B&W	8S50MC-C	392.7	SSD	1	BSV	20.80	4900	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9203291	LIBERTY KING	538009492	AUTO CARRIER	1998	14314	B&W	7S60MC	648.0	SSD	1/0	BSV	19.00	6402	> 6000 cars	583	1326	954	664	92	184	309	301
9621039	LILA CASABLANCA	636021837	BULK CARRIER	2012	5972	MAN-B&W	6S46MC-C8	321.1	SSD	2	BSV	14.00	0	35,000 - 45,000	255	283	523	261	58	140	172	172
9450806	LONGSHORE	538009912	BULK CARRIER	2009	7900	MAN-B&W	5S50MC-C	392.7	SSD	1	BSV	14.00	0	25,000 - 35,000	255	283	523	261	58	140	172	172
9372315	LUNA SPIRIT	372610000	AUTO CARRIER	2006	11560	Mitsubishi	8UEC50LSII	382.9	SSD	1	OTH	19.90	3205	2000 - 4000 cars	583	1326	954	664	92	184	309	301
9782091	LYDDEN	636018494	AUTO CARRIER	2015	13200	MAN-B&W	7S60ME-C	678.6	SSD	2	BSV	20.00	7429	> 6000 cars	583	1326	954	664	92	184	309	301

2022 Vessel Information

LR/IMO#	LLOYDNAM	MMSI	_TYPE	KEEL	MAIN_KW	DESIGN	DESIGNATIO	DISP	MAIN_ENGIN	Tier	LLAF	SPEED	Cars/TEUS/Pas	Size	T Aux Load	M Aux Load	H Aux Load	A Aux Load	T Boil Load	M Boil Load	H Boil Load	A Boil Load
9284752	LYRA LEADER	431190000	AUTO CARRIER	2004	15540	Mitsubishi	8UEC60LSII	650.3	SSD	1	OTH	20.00	6324	> 6000 cars	583	1326	954	664	92	184	309	301
9614141	MAJESTIC PRINCESS	232002990	PASSENGER >4000	2010	62400	Wartsila	12V46F	96.4	MSD-ED	1	NON	22.00	4450	> 4000 Pass	12500	14000	12000	9900	335	29	503	503
9469778	MALCOLM	636021433	GENERAL CARGO	2008	8730	Wartsila	6RTA48T	361.9	SSD	1	OTH	16.00	964	< 25,000	467	1104	809	180	93	114	148	150
9179725	MANON	259001000	AUTO CARRIER	1999	16358	B&W	8S60MC	648.0	SSD	1/0	BSV	20.50	7194	> 6000 cars	583	1326	954	664	92	184	309	301
9619684	MARJORIE C	367641230	RORO	2011	19040	MAN-B&W	8S60ME-C8	678.6	SSD	2	BSV	20.00	1400	20,000 - 30,000	283	849	490	283	67	148	259	251
9209518	MERIDIAN ACE	431221000	AUTO CARRIER	1999	14123	Mitsubishi	8UEC60LS	622.0	SSD	0	OTH	19.00	6043	> 6000 cars	583	1326	954	664	92	184	309	301
9189251	MIGNON	265491000	AUTO CARRIER	1999	14710	B&W	8S60MC	648.0	SSD	1/0	BSV	20.50	7194	> 6000 cars	583	1326	954	664	92	184	309	301
9293521	MIRACULOUS ACE	431082000	AUTO CARRIER	2005	15100	Mitsubishi	8UEC60LSII	650.3	SSD	1	OTH	20.50	6141	> 6000 cars	583	1326	954	664	92	184	309	301
9633185	MORNING CINDY	353647000	AUTO CARRIER	2010	13260	Mitsubishi	8UEC60LSII	650.3	SSD	1	OTH	20.00	6215	> 6000 cars	583	1326	954	664	92	184	309	301
9620683	MORNING CLAIRE	373398000	AUTO CARRIER	2010	15090	MAN-B&W	7S60MC-C	678.6	SSD	1	BSV	20.60	6257	> 6000 cars	583	1326	954	664	92	184	309	301
9336074	MORNING COMPOSER	371659000	AUTO CARRIER	2007	14342	MAN-B&W	7S60MC	648.0	SSD	1	BSV	20.50	6500	> 6000 cars	583	1326	954	664	92	184	309	301
9336050	MORNING CONDUCTOR	372914000	AUTO CARRIER	2007	14342	MAN-B&W	7S60MC	648.0	SSD	1	BSV	20.50	6500	> 6000 cars	583	1326	954	664	92	184	309	301
9367580	MORNING MARGARETA	563077000	AUTO CARRIER	2008	14120	MAN-B&W	7S60MC-C	678.6	SSD	1	BSV	19.30	5195	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9367580	MORNING MARGARITA	563077000	AUTO CARRIER	2008	14120	MAN-B&W	7S60MC-C	678.6	SSD	1	BSV	19.30	5195	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9378450	NIEUW AMSTERDAM	246648000	PASSENGER 2500-3000	2008	64000	MaK	8M43C	88.6	MSD-ED	1	NON	21.90	2735	2500 - 3000 Pass	9781	8309	6089	5916	596	602	431	895
9230115	NOORDAM	246028000	PASSENGER 2500-3000	2004	75140	Sulzer	16ZAV40S	70.4	MSD-ED	1	NON	22.00	2596	2500 - 3000 Pass	9781	8309	6089	5916	596	602	431	895
9782649	NORD KANMON	563053200	BULK CARRIER	2015	8337	MAN-B&W	6S50ME-B9	434.7	SSD	2	BSV	14.50	0	45,000 - 90,000	255	283	523	261	58	140	172	172
9667588	NORDIC DALIAN	636018581	BULK CARRIER	2011	6350	Wartsila	5RT-flex50	402.5	SSD	2	OTH	14.20	0	35,000 - 45,000	255	283	523	261	58	140	172	172
9392339	NORTHERN HIGHWAY	538007592	AUTO CARRIER	2008	11000	Mitsubishi	8UEC50LSII	382.9	SSD	1	OTH	19.40	3893	2000 - 4000 cars	583	1326	954	664	92	184	309	301
9304045	NORWEGIAN JEWEL	311827000	PASSENGER 3000-3500	2004	72080	MAN	12V48/60B	108.6	MSD-ED	1	NON	24.60	3000	3000 - 3500 Pass	8282	10369	8292	7475	697	1199	1068	1984
9437335	OCEAN GIANT	367535950	GENERAL CARGO	2009	9800	MAN	7LS8/64CD	169.1	MSD	1	OTH	17.50	1011	< 25,000	467	1104	809	180	93	114	148	150
9419008	OCEAN GLOBE	538009118	GENERAL CARGO	2009	9800	MAN	7LS8/64CD	169.1	MSD	1	OTH	17.50	1011	< 25,000	467	1104	809	180	93	114	148	150
9681833	OCEAN GLORY	367721220	GENERAL CARGO	2014	7860	MAN-B&W	6S46ME-B8	321.1	SSD	2	BSV	16.50	972	< 25,000	467	1104	809	180	93	114	148	150
9681821	OCEAN GRAND	367665030	GENERAL CARGO	2014	7860	MAN-B&W	6S46ME-B8	321.1	SSD	2	BSV	16.50	972	< 25,000	467	1104	809	180	93	114	148	150
9868869	OCEAN VICTORY	311000868	PASSENGER <1500	2019	5600	Wartsila	8L20	8.8	MSD-ED	3	NON	15.50	186	< 1500 Pass	3994	5268	3069	2289	992	784	766	867
9207388	PALMELA	351340000	AUTO CARRIER	1999	14121	Mitsubishi	8UEC60LS	622.0	SSD	0	OTH	20.00	5080	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9293648	PARADISE ACE	352142000	AUTO CARRIER	2004	12170	Mitsubishi	7UEC60LSII	650.3	SSD	1	OTH	20.65	6354	> 6000 cars	583	1326	954	664	92	184	309	301
9150341	PEGASUS ACE	431339000	AUTO CARRIER	1997	10592	Mitsubishi	8UEC52LS	392.9	SSD	0	OTH	19.00	3600	2000 - 4000 cars	583	1326	954	664	92	184	309	301
9597630	PETRA	538008969	GENERAL CARGO	2010	6250	Mitsubishi	6UEC45LSE	292.6	SSD	1	OTH	14.20	0	25,000 - 35,000	467	1104	809	180	93	114	148	150
9210438	PLATINUM RAY	308726000	AUTO CARRIER	1999	15520	Sulzer	7RTA62U	649.1	SSD	0	OTH	20.50	6658	> 6000 cars	583	1326	954	664	92	184	309	301
9409338	PORGY	351126000	AUTO CARRIER	2008	14280	MAN-B&W	7S60MC	648.0	SSD	1	BSV	19.80	6402	> 6000 cars	583	1326	954	664	92	184	309	301
9213454	PRESTIGE ACE	355745000	AUTO CARRIER	1999	14121	Mitsubishi	8UEC60LS	622.0	SSD	0	OTH	20.00	6043	> 6000 cars	583	1326	954	664	92	184	309	301
9798985	QUEST	366945000	PASSENGER <1500	2015	2386	M.T.U.	12V4000M	4.1	HSD	2	OTH	12.00	100	< 1500 Pass	3994	5268	3069	2289	992	784	766	867
9195195	RADIANCE OF THE SEAS	311319000	PASSENGER 2000-2500	1999	57500	GE Marine	LM2500	0.0	GT-ED	0	NON	24.00	2496	2000 - 2500 Pass	11000	11350	6900	4707	1382	1773	1506	3005
9277802	RCC AMERICA	311595000	AUTO CARRIER	2003	15540	Sulzer	7RTA62U	649.1	SSD	1	OTH	20.00	6658	> 6000 cars	583	1326	954	664	92	184	309	301
9391581	RCC ASIA	311003200	AUTO CARRIER	2007	15820	MAN-B&W	7S60ME-C	678.6	SSD	1	BSV	20.00	6658	> 6000 cars	583	1326	954	664	92	184	309	301
9441609	RCC CLASSIC	311072300	AUTO CARRIER	2012	14280	MAN-B&W	7S60MC-C	678.6	SSD	2	BSV	20.50	6500	> 6000 cars	583	1326	954	664	92	184	309	301
9441611	RCC COMPASS	311072400	AUTO CARRIER	2012	15820	MAN-B&W	7S60ME-C	678.6	SSD	2	BSV	20.50	6500	> 6000 cars	583	1326	954	664	92	184	309	301
9391593	RCC EUROPE	311003100	AUTO CARRIER	2007	15820	MAN-B&W	7S60ME-C	678.6	SSD	1	BSV	20.00	6658	> 6000 cars	583	1326	954	664	92	184	309	301
9453107	RCC PASSION	311048200	AUTO CARRIER	2011	11620	MAN-B&W	7S50MC-C8	392.7	SSD	2	BSV	19.60	3700	2000 - 4000 cars	583	1326	954	664	92	184	309	301
9361823	RCC SHANGHAI	311003600	AUTO CARRIER	2007	12640	MAN-B&W	8S50MC-C	392.7	SSD	1	BSV	20.80	4900	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9361835	RCC TIANJIN	311003500	AUTO CARRIER	2008	12640	MAN-B&W	8S50MC-C	392.7	SSD	1	BSV	20.00	4900	4000 - 6000 cars	583	1326	954	664	92	184	309	301
9156474	REGATTA	538001664	PASSENGER <1500	1998	18600	Wartsila	12V32	32.2	MSD-ED	0	NON	18.00	824	< 1500 Pass	3994	5268	3069	2289	992	784	766	867
9355214	RHEA LEADER	432664000	AUTO CARRIER	2008	16360	Mitsubishi	8UEC60LSII	650.3	SSD	1	OTH	20.00	6324	> 6000 cars	583	1326	954	664	92	184	309	301
9584712	ROYAL PRINCESS	310661000	PASSENGER >4000	2011	62400	Wartsila	12V46F	96.4	MSD-ED	2	NON	22.00	4250	> 4000 Pass	12500	14000	12000	9900	335	29	503	503
9378462	RUBY PRINCESS	310567000	PASSENGER 3500-4000	2006	67200	Wartsila	12V46C	96.4	MSD-ED	1	NON	22.50	3575	3500 - 4000 Pass	9945	11411	10445	10191	401	347	868	989
9160798	SAGA BEIJA FLOR	477554000	GENERAL CARGO	1997	8952	Sulzer	7RTA52	382.3	SSD	0	OTH	14.50	0	45,000 - 90,000	467	1104	809	180	93	114	148	150
9014066	SAGA CREST	477818000	GENERAL CARGO	1993	8951	Sulzer	7RTA52	382.3	SSD	0	OTH	15.00	0	45,000 - 90,000	467	1104	809	180	93	114	148	150
9343493	SAGA EXPLORER	477607600	GENERAL CARGO	2004	9510	Sulzer	7RTA52	382.3	SSD	1	OTH	14.50	760	45,000 - 90,000	467	1104	809	180	93	114	148	150
9609457	SAGA FUJI	477050700	GENERAL CARGO	2010	9474	Wartsila	6RT-flex50	402.5	SSD	1	OTH	14.50	2002	45,000 - 90,000	467	1104	809	180	93	114	148	150
9121297	SAGA HORIZON	477379000	GENERAL CARGO	1995	8952	Sulzer	7RTA52	382.3	SSD	0	OTH	15.00	0	45,000 - 90,000	467	1104	809	180	93	114	148	150
9200421	SAGA JANDAIA	477398000	GENERAL CARGO	1998	8952	Sulzer	7RTA52	382.3	SSD	0	OTH	15.00	0	45,000 - 90,000	467	1104	809	180	93	114	148	150
9014078	SAGA SPRAY	477857000	GENERAL CARGO	1993	8952	Sulzer	7RTA52	382.3	SSD	0	OTH	15.00	1688	45,000 - 90,000	467	1104	809	180	93	114	148	150
9160803	SAGA TUCANO	477587000	GENERAL CARGO	1997	8952	Sulzer	7RTA52	382.3	SSD	0	OTH	14.50	0	45,000 - 90,000	467	1104	809	180	93	114	148	150
9228186	SAPPHIRE PRINCESS	235103357	PASSENGER 2500-3000	2001	60700	Wartsila	9L46C	96.4	MSD-ED	1	NON	23.00	2988	2500 - 3000 Pass	9781	8309	6089	5916	596	602	431	895
9797371	SCENIC ECLIPSE	311000995	PASSENGER <1500	2017	14000	A.B.C.	16VDZC	16.0	MSD-ED	3	NON	17.00	228	< 1500 Pass	3994	5268	3069	2289	992	784	766	867
9836919	SEATTLE HARMONY	371085000	BULK CARRIER	2015	6050	MAN-B&W	6S46ME-B8	321.1	SSD	2	BSV	14.70	0	35,000 - 45,000	255	283	523	261	58	140	172	172
9703150	SEVEN SEAS EXPLORER	538006712	PASSENGER <1500	2015	32000	MaK	8M43C	88.6	MSD-ED	2	NON	20.00	754	< 1500 Pass	3994	5268	3069	2289	992	784	766	867
9210139	SEVEN SEAS MARINER	311622000	PASSENGER <1500	2000	33600	Wartsila	12V38	53.9	MSD-ED	1	NON	19.50	730	< 1500 Pass	3994	5268	3069	2289	992	784	766	867
8903935	SILVER WIND	308814000	PASSENGER <1500	1990	11700	Wartsila	6R46	96.4	MSD	0	OTH	17.00	306	< 1500 Pass	3994	5268	3069	2289	992	784	766	867
9418975	SLNC MAGOTHY	366230000	GENERAL CARGO	2008	9800	MAN	7LS8/64CD	169.1	MSD	1	OTH	17.50	1031	< 25,000	467	1104	809	180	93	114	148	150
9538907	SLNC YORK	338273000	GENERAL CARGO	2009	8000	MAN	16V32/40	32.2	MSD	1	OTH	17.00	791	< 25,000	467	1104	809	180	93	114	148	150
9338632	SOUTHERN HIGHWAY	431857000	AUTO CARRIER	2007	10999	Mitsubishi	8UEC50LSII	382.9	SSD	1	OTH	20.00	3893	2000 - 4000 cars	583	1326	954	664	92	184	309	301
8807997	STAR BREEZE	311083000	PASSENGER <1500	1988	7280	Normo	KVMB-12	14.7	MSD	0	OTH	16.00	208	< 1500 Pass	3994	5268	3069	2289	992	784	766	867
9103130	STAR HARMONIA	259885000	GENERAL CARGO	1997	10519	B&W	6S60MC	648.0	SSD	1/0	BSV	16.00	1950	45,000 - 90,000	467	1104	809	180	93	114	148	150
9071569	STAR HIDRA	258964000	GENERAL CARGO	1994	10519	B&W	6S60MC	648.0	SSD	1/0	BSV	16.30	1950	45,000 - 90,000	467	1104	809	180	93	114	148	150
9254654	STAR JAPAN	257329000	GENERAL CARGO	2003	10519	MAN-B&W	6S60MC	648.0	SSD	1	BSV	16.55	2070	35,000 - 45,000	467	1104	809	180	93	114	148	150
9396139	STAR KILIMANJARO	257350000	GENERAL CARGO	2009	11900	MAN-B&W	5S60MC-C	678.6	SSD	1	BSV	16.00	1420	45,000 - 90,000	467	1104	809	180	93	114	148	150
9189940	STAR MAIA	235088041	GENERAL CARGO	1998	10473	Mitsubishi	6UEC60LSII	650.3	SSD	0	OTH	15.55	0	45,000 - 90,000	467	1104	809	180	93	114	148	150
9800635	STH MONTREAL	538009163	BULK CARRIER	2015	7800	MAN-B&W	6S50ME-B9	434.7	SSD	2	BSV	14.50	0	45,000 - 90,000	255	283	523	261	58	140	172	172
9327748	TARIFA	309847000	AUTO CARRIER	2006	15539	MAN-B&W	7S60MC-C	678.6	SSD	1	BSV	20.40	6658	> 6000 cars	583	1326	954	664	92	184	309	301
9219331	THE WORLD	311213000	PASSENGER <1500	2000	11040	Wartsila	12V32	32.2	MSD	1	OTH	19.00	699	< 1500 Pass	3994	5268	3069	2289	992	784	766	867
9319753	TOMBARRA	249758000	AUTO CARRIER	2005	12390	Mitsubishi	7UEC60LS	622.0	SSD	1	OTH	19.50	6400	> 6000 cars	583	1326	954	664	92	184	309	301
9398321	TORINO	248906000	AUTO CARRIER	2008	14315	Mitsubishi	7UEC60LSII	650.3	SSD	1	OTH	19.50	6542	> 6000 cars	583	1326	954	664	92	184	309	301
9553103	TRITON LEADER	357795000	AUTO CARRIER	2008	15540	Mitsubishi	8UEC60LSII	650.3	SSD	1	OTH	19.50	6502	> 6000 cars	583	1326	954	664	92	184	309	301
9892535	UHL FELICITY	255806358	BULK CARRIER, HL	2015	5750	MAN-B&W	7S40ME-B9	222.4	SSD	2	BSV	15.00	0	< 25,000	359	949	211	253	35	94	125	125
9897121	UHL FREEDOM	255806351	BULK CARRIER, HL	2015	5750	MAN-B&W	7S40ME-B9	222.4	SSD	2	BSV	15.00	0	< 25,000	359	949	211	253	35	94	125	125
9240160	UNDINE	265884000	AUTO CARRIER	2002	16358	B&W	8S60MC	648.0	SSD	1	BSV	20.50	7194	> 6000 cars	583	1326	954	664	92	184	309	301
9673018	VIKING ADVENTURE	538009728	AUTO CARRIER	2014	14280	MAN-B&W	6S60ME-C8	678.6	SSD	2	BSV	16.00	6700	> 6000 cars	583	1326	954	664	92	184	309	301
9728863	VIKING DESTINY	538007385	AUTO CARRIER	2014	14280	MAN-B&W	6S60ME-C8	678.6	SSD	2	BSV	18.00	6700	> 6000 cars	583	1326	954	664	92	184	309	301
9188817	VIKING DRIVE	538009954	AUTO CARRIER	1999	9989	B&W	7S50MC	375.0	SSD	1/0	BSV	18.50	3578	2000 - 4000 cars	583	1326	954	664	92	184	309	301
9796250	VIKING ORION	257034130	PASSENGER <1500	2014	23520	MAN	9L32/44CR	35.4	MSD-ED	2	NON	20.00	954	< 1500 Pass	3994	5268	3069	2289	992	784	766	867
9318462	VIKING QUEEN	538009733	AUTO CARRIER	2006	14220	MAN-B&W	9S50MC-C	392.7	SSD	1	BSV	20.80	6500	> 6000 cars	583	1326	954	664	92	184	309	301
9831505	WESTERN DONCASTER	548977000	BULK CARRIER	2015	6050	MAN-B&W	5S50ME-B9	434.7	SSD	2	BSV	14.00	0	35,000 - 45,000	255	283	523	261	58	140	172	172
9221279	ZUIDERDAM	245304000	PASSENGER 2500-3000	2001	75140	Sulzer	16ZAV40S	70.4	MSD-ED	1	NON	22.00	2502	2500 - 3000 Pass	9781	8309	6089	5916	596	602	431	895

2022 Vessel AIS Data - Time, Speed, and Load Calculations

				Per Call													
				Cruise			VSR40			VSR20			Manuever			Hotel	Anchor	Cold Iron
Ship	IMO	Ship Type	Calls	Hrs	Speed	LF	Hrs	Speed	LF	Hrs	Speed	LF	Hrs	Speed	LF	Hrs	Hrs	Hrs
ALTAIR LEADER	9539171	AUTO CARRIER	1	0.211	9.76	0.09	2.205	9.68	0.08	3.620	9.24	0.07	2.259	8.09	0.05	12.429	0.00	0.00
ANDROMEDA SPIRIT	9372327	AUTO CARRIER	4	0.163	8.63	0.07	2.798	8.59	0.07	5.854	7.98	0.05	2.201	8.55	0.07	6.195	0.00	0.00
APOLLON HIGHWAY	9728083	AUTO CARRIER	1	0.172	11.00	0.14	1.850	10.90	0.13	3.564	9.16	0.08	2.049	9.25	0.08	6.493	0.00	0.00
BERGAMOT ACE	9403281	AUTO CARRIER	1	0.172	13.20	0.24	3.420	7.34	0.04	6.455	7.59	0.05	2.336	8.04	0.05	7.201	0.00	0.00
CEPHEUS LEADER	9308883	AUTO CARRIER	1	0.348	6.25	0.03	2.530	7.80	0.05	3.703	8.94	0.07	2.203	8.21	0.06	10.159	0.00	0.00
COMET ACE	9182356	AUTO CARRIER	1	0.256	9.83	0.12	6.630	3.60	0.02	5.028	10.13	0.13	2.083	8.76	0.08	6.512	0.00	0.00
CRYSTAL RAY	9210440	AUTO CARRIER	2	0.109	12.26	0.18	1.900	10.85	0.12	4.741	9.32	0.08	2.228	8.02	0.05	16.849	0.00	0.00
CYGNUS LEADER	9381249	AUTO CARRIER	2	0.198	8.72	0.08	2.272	8.75	0.08	4.589	7.79	0.05	2.231	7.99	0.06	9.222	0.00	0.00
DIGNITY ACE	9441506	AUTO CARRIER	2	0.178	10.29	0.10	4.077	5.62	0.02	4.355	9.50	0.08	2.230	8.26	0.05	9.874	0.00	0.00
DIONYSOS LEADER	9426350	AUTO CARRIER	2	0.142	6.69	0.03	1.706	8.44	0.06	4.290	8.15	0.06	2.141	8.55	0.06	9.633	0.00	0.00
DONG A METIS	9419747	AUTO CARRIER	1				0.543	15.51	0.36	3.332	9.83	0.09	2.176	8.47	0.06	10.469	0.00	0.00
DREAM BEAUTY	9303168	AUTO CARRIER	1	0.293	5.99	0.02	3.461	5.91	0.02	5.561	6.42	0.03	2.324	8.05	0.06	6.078	0.00	0.00
DREAM DIAMOND	9325788	AUTO CARRIER	1	0.072	12.80	0.24	1.842	13.15	0.26	3.891	12.11	0.20	2.287	9.75	0.10	8.848	0.00	0.00
EMERALD ACE	9539236	AUTO CARRIER	1	0.197	8.06	0.05	2.875	7.54	0.04	4.758	7.06	0.03	2.125	8.67	0.06	5.559	0.00	0.00
GLOVIS CARAVEL	9441594	AUTO CARRIER	1	0.170	13.00	0.21	1.617	13.18	0.22	3.242	10.88	0.12	2.319	7.92	0.05	7.938	0.00	0.00
GLOVIS CENTURY	9590589	AUTO CARRIER	1	0.164	16.70	0.45	1.219	15.95	0.39	2.875	12.89	0.20	1.904	9.78	0.09	9.040	0.00	0.00
GLOVIS CHALLENGE	9590591	AUTO CARRIER	1	0.000	0.00	0.00	0.492	17.70	0.53	2.859	12.72	0.20	2.355	7.72	0.04	22.155	0.00	0.00
GLOVIS CLIPPER	9441582	AUTO CARRIER	1	0.167	15.25	0.34	1.345	15.02	0.32	2.792	11.72	0.15	2.122	8.63	0.06	11.593	0.00	0.00
GLOVIS COMET	9122942	AUTO CARRIER	2	0.161	11.14	0.14	1.883	10.60	0.12	3.548	9.87	0.10	2.123	8.77	0.07	11.432	0.00	0.00
GLOVIS COUGAR	9451898	AUTO CARRIER	2	0.077	12.75	0.23	0.860	14.07	0.31	2.547	12.64	0.22	2.288	8.04	0.06	15.493	0.00	0.00
GLOVIS CROWN	9706994	AUTO CARRIER	1				11.095	3.57	0.02	2.881	11.37	0.14	2.147	8.35	0.06	10.416	0.00	0.00
GLOVIS SIGMA	9736810	AUTO CARRIER	2				0.187	11.91	0.19	2.806	9.23	0.09	2.153	8.36	0.06	13.218	0.00	0.00
GLOVIS SIRIUS	9749582	AUTO CARRIER	1							1.900	10.56	0.12	2.276	7.92	0.05	21.433	0.00	0.00
GLOVIS SONIC	9798387	AUTO CARRIER	1							2.010	11.33	0.15	2.229	8.33	0.06	10.956	0.00	0.00
GLOVIS SPIRIT	9674165	AUTO CARRIER	2				0.231	15.86	0.41	3.402	9.77	0.10	2.633	7.11	0.04	8.807	0.00	0.00
GLOVIS SPRING	9749594	AUTO CARRIER	1	0.170	10.80	0.13	2.117	11.38	0.15	4.543	11.08	0.14	2.272	8.49	0.06	7.644	0.00	0.00
GLOVIS SUMMIT	9702417	AUTO CARRIER	1				0.244	11.30	0.15	3.156	10.21	0.11	1.930	9.15	0.08	17.219	0.00	0.00
GLOVIS SUN	9749568	AUTO CARRIER	2							1.941	11.09	0.14	2.218	8.26	0.06	16.326	0.00	0.00
GLOVIS SUNLIGHT	9798416	AUTO CARRIER	2	0.042	14.10	0.29	12.218	2.04	0.02	2.916	10.02	0.10	2.448	7.52	0.04	12.809	0.00	0.00
GLOVIS SUNRISE	9702405	AUTO CARRIER	1	0.161	12.07	0.18	1.282	15.93	0.42	2.556	13.45	0.25	2.358	7.84	0.05	9.607	0.00	0.00
GLOVIS SUPREME	9674177	AUTO CARRIER	2	0.042	15.20	0.36	0.795	15.58	0.39	2.560	12.66	0.21	2.282	8.37	0.06	13.418	0.00	0.00
GOLIATH LEADER	9357315	AUTO CARRIER	1	0.222	8.21	0.05	2.686	7.62	0.04	3.983	8.34	0.06	2.182	8.48	0.06	11.486	0.00	0.00
GRAND AURORA	9279331	AUTO CARRIER	1							1.628	8.79	0.07	2.317	8.29	0.06	10.034	0.00	0.00
GRAND CHAMPION	9340570	AUTO CARRIER	1							2.107	8.91	0.08	2.181	8.26	0.06	9.653	0.00	0.00
GRAND COSMO	9303182	AUTO CARRIER	1				1.239	9.58	0.09	3.761	8.43	0.06	2.320	7.89	0.05	33.894	0.00	0.00
GRAND DAHLIA	9355238	AUTO CARRIER	1	0.033	13.50	0.26	2.377	11.15	0.15	6.181	8.37	0.06	2.129	8.65	0.07	13.541	0.00	0.00
GRAND DIAMOND	9303223	AUTO CARRIER	1	0.122	15.27	0.38	1.297	16.12	0.44	2.502	12.93	0.23	2.286	8.58	0.07	11.359	0.00	0.00
GRAND EAGLE	9267663	AUTO CARRIER	1	0.169	15.30	0.38	1.348	15.30	0.38	2.945	11.55	0.16	2.575	7.63	0.05	19.408	0.00	0.00
GRAND HERO	9339806	AUTO CARRIER	1							1.954	10.23	0.11	2.222	8.55	0.07	9.647	0.00	0.00
GRAND LEGACY	9355240	AUTO CARRIER	1	0.195	9.44	0.09	2.239	8.99	0.08	4.037	8.20	0.06	2.225	8.24	0.06	11.181	0.00	0.00
GRAND PACE	9169328	AUTO CARRIER	3				0.410	15.46	0.43	2.791	12.05	0.20	2.286	8.21	0.06	9.824	0.00	0.00
GRAND PHOENIX	9284764	AUTO CARRIER	1				0.723	11.50	0.16	3.522	9.62	0.09	2.311	7.77	0.05	10.152	0.00	0.00
GRAND RACE	9184940	AUTO CARRIER	2				0.667	14.24	0.34	3.381	12.27	0.21	2.223	8.26	0.07	9.651	0.00	0.00
GRAND VEGA	9355252	AUTO CARRIER	1				0.919	11.09	0.14	3.484	9.86	0.10	2.273	7.99	0.05	12.444	0.00	0.00
GRANDE HALIFAX	9784051	AUTO CARRIER	1	0.271	12.89	0.26	3.281	12.26	0.22	10.705	5.26	0.02	2.381	7.82	0.06	7.267	0.00	0.00
GREEN LAKE	9158288	AUTO CARRIER	2				0.692	9.16	0.09	4.085	8.79	0.08	1.697	6.15	0.03	31.962	0.00	0.00
GREEN RIDGE	9177428	AUTO CARRIER	3	0.072	11.60	0.20	5.057	5.24	0.02	3.543	7.92	0.06	2.948	6.05	0.03	72.139	0.00	0.00
HESTIA LEADER	9355226	AUTO CARRIER	2	0.193	8.93	0.07	2.145	9.35	0.08	3.905	8.93	0.07	2.263	8.25	0.06	11.162	0.00	0.00
HYPERION RAY	9690559	AUTO CARRIER	1	0.086	12.10	0.32	1.704	12.15	0.33	28.391	2.09	0.02	2.445	7.51	0.08	7.146	0.00	0.00
IRIS ACE	9515474	AUTO CARRIER	2	0.047	13.00	0.23	5.993	4.35	0.02	7.900	6.98	0.04	2.286	8.00	0.05	16.385	0.00	0.00
ISTRA ACE	9318503	AUTO CARRIER	2	1.435	2.39	0.02	13.194	2.59	0.02	4.034	10.06	0.09	2.036	8.88	0.06	7.752	0.00	0.00
IVORY ARROW	9277838	AUTO CARRIER	1	0.261	7.29	0.04	2.776	7.30	0.04	4.250	7.87	0.05	2.106	8.72	0.07	4.932	0.00	0.00
JASPER ARROW	9267912	AUTO CARRIER	1	0.114	10.60	0.12	1.988	10.44	0.11	3.528	9.00	0.07	2.077	8.87	0.07	4.392	0.00	0.00
JEAN ANNE	9233167	AUTO CARRIER	26							2.278	10.27	0.11	3.376	8.36	0.06	30.284	0.00	0.00

2022 Vessel AIS Data - Time, Speed, and Load Calculations

				Per Call													
				Cruise			VSR40			VSR20			Manuever			Hotel	Anchor	Cold Iron
Ship	IMO	Ship Type	Calls	Hrs	Speed	LF	Hrs	Speed	LF	Hrs	Speed	LF	Hrs	Speed	LF	Hrs	Hrs	Hrs
JIUYANG FORTUNE	9088237	AUTO CARRIER	1	0.100	15.23	0.37	1.300	15.08	0.36	2.758	12.19	0.19	2.170	8.32	0.06	7.604	0.00	0.00
JUPITER SPIRIT	9509401	AUTO CARRIER	4	0.317	6.34	0.03	2.382	9.27	0.08	5.117	8.04	0.05	2.186	8.40	0.06	5.195	0.00	0.00
K.ASIAN BEAUTY	9070462	AUTO CARRIER	1				0.664	11.98	0.24	3.131	10.42	0.16	2.206	8.70	0.09	10.554	0.00	0.00
LAKE GENEVA	9713882	AUTO CARRIER	3				0.431	11.97	0.18	4.038	9.43	0.09	2.492	7.43	0.04	8.992	0.00	0.00
LAPIS ARROW	9361809	AUTO CARRIER	1	0.169	10.20	0.10	2.033	10.05	0.09	3.587	9.88	0.09	2.189	8.45	0.06	11.496	0.00	0.00
LIBERTY KING	9203291	AUTO CARRIER	1				0.550	11.30	0.17	3.728	8.28	0.07	2.214	8.55	0.07	17.290	0.00	0.00
LUNA SPIRIT	9372315	AUTO CARRIER	1	0.121	7.90	0.05	3.185	7.21	0.04	4.795	6.92	0.03	2.121	9.06	0.08	6.084	0.00	0.00
LYDDEN	9782091	AUTO CARRIER	1				0.578	8.90	0.07	4.353	7.98	0.05	2.409	7.54	0.04	6.062	0.00	0.00
LYRA LEADER	9284752	AUTO CARRIER	1	0.266	7.43	0.04	2.489	8.37	0.06	4.608	8.14	0.06	1.957	8.64	0.07	9.916	0.00	0.00
MANON	9179725	AUTO CARRIER	1	0.406	8.48	0.06	20.546	2.64	0.02	4.404	11.95	0.16	2.263	8.32	0.06	9.827	0.00	0.00
MERIDIAN ACE	9209518	AUTO CARRIER	1	0.127	8.17	0.07	2.751	7.99	0.06	4.344	8.64	0.08	2.157	8.52	0.07	6.458	0.00	0.00
MIGNON	9189251	AUTO CARRIER	1	8.130	6.79	0.03	10.791	4.57	0.02	5.160	10.34	0.11	2.478	7.54	0.04	23.394	0.00	0.00
MIRACULOUS ACE	9293521	AUTO CARRIER	1				2.014	6.92	0.03	5.989	8.60	0.06	2.125	8.61	0.06	5.610	0.00	0.00
MORNING CINDY	9633185	AUTO CARRIER	1				1.731	9.53	0.09	5.675	8.89	0.07	2.313	8.24	0.06	22.623	0.00	0.00
MORNING CLAIRE	9620683	AUTO CARRIER	1	0.428	3.94	0.02	6.291	3.95	0.02	8.281	6.23	0.02	2.186	8.57	0.06	9.707	0.00	0.00
MORNING COMPOSER	9336074	AUTO CARRIER	1				0.839	11.55	0.15	4.911	10.34	0.11	2.304	7.90	0.05	5.671	0.00	0.00
MORNING CONDUCTOR	9336050	AUTO CARRIER	1	0.221	13.20	0.22	1.881	11.51	0.15	3.627	10.02	0.10	2.336	7.87	0.05	7.002	0.00	0.00
MORNING MARGARETA	9367580	AUTO CARRIER	2	0.050	13.05	0.25	2.362	11.20	0.16	5.150	10.27	0.12	2.231	8.27	0.06	7.212	0.00	0.00
NORTHERN HIGHWAY	9392339	AUTO CARRIER	1							2.181	7.46	0.05	2.438	8.11	0.06	8.536	0.00	0.00
PALMELA	9207388	AUTO CARRIER	1	0.070	13.10	0.23	5.988	3.55	0.02	4.745	10.59	0.12	2.247	7.97	0.05	6.298	0.00	0.00
PARADISE ACE	9293648	AUTO CARRIER	1	0.075	10.24	0.10	2.013	9.79	0.09	4.003	8.66	0.06	2.213	8.09	0.05	6.474	0.00	0.00
PEGASUS ACE	9150341	AUTO CARRIER	1				1.119	12.01	0.21	4.547	10.88	0.15	2.052	8.99	0.09	5.876	0.00	0.00
PLATINUM RAY	9210438	AUTO CARRIER	1				0.131	11.99	0.16	3.003	10.35	0.11	2.159	8.33	0.06	16.058	0.00	0.00
PORGY	9409338	AUTO CARRIER	1	0.089	12.10	0.19	2.869	9.26	0.08	5.833	8.72	0.07	2.106	9.00	0.08	8.424	0.00	0.00
PRESTIGE ACE	9213454	AUTO CARRIER	2	0.132	11.21	0.14	1.831	11.11	0.14	4.349	9.15	0.08	2.219	8.13	0.06	5.405	0.00	0.00
RCC AMERICA	9277802	AUTO CARRIER	1				33.039	1.49	0.02	3.922	8.42	0.06	2.346	7.83	0.05	11.331	0.00	0.00
RCC ASIA	9391581	AUTO CARRIER	1	0.125	12.10	0.18	1.656	12.25	0.19	3.411	11.36	0.15	2.126	8.64	0.07	7.967	0.00	0.00
RCC CLASSIC	9441609	AUTO CARRIER	1	0.083	9.00	0.07	3.267	6.93	0.03	12.936	3.10	0.02	2.216	7.85	0.05	9.435	0.00	0.00
RCC COMPASS	9441611	AUTO CARRIER	1	0.122	12.66	0.19	1.700	11.77	0.16	3.206	10.48	0.11	2.378	7.59	0.04	11.058	0.00	0.00
RCC EUROPE	9391593	AUTO CARRIER	1	0.122	11.00	0.14	2.394	9.44	0.09	6.695	7.88	0.05	2.241	7.87	0.05	8.802	0.00	0.00
RCC PASSION	9453107	AUTO CARRIER	1	0.153	11.20	0.15	11.608	2.85	0.02	7.299	7.76	0.05	2.360	8.00	0.06	7.233	0.00	0.00
RCC SHANGHAI	9361823	AUTO CARRIER	2	0.118	10.99	0.12	11.847	2.81	0.02	3.383	9.81	0.09	2.295	8.01	0.05	11.575	0.00	0.00
RCC TIANJIN	9361835	AUTO CARRIER	4	0.396	3.03	0.02	4.853	3.58	0.02	3.795	9.10	0.08	2.190	8.54	0.06	9.218	0.00	0.00
RHEA LEADER	9355214	AUTO CARRIER	1	0.230	10.21	0.11	1.820	11.03	0.14	3.411	10.02	0.10	2.251	8.00	0.05	19.381	0.00	0.00
SOUTHERN HIGHWAY	9338632	AUTO CARRIER	2	0.226	8.52	0.06	2.368	8.58	0.06	4.373	8.25	0.06	2.305	7.98	0.05	6.441	0.00	0.00
TARIFA	9327748	AUTO CARRIER	1	0.077	16.84	0.46	1.277	16.84	0.46	2.881	11.88	0.16	1.976	9.35	0.08	9.268	0.00	0.00
TOMBARRA	9319753	AUTO CARRIER	1	0.083	9.40	0.09	3.133	6.56	0.03	4.433	7.97	0.06	2.407	7.75	0.05	9.039	0.00	0.00
TORINO	9398321	AUTO CARRIER	1	0.170	6.90	0.04	3.867	7.22	0.04	6.472	8.06	0.06	2.716	6.82	0.04	10.079	0.00	0.00
TRITON LEADER	9553103	AUTO CARRIER	1				0.461	10.29	0.12	4.495	7.59	0.05	2.352	7.73	0.05	10.156	0.00	0.00
UNDINE	9240160	AUTO CARRIER	1	0.170	9.15	0.07	2.997	9.67	0.09	5.623	9.17	0.07	2.417	7.61	0.04	7.874	0.00	0.00
VIKING ADVENTURE	9673018	AUTO CARRIER	1	0.000	0.00	0.00	0.000	0.00	0.00	2.562	8.80	0.14	2.086	8.77	0.14	8.595	0.00	0.00
VIKING DESTINY	9728863	AUTO CARRIER	1	0.117	12.04	0.25	1.664	11.99	0.24	3.423	13.18	0.32	2.049	9.07	0.11	17.715	0.00	0.00
VIKING DRIVE	9188817	AUTO CARRIER	3	0.085	12.20	0.24	0.546	12.47	0.25	2.178	10.67	0.16	2.219	8.32	0.07	7.377	0.00	0.00
VIKING QUEEN	9318462	AUTO CARRIER	1	0.239	10.62	0.11	2.498	15.67	0.35	3.973	14.44	0.28	2.058	9.00	0.07	19.136	0.00	0.00
DALIAN HIGHWAY	9565560	AUTO CARRIER	1	0.172	11.000	0.14	1.850	10.898	0.13	3.564	9.155	0.08	2.049	9.249	0.08	6.967	0.00	0.00
DELTA	9595395	BULK CARRIER	1							3.23	5.73	0.06	1.66	7.11	0.11	66.00	69.69	0.00
EURUS VENTURE	9725897	BULK CARRIER	1				0.40	11.89	0.50	3.46	9.90	0.29	1.83	6.44	0.08	210.98	0.00	0.00
GEORGIA HARMONY	9836921	BULK CARRIER	1							1.51	10.30	0.28	1.77	7.39	0.10	204.76	0.00	0.00
HAMBURG CITY	9863170	BULK CARRIER	1							1.78	9.27	0.24	1.69	7.44	0.12	32.76	0.00	0.00
LILA CASABLANCA	9621039	BULK CARRIER	1							4.30	5.59	0.05	1.98	6.29	0.07	174.69	14.80	0.00
LONGSHORE	9450806	BULK CARRIER	1							7.11	4.60	0.03	1.86	6.59	0.09	179.55	81.81	0.00
NORD KANMON	9782649	BULK CARRIER	1	0.15	11.05	0.36	2.03	10.13	0.28	3.96	8.70	0.18	2.04	6.28	0.07	207.95	0.00	0.00
NORDIC DALIAN	9667588	BULK CARRIER	1				0.90	8.82	0.20	11.26	3.67	0.02	2.21	5.89	0.06	31.92	0.00	0.00
SEATTLE HARMONY	9836919	BULK CARRIER	1				3.27	12.45	0.50	7.94	7.66	0.12	2.13	5.82	0.05	66.30	4.15	0.00

2022 Vessel AIS Data - Time, Speed, and Load Calculations

				Per Call														
				Cruise			VSR40			VSR20			Manuever			Hotel	Anchor	Cold Iron
Ship	IMO	Ship Type	Calls	Hrs	Speed	LF	Hrs	Speed	LF	Hrs	Speed	LF	Hrs	Speed	LF	Hrs	Hrs	Hrs
STH MONTREAL	9800635	BULK CARRIER	1	0.17	9.60	0.24	2.66	7.57	0.12	6.86	6.05	0.06	4.92	2.60	0.02	247.77	301.94	0.00
WESTERN DONCASTER	9831505	BULK CARRIER	1				0.43	11.96	0.51	3.15	10.02	0.30	1.73	6.93	0.10	166.82	0.00	0.00
UHL FELICITY	9892535	BULK CARRIER	1	0.17	15.40	0.89	1.37	15.51	0.91	3.28	10.70	0.30	1.63	7.67	0.11	86.53	72.01	0.00
UHL FREEDOM	9897121	BULK CARRIER	1							1.82	9.19	0.19	1.81	6.46	0.07	81.52	0.00	0.00
DOLE ATLANTIC	9703069	CONTAINER SHIP	17							1.57	9.52	0.10	1.53	8.03	0.06	68.97	0.00	62.45
DOLE CARIBBEAN	9703071	CONTAINER SHIP	17							1.56	9.70	0.10	1.62	7.47	0.05	65.49	0.00	59.30
DOLE PACIFIC	9703057	CONTAINER SHIP	17							1.50	9.73	0.10	1.65	7.38	0.04	67.25	0.00	60.89
ARACARI ARROW	9008706	GENERAL CARGO	1	0.17	10.39	0.27	1.95	10.39	0.27	8.19	4.83	0.03	1.88	6.47	0.07	17.07	12.60	0.00
ATLANTIS FORTUNE	9374351	GENERAL CARGO	1	0.17	12.95	0.59	1.94	12.90	0.58	5.20	10.20	0.29	2.35	5.37	0.04	26.46	0.00	0.00
BBC FUJI	9508419	GENERAL CARGO	1				0.31	12.93	0.40	3.35	9.32	0.15	1.61	7.42	0.07	51.46	0.00	0.00
BBC TEXAS	9388883	GENERAL CARGO	1				0.55	14.04	0.61	2.71	11.39	0.33	1.56	8.14	0.12	8.03	0.00	0.00
BBC VESUVIUS	9508471	GENERAL CARGO	1							1.70	9.65	0.16	1.82	6.74	0.06	11.46	0.00	0.00
BLUE BAIE	9309617	GENERAL CARGO	1							1.57	8.35	0.16	1.62	7.67	0.12	13.80	59.57	0.00
DONALD	9273791	GENERAL CARGO	1	0.17	10.21	0.18	2.06	10.21	0.18	3.30	10.67	0.20	1.57	7.76	0.08	214.10	0.00	0.00
ECO DYNAMIC	9277486	GENERAL CARGO	1							1.85	8.54	0.18	1.84	6.75	0.09	258.81	0.00	0.00
INDIANA	9186211	GENERAL CARGO	1							4.64	7.68	0.09	2.09	5.83	0.04	133.66	7.55	0.00
MALCOLM	9469778	GENERAL CARGO	1							1.66	9.48	0.17	1.61	7.64	0.09	164.95	0.00	0.00
OCEAN GIANT	9437335	GENERAL CARGO	1	0.05	16.40	0.68	1.53	16.65	0.71	3.44	14.28	0.45	1.77	6.99	0.05	171.36	0.00	0.00
OCEAN GLOBE	9419008	GENERAL CARGO	1							1.93	10.23	0.16	1.60	7.63	0.07	66.00	204.45	0.00
OCEAN GLORY	9681833	GENERAL CARGO	1							3.07	10.51	0.21	1.78	6.86	0.06	154.41	0.00	0.00
OCEAN GRAND	9681821	GENERAL CARGO	1							6.72	8.91	0.13	2.95	7.80	0.09	94.95	20.58	0.00
PETRA	9597630	GENERAL CARGO	1	0.10	12.00	0.50	2.27	10.90	0.37	6.93	7.71	0.13	1.73	7.21	0.11	19.38	76.55	0.00
SAGA CREST	9014066	GENERAL CARGO	1	0.18	12.90	0.52	2.23	11.87	0.41	6.18	8.74	0.16	1.80	6.83	0.08	112.54	51.15	0.00
SAGA EXPLORER	9343493	GENERAL CARGO	1							4.47	5.80	0.05	2.00	6.10	0.06	88.64	9.82	0.00
SAGA FUJI	9609457	GENERAL CARGO	1	0.17	11.70	0.43	1.69	11.84	0.45	3.23	10.72	0.33	2.07	5.71	0.05	120.87	0.00	0.00
SAGA HORIZON	9121297	GENERAL CARGO	1	0.28	8.45	0.15	2.10	11.22	0.34	5.45	9.80	0.23	2.01	6.19	0.06	55.06	0.00	0.00
SAGA JANDAIA	9200421	GENERAL CARGO	1				0.37	11.38	0.36	4.22	7.78	0.11	2.09	5.85	0.05	114.78	63.78	0.00
SAGA SPRAY	9014078	GENERAL CARGO	1				0.81	10.34	0.27	5.11	9.44	0.20	2.03	6.11	0.06	196.79	0.00	0.00
SAGA TUCANO	9160803	GENERAL CARGO	1				0.44	12.47	0.52	5.10	9.34	0.22	1.61	7.84	0.13	83.37	0.00	0.00
SLNC MAGOTHY	9418975	GENERAL CARGO	1	0.22	7.90	0.08	2.50	8.05	0.08	4.13	9.43	0.13	1.44	8.50	0.09	172.95	0.00	0.00
SLNC YORK	9538907	GENERAL CARGO	3	0.13	12.78	0.35	1.61	12.53	0.33	4.34	9.13	0.13	1.87	6.85	0.05	217.89	10.28	0.00
STAR HARMONIA	9103130	GENERAL CARGO	1							3.98	6.13	0.05	1.81	6.43	0.05	238.47	0.00	0.00
STAR HIDRA	9071569	GENERAL CARGO	2				0.35	12.04	0.33	4.28	9.04	0.14	1.75	7.13	0.07	230.41	0.00	0.00
STAR JAPAN	9254654	GENERAL CARGO	1				0.33	13.47	0.44	4.59	7.51	0.08	1.63	7.71	0.08	105.11	105.51	0.00
STAR KILIMANJARO	9396139	GENERAL CARGO	1							3.08	9.10	0.15	1.77	6.79	0.06	91.91	0.00	0.00
STAR MAIA	9189940	GENERAL CARGO	1							2.45	9.93	0.21	2.00	6.44	0.06	344.94	0.00	0.00
SAGA BEIJA FLOR	9160798	GENERAL CARGO	1	0.17	11.70	0.43	1.69	11.84	0.45	3.23	10.72	0.33	2.07	5.71	0.05	118.43	0.00	0.00
CARNIVAL MIRACLE	9237357	PASSENGER	1				0.00	0.00	0.00	1.77	11.30	0.11	1.48	6.59	0.02	9.59	0.00	0.000
CELEBRITY MILLENNIUM	9189419	PASSENGER	2	0.04	18.70	0.39	0.58	19.10	0.41	2.14	14.45	0.18	1.49	6.45	0.02	12.02	0.00	1.521
CELEBRITY SOLSTICE	9362530	PASSENGER	2	0.31	9.19	0.05	6.63	8.93	0.04	12.36	6.65	0.02	1.65	5.87	0.02	36.08	193.32	0.000
CROWN PRINCESS	9293399	PASSENGER	1	0.08	14.50	0.22	1.24	17.22	0.37	2.65	12.78	0.15	1.78	5.59	0.02	17.00	0.00	0.000
DIAMOND PRINCESS	9228198	PASSENGER	4							1.34	11.70	0.11	1.42	6.75	0.02	29.08	0.00	0.000
DISCOVERY PRINCESS	9837468	PASSENGER	6				0.30	14.11	0.22	2.46	11.53	0.12	1.52	6.24	0.02	12.52	0.00	0.000
DISNEY WONDER	9126819	PASSENGER	33				1.17	9.30	0.07	2.52	9.71	0.08	1.24	7.67	0.04	10.41	0.00	5.066
EURODAM	9378448	PASSENGER	2							1.45	13.08	0.18	1.54	6.23	0.02	10.33	0.00	7.635
GRAND PRINCESS	9104005	PASSENGER	1							1.55	10.27	0.08	1.56	5.84	0.02	14.21	0.00	0.000
INSIGNIA	9156462	PASSENGER	3	0.06	12.10	0.25	266.89	0.05	0.02	2.52	11.08	0.19	1.35	7.21	0.05	18.89	0.00	0.000
KONINGSDAM	9692557	PASSENGER	21	0.00	14.10	0.25	0.24	11.10	0.12	1.94	10.77	0.11	1.48	6.62	0.03	10.19	0.00	6.230
MAJESTIC PRINCESS	9614141	PASSENGER	5				0.77	10.01	0.08	3.07	10.36	0.09	1.37	6.79	0.02	13.01	0.00	11.306
NAT GEO QUEST	9798985	PASSENGER	1				0.00	0.00	0.00	2.37	10.67	0.58	1.49	8.10	0.25	16.61	0.00	5.788
NIEUW AMSTERDAM	9378450	PASSENGER	2				1.69	7.96	0.04	4.28	8.66	0.05	1.42	6.22	0.02	12.57	0.00	10.077
NOORDAM	9230115	PASSENGER	2				0.25	16.43	0.34	2.11	12.70	0.16	1.47	6.28	0.02	12.43	0.00	1.500
NORWEGIAN JEWEL	9304045	PASSENGER	5							1.21	13.09	0.12	1.51	6.64	0.02	10.36	0.00	0.000
OCEAN VICTORY	9868869	PASSENGER	2				0.18	13.68	0.57	2.77	11.15	0.31	1.83	6.14	0.05	35.14	0.00	0.000

2022 Vessel AIS Data - Time, Speed, and Load Calculations

				Per Call													
				Cruise			VSR40			VSR20			Manuever			Hotel	Anchor	Cold Iron
Ship	IMO	Ship Type	Calls	Hrs	Speed	LF	Hrs	Speed	LF	Hrs	Speed	LF	Hrs	Speed	LF	Hrs	Hrs	Hrs
RADIANCE OF THE SEAS	9195195	PASSENGER	1	0.24	7.59	0.03	4.02	9.99	0.06	5.45	9.83	0.06	1.28	7.71	0.03	10.39	0.00	0.000
REGATTA	9156474	PASSENGER	1							2.76	10.42	0.16	1.54	6.48	0.04	11.51	0.00	0.000
ROYAL PRINCESS	9584712	PASSENGER	5	0.02	18.90	0.52	0.37	14.31	0.23	2.98	10.63	0.09	1.54	6.25	0.02	12.61	0.00	0.000
RUBY PRINCESS	9378462	PASSENGER	3							1.31	11.56	0.11	1.45	6.64	0.02	14.98	0.00	4.374
SAPPHIRE PRINCESS	9228186	PASSENGER	2							1.67	9.83	0.06	1.53	6.43	0.02	13.23	0.00	0.000
SCENIC ECLIPSE	9797371	PASSENGER	1	0.09	13.20	0.39	1.46	13.62	0.42	3.17	11.41	0.25	1.46	6.47	0.05	9.94	0.00	0.000
SEVEN SEAS EXPLORER	9703150	PASSENGER	1				1.88	10.76	0.13	2.86	9.94	0.10	0.67	7.34	0.04	17.42	0.00	0.000
SEVEN SEAS MARINER	9210139	PASSENGER	3	0.06	14.00	0.30	0.50	13.74	0.29	2.03	13.09	0.25	1.32	7.08	0.04	14.91	0.00	3.624
SILVER WIND	8903935	PASSENGER	1				0.53	8.02	0.09	3.77	8.99	0.12	1.19	8.04	0.09	12.36	0.00	0.000
STAR BREEZE	8807997	PASSENGER	3	0.09	6.24	0.05	1.07	6.28	0.05	9.62	10.32	0.22	1.48	6.68	0.06	21.53	0.00	0.000
THE WORLD	9219331	PASSENGER	1							4.24	6.57	0.03	2.18	6.81	0.04	45.53	29.02	0.000
VIKING ORION	9796250	PASSENGER	3	0.09	12.14	0.18	1.43	12.91	0.22	4.38	11.23	0.15	1.42	6.80	0.03	12.33	0.00	0.000
ZUIDERDAM	9221279	PASSENGER	8				0.30	10.11	0.08	1.86	11.23	0.11	1.54	6.22	0.02	10.91	0.00	2.408
MV DISCOVERY BAY	9143740	REEFER	1	0.19	12.44	0.22	1.41	16.77	0.54	5.58	10.00	0.11	1.56	7.42	0.05	341.14	69.97	0.000
MARJORIE C.	9619684	RORO	25	0.17	10.75	0.13	2.12	10.21	0.11	3.59	9.50	0.09	2.52	7.80	0.05	23.81	0.00	0.000

2022 Harbor Craft Activity

		Main			Auxiliary			Hours in Bay		Hours Ouside Bay		Load Factor		Useful Life		Age	
Vessel Type	**Number**	**MY**	**kW**	**No**	**MY**	**kW**	**No**	**Main**	**Aux**	**Main**	**Aux**	**Main**	**Aux**	**Main**	**Aux**	**Main**	**Aux**
Assist	1	2009	1764	2	2017	166	2	987	557	52	29	0.163	0.338	14	16	11.55	5
Assist	1	2013	1678	2	2014	112	2	918	574	49	30	0.163	0.338	14	16	9	8
Assist	1	2021	599	2	2013	59	2	1003	2063	668	1376	0.163	0.338	14	16	1	9
Assist	1	2007	1119	2	2011	115	3	2438	735	2750	828	0.163	0.338	14	16	14	11
Towboat	1	2020	373	2	2015	9.5	1	774	800	0	0	0.334	0.37	14	16	2	7
Towboat	1	2020	373	2	2015	11	1	265	365	0	0	0.334	0.37	14	16	2	7
Towboat	1	2004	336	2	2004	7	1	149	190	0	0	0.334	0.37	14	16	14	16
Ocean Tug	1	2011	671	2	2011	30	1	520	600	126	135	0.334	0.37	14	16	11	11
Ocean Tug	1	2020	821	2	2014	121	2	1271	677	1908	1015	0.334	0.37	14	16	2	8
Ocean Tug	1	2006	1194	1	2011	92	3	320	350	960	1050	0.334	0.37	14	16	14	11
Ocean Tug	1	2012	1119	2	2009	154	3	128	55	512	218	0.334	0.37	14	16	10	13
Excursion	1	2018	149	1	0	0	0	300	292	0	0	0.268	0.403	15	14	4	14
Ferry	1	2016	298	2	1964	31	2	5575	2666	0	0	0.314	0.388	15	13	2.15	4.5
Excursion	1	2016	242	2	2016	121	2	501	531	0	0	0.268	0.403	15	14	6	6
Excursion	1	2022	372	2	2021	220	2	135	192	0	0	0.268	0.403	15	14	0	1
Excursion	1	2012	108	1	0	0	0	91	88	0	0	0.268	0.403	15	14	10	14
Excursion	1	2011	261	2	2002	38.5	2	772	479	331	205	0.268	0.403	15	14	10.88	14
Excursion	1	2013	1050	2	0	0	0	243	236	0	0	0.268	0.403	15	14	9	14
Excursion	1	1986	448	2	2020	20	2	122	240	0	0	0.268	0.403	15	14	15	2
Ferry	1	2017	242	2	1987	15	1	4944	4805	0	0	0.314	0.388	15	13	2.43	13
Excursion	1	2019	373	2	2014	121	2	3276	2232	0	0	0.268	0.403	15	14	3	5.4
Excursion	1	2011	970	2	2011	261	2	317	573	3	6	0.268	0.403	15	14	11	11
Excursion	1	2016	429	2	2017	246	2	1438	2016	76	106	0.268	0.403	15	14	6	5
Excursion	1	2013	556	2	2013	175	2	1334	1010	572	433	0.268	0.403	15	14	6.3	8.3
Excursion	1	2018	302	2	2016	63	2	414	377	4	4	0.268	0.403	15	14	4	6
Excursion	1	2014	172	2	2016	75	1	224	193	0	0	0.268	0.403	15	14	8	6
Research	1	1978	634	2	1978	230	2	38	41	3773	4089	0.323	0.438	22	28	3.15	2.91
Research	1	2011	555	2	2011	555	2	10	11	350	379	0.323	0.438	22	22	11	11
Work	1	2004	119	1				800	0	0	0	0.333		22		18	
Work	1	2011	112	1				250	0	0	0	0.333		22		11	
Work	1	2002	343	2				878	0	0	0	0.333		15		15	
Work	1	2012	317	2				75	0	0	0	0.333		22		10	
Commercial Fishing	68	1995	256	1.5	1996	75	1	33	40	67	80	0.27	0.43	31	31	25	27
Sportfishing – Overall	54	2009															
Sportfishing – ½ Day Boat	*3*	*2004*	*280*	*2*	*2008*	*38*	*1*	*484*	*1936*	*669*	*2678*	*0.288*	*0.454*	*16*	*19*	*16*	*14*
Sportfishing – 1 Day Boat	*3*	*2011*	*290*	*2*	*2014*	*37*	*2*	*150*	*600*	*207*	*830*	*0.288*	*0.454*	*16*	*19*	*11*	*8*
Sportfishing – 1.5 to 4 Day Boat	*37*	*2010*	*355*	*2*	*2006*	*45*	*2*	*1118*	*4470*	*1546*	*6182*	*0.288*	*0.454*	*16*	*19*	*12*	*16*
Sportfishing – Long-Range Boat, 5-16 Days	*11*	*2007*	*671*	*2*	*2006*	*149*	*2*	*150*	*600*	*207*	*830*	*0.288*	*0.454*	*16*	*19*	*15*	*16*

2022 Cargo Handling Equipment Activity

Terminal	Type	Quantity	Description	Original MY	Engine MY	HP	Fuel	RD99	Annual Usage (hr)	Deterior Hours 12,000 max	Aftermarket emission control strategy installed?	Emission Control Type	Level of Control (1, 2, or 3)	Type
TAMT	Hostler	10	CAPACITY TJ5000	2007	2011	200	Diesel		1612	12000				Yard Tractor
TAMT	REACH STACKER	1	TAYLOR	2002	2010	330	Diesel		770	9240				Reach Stacker
TAMT	REACH STACKER	1	TEREX	2016	2016	315	Diesel		325	1950				Reach Stacker
TAMT	Hostler	5	ORANGE EV	2022	2022	225	Electric		1612	NA				Yard Tractor
TAMT	Forklift	1	DOOSAN	2022	2021	106	Electric		879	NA				Forklift
TAMT	Forklift	1	DOOSAN	2022	2022	106	Electric		879	NA				Forklift
TAMT	Yard Tractor	1	KALMAR 4x2	2007	2007	200	Diesel		679	10185	No			Yard Tractor
TAMT	Yard Tractor	1	KALMAR 4x2	2007	2007	200	Diesel		628	9420	No			Yard Tractor
TAMT	Yard Tractor	1	KALMAR 4x2	2007	2007	200	Diesel		553	8295	No			Yard Tractor
TAMT	Yard Tractor	1	KALMAR 4x2	2007	2007	200	Diesel		452	6780	No			Yard Tractor
TAMT	Yard Tractor	1	KALMAR 4x2	2007	2007	200	Diesel		490	7350	No			Yard Tractor
TAMT	Yard Tractor	1	KALMAR T2	2019	2019	173	Diesel		818	2454	No			Yard Tractor
TAMT	Yard Tractor	1	KALMAR T2	2019	2019	173	Diesel		1558	4674	No			Yard Tractor
TAMT	Forklift	1	CAT PD8000 3.4 MT Cap	2012	2012	63	Diesel		375	3750	No			Forklift
TAMT	Forklift	1	CAT PD8000 3.4 MT Cap	2012	2012	63	Diesel		245	2450	No			Forklift
TAMT	Forklift	1	CAT PD8000 2.9 MT Cap	2012	2012	63	Diesel		204	2040	No			Forklift
TAMT	Forklift	1	CAT PD8000 2.9 MT Cap	2012	2012	63	Diesel		293	2930	No			Forklift
TAMT	Forklift	1	MITSUBISHI HD80	2006	2006	134	Diesel		43	688	Yes	Diesel Particulate Filter (DPF)	3	Forklift
TAMT	Forklift	1	CAT P33000	2008	2008	200	Diesel		281	3934	No			Forklift
TAMT	Forklift	1	TAYLOR TX330M	2013	2013	165	Diesel		298	2682	No			Forklift
TAMT	Forklift	1	TAYLOR TX330M	2013	2013	165	Diesel		280	2520	No			Forklift
TAMT	Forklift	1	TAYLOR TXH400L	2008	2008	250	Diesel		164	2296	Yes	Diesel Particulate Filter (DPF)	3	Forklift
TAMT	Forklift	1	TAYLOR TXH400L	2008	2008	250	Diesel		235	3290	Yes	Diesel Particulate Filter (DPF)	3	Forklift
TAMT	Forklift	1	TAYLOR TXH400L	2008	2008	250	Diesel		258	3612	Yes	Diesel Particulate Filter (DPF)	3	Forklift
TAMT	Forklift	1	TAYLOR TXH400L	2008	2008	250	Diesel		291	4074	Yes	Diesel Particulate Filter (DPF)	3	Forklift
TAMT	Forklift	1	HOIST P550	2008	2008	250	Diesel		183	2562	Yes	Diesel Particulate Filter (DPF)	3	Forklift
TAMT	Forklift	1	TAYLOR XH550M	2022	2022	248	Diesel		35	35	No			Forklift
TAMT	Top Handler	1	TAYLOR TEC-9501	2005	2005	280	Diesel		402	6834	Yes	Diesel Particulate Filter (DPF)	3	Top Handler
TAMT	Top Handler	1	TAYLOR XLC976	2021	2021	382	Diesel		940	940				Top Handler
TAMT	Forklift	1	CW CBB52	2008	2008	250	Diesel		102	1428	Yes	Diesel Particulate Filter (DPF)	3	Forklift
TAMT	Crane	1	Rental	2011	2011	551	Diesel		6	66				Crane
TAMT	Crane	1	Rental	2011	2011	551	Diesel		6	66				Crane
CST	Forklift	7	HYSTER	2000	2000	106	Electric		1000	NA				Forklift
CST	Forklift	7	TOYOTA	2000	2000	106	Electric		1000	NA				Forklift
TAMT	Air Compressor	1	Sullar 185	2006	2006	60	Diesel	Yes	43	688	No			Compressor
TAMT	Vac Truck	1	Ford F-650	2001	2001	320	Diesel		40	840	No			Vacuum truck
TAMT	Forklift	1	Uni Carriers Model- MAP1F2A25LV	2017	2017	106	Propane		95	475	No			Forklift
TAMT	Pump Truck	1	Ford F-350 Super Duty Cab & Chasis	2004	2004	450	Gasoline		243	4374	No			0
TAMT	Tommy Slick	1	American Work Boats	1992	2012		Diesel	Yes	75	750	No			Other
TAMT	Forklift	3	Caterpillar EC30	2004	2004	106	Electric		14	NA	No			Forklift
TAMT	Forklift	8	Caterpillar ET3000	2007	2007	106	Electric		48	NA	No			Forklift
TAMT	Reach Stacker	3	JCB	2022	2022	337	Diesel		21	21	No			Reach Stacker
TAMT	Forklift	1		2014	2014	67	Diesel		879	7032	No			Forklift
TAMT	Forklift	1	HELI CPYD30-TY5	2016	2016	149	Propane		208	1248	No			Forklift
TAMT	Forklift	1	TOYOTA 8FBE20U	2019	2019	106	Electric		100	NA	No			Forklift
TAMT	Cart	1	Clubcar	2003	2007	9	Gasoline		400	6000	No			Cart
TAMT	Front Loader	1	Rubber Tire LoaderCAT 928 G	1999	1999	125	Diesel		200	4600	No			Loader
TAMT	Reach Stacker	1	Fantuzzi	2001	2009	400	Diesel		100	1300	Yes	Diesel Particulate Filter (DPF)		Reach Stacker
TAMT	Reach Stacker	1	Fantuzzi	2001	2008	330	Diesel		100	1400	Yes	Diesel Particulate Filter (DPF)		Reach Stacker
TAMT	Reach Stacker	1	Fantuzzi	1999	2010	354.340673	Electric		100	NA				Reach Stacker
TAMT	Top Handler	1	Taylor TEC950L	1999	1999	280	Diesel		0	0	Yes	Diesel Particulate Filter (DPF)		Top Handler
TAMT	Forklift	1	TL-FL33E	2023	2023	106	Electric		400	NA				Forklift
TAMT	Reach Stacker	1	TI-RS55E	2022	2022	337	Electric		100	NA				Reach Stacker
TAMT	Forklift	1	Kalmar	2018	2018	170	Electric		400	NA				Forklift
TAMT	Forklift	1	Doosan	2020	2020	162	Diesel		400	800				Forklift
TAMT	Forklift	1	Doosan	2018	2018	140	Diesel		400	1600				Forklift
TAMT	Crane	1	Gottwald HMK300 Mobile Harbor Crane	2001	2001	1030	Diesel		437.1	9179.1	No			Crane
CST	Forklift	1	Komatsu 6000LB	2003	2003	65.7	Propane		879		No			Forklift
CST	Telescopic Reach Lift	1	JLG Skytrack 10054 Reach Lift	2007	2007	110	Diesel	Yes	100		No			Lift
CST	Telescopic Boom Lift	1	JLG Sky Track	2012	2012	82	Propane		100		No			Lift
CST	Forklift	1	DOOSAN B35X-5	2010		28.2	Electric		117					Forklift
TAMT	Sweeper/scrubber	1	Tennant T20 Scrubber	2017	2017	28	Propane		464					Sweeper
TAMT	Sweeper/scrubber	1	Tennant ATLV 4300 Litter Vacuum	2017	2017	32.8	Diesel	Yes	464					Sweeper
NCMT	UTR/Spotting Tractor	1	Terberg 4x4 Off-Road	2014	2014	225	Diesel		250	2000	Yes	Other	DEF	Yard Tractor
NCMT	UTR/Spotting Tractor	1	Terberg 4x2 Off-Road	2014	2014	225	Diesel		250	2000	Yes	Other	DEF	Yard Tractor
NCMT	UTR/Spotting Tractor	1	Ottawa 4x2 Off-Road	2015	2015	225	Diesel		250	1750				Yard Tractor
NCMT	UTR/Spotting Tractor	1	Ottawa 4x2 Off-Road	2015	2015	225	Diesel		250	1750				Yard Tractor
NCMT	UTR/Spotting Tractor	1	BYD 8Y Electric	2017	2017	225	Electric		250	NA				Yard Tractor
NCMT	Utility Vehicle	1	John Deere TX Gator	2012	2012	16	Gasoline		1560	12000				ATV
NCMT	Utility Vehicle	1	John Deere TX Gator	2012	2012	16	Gasoline		1560	12000				ATV
NCMT	Utility Vehicle	1	John Deere TX Gator	2012	2012	16	Gasoline		1560	12000				ATV
NCMT	Utility Vehicle	1	John Deere TX Gator	2012	2012	16	Gasoline		1560	12000				ATV
NCMT	Utility Vehicle	1	John Deere TX Gator	2013	2013	16	Gasoline		1560	12000				ATV
NCMT	Utility Vehicle	1	John Deere TX Gator	2013	2013	16	Gasoline		1560	12000				ATV
NCMT	Utility Vehicle	1	John Deere TX Gator	2013	2013	16	Gasoline		1560	12000				ATV
NCMT	Utility Vehicle	1	John Deere TX Gator	2013	2013	16	Gasoline		1560	12000				ATV

2022 Cargo Handling Equipment Activity

Terminal	Type	Quantity	Description	Original MY	Engine MY	HP	Fuel	RD99	Annual Usage (hr)	Deterior Hours 12,000 max	Aftermarket emission control strategy installed?	Emission Control Type	Level of Control (1, 2, or 3)	Type
NCMT	Utility Vehicle	1	John Deere TX Gator	2015	2015	16	Gasoline		1560	10920				ATV
NCMT	Utility Vehicle	1	John Deere TX Gator	2017	2017	16	Gasoline		1560	7800				ATV
NCMT	Utility Vehicle	1	John Deere TX Gator	2017	2017	16	Gasoline		1560	7800				ATV
NCMT	Utility Vehicle	1	John Deere TX Gator	2017	2017	16	Gasoline		1560	7800				ATV
NCMT	Utility Vehicle	1	John Deere TX Gator	2017	2017	16	Gasoline		1560	7800				ATV
NCMT	2.5 Ton Forklift	1	Clark C24LPG	2011	2011	67	Propane		100	1100				Forklift
NCMT	2.5 Ton Forklift	1	Mitsubishi FG25N-LP	2013	2013	61	Propane		100	900				Forklift
NCMT	2.5 Ton Forklift	1	Mitsubishi FG25N-LP	2013	2013	61	Propane		100	900				Forklift
NCMT	10 Ton Forklift	1	Taylor TX-220S	2011	2011	160	Diesel		100	1100				Forklift
NCMT	15 Ton Forklift	1	Kalmar DCD160-9	2008	2008	160	Diesel		100	1400				Forklift
NCMT	16 Ton Forklift	1	Taylor TX370M	2011	2011	173	Diesel		80	880				Forklift
NCMT	Forklift	1	Caterpilar Model Forklift	2000	2000	106	Propane		879	12000				Forklift
NCMT	Rail Loader (yellow)	1	Rail Loader (yellow)	2002	2002	138	Gasoline		780	12000				Loader
NCMT	Rail Loader (yellow)	1	Rail Loader (yellow)	2002	2002	138	Gasoline		780	12000				Loader
NCMT	Rail Loader (yellow)	1	Rail Loader (yellow)	2002	2002	138	Gasoline		780	12000				Loader
NCMT	Hyster Forklift 18726	1	Hyster Forklift	2003	2003	103	Propane		879	12000				Forklift
NCMT	Hyster Forklift N40ZR-16.5	1	Hyster Forklift	2003	2003	103	Propane		879	12000				Forklift
NCMT	Gator	1	John Deere - Gator TS	2007	2007	13	Gasoline		780	11700				ATV
NCMT	Sweeper	1	Tennet Sweeper 800 Series	1998	1998	83	Gasoline		479	11496				Sweeper
NCMT	Gator	1	John Deere - Gator TX	2007	2007	13	Gasoline		479	7185				ATV
NCMT	Segway	1	Segway	2008	2008	2	Electric		375	NA				Segway
NCMT	Segway	1	Segway	2008	2008	2	Electric		375	NA				Segway
NCMT	Polaris Ranger	1	Polaris Ranger	2008	2008	32	Gasoline		780	10920				Cart
NCMT	ATV CLUB CAR	1	ATV CLUB CAR	2013	2013	20	Gasoline		479	4311				Cart
NCMT	ATV CLUB CAR	1	ATV CLUB CAR	2013	2013	20	Gasoline		479	4311				Cart
NCMT	2- Post lift	1	Western Hoist	2003	2003	2	Electric		1560	NA				Lift
NCMT	2- Post lift	1	Western Hoist	2003	2003	2	Electric		1560	NA				Lift
NCMT	2- Post lift	1	Western Hoist	2003	2003	2	Electric		1560	NA				Lift
NCMT	4 POST LIFT	1	ROTARY	2017	2017	2	Electric		1560	NA				Lift
NCMT	4 POST LIFT	1	ROTARY	2017	2017	2	Electric		1560	NA				Lift
NCMT	4 POST LIFT	1	ROTARY	2017	2017	2	Electric		1560	NA				Lift
NCMT	4 POST LIFT	1	ROTARY	2017	2017	2	Electric		1560	NA				Lift
NCMT	4 POST LIFT	1	ROTARY	2017	2017	2	Electric		1560	NA				Lift
NCMT	4 POST LIFT	1	ROTARY	2017	2017	2	Electric		1560	NA				Lift
NCMT	4 POST LIFT	1	ROTARY	2017	2017	2	Electric		1560	NA				Lift
NCMT	4 POST LIFT	1	ROTARY	2017	2017	2	Electric		1560	NA				Lift
NCMT	2- Post lift	1	Benwil Hoist	2003	2003	2	Electric		1560	NA				Lift
NCMT	2- Post lift	1	Benwil Hoist	2003	2003	2	Electric		1560	NA				Lift
NCMT	2- Post lift	1	Western Hoist	2003	2003	2	Electric		1560	NA				Lift
NCMT	2- Post lift	1	Western Hoist	2003	2003	2	Electric		1560	NA				Lift
NCMT	2- Post lift	1	Western Hoist	2003	2003	2	Electric		1560	NA				Lift
NCMT	2- Post lift	1	Western Hoist	2003	2003	2	Electric		1560	NA				Lift
NCMT	2- Post lift	1	Western Hoist	2003	2003	2	Electric		1560	NA				Lift
NCMT	2- Post lift	1	Western Hoist	2003	2003	2	Electric		1560	NA				Lift
NCMT	2- Post lift	1	Western Hoist	2003	2003	2	Electric		1560	NA				Lift
NCMT	2- Post lift	1	Western Hoist	2003	2003	2	Electric		1560	NA				Lift
NCMT	Car Wash Long Tunnel	1	N/A	2003	2003	6	Electric		780	NA				Other
NCMT	Car Wash Short Tunnel	1	N/A	2003	2003	4	Electric		780	NA				Other
NCMT	Compactor	1	60IID	2003	2003	5	Electric		780	NA				Other
NCMT	Compactor	1	EA30485HDS	2003	2003	5	Electric		780	NA				Other
NCMT	Portable Compressor	1	ES20	2003	2003	5	Electric		1560	NA				Compressor
NCMT	Portable Compressor	1	QX2X/ES20	2003	2003	5	Electric		1560	NA				Compressor
NCMT	Portable Compressor	1	ES20	2003	2003	5	Electric		1560	NA				Compressor
NCMT	Portable Compressor	1	Predator/R420	2003	2003	5	Gasoline		600	11400				Compressor
NCMT	Atlas Air Compressor	1	KT10V12034	2003	2003	15	Electric		1560	NA				Compressor
NCMT	Atlas Air Compressor	1	KT10V12034	2003	2003	15	Electric		1560	NA				Compressor
NCMT	Atlas Air Compressor	1	GA18PA	2003	2003	15	Electric		1560	NA				Compressor
NCMT	Falcon Air Compressor	1	B-2 Falcon	2003	2003	5	Electric		1560	NA				Compressor
NCMT	Tire Balancer	1	1025S	2003	2003	2	Electric		260	NA				Other
NCMT	Tire Machine	1	10430	2003	2003	1	Electric		260	NA				Other
NCMT	Tire Balancer	1	LS8153	2003	2003	2	Electric		260	NA				Other
NCMT	Tire Machine	1	9024-E	2003	2003	1	Electric		260	NA				Other
NCMT	Tire Machine	1	IC4KOCC	2003	2003	1	Electric		260	NA				Other
NCMT	Tire Balancer	1	GSP9712	2003	2003	2	Electric		260	NA				Other
NCMT	Tire Machine	1	TC3250	2003	2003	1	Electric		260	NA				Other
NCMT	Tire Balancer	1	GSP9712	2003	2003	2	Electric		260	NA				Other

Appendix C

Regulatory Setting

Various regulations and strategies are driving the reduction of air emissions from maritime sources. **Table B-1** summarizes selected air quality regulations and strategies for maritime air emission sources that have been adopted recently and are currently active.

Table B-1. Summary of Recently Adopted Air Emissions Regulations and Strategies

Agency/Organization	Regulation or Strategy	Year of Adoption	Emission Source	Target Pollutants
CARB	At Berth Amendments	2020	Ocean-going vessels	Particulate matter (PM), DPM, NO_x, ROG, and GHG
IMO	Data Collection System for Fuel Oil Consumption of Ships (MEPC.278[70])	2016	Ocean-going vessels	GHG
IMO	Low Sulfur Fuel Requirements for Marine Engines (MEPC.280[70])	2016	Ocean-going vessels	SO_x
IMO	Carbon Intensity Indicator (MEPC.328[76])	2021	Ocean-going vessels	GHG
IMO	2023 IMO Strategy on Reduction of GHG Emissions from Ships (MEPC.377[80])	2023	Ocean-going vessels	GHG
CARB	Commercial Harbor Craft Amendments	2022	Commercial harbor craft	DPM, SO_x, NO_x, and GHG
CARB	Large Spark-Ignition Engine Fleets Amendments	2016	Off-road large spark-ignition fleets	NO_x and hydrocarbons
CARB	In-Use Off-Road Diesel-Fueled Fleets Amendments	2023	Off-road diesel fleets	DPM, NO_x, and other criteria air pollutants
CARB	Advanced Clean Trucks Regulation	2021	Medium- and heavy-duty vehicles (Class 2B-8)	PM, NO_x, and other criteria air pollutants; GHG; and toxic air contaminants
CARB	Clean Truck Check Program (Heavy-Duty Inspection/Maintenance Regulation)	2022	Heavy-duty non-gasoline vehicles (Class 4-8)	PM and NO_x
CARB	Heavy-Duty Vehicle and Engine Omnibus Low NO_x Amendments	2023	Heavy-duty vehicles (Class 4-8)	PM and NO_x
CARB	Transport Refrigeration Unit Amendments	2022	Transport refrigeration units	DPM, NO_x, and GHG
CARB	2020 Mobile Source Strategy	2021	Multiple	Criteria air pollutants, GHG, and toxic air contaminants
CARB	2022 State Strategy for the State Implementation Plan	2022	Multiple	Criteria air pollutants