# Port of San Diego 2016 Maritime Air Emissions Inventory


**Prepared for:**

PORT of SAN DIEGO

San Diego Unified Port District
3165 Pacific Highway
San Diego, CA 92101

**Prepared by:**

ICF

ICF
525 B Street, Suite 1700
San Diego, CA 92101

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# Table of Contents

# List of Tables

# List of Figures

# Acronyms and Abbreviations

| | |
|---|---|
| AB | Assembly Bill |
| AIS | Automatic Identification System |
| AR4 | IPCC Fourth Assessment Report |
| ARB | California Air Resources Board |
| BACT | best available control technology |
| bhp-hr | brake horsepower-hour |
| BNSF | Burlington Northern Santa Fe |
| Cal/EPA | California Environmental Protection Agency |
| CalEEMod | California Emissions Estimator Model |
| CAP | Climate Action Plan |
| CCR | California Code of Regulations |
| CFR | Code of Federal Regulations |
| $CH_4$ | methane |
| CHC | commercial harbor craft |
| CHE | cargo handling equipment |
| CHEI | Cargo Handling Emissions Inventory |
| CO | carbon monoxide |
| $CO_2$ | carbon dioxide |
| $CO_2e$ | carbon dioxide equivalent |
| CST | Cruise Ship Terminal |
| DPM | diesel particulate matter |
| ECA | Emission Control Area |
| ED | electrically powered propulsion |
| EPA | U.S. Environmental Protection Agency |
| FR | *Federal Register* |

| | |
|---|---|
| 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-hrs | horsepower-hours |
| I- | Interstate |
| IMO | International Maritime Organization |
| IPCC | Intergovernmental Panel on Climate Change |
| kW | kilowatt |
| kWh | kilowatt-hour |
| LDA | light-duty automobile |
| LDT1 | light-duty truck 1 |
| LDT2 | light-duty truck 2 |
| MARPOL | International Convention for the Prevention of Pollution from Ships |
| MOU | Memorandum of Understanding |
| MSD | medium-speed diesel |
| MW | megawatts |
| MWh | megawatt-hours |
| $N_2O$ | nitrous oxide |

| | |
|---|---|
| NAAQS | National Ambient Air Quality Standards |
| NCMT | National City Marine Terminal |
| nm | nautical mile |
| NO | nitric oxide |
| $NO_2$ | nitrogen dioxide |
| $NO_X$ | nitrogen oxides |
| $O_3$ | ozone |
| OGV | ocean-going vessel |
| PC Model | Pleasure Craft Emissions Model |
| PM10 | particulate matter 10 microns or less in diameter |
| PM2.5 | particulate matter 2.5 microns or less in diameter |
| Port | San Diego Unified Port District |
| ppm | parts per million |
| ROG | reactive organic gas |
| RSD | Regulatory Support Document |
| SB | Senate Bill |
| $SO_2$ | sulfur dioxide |
| $SO_X$ | sulfur oxides |
| SSD | slow-speed diesel |
| TAC | toxic air contaminant |
| TAMT | Tenth Avenue Marine Terminal |
| UPRR | Union Pacific Railroad |
| VMT | vehicle miles traveled |
| VOC | volatile organic compound |
| VSR | vessel speed reduction |

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# Executive Summary

The San Diego Unified Port District (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 2016. The Port conducted its first maritime air emissions inventory based on activity in the 2006 calendar year (the “2006 inventory”), and its second maritime air emissions inventory based on activity in the 2012 calendar year (the “2012 inventory”). This inventory of 2016 conditions is compared to activity and emissions in both the 2006 and 2012 inventories herein.

This Executive Summary presents an overview of the results of the 2016 Maritime Air Emissions Inventory, as well as a comparison to previous maritime air emissions inventories in terms of activity, emissions, and the efficiency of cargo movements (e.g., emissions per a given level of activity) over time.

## ES.1 Scope of Inventory

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

- Ocean-going vessels (OGVs)
- Harbor craft, including commercial and sport fishing
- Cargo handling equipment
- Locomotives
- Heavy-duty trucks and on-road vehicles
- Recreational boating

This inventory includes the following criteria pollutant emission types:

- Particulate matter 10 microns or less in diameter (PM10) and 2.5 microns or less in diameter (PM2.5)
- Oxides of nitrogen ($NO_X$)
- Sulfur dioxide ($SO_2$)
- Reactive organic gases (ROG)
- Carbon monoxide (CO)

This inventory includes the following toxic air contaminant emission type:

- Diesel particulate matter (DPM)

Additionally, the inventory includes the following greenhouse gas (GHG) emission types:

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

As noted above, the 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 Fourth Assessment Report.[1] 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.

## ES.2 Summary of Results

Table ES-1 summarizes the findings from the 2016 Maritime Emissions Inventory. For comparison, the results of the 2012 and 2006 Maritime Emissions Inventories are presented in Table ES-2 and in Table ES-3, respectively. Key results are presented in **bold** below.

**Compared to the 2006 inventory, all emissions have decreased.** Overall, emissions are decreasing. Between 2016 and 2006, all emissions have decreased, and between 2016 and 2012, all emissions except for CO and GHGs have decreased. This decreasing trend in emissions is the product of activity (e.g., the number of vessel calls and operational changes) and the emissions efficiency (e.g., emissions factors) over time. Even as activity increases in some cases, particularly for sources that are continually getting cleaner, emissions trend down. This is explained in more detail in Chapter 8, *Results and Discussion*.

**Table ES-1. Summary of 2016 Maritime Air Emission Inventory (tons)**

| Sector | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ (tons)* | $CO_2e$ (MT)* |
|---|---|---|---|---|---|---|---|---|---|
| Ocean-Going Vessels | 20.4 | 31.7 | 322.7 | 7.6 | 7.0 | 6.1 | 15.2 | 25,802 | 22,500 |
| Harbor Craft | 28.9 | 183.1 | 234.8 | 7.8 | 7.5 | 7.8 | 0.5 | 28,109 | 25,500 |
| Cargo Handling Equipment | 4.3 | 26.1 | 13.7 | 0.6 | 0.5 | 0.5 | 1.6 | 2,407 | 2,183 |
| Freight Rail | 1.9 | 7.5 | 30.3 | 1.2 | 1.2 | 1.2 | 0.5 | 2,916 | 2,646 |
| On-Road Vehicles | 3.1 | 12.3 | 51.4 | 0.3 | 0.3 | 0.3 | 0.1 | 16,095 | 14,601 |
| ***Total Emissions*** | ***58.6*** | ***260.7*** | ***652.9*** | ***17.4*** | ***16.5*** | ***15.9*** | ***17.9*** | ***74,330*** | ***67,431*** |

*GHG emissions are presented in tons for comparison with previous Maritime Emissions Inventories and in metric tons for comparison with the Port's Climate Action Plan

[1] For more information, please see "Climate Change 2007: Working Group I: The Physical Science Basis," Section 2.10.2: Direct Global Warming Potentials. Available at: https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html.

**Table ES-2. Comparison of 2006 and 2016 Maritime Air Emission Inventories (tons)**

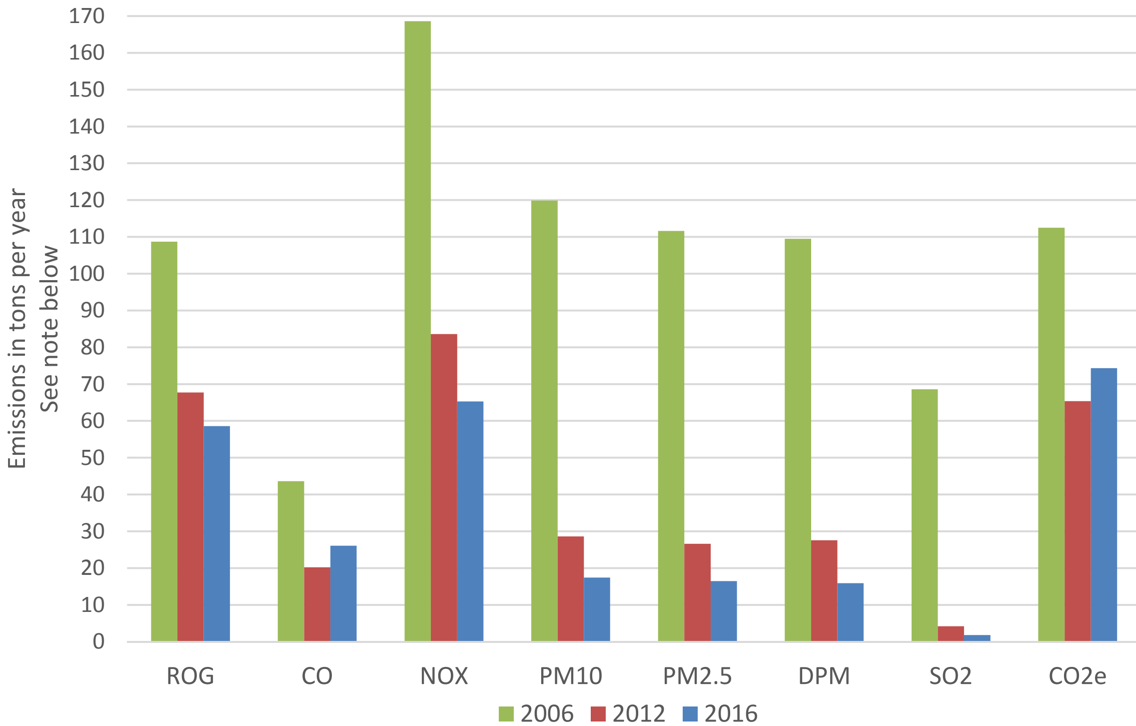
| Sector | ROG | CO | $NO_x$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ (tons) | $CO_2e$ (MT) |
|---|---|---|---|---|---|---|---|---|---|
| **2006 Inventory** | | | | | | | | | |
| Ocean-Going Vessels | 31.2 | 61.0 | 726.0 | 82.4 | 75.8 | 72.2 | 681.0 | 42,963 | 38,975 |
| Harbor Craft | 54.6 | 150.0 | 528.0 | 23.8 | 23.1 | 23.8 | 0.2 | 25,116 | 22,785 |
| Cargo Handling Equipment | 4.0 | 43.0 | 33.0 | 1.0 | 0.9 | 0.9 | 0.0 | 4,452 | 4,039 |
| Freight Rail | 3.4 | 9.0 | 61.0 | 2.1 | 2.0 | 2.1 | 4.1 | 3,400 | 3,084 |
| On-Road Vehicles | 15.5 | 174.0 | 338.0 | 10.6 | 9.8 | 10.5 | 0.2 | 36,567 | 33,173 |
| ***2006 Total*** | ***108.7*** | ***436.0*** | ***1,686.0*** | ***119.9*** | ***111.6*** | ***109.5*** | ***686.0*** | ***112,498*** | ***102,056*** |
| ***Change Since 2006*** | | | | | | | | | |
| Ocean-Going Vessels | -10.8 | -29.3 | -403.3 | -74.8 | -68.8 | -66.1 | -665.8 | -18,161 | -16,475 |
| Harbor Craft | -25.7 | 33.1 | -293.2 | -16.0 | -15.6 | -16.0 | 0.3 | 2,993 | 2,715 |
| Cargo Handling Equipment | 0.3 | -16.9 | -19.3 | -0.4 | -0.4 | -0.4 | 1.6 | -2,045 | -1,855 |
| Freight Rail | -1.5 | -1.5 | -30.7 | -0.9 | -0.8 | -0.9 | -3.6 | -484 | -439 |
| On-Road Vehicles | -12.4 | -161.7 | -286.6 | -10.3 | -9.5 | -10.2 | -0.1 | -20,472 | -18,572 |
| ***Total Change*** | ***-50.1*** | ***-175.3*** | ***-1,033.1*** | ***-102.5*** | ***-95.1*** | ***-93.6*** | ***-668.1*** | ***-38,168*** | ***-34,626*** |
| *Percent Change* | *-46%* | *-40%* | *-61%* | *-85%* | *-85%* | *-85%* | *-97%* | *-34%* | *-34%* |

Table ES-3. Comparison of 2012 and 2016 Maritime Air Emission Inventories (tons)

| Sector | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ (tons) | $CO_2e$ (MT) |
|---|---|---|---|---|---|---|---|---|---|
| **2012 Inventory** | | | | | | | | | |
| Ocean-Going Vessels | 20.9 | 31.0 | 368.0 | 9.3 | 8.5 | 8.3 | 41.2 | 22,551 | 20,458 |
| Harbor Craft | 40.1 | 136.0 | 362.0 | 14.8 | 14.4 | 14.8 | 0.2 | 23,387 | 21,216 |
| Cargo Handling Equipment | 1.1 | 10.0 | 12.0 | 0.3 | 0.3 | 0.3 | 0.0 | 1,680 | 1,524 |
| Freight Rail | 1.9 | 6.0 | 32.0 | 1.1 | 1.1 | 1.1 | 0.0 | 3,192 | 2,896 |
| On-Road Vehicles | 3.7 | 18.0 | 62.0 | 3.1 | 2.4 | 3.1 | 0.0 | 14,573 | 13,220 |
| ***2012 Total*** | ***67.7*** | ***202.0*** | ***836.0*** | ***28.6*** | ***26.6*** | ***27.6*** | ***42.0*** | ***65,383*** | ***59,314*** |
| ***Change Since 2012*** | | | | | | | | | |
| Ocean-Going Vessels | -0.5 | 0.7 | -45.3 | -1.7 | -1.6 | -2.2 | -26.0 | 2,251 | 2,042 |
| Harbor Craft | -11.2 | 47.1 | -127.2 | -7.0 | -6.8 | -7.0 | 0.3 | 4,722 | 4,284 |
| Cargo Handling Equipment | 3.2 | 16.1 | 1.7 | 0.3 | 0.3 | 0.2 | 1.6 | 727 | 659 |
| Freight Rail | 0.0 | 1.5 | -1.7 | 0.1 | 0.2 | 0.1 | 0.5 | -276 | -250 |
| On-Road Vehicles | -0.6 | -5.7 | -10.6 | -2.8 | -2.2 | -2.8 | 0.1 | 1,522 | 1,381 |
| ***Total Change*** | ***-9.1*** | ***58.7*** | ***-183.1*** | ***-11.2*** | ***-10.1*** | ***-11.6*** | ***-24.1*** | ***8,947*** | ***8,116*** |
| *Percent Change* | *-13%* | *29%* | *-22%* | *-39%* | *-38%* | *-42%* | *-57%* | *14%* | *14%* |

Figure ES-1 compares the trend in emissions between 2016, 2012, and 2006 emission inventories. As shown, each emissions type has decreased since 2006, and only CO and $CO_2e$ increased since 2012. Note that this increase in CO and $CO_2e$ since 2012 is mainly due to two factors that affect overall emissions: that the size of vessels calling at the Port is increasing, and that the 2016 inventory includes charter and sport fishing within the Harbor Craft category, which was not included in the 2012 emissions inventory. A description of these sources and changes is included in Chapter 2 and Chapter 3, respectively.

**Figure ES-1. Comparison of Maritime Emissions between 2006, 2012, and 2016**

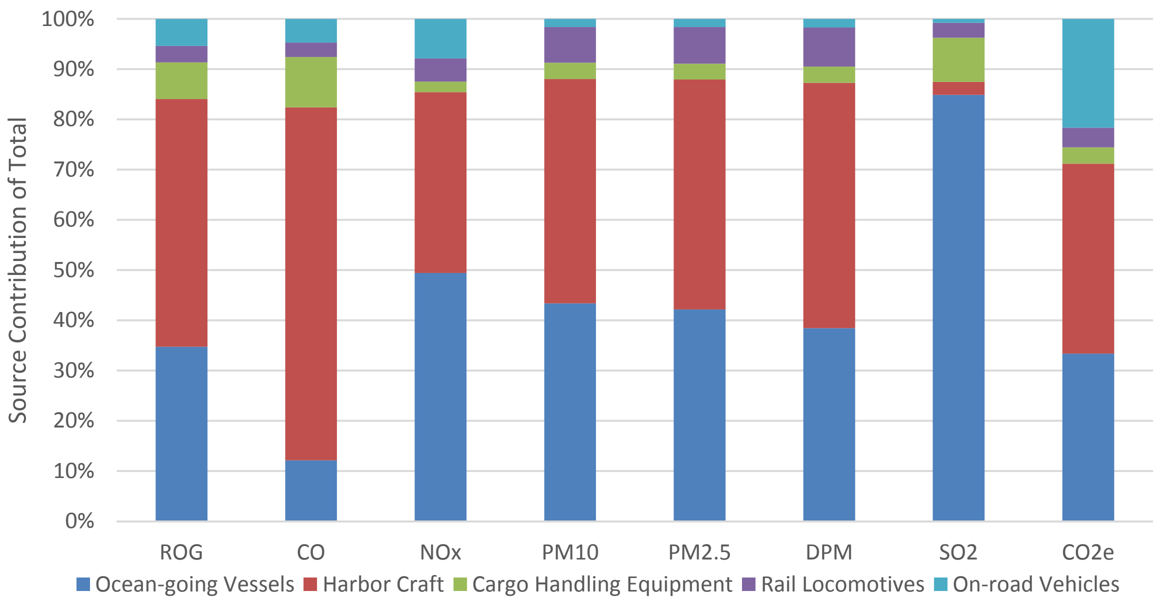



*For presentation purposes, ROG, PM10, PM2.5, and DPM shown in tons per year; CO and $NO_X$ shown in tons per year divided by 10; and $CO_2e$ shown in tons per year divided by 1,000.*

The trend in emissions over time is the result of changes in activity and the emissions profile of that activity. It is important to note that activity is not static. The majority of cargo at the Port arrives by vessel. The number of vessel calls changes from year to year, which, in turn, creates a cascading effect of different levels of activity for other maritime sources of emissions. Although activity plays a significant role in emissions generated from the maritime sector, regulations requiring technologies to reduce criteria pollutants have led to a reduction of most emissions, both in total and on a per-vessel-call basis.

**Harbor Craft and Ocean Going Vessels are the dominate emissions sources**. Figure ES-2 shows the relative contribution of each source category in 2016. Generally, harbor craft contributes the greatest share of emissions (for ROG, CO, DPM, and $CO_2e$) followed by OGVs ($SO_2$ and $NO_X$) and on-road vehicles. This is partially because the inventory only accounts for emissions within the air basin; most if not all harbor craft emissions occur within the air basin, while emissions from OGV, rail, and truck sources occur not only within the air basin but throughout the state, nation, and internationally. Further, harbor craft are comprised of a large fleet of vessel types which operate within and out of San Diego Bay, including ferries and excursion vessels, sport fishing, commercial fishing, assist tugs, and towboats. Those harbor craft directly involved in freight and passenger movement (i.e., tug boats, towboats, and pilot boats) at the Port's marine terminals are less of an overall source of emissions than the OGV category.

**Figure ES-2. Distribution of 2016 Emissions by Source Category**




**Emissions efficiency is increasing.** Table ES-4 summarizes the relative efficiency of Port operations from an emissions standpoint. It presents the total amount of maritime emissions (in pounds, from all sources) per vessel call for each of the years an inventory has been produced. As shown, 2006 saw the most vessel calls, and was also the least efficient from an emissions perspective (had the highest emissions per vessel call) compared to any other year for each pollutant. Since that time, calls declined in 2012 but then increased in 2016. Despite the increase, most pollutants showed a consistent increase in emissions efficiency (lower emissions per call) over this period. Table ES-4 indicates that regulations to reduce criteria pollutants are succeeding to decrease emissions even with adjustments to activity levels. CO and $CO_2$e emissions increased since 2012 as activity levels also rose. GHG emissions are expected to decrease over time as the Port institutes further GHG reduction measures and the state of California pursues the GHG reduction strategies, such as those in the *Sustainable Freight Action Plan*[2], which identifies policies, programs, and investments to increase the use of zero and near-zero emission vehicles and equipment involved in freight movement. This is discussed in more detail in Chapter 8, *Results and Discussion*.

[2] California Sustainable Freight Action Plan. Accessed (May 11, 2018): http://dot.ca.gov/hq/tpp/offices/ogm/cs_freight_action_plan/main.html

**Table ES-4. Efficiency of Activity – Pounds of Maritime Emissions per Call by Year**

| Year | Calls | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | 530 | 410 | 1,645 | 6,362 | 452 | 421 | 413 | 2,589 | 424,521 |
| 2012 | 411 | 329 | 983 | 4,068 | 139 | 129 | 134 | 204 | 318,165 |
| 2016 | 420 | 279 | 1,242 | 3,109 | 83 | 79 | 76 | 85 | 353,951 |

# 1 Introduction

The San Diego Unified Port District (Port) is updating its maritime emissions inventory to reflect calendar year 2016 conditions. This inventory allows the Port to track efforts to reduce air emissions due to changes in activity, regulations promulgated at the state and federal levels, as well as reductions associated with Port measures and programs. The Port performed a maritime air emissions inventory based on calendar year 2006 activities, which established a baseline for future comparison. The first comparison to the 2006 inventory was performed based on calendar year 2012 activity. The 2016 inventory marks the second comparative analysis to the 2006 baseline.

This emissions inventory highlights the Port’s continued commitment to understanding the sources and magnitude of emissions from its maritime-related operations. This inventory includes a quantification of emissions from sources related to passenger and goods movement. The 2016 inventory also includes a quantification of emissions associated with pleasure craft or recreational boating that occurs in San Diego Bay. This sector is not common in maritime air emissions inventories, as it is not related to passenger and goods movement. However, quantifying the emissions from recreational boating will allow the Port to understand the full suite of emissions that occur from marine vessels.

## 1.1 Purpose of the Inventory

This emissions inventory highlights the Port’s continued commitment to understanding the sources and magnitude of emissions from its maritime-related operations. The geographic scope of the inventory presented here is the same as previous inventories, as described below. This inventory includes Port-related maritime operations within a waterside boundary that extends 24 nautical miles (nm) from the coastline as well as the landside boundaries of San Diego County as shown in Figure 1-1. The results presented in this inventory are intended to be compared to the 2012 and 2006 inventory results to evaluate changes in emissions over time due to changes in activity, federal and state regulations, and the implementation of Port measures. This emissions inventory includes a quantification of emissions from all sources associated with the maritime sector, which include goods movement (e.g., ocean-going vessels [OGVs], tugs, freight rail, and drayage trucks) as well as activity directly attributable to Port-owned facilities along the water, particularly including marinas and boat launch facilities. Furthermore, this inventory helps the Port track progress of its Climate Action Plan (CAP), which includes baseline (2006) and future year (2020 and 2035) emission estimates from both maritime and landside (e.g., hotels, boatyards) sources. The CAP has a baseline year of 2006 and a target year of 2020; thus, the 2006 inventory established baseline maritime conditions, and the 2012 and 2016 inventories allow the Port to track progress toward its 2020 target. Lastly, because the CAP presents emissions in metric tons (one metric ton is 1,000 kilograms or 2204.62 pounds) instead of short or English tons (2,000 pounds), all greenhouse gases (GHGs) are presented in short tons in each chapter and are summarized in metric tons in Chapter 8, *Results and Discussion*.

## 1.2 Sources Covered

Included in this analysis are emissions from the sources that are associated with the maritime and landside transport of goods and passengers, from ship to land to customer (or first point of rest). Moreover, this inventory includes emissions from other sources that, while not related to movement of goods or people, are facilitated by Port-owned marine facilities, including marinas, yacht clubs, and launch ramps. The sources of emissions included in this analysis are as follows:

- OGVs
- Harbor craft, including commercial and sport fishing
- Cargo handling equipment
- Locomotives
- Heavy-duty trucks and on-road vehicles
- Recreational boating

## 1.3 Pollutants Covered

This report includes analysis of several different criteria pollutants, precursors of criteria pollutants, toxic air contaminants (TACs), and pollutants that contribute to climate change. Criteria pollutants include common air pollutants that are identified by both the federal and California Clean Air Acts, such as particulate matter 10 microns or less in diameter (PM10) and 2.5 microns or less in diameter (PM2.5); precursors to ground-level ozone ($O_3$), which include nitrogen oxides ($NO_X$) and reactive organic gases (ROGs); sulfur dioxide ($SO_2$); and carbon monoxide (CO). TACs are air contaminants that are known or suspected to cause cancer, reproductive or birth defects, other health effects, or adverse environmental effects, but do not have established ambient air quality standards. Because the majority of emissions at the Port are generated by diesel engine-powered sources, diesel particulate matter (DPM) is the TAC of primary concern.

- **Particulate matter:** PM10 and PM2.5 consist of finely divided solids or liquids such as soot, dust, aerosols, fumes, and mists. Two forms of fine particulates are considered criteria pollutants—inhalable coarse particles, or PM10, and inhalable fine particles, or PM2.5. Particulate discharge into the atmosphere results primarily from industrial, agricultural, construction, and transportation activities. Both PM10 and PM2.5 may adversely affect the human respiratory system, especially in those people who are naturally sensitive or susceptible to breathing problems. DPM is particulate matter generated from diesel engine combustion. DPM is a complex mixture of hundreds of substances, and is listed as a TAC by the California Air Resources Board (CARB).
- **Reactive organic gases (ROGs)** are a precursor to $O_3$ formation along with $NO_X$. Hydrocarbons are organic gases that are formed solely of hydrogen and carbon. There are several subsets of organic gases, including ROGs and volatile organic compounds (VOCs). ROGs are defined by California rules and regulations and include all hydrocarbons except those exempted by CARB that contribute to smog formation, while

VOCs are defined by federal rules and regulations and include all hydrocarbons except those exempted by the United States Environmental Protection Agency (EPA). ROGs are emitted from incomplete combustion of hydrocarbons or other carbon-based fuels. Combustion engine exhaust, oil refineries, and oil-fueled power plants are the primary sources of hydrocarbons. Another source of hydrocarbons is evaporation from petroleum fuels, solvents, dry cleaning solutions, and paint. Generally speaking, ROGs and VOCs are similar but not identical, and their terms are used interchangeably.

- **Nitrogen oxides ($NO_X$)** is a precursor to $O_3$, created when combined with ROG in the presence of sunlight to form $O_3$. The two major forms of $NO_X$ are nitric oxide (NO) and nitrogen dioxide ($NO_2$). NO is a colorless, odorless gas formed from atmospheric nitrogen and oxygen when combustion takes place under high temperature and/or high pressure. $NO_2$ is a reddish-brown irritating gas formed by the combination of NO and oxygen. $NO_X$ acts as an acute respiratory irritant and increases susceptibility to respiratory pathogens.
- **Carbon monoxide (CO)** is a colorless, odorless, toxic gas produced by incomplete combustion. The primary adverse health effect associated with CO is interference with normal oxygen transfer to the blood, which may result in tissue oxygen deprivation.
- **Sulfur dioxide ($SO_2$)** is a subset of sulfur oxides ($SO_X$). In fuel combustion, essentially all $SO_X$ is $SO_2$. It is a product of oxidized sulfur in the fuel. $SO_2$ is an irritant gas that attacks the throat and lungs. It can cause acute respiratory symptoms and diminished ventilator function in children. $SO_2$ also can cause plant leaves to turn yellow and can erode iron and steel. In recent years, $SO_2$ concentrations have been reduced by the increasingly stringent controls placed on stationary-source emissions of $SO_2$ and limits on the sulfur content of fuels. $SO_X$ and $SO_2$ are often used interchangeably, but the term $SO_2$ is used in this report consistent with EPA rulemaking for large marine diesel engines.

Climate change pollutants include GHGs that are included in the emission estimates produced by CARB as part of its annual inventory, including carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$). CARB includes other GHG types, including hydrofluorocarbons, sulfur hexafluoride, and others, but these emission types are not associated with mobile source fuel combustion and therefore are not included in this analysis.

- **Carbon dioxide ($CO_2$)** enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, respiration, and also as a result of other chemical reactions (e.g., manufacture of cement). $CO_2$ is also removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle. $CO_2$ made up 84.0% of statewide GHG emissions in 2015.
- **Methane ($CH_4$)** is emitted during the production and transport of coal, natural gas, and oil, through fuel combustion, as well as from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills. $CH_4$ made up 9.0% of statewide GHG emissions in 2015.

- **Nitrous oxide ($N_2O$)** is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste. $N_2O$ made up 2.7% of statewide GHG emissions in 2015.

Methods have been set forth to describe emissions of GHGs in terms of a single gas to simplify reporting and analysis. The most commonly accepted method to compare GHG emissions is the global warming potential (GWP) methodology defined in the Intergovernmental Panel on Climate Change (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 warming potential of $CO_2$ (which has a GWP of 1 by definition). The GWP values used in this report are based on century scale warming potentials from the IPCC Fourth Assessment Report (AR4) and United Nations Framework Convention on Climate Change reporting guidelines.[1] The AR4 GWP values are used in CARB's California inventory and Assembly Bill (AB) 32[2] Scoping Plan updates. The GWPs for the included gases are as follows:

- $CO_2$ = 1
- $CH_4$ = 25
- $N_2O$ = 298

## 1.4 Geographic Domain of Analysis

The geographic scope of the inventory presented here is the same as the 2012 and 2006 emissions inventories. The inventory includes Port-related maritime operations within a waterside boundary, which extends 24 nm from the coastline (or what the National Oceanic and Atmospheric Administration refers to as the California Baseline), consistent with CARB rulemaking and the National Oceanic and Atmospheric Administration contiguous zone, and the landside boundary for trucks and rail, which extends to the county and air basin boundary. The waterside and landside boundaries are shown in Figure 1-1.

[1] IPCC Fourth Assessment, TS.2.5 Net Global Radiative Forcing, Global Warming Potentials and Patterns of Forcing, available at: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/tssts-2-5.html#table-ts-2.

[2] AB 32 requires California to reduce its GHG emissions to 1990 levels by 2020. To achieve emission reductions, the ARB adopts regulations that reduce emissions and reports emissions annually to track progress. Senate Bill 32 extends the timeline and requires California to reduce its GHG emissions to 40% below 1990 levels by 2030.

**Figure 1-1. Geographic Scope of Emissions Inventory**


## 1.5 Regulations Affecting Emissions

Various regulations promulgated at the international, federal, and state levels affect emissions from maritime activities.

At the international level, the International Maritime Organization (IMO) has adopted standards for ships engaged in international transportation, which are contained in the International Convention for the Prevention of Pollution from Ships (MARPOL). To date there are six "Annexes," with each Annex pertaining to a specific pollutant type and source. These standards become binding when they are ratified by member countries. Most recently and most relevant to this emissions inventory is Annex VI and subsequent amendments, which adopt $NO_X$ engine emissions limits for marine diesel engines.

At the federal level, the EPA has historically developed rules and regulations as part of its implementation of the federal Clean Air Act in order to help regions meet the appropriate National Ambient Air Quality Standards (NAAQS). Many large ports, including the large ports in California, are located in or near areas that have air pollutant concentrations that exceed the applicable NAAQS (i.e., nonattainment areas) or have previously violated but are now meeting an NAAQS (maintenance areas). Note that the San Diego region is currently nonattainment for the $O_3$ NAAQS but is in attainment or maintenance for all other NAAQS, including PM10 and PM2.5.[3] As part of its work, the EPA has established various rules and regulation to reduce emissions from all sources associated with goods movement throughout the nation, including at the Port of San Diego. The goal of EPA's Ports Initiative is to reduce air pollution and GHGs at the nation's ports, to achieve environmental sustainability for ports, and improve air quality at near-port communities. The recent *National Port Strategy Assessment: Reducing Air Pollution and Greenhouse Gases at U.S. Ports*[4] details the potential range of available strategies to reduce diesel emissions from port-related activity. This assessment determined the effectiveness of a range of available emission reduction strategies under different scenarios, such as replacing older diesel fleets with newer technologies, improving operational efficiency to reduce idling, switching to cleaner fuels, and examining the potential of zero emission (e.g., electric) vehicles and equipment and other emerging technologies.

At the state level, activities and regulations to reduce emissions from activities related to goods movement can be traced to CARB's 2006 *Emission Reduction Plan for Ports and Goods Movement in California*.[5] This plan proposed various measures that would reduce emissions from sources associated with port activities, including ships, harbor craft, terminal equipment, trucks, and locomotives. This effort was a step in implementing the *Goods Movement Action Plan*[6] developed by the California Business, Transportation, and Housing Agency and the California Environmental Protection Agency (Cal/EPA). The primary goal of the *2006 Emission Reduction Plan for Ports and Goods Movement in California* is to reduce community exposure to air pollution and to meet federal air quality standards for $O_3$ and fine particulate matter (PM2.5). Since then, the state has adopted various regulations to reduce emissions and community exposure to air pollution, including regulations that reduce emissions from all sources associated with goods movements at the Port of San Diego.

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[3] Attainment designations can be accessed at: https://www3.epa.gov/airquality/greenbook/ancl3.html.

[4] The National Port Strategy can be accessed at: https://www.epa.gov/ports-initiative/national-port-strategy-assessment.

[5] *Final Emission Reduction Plan for Ports and Goods Movement in California*. 2006. Available: https://www.arb.ca.gov/planning/gmerp/plan/final_plan.pdf.

[6] *Goods Movement Action Plan*. 2005, 2007. Available: http://www.dot.ca.gov/hq/tpp/offices/ogm/gmap.html.

The majority of rules and regulations adopted to reduce emissions from goods movement have been focused on reducing the direct human health effects of emissions (e.g., localized sources of particulate matter) as well as to attain air quality standards (e.g., reduce $NO_X$ to meet $O_3$ NAAQS). Despite the progress made, freight transport emissions remain a large contributor to air pollution. Goods movement currently accounts for about half of the statewide DPM emissions, which are both a TAC and a contributor to black carbon, a powerful short-lived climate pollutant. Freight operations also accounted for approximately 45% of the statewide $NO_X$ emissions and 6% of the statewide GHG emissions in 2015.[7] As noted by CARB, unlike $NO_X$ and particulate matter, GHG emissions from goods movement have historically increased and are predicted to continue to increase over time because existing control strategies have primarily focused on reducing air toxic and criteria pollutants. However, as part of California's efforts to reduce GHG emissions from all sources to meet statewide reduction targets promulgated in AB 32 and Senate Bill (SB) 32, the state is beginning to implement strategies that reduce GHG emissions from goods movement, particularly focusing on strategies that provide both air quality and GHG benefits. Executive Order B-32-15 requires state agencies to develop an integrated action plan that establishes clear targets to improve freight efficiency, transition to zero-emission technologies, and increase the competitiveness of California's freight system. The *California Sustainable Freight Action Plan* was adopted in July 2016 and identifies potential state policies, programs, and investments to achieve these targets. The plan provides a high-level vision and broad direction and recommendations on long-term vision for 2030 and 2050, short-term actions to initiate in the next 5 years, pilot project opportunities, and additional concepts to explore. Moreover, SB 535 requires Cal/EPA to identify disadvantaged communities based on geographic, socioeconomic, public health, and environmental hazard criteria. SB 535 also requires that the investment plan developed and submitted to the Legislature pursuant to AB 1550[8] allocate no less than 25% of available proceeds from the carbon auctions held under AB 32 to projects that will benefit these disadvantaged communities. According the Cal/EPA and the Office of Environmental Health Hazard Assessment, "disadvantaged communities" are defined as the top 25% scoring areas from CalEnviroScreen along with other areas with high amounts of pollution and low population.[9] There are various "disadvantaged communities" along San Diego Bay, including the areas that surround both the Tenth Avenue Marine Terminal (TAMT) and the National City Marine Terminal (NCMT) as well as the entire areas in between.

A description of all rules and regulations that affect emissions at the Port of San Diego by source is provided below.

[7] *Sustainable Freight: Pathways to Zero and Near-Zero Emissions*. April 2015.

[8] AB 1550 (Gomez) requires that 25 percent of proceeds from the GHG fund be spent on projects located in disadvantaged communities.

[9] SB 535 Disadvantaged Communities and CalEnviroScreen can be accessed at: https://oehha.ca.gov/calenviroscreen/sb535.

### 1.5.1 Ocean-Going Vessels

Emissions from OGVs are managed by regulations and emission limits implemented at the international, federal, state, and local levels. The IMO MARPOL Annex VI, which came into force in May 2005, set new international $NO_X$ emission limits on marine engines over 130 kilowatts installed on new vessels retroactive to the year 2000. In October 2008, IMO adopted amendments to international requirements under MARPOL Annex VI, which introduced $NO_X$ emission standards for new engines and more stringent fuel quality requirements. Annex VI was ratified by the United States in 2008. The waters off North American coasts, which include the Port of San Diego, are considered Emission Control Areas (ECAs), and ships operating in ECAs are required to comply with more stringent fuel sulfur and engine $NO_X$ limits. Applicable requirements at the Port of San Diego include the following:

- Caps on the sulfur content of fuel as a measure to control $SO_X$ emissions and, indirectly, particulate matter emissions. For ECAs, the sulfur limits were capped at 1.0% starting in 2012 and 0.1% starting in 2015.[10] This inventory assumes full compliance with MARPOL Annex VI sulfur limits.
- $NO_X$ engine emission rate limits for new engines. Tier I rate limits, effective in 2000, and Tier II rate limits, effective in 2011, are global limits and apply to all new vessel builds, whereas Tier III limits, effective in 2016, apply only in $NO_X$ ECAs.

To reduce emissions from Category 3 engines (propulsion engines on OGVs), EPA established 2003 Tier 1 $NO_X$ standards for marine diesel engines above 30 liters per cylinder, and large Category 3 marine propulsion engines on U.S. flagged OGVs (40 Code of Federal Regulations [CFR] Parts 9 and 94) (68 *Federal Register* [FR] 9745–9789). The standards went into effect for new engines built in 2004 and later. Tier 1 limits were achieved by engine-based controls, without the need for exhaust gas after-treatment.

In December 2009, EPA adopted Tier 2 and Tier 3 emissions standards for newly built Category 3 engines installed on U.S. flagged vessels, as well as marine fuel sulfur limits. The Tier 2 and 3 engine standards and fuel limits are equivalent to the amendments to MARPOL Annex VI. Tier 2 $NO_X$ standards for newly built engines apply beginning in 2011 and require the use of engine-based controls, such as engine timing, engine cooling, and advanced electronic controls. Tier 3 standards apply beginning in 2016 in ECAs and would be met with the use of high-efficiency emission control technology, such as selective catalytic reduction. According to the EPA's Regulatory Announcement, Tier 2 standards are anticipated to result in a 15 to 25% $NO_X$ reduction below the Tier 1 levels, while Tier 3 standards are expected to achieve $NO_X$ reductions 80% below the Tier 1 levels. In addition to the Tier 2 and Tier 3 $NO_X$ standards, the final regulation established standards for hydrocarbons and CO (particulate matter is reduced from fuel sulfur requirements).

[10] The sulfur requirements in ECAs are 1.0% as of July 2010 and 0.1% starting in January 2015. North America was designated as an ECA in August 2012, and the sulfur requirements became applicable at the time of designation.

In addition, existing ships that were built between 1990 and 2000, with marine diesel engines greater than 5,000 kilowatts and a per-cylinder displacement 90 liters or more, are subject to retrofit requirements of the Tier 1 $NO_X$ standard if a remanufactured system (or approved method) has been certified. Of the vessels that called at the Port during 2016, only vessels equipped with B&W S-series engine vessels fit in this category and have certified retrofit kits. There were eight B&W S-series vessels that made up 11 calls during 2016, and the assumption is that each of these had been retrofit by 2016.

At the state level, CARB approved the *Regulation for Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline* (13 California Code of Regulations [CCR] 2299.2) in 2008. This regulation requires vessel propulsion engines, auxiliary engines, and auxiliary boilers operating in California waters since July 2009 to either use marine diesel oil with a maximum sulfur content of 0.5% or marine gas oil with a maximum sulfur content of 1.5%. By January 1, 2014, these source activities were required to meet a marine diesel or gas oil sulfur limit of 0.1%, which is now in effect. The analysis herein assumes all vessels comply with the 0.1% sulfur limit.

Additionally, CARB adopted a regulation to reduce emissions from diesel auxiliary engines on OGVs while at berth for container, passenger cruise, and refrigerated cargo vessels (17 CCR 93118.3). The regulation requires that auxiliary diesel engines on OGVs be shut down for specified percentages of a fleet's visits and also that the fleet's at-berth auxiliary engine power generation be reduced by the same percentages. Vessels can either plug into the electrical grid (i.e., shore power, otherwise known as cold-ironing or alternative maritime power) or use an alternative emission control device. The law sets compliance percentages that phase in over time. By 2014, vessel operators were required to shut down their auxiliary engines at berth for 50% of the fleet's vessel visits and also reduce their onboard auxiliary engine power generation by 50%. The specified percentages will increase to 70% in 2017 and 80% in 2020. Vessel operators can also choose an emissions reduction equivalency alternative; the regulation requires a 10% reduction in OGV hoteling emissions starting in 2010, increasing in stringency to an 80% reduction by 2020. Note that this regulation only applies to container, passenger cruise, and refrigerated cargo vessels and does not yet apply to the auto carrier and roll-on/roll-off, bulk, and general cargo vessels that call at the Port. As of August 2016, CARB is considering extending the at-berth regulation to all vessels, but at present no formal rulemaking has been drafted or adopted. Shore power capabilities currently exist at both B Street Pier and Broadway Pier at the Cruise Ship Terminal and at berths 10-3/10-4 at TAMT.

While not specific to OGVs, California's Renewables Portfolio Standard helps to further reduce emissions over time for vessels that plug in to shore power. The Renewables Portfolio Standard originally obligated investor-owned utilities, energy service providers, and Community Choice Aggregations to procure an additional 1% of retail sales per year from eligible renewable sources until 20% was reached by 2010. SB X 1-2, called the California Renewable Energy Resources Act, obligates all California electricity providers to obtain at least 33% of their energy from renewable resources by 2020. Finally, SB 350 requires electricity providers to obtain at least 50% of their energy from renewable resources by 2030 while requiring a doubling of efficiency for existing buildings by 2030. As of 2016, San Diego Gas and Electric's renewable procurement was at 43%, with 45.2% procured under contract for 2020. OGVs that cold iron while at berth receive additional emissions benefit over time; as the grid becomes increasingly renewable, GHG emissions per unit of electricity consumed from vessels that cold iron will decrease over time.

### 1.5.2 Harbor Craft

At the federal level, the EPA has adopted emission standards for new Category 1 (0 to 7 liters per cylinder) and Category 2 (between 7 and 30 liters per cylinder, which includes most harbor craft) diesel engines rated over 50 horsepower (hp) (or 37 kilowatts) used for propulsion in most harbor craft. The new Tier 3 engine standards began phase-in starting in 2009 and the more stringent Tier 4 engine standards were phased in beginning in 2014 and only for commercial marine diesel engines greater than 800 hp. The regulation also includes requirements for remanufacturing commercial marine diesel engines greater than 800 hp. Additionally, the EPA has set sulfur limitations for non-road diesel fuel, including locomotives and marine vessels (though not for the marine residual fuel used by very large engines on OGVs). Under this rule, diesel fuel used by locomotives and harbor craft was limited to 500 parts per million (ppm) sulfur content starting June 1, 2007, and further limited to 15 ppm sulfur content (ultra-low-sulfur diesel) starting January 1, 2010, for non-road fuel and June 2012 for marine and locomotive fuels.

At the state level, CARB adopted a regulation that reduces DPM and $NO_X$ emissions from new and in-use commercial harbor craft operating in Regulated California Waters (i.e., 24 nm of the California coastline). CARB adopted this regulation on November 17, 2007 and it became effective on January 1, 2009. ARB's definition for commercial harbor craft includes tugboats, towboats, ferries, excursion vessels, workboats, crew boats, and fishing vessels that do not otherwise meet the definition of OGVs or recreational vessels. All in-use, newly purchased, or replacement engines must repower or meet the EPA's current emission standards up to Tier 3 according to the compliance schedule set by ARB. In addition, propulsion engines on all new ferries acquired after January 1, 2009, with a capacity of more than 75 passengers are required to apply best available control technologies (BACT) to engines to meet EPA Tier 2 or Tier 3 marine engine standards at the time of vessel acquisition. ARB amended the commercial harbor craft regulation in 2010 to include crew and supply vessels, barges, and dredge vessels as well as to clarify requirements and address issues that arose during implementation of the initial regulation. CARB set sulfur limitations for diesel fuel sold in California for use in on- and off-road motor vehicles (13 CCR 2281–2285; 17 CCR 93114). Harbor craft and intrastate locomotives were originally excluded from the rule, but were later included by a 2004 rule amendment. Under this rule, diesel fuel used in motor vehicles except harbor craft and intrastate locomotives has been limited to 500 ppm sulfur since 1993. The sulfur limit was reduced to 15 ppm on September 1, 2006. A federal diesel rule similarly limited sulfur content nationwide to 15 ppm by October 15, 2006.

### 1.5.3 Cargo Handling Equipment

Emissions from cargo handling equipment are managed by regulations and emission limits implemented at the federal, state, and local levels. The EPA has established a series of increasingly strict emission standards for new non-road diesel engines. Tier 1 standards were phased in on newly manufactured equipment from 1996 through 2000 (year of manufacture), depending on the engine horsepower category. Tier 2 standards were phased in on newly manufactured equipment from 2001 through 2006. Tier 3 standards were phased in on newly manufactured equipment from 2006 through 2008. Tier 4 standards, which require advanced emission control technology to attain them, were phased in between 2008 and 2015.

In December 2005, CARB approved the *Regulation for Mobile Cargo-Handling Equipment at Ports and Intermodal Rail Yards* (13 CCR 2479) designed to use BACT to reduce DPM and $NO_X$ emissions from mobile cargo handling equipment at ports and intermodal rail yards. Since January 1, 2007, the regulation has imposed emission performance standards on new and in-use terminal equipment that vary by equipment type.

Additionally, CARB has promulgated more stringent emissions standards for hydrocarbons and $NO_X$ combined emissions and test procedures for gasoline-powered forklifts and other industrial equipment. The engine emission standards and test procedures were implemented in two phases. The first phase was implemented for engines built between January 2007 and December 2009. The second, more stringent, phase was implemented for engines built starting in January 2010. The regulation was amended in 2010, establishing fleet average emissions requirements for existing engines.

### 1.5.4 Locomotives

Emissions from locomotives are managed by regulations and emission limits implemented at the federal, state, and local levels. The EPA has established a series of increasingly strict emission standards for new or remanufactured locomotive engines (63 FR 18997-19084). Tier 0 standards, effective as of 2000, applied to engines manufactured or remanufactured from 1973 to 2001. Tier 1 standards applied to engines manufactured/remanufactured from 2002 to 2004. Tier 2 standards applied to engines manufactured/remanufactured after 2004. In 2008, EPA strengthened the Tier 0 through 2 standards to apply to existing locomotives and introduced more stringent Tier 3 and 4 emission requirements (73 FR 88 25098-25352). Tier 3 standards, met by engine design methods, were phased in between 2011 and 2014. Tier 4 standards, which are expected to require exhaust gas after-treatment technologies, became effective starting in 2015.

The ARB has two agreements with Class 1 railroads that affect emissions from locomotives in Southern California. In 1998, the ARB, Class I freight railroads operating in the South Coast Air Basin (Burlington Northern Santa Fe [BNSF] and Union Pacific Railroad [UPRR]), and EPA signed the 1998 Memorandum of Understanding (MOU), agreeing to a locomotive fleet average emissions program. The 1998 MOU required that, by 2010, the Class I freight railroad fleet of locomotives in the South Coast Air Basin achieve average emissions equivalent to the $NO_X$

emission standard established by EPA for Tier 2 locomotives (5.5 grams per brake horsepower-hour). BNSF and UPRR must continue to comply with the Tier 2 locomotive fleet average from 2010 to 2030. The MOU applies to both line-haul (freight) and switch locomotives operated by the railroads.[11] This MOU also provides emission reductions at the Port of San Diego because all trains arrive from and depart to the South Coast Air Basin. BNSF's $NO_X$ emission level is 5.1 grams per brake horsepower-hour as of its most recent reporting. In 2005, the same parties signed another MOU agreeing to several program elements intended to reduce the emission impacts of railyard operations on local communities. The 2005 MOU includes a locomotive idling-reduction program, early introduction of lower-sulfur diesel fuel in interstate locomotives, and a visible emission reduction and repair program. The 2005 agreement also required a number of efforts to gather information and assess advanced technologies to further reduce locomotive and railyard emissions in the future, including the preparation of emission inventories and health risk assessments at the 17 major railyards in the state (including San Diego Railyard), community and air district involvement, evaluation and development of measures to further reduce impacts on local communities, and ongoing efforts to evaluate and assess advanced control technologies.[12]

### 1.5.5 Heavy-Duty Trucks

Emissions from heavy-duty trucks are managed by regulations and emission limits implemented at the federal, state, and local levels. In December 2000, EPA signed the Heavy-Duty Highway Rule, which reduces emissions from on-road, heavy-duty diesel trucks by establishing a series of increasingly strict emission standards for new engines. Manufacturers were required to produce new diesel vehicles that meet particulate matter and $NO_X$ emission standards beginning with model year 2007, with the phase-in period being between 2007 and 2010. The phase-in was based on a percentage-of-sales basis: 50% from 2007 to 2009 and 100% in 2010.

The ARB adopted the drayage truck regulation in December 2007 to modernize the Class 8 drayage truck fleet (trucks with a Gross Vehicle Weight Rating [GVWR] greater than 33,000 pounds) in use at California's ports. Emergency vehicles and yard trucks are exempted from this regulation. The regulatory objective was to be achieved in two phases.

1. By December 31, 2009, pre-1994 model year engines were to be retired or replaced with 1994 and newer model year engines. In addition, all drayage trucks with 1994 to 2003 model year engines were required to achieve an 85% particulate matter emission reduction through the use of an ARB-approved Level 3 verified diesel emission control strategy.

[11] The 1998 MOU and related information is available at: https://www.arb.ca.gov/railyard/1998agree/1998agree.htm.

[12] The 2005 MOU and related information is available at https://www.arb.ca.gov/railyard/2005agreement/2005agreement.htm.

2. By December 31, 2013, all trucks operating at California ports must have complied with the 2007 and newer on-road heavy-duty engine standards.

In December 2010, ARB amended the regulation to include Class 7 drayage trucks with a GVWR between 26,000 and 33,001 pounds. ARB further expanded the definition of drayage trucks to include dray-offs, those non-compliant trucks that may not directly come to the ports to pick up/drop off cargo but that engage in moving cargo destined to or originating from port facilities and to/from near-port facilities or railyards. The ARB's On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation—Truck and Bus Regulation also requires existing heavy-duty trucks to be replaced with trucks meeting the latest $NO_X$ and particulate matter BACT, or be retrofitted to meet these levels. Trucks with a GVWR less than 26,000 pounds (most construction trucks) are required to replace engines with 2010 or newer engines, or equivalent, by January 2023. Trucks with a GVWR greater than 26,000 pounds (most drayage trucks) must meet particulate matter BACT and upgrade to a 2010 or newer model year emissions equivalent engine pursuant to the compliance schedule set forth by the rule. By January 1, 2023, all model year 2007 Class 8 drayage trucks are required to meet $NO_X$ and particulate matter BACT (i.e., EPA 2010 and newer standards). Various trucks are exempt from the drayage truck rule. This list includes dedicated use vehicles, such as those with unibody construction, which include car carriers, refuse trucks, cement mixers, fuel delivery vehicles, mobile cranes, and dump trucks, as well as emergency equipment and military tactical support trucks. While these trucks are not regulated under the Drayage Truck Rule, they are subject to the Truck and Bus Rule.

In addition, the ARB adopted an Airborne Toxic Control Measure in 2005 to limit diesel-fueled commercial motor vehicle idling. This regulation states that diesel vehicles with a GVWR greater than 10,000 pounds shall not idle the vehicle's diesel-powered primary or auxiliary power system for more than 5 minutes at any location (13 CCR 1956.8 and 2485). This regulation applies to all trucks that visit the Port.

### 1.5.6 Recreational Boating

Recreational boating includes personal watercraft (jet skis), sailboats, jet boats, and yachts. Smaller watercraft are usually gasoline powered and larger yachts are usually diesel powered. The ARB has proposed and adopted regulations for certain marine vessels and regulations have been proposed for other spark-ignition engines used in boats for propulsion to reduce hydrocarbons and $NO_X$ emissions. Spark-ignition auxiliary marine engines (power generators, winches, or auxiliary propulsion engines for sail boats) are defined as small off-road spark-ignition engines (below 25 hp) or large off-road spark-ignition engines (25 hp and greater) depending on their size. Compression-ignition auxiliary and propulsion marine engines under 50 hp are defined as off-road diesel (compression-ignition) engines. Large yachts generally include engines that are regulated under the ARB's harbor craft rules.

### 1.5.7 Port of San Diego Programs and Actions

The Port has adopted various programs and plans as well as reduction measures through the environmental review process that affect emissions from maritime activities.

The goal of the Port's Clean Air Program is to reduce criteria pollutants and GHG emissions from current and future Port operations through the identification and evaluation of feasible and effective control measures for each category of Port emissions. The Port has developed various control measures geared toward reducing emissions from the greatest contributors of air pollution. The Clean Air Program identified control measures including shore power (to enable ships to turn off their vessels and plug into electric power while docked), truck replacement/ retrofits, replacement/retrofits of cargo handling equipment, and voluntary vessel speed reductions.

The Clean Truck Program (implemented in 2009) requires all drayage trucks with 2004 model year or older engines and with a GVWR greater than 33,000 pounds to be equipped with a level 3 verified diesel emission control strategy (likely diesel particulate filters) for particulate matter emissions or be replaced with a new truck. The Clean Truck Program has similar requirements to, and ensures compliance with, ARB's drayage truck regulation. Currently all drayage trucks operating at the Port must meet 2007 engine emissions standards.

Additionally, the Port has installed shore power at TAMT and the Cruise Ship Terminal. Vessels equipped to connect to shore power use electric grid power at berth (e.g., while "hoteling") rather than power generated by running the ship's engines. Of the vessels that call at the Port of San Diego, only the Dole-owned or -operated refrigerated container vessels and various cruise ships are required to implement at-berth emissions reductions. The majority of Dole's vessels that visit the Port have shore power capability.

The Port's vessel speed reduction (VSR) program is a voluntary strategy to reduce air pollutants and GHG emissions from cargo and cruise ships by reducing speeds in the vicinity of San Diego Bay. The VSR program asks cargo vessel operators entering or leaving San Diego Bay to observe a 12-knot speed limit and for cruise ships to observe a 15-knot speed limit. The VSR zone extends 20 nm seaward from Point Loma.

The Port adopted a CAP in December 2013. The CAP identifies various GHG emissions reduction measures to be implemented to support meeting the statewide reduction goals set forth in AB 32 (1990 levels by 2020). The CAP includes targeted policies and measures aimed at reducing emissions from all emission sectors at the Port, including maritime. Measures to reduce maritime activity include implementing the VSR program; supporting and promoting the implementation of alternative fuel and electric cargo handling equipment; implementing anti-idling restrictions for locomotives; supporting and promoting the use of advanced technologies for rail, vessels, and other sources; and supporting implementation of on-site alternative energy generation. While these measures are aimed at reducing GHG emissions, implementation of these measures, combined with the regulations discussed above, will contribute to reductions in criteria pollutant (e.g., $NO_X$) and TAC (e.g., DPM) emissions over time.

Lastly, recent environmental review documents as part of the California Environmental Quality Act process at the Port have included various mitigation measures aimed at reducing or eliminating environmental impacts associated with projects at both TAMT and NCMT. These mitigation measures include mandatory compliance with relevant CAP measures (including 80% compliance with VSR out to 20 nm from Point Loma), implementation of VSR beyond the goal in the CAP (90% compliance out to 40 nm from Point Loma), replacement of non-electric cargo handling equipment with electric cargo handling equipment, and implementation of an at-berth Emission Capture and/or Control System (i.e., bonnet system) once TAMT reaches a certain annual throughput. Similar to measures in the CAP, these mitigation strategies will affect operations at both TAMT and NCMT and will contribute to reductions in GHG, criteria pollutant, and TAC emissions over time.

# 2 Ocean-Going Vessels

Ocean-going vessels (OGVs) are used to transport goods and people 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 2016. OGV activity and emissions estimates take into account demonstration with the voluntary vessel speed reduction (VSR)[1] and shore power programs at the Port. 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.

## 2.1 Source Description

OGVs are defined as vessels that move cargo and people 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 as shown in Table 2-1. Category 1 and 2 harbor craft are discussed in Chapter 3 of this report. OGVs vary greatly in speed and engine sizes based on ship type. Vessel types have been broken out by the cargo they carry. Table 2-2 lists the OGV types used in this inventory.

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

| Category | Specification | Use |
|---|---|---|
| 1 | Gross Engine Power ≥ 37 kW<br>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 2-2. EPA Marine Compression Ignition Engine Categories**

| Ship Type | Description |
|---|---|
| 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 Ships | Self-propelled cruise ship |

[1] A voluntary VSR program was established by the Port in 2009. The VSR zone includes a 20-nautical-mile radius from Point Loma whereby vessel operators are encouraged to slow speeds to 12 knots for cargo ships and 15 knots for cruise ships.

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). Less typical are vessels powered by gas turbines (GT); however, one passenger ship that visited the Port was propelled by a GT. 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 (used 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 is shown in Table 2-3.

**Table 2-3. Average Propulsion and Auxiliary Power by Ship Type**

| Ship Type | Engine Type | Calls | Average Power (kW) | |
|---|---|---|---|---|
| | | | Propulsion | Auxiliary |
| Auto Carrier | SSD | 252 | 13,914 | 3,399 |
| Bulk Carrier | SSD | 6 | 7,391 | 1,259 |
| Container Ship* | MSD | 1 | 9,600 | 3,820 |
| | SSD | 62 | 20,628 | 8,348 |
| General Cargo | MSD | 4 | 5,280 | 1,995 |
| | SSD | 21 | 9,495 | 2,326 |
| Passenger | GT-ED | 4 | 70,742 | |
| | MSD-ED | 70 | 48,626 | |

*Container ships include refrigerated containerized cargo vessels that call on the Tenth Avenue Marine Terminal.

## 2.2 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 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.

ICF purchased AIS data from Port Vision to be processed for actual ship movements within the area of interest. The AIS data included vessel position (latitude and longitude), International Maritime Organization and Maritime Mobile Service Identity numbers, speed, direction, destination, and date/time for all cargo vessels over 100 tons calling the Port. We used this to determine operating mode, as discussed in Section 2.3. This was chosen to cover movements from the Orange County border to the international border and 24 nautical miles for the coastline. Data boundaries were defined as latitudes between 32.5° and 33.4° and longitudes between -117° and -117.7°. The calendar year for reporting is 2016. Limiting the data to every 3 minutes produced approximately 24 million records.

Vessels that did not stop at the Port during 2016 were eliminated from the analysis. An area around the Port was defined as between latitudes of 32.589° and 32.719° and longitudes between -117.263° and -117.081°. Any vessels that did not enter this zone were considered innocent passage vessels (i.e., they traveled by, but did not stop at, the Port).

Of the 24 million records, 860,460 were attributed to innocent passage vessels.

The ships that stopped at the Port were then categorized as shown in Table 2-4.

**Table 2-4. Ship Categories in AIS Data**

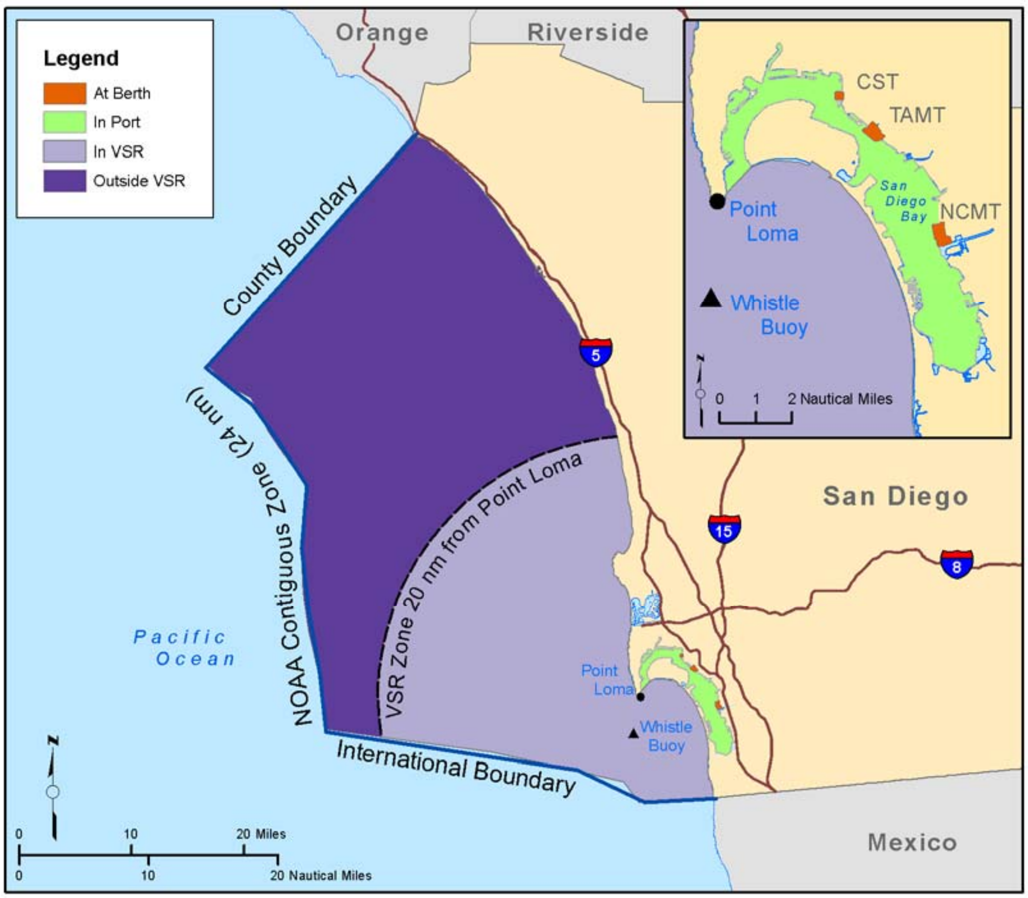
| Vessel Category | Description |
|---|---|
| OGV | Ocean-Going Vessels |
| HC | Harbor craft such as tugs, tows, work boats and supply boats |
| EXC | Excursion vessels |
| CF | Commercial fishing vessels |
| SF | Sport Fishing Vessels |
| RBP | Motor yachts |
| RBS | Sailboats with diesel auxiliary engines |

Approximately 365,000 records were associated with OGVs. These were first assigned by ship type listed in Table 2-2 and then assigned a location. Location definitions are shown in Table 2-5 and on Figure 2-1. Those considered Open Ocean, which were located outside of the inventory boundaries, were eliminated.

**Table 2-5. Ship Categories in AIS Data**

| Vessel 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 |
| VSR | Outside the Bay but within the 20-nautical-mile radius of Point Loma. Includes anchorage time. |
| Outside VSR | Outside the VSR zone but within the inventory boundaries |
| Open Ocean | Outside the inventory boundaries |

**Figure 2-1. OGV Locations**



Finally, each record was assigned as an activity mode. The OGV activity modes are shown in Table 2-6.

**Table 2-6. OGV Activity Modes**

| Mode | Description |
|---|---|
| Transit | Movements in the Outside VSR zone |
| VSR | Movements within the VSR zone |
| Maneuvering | Movements inside the port area |
| Hoteling | Stopped at berth |
| Anchorage | Stopped within the port area or VSR zone but not at berth |

Lloyd's data were purchased from IHS Global Limited, headquartered in Bracknell, England. Lloyd's data were used to define vessel characteristics (e.g., engine model year, engine sizes, service speed). The list of vessel characteristics that were used for 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 International Maritime Organization number.

Moreover, various OGVs plugged into shore power while at berth in 2016. Shore power infrastructure exists at Tenth Avenue Marine Terminal (TAMT) (Berths 10-2, 10-3 and 10-4) and at the Cruise Ship Terminal (CST) (B Street and Broadway Piers). The Port provided ICF with shore power consumption information by vessel and by call. In 2016, a total of 87 calls utilized shore power, including 50 container vessel calls and 37 cruise ship calls, representing approximately 21% of total vessel calls. In total, cruise ships at CST (all but one call at B Street) used shore power for 264 hours and consumed 1,949 megawatt-hours (MWh) of electricity, while container vessels at TAMT (split between Berths 10-2 and 10-3) used shore power for 3,134 hours and consumed 5,216 MWh of electricity.

## 2.3 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 modes as shown in Table 2-6.

OGVs include 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 equation:

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

Where E = Emissions (grams [g])

Pp = Maximum Continuous Rating Power for propulsion engines (kilowatts [kW])
LFp = Propulsion Load Factor (percent of vessel's total propulsion power)
A = Activity (hours [h]) (hours/call)
EF = Emission Factor (grams per kilowatt-hour [g/kWh])
LLAF = Low Load Adjustment Factor for when the load factor is below 20%
Conv = Grams to short tons or metric tons conversion

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

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

Where E = Emissions (g)

Pa = Maximum Continuous Rating Power for auxiliary engines (kW)
LFa = Auxiliary Load Factor (percent of vessel's total auxiliary power)
A = Activity (hours [h]) (hours/call)
EF = Emission Factor (g/kWh)

Auxiliary load is the actual power used, and is the product of auxiliary engine power (Pa) and the engine's load factor (LFa). For container ships, the actual engine load while at berth was obtained from ship operators reporting to the California Air Resources Board (ARB). For these vessels, auxiliary engine emissions while hoteling are calculated according to the general equation:

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

Where E = Emissions (g)

$L_A$ = Auxiliary Load (vessel auxiliary power)
A = Activity (hours [h]) (hours/call)
EF = Emission Factor (g/kWh)

Auxiliary boiler emissions are calculated using the general equation below:

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

Where E = Emissions (g)
$L_B$ = Boiler Load (kW)
A = Activity (hours [h]) (hours/call)
EF = Emission Factor (g/kWh)

The emission factor is in terms of emissions per unit of energy from the engine. It is multiplied by the energy consumed while in a given mode.

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 ARB 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, 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. Every passenger ship that called on the Port in 2016 was electrically driven.

Emission factors are considered to be constant down to about 20 percent load. Below that threshold, emission factors tend to increase as the load decreases. This trend results 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] Low load adjustment factors were applied to propulsion engine emissions calculations, as described at the beginning of this section. Table 2-7 shows these low-load multiplicative adjustment factors, not including adjustments for sulfur dioxide ($SO_2$) or carbon dioxide ($CO_2$) due to the change in fuel consumption to be consistent

[2] California Air Resources Board, *Emissions Estimation Methodology for Ocean-Going Vessels,* May 2011. Available at http://www.arb.ca.gov/regact/2011/ogv11/ogv11appd.pdf.

[3] Energy and Environmental Analysis, Inc., *Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data*, EPA420-R-00-002, February 2000. Available at https://www3.epa.gov/otaq/models/nonrdmdl/c-marine/r00002.pdf.

with previous inventories.[4] These adjustment factors are applicable only for diesel (MSD and SSD) engines. Note that in the 2012 and 2006 inventories, low-load multiplicative adjustment factors were not assumed for $SO_2$ or $CO_2$, so the factors were assumed to be 1.0 for all loads.

**Table 2-7. Calculated Propulsion Engine Low Load Multiplicative Adjustment Factors**

| Load | $NO_X$ | PM | ROG | CO | $SO_2$ | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|---|---|---|---|---|
| 2% | 4.63 | 7.29 | 21.18 | 9.68 | 1.00 | 1.00 | 21.18 | 4.63 |
| 3% | 2.92 | 4.33 | 11.68 | 6.46 | 1.00 | 1.00 | 11.68 | 2.92 |
| 4% | 2.21 | 3.09 | 7.71 | 4.86 | 1.00 | 1.00 | 7.71 | 2.21 |
| 5% | 1.83 | 2.44 | 5.61 | 3.89 | 1.00 | 1.00 | 5.61 | 1.83 |
| 6% | 1.60 | 2.04 | 4.35 | 3.25 | 1.00 | 1.00 | 4.35 | 1.60 |
| 7% | 1.45 | 1.79 | 3.52 | 2.79 | 1.00 | 1.00 | 3.52 | 1.45 |
| 8% | 1.35 | 1.61 | 2.95 | 2.45 | 1.00 | 1.00 | 2.95 | 1.35 |
| 9% | 1.27 | 1.48 | 2.52 | 2.18 | 1.00 | 1.00 | 2.52 | 1.27 |
| 10% | 1.22 | 1.38 | 2.20 | 1.96 | 1.00 | 1.00 | 2.20 | 1.22 |
| 11% | 1.17 | 1.30 | 1.96 | 1.79 | 1.00 | 1.00 | 1.96 | 1.17 |
| 12% | 1.14 | 1.24 | 1.76 | 1.64 | 1.00 | 1.00 | 1.76 | 1.14 |
| 13% | 1.11 | 1.19 | 1.60 | 1.52 | 1.00 | 1.00 | 1.60 | 1.11 |
| 14% | 1.08 | 1.15 | 1.47 | 1.41 | 1.00 | 1.00 | 1.47 | 1.08 |
| 15% | 1.06 | 1.11 | 1.36 | 1.32 | 1.00 | 1.00 | 1.36 | 1.06 |
| 16% | 1.05 | 1.08 | 1.26 | 1.24 | 1.00 | 1.00 | 1.26 | 1.05 |
| 17% | 1.03 | 1.06 | 1.18 | 1.17 | 1.00 | 1.00 | 1.18 | 1.03 |
| 18% | 1.02 | 1.04 | 1.11 | 1.11 | 1.00 | 1.00 | 1.11 | 1.02 |
| 19% | 1.01 | 1.02 | 1.05 | 1.05 | 1.00 | 1.00 | 1.05 | 1.01 |
| 20% | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

Finally, low-load adjustment factors are not applied to diesel electric drive systems or auxiliary engines for loads below 20% maximum continuous rating.[5] In these cases, several engines are used to generate power and some can be shut down to allow others to operate at a more efficient setting. Note that the previous inventory did not use factors for either $SO_2$ or $CO_2$ similar to the low-load factors used in the 2014 Port of Long Beach inventory. The point of the low-load factors is to correctly calculate all emission types when an engine is operating in a less efficient zone. The factors that Energy and Environmental Analysis, Inc. provide also include changes in specific fuel consumption, which is directly tied to both $CO_2$ and $SO_2$ emissions. The Ports of Los Angeles and Long Beach recognized this and included low-load adjustments for $SO_2$ or $CO_2$ in their 2016 emission inventories. While the previous Port inventories in 2006 and

[4] ICF. *Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories*, April 2009. Available at: http://archive.epa.gov/sectors/web/pdf/ports-emission-inv-april09.pdf.

[5] The maximum output of an engine.

2012 did not include low-load adjustments for $SO_2$ or $CO_2$, a comparison both with and without these adjustments is included herein.

Auxiliary load factors were taken from ARB methodology[6] except for passenger ships and hoteling for container ships. Passenger ship load factors were calculated from the 2015 Port of Long Beach inventory[7] based upon the passenger counts and total power (from Lloyd's). A container ship hoteling load factor was calculated based on shore power assumed for container vessel auxiliary engine loads obtained from Port staff based on tenant shore power reporting to the ARB. Based on this reporting, the following auxiliary engine loads were assumed for container ships that use shore power: Dole California, Dole Ecuador, and Dole Costa Rica have a 2,500 kW load; Dole Pacific, Dole Caribbean, and Dole Atlantic have a 1,500 kW load; and Hansa Freyburg has a 920 kW load. For other container calls that did not use shore power, auxiliary load was taken from similar ships in the Port of Long Beach Inventory. The auxiliary load factors for all other OGVs used in this inventory are shown in Table 2-8.

**Table 2-8. Auxiliary Engine Load Factors**

| Ship Type | Transit/VSR | Maneuver | Hotel | Anchor |
|---|---|---|---|---|
| Auto Carriers | 0.15 | 0.45 | 0.26 | 0.15 |
| Bulk Carriers | 0.17 | 0.45 | 0.10 | 0.17 |
| Container Ships | 0.13 | 0.50 | NA* | 0.13 |
| General Cargo | 0.17 | 0.45 | 0.10 | 0.17 |
| Passenger Ships** | 0.13 | 0.13 | 0.12 | 0.12 |

* Container ships emissions at berth are based on engine loads instead of load factors.

** Passenger ship auxiliary load factors applied to total ship power.

Boiler loads were taken directly from the 2015 Port of Long Beach inventory and are listed in Table 2-9. They are used for all modes when the propulsion load factor is less than 20%. When the propulsion load factor is 20% or greater, exhaust economizers supply the needed steam, so boiler load is assumed to be zero.

[6] California Air Resources Board, *Emissions Estimation Methodology for Ocean-Going Vessels,* May 2011. Available at http://www.arb.ca.gov/regact/2011/ogv11/ogv11appd.pdf.

[7] All Port of Long Beach Air Emissions Inventory documents are available at http://www.polb.com/environment/air/emissions.asp.

**Table 2-9. Boiler Loads**

| Ship Type | Size | Boiler Load (kW) |
|---|---|---|
| Auto Carriers | All | 351 |
| Bulk Carriers | All | 132 |
| Container Ships | 0 – 1000 TEU* | 241 |
| | 1000 – 2000 TEU | 325 |
| | 3000 – 4000 TEU | 492 |
| | 5000 – 6000 TEU | 577 |
| General Cargo | All | 135 |
| Passenger Ships | All | 1393 |

*twenty-foot equivalent units

Emission factors for propulsion engines were also taken from the 2014 Port of Long Beach inventory.[8] These emission factors are listed in Table 2-10. Reactive organic gas (ROG) from total hydrocarbons was calculated using the ARB conversion factor of 1.26639 for diesel engines.[9]

**Table 2-10. Propulsion Engine Emission Factors**

| Engine Type | Tier | Model Years | Propulsion Engine Emission Factors (g/kWh) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $NO_x$ | DPM | $PM_{2.5}$ | ROG | CO | $SO_2$ | $CO_2$ | $CH_4$ | $N_2O$ |
| MSD | 0 | Pre-2000 | 13.2 | 0.26 | 0.24 | 0.63 | 1.1 | 0.40 | 649 | 0.010 | 0.029 |
| | 1 | 2000 – 2010 | 12.2 | 0.26 | 0.24 | 0.63 | 1.1 | 0.40 | 649 | 0.010 | 0.029 |
| | 2 | 2011-2015 | 10.5 | 0.26 | 0.24 | 0.63 | 1.1 | 0.40 | 649 | 0.010 | 0.029 |
| | 3 | 2016+ | 2.6 | 0.26 | 0.24 | 0.63 | 1.1 | 0.40 | 649 | 0.010 | 0.029 |
| SSD | 0 | Pre-2000 | 17.0 | 0.26 | 0.24 | 0.76 | 1.4 | 0.40 | 589 | 0.012 | 0.029 |
| | 1 | 2000 – 2010 | 16.0 | 0.26 | 0.24 | 0.76 | 1.4 | 0.40 | 589 | 0.012 | 0.029 |
| | 2 | 2011-2015 | 14.4 | 0.26 | 0.24 | 0.76 | 1.4 | 0.40 | 589 | 0.012 | 0.029 |
| | 3 | 2016+ | 3.4 | 0.26 | 0.24 | 0.76 | 1.4 | 0.40 | 589 | 0.012 | 0.029 |
| GT | All | All | 5.7 | 0.00 | 0.01 | 0.13 | 0.2 | 0.60 | 922 | 0.002 | 0.075 |

Emission Factors for auxiliary engines and boilers are shown in Table 2-11. These emission factors are consistent with the Port of Long Beach emission inventories. For passenger ships,

[8] The 2015 Port of Long Beach inventory did not summarize emission factors, so the 2014 inventory was used.

[9] ARB, *Factors For Converting THC Emission Rates TOG/ROG.* Available at: https://www.arb.ca.gov/msei/onroad/downloads/tsd/HC_Conversions.pdf.

the propulsion engine load factor was used for all calculations, as engines on passenger ships are Category 3 engines. Similar to propulsion engines, ROG from total hydrocarbons was calculated using the ARB conversion factor of 1.26639 for diesel engines. Boiler particulate matter 10 microns or less in diameter (PM10) is by definition not considered diesel particulate matter (DPM).

**Table 2-11. Auxiliary Engine and Boiler Emission Factors**

| Engine Type | Tier | Model Years | Auxiliary Engine and Boiler Emission Factors (g/kWh) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $NO_x$ | DPM | $PM_{2.5}$ | ROG | CO | $SO_2$ | $CO_2$ | $CH_4$ | $N_2O$ |
| Auxiliary | 0 | Pre-2000 | 13.8 | 0.26 | 0.24 | 0.51 | 1.10 | 0.50 | 686 | 0.008 | 0.029 |
| | 1 | 2000- 2010 | 12.2 | 0.26 | 0.24 | 0.51 | 1.10 | 0.50 | 686 | 0.008 | 0.029 |
| | 2 | 2011-2015 | 10.5 | 0.26 | 0.24 | 0.51 | 1.10 | 0.50 | 686 | 0.008 | 0.029 |
| | 3 | 2016+ | 2.6 | 0.26 | 0.24 | 0.51 | 1.10 | 0.50 | 686 | 0.008 | 0.029 |
| Boiler | All | All | 2.0 | 0.00 | 0.13 | 0.13 | 0.2 | 0.60 | 922 | 0.002 | 0.075 |

For the ships that shore powered (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 (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 are calculated for the hoteling time when the ship is not connected to the grid. In addition, electrical grid emission factors in $CO_2e$ are calculated for the time the ship is connected to the grid. The power plant emission factor used for this inventory was 242 g/kWh $CO_2e$ based upon San Diego Gas & Electric's 2018 Energy Resource Recovery Account forecast.[10]

## 2.4 Results

OGV emissions calculated for 2016 for the Port are shown in Table 2-12 by ship type, Table 2-13 by terminal, and Table 2-14 by activity mode.

[10] San Diego Gas and Electric's 2016 emission factor is available at: https://www.sdge.com/sites/default/files/regulatory/FINAL%20Public%20November%20Update.pdf.

**Table 2-12. OGV Emissions by Ship Type (tons)**

| Vessel Type | $NO_X$ | DPM | PM10 | PM2.5 | ROG | CO | $SO_2$* | $CO_2e$ (tons)** | $CO_2e$ (MT)** |
|---|---|---|---|---|---|---|---|---|---|
| Auto Carriers | 174.74 | 3.42 | 4.24 | 3.90 | 12.60 | 19.85 | 8.22 | 12,013 | 10,898 |
| Bulk Carriers | 1.92 | 0.03 | 0.04 | 0.04 | 0.12 | 0.21 | 0.09 | 133 | 121 |
| Container Ships | 42.07 | 0.71 | 1.02 | 0.94 | 2.47 | 4.40 | 2.24 | 4,675 | 4,241 |
| General Cargo | 8.54 | 0.16 | 0.19 | 0.18 | 0.48 | 0.89 | 0.39 | 567 | 514 |
| Passenger Ships | 95.49 | 1.80 | 2.06 | 1.89 | 4.69 | 6.33 | 4.26 | 7,414 | 6,726 |
| Total | 322.74 | 6.12 | 7.56 | 6.95 | 20.35 | 31.68 | 15.19 | 25,802 | 22,500 |

* Does not include low-load adjustments for $SO_2$ and $CO_2$
** $CO_2e$ includes both vessel exhaust and shore power emissions

**Table 2-13. OGV Emissions by Terminal (tons)**

| Terminal | $NO_X$ | DPM | PM10 | PM2.5 | ROG | CO | $SO_2$* | $CO_2e$ (tons)** | $CO_2e$ (MT)** |
|---|---|---|---|---|---|---|---|---|---|
| TAMT | 52.52 | 0.90 | 1.26 | 1.16 | 3.07 | 5.49 | 2.71 | 5,345 | 4,876 |
| NCMT | 174.74 | 3.42 | 4.24 | 3.90 | 12.60 | 19.85 | 8.22 | 12,013 | 10,898 |
| CST | 95.49 | 1.80 | 2.06 | 1.89 | 4.69 | 6.33 | 4.26 | 7,414 | 6,726 |
| Total | 322.74 | 6.12 | 7.56 | 6.95 | 20.35 | 31.68 | 15.19 | 25,802 | 22,500 |

* Does not include low-load adjustments for $SO_2$ and $CO_2$
** $CO_2e$ includes both vessel exhaust and shore power emissions

**Table 2-14. OGV Emissions by Mode (tons)**

| Mode | $NO_X$ | DPM | PM10 | PM2.5 | ROG | CO | $SO_2$* | $CO_2e$ (tons)** | $CO_2e$ (MT)** |
|---|---|---|---|---|---|---|---|---|---|
| Transit | 17.16 | 0.36 | 0.38 | 0.35 | 1.74 | 2.07 | 0.48 | 734 | 666 |
| VSR | 76.49 | 1.55 | 1.65 | 1.52 | 6.41 | 9.10 | 2.40 | 3,722 | 3,377 |
| Maneuver | 50.71 | 0.78 | 1.15 | 1.05 | 4.17 | 6.33 | 1.78 | 2,661 | 2,414 |
| Hotel | 147.78 | 2.83 | 3.56 | 3.27 | 6.66 | 11.31 | 8.42 | 14,574 | 13,221 |
| Anchor | 30.60 | 0.60 | 0.83 | 0.76 | 1.37 | 2.87 | 2.11 | 3,111 | 2,822 |
| Total | 322.74 | 6.12 | 7.56 | 6.95 | 20.35 | 31.68 | 15.19 | 25,802 | 22,500 |

* Does not include low-load adjustments for $SO_2$ and $CO_2$
** $CO_2e$ includes both vessel exhaust and shore power emissions

Figure 2-2 shows the relative contribution of each pollutant for each vessel type. As shown, the majority of emissions are from auto carriers at National City Marine Terminal (NCMT) and passenger ships at CST, followed by container ships, general cargo, and bulk carriers. Figure 2-3 portrays the relative contribution of each pollutant by activity mode. As shown, the majority of emissions are from vessel hoteling and transit within the VSR zone, followed by maneuvering in the harbor, anchorage, and transit outside of the VSR zone. This is because OGVs spend more time in the VSR zone than outside the VSR zone in transit, as many calls travel to and from the Port within the VSR zone only. For instance, all container ships travel from and to Latin

America, and once ships cross the international boundary, they are immediately within the VSR zone. Overall, vessels spent approximately 77% of transit time covering 85% of transit mileage within the VSR zone and only 23% of transit time covering 15% of transit mileage outside of the VSR zone. A summary of time and distance traveled in each mode is provided in Chapter 8. Also of note is that the majority of nitrogen oxide ($NO_X$) (62%) and DPM (59%) emissions occur within the harbor associated with maneuvering and hoteling.

**Figure 2-2. Relative Contribution of Emissions by Vessel Type**

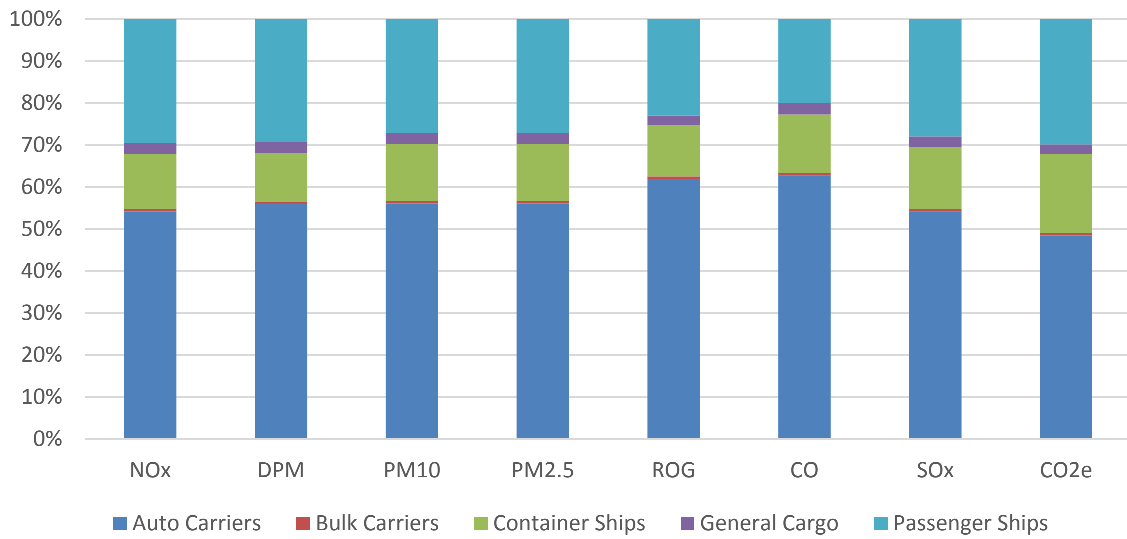
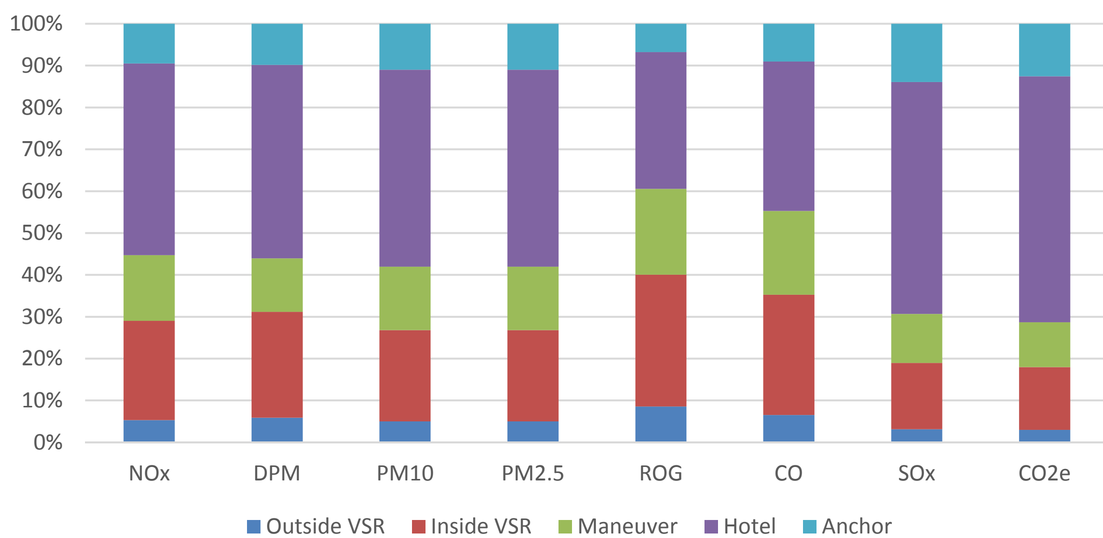



**Figure 2-3. Relative Contribution of Pollutants by Activity Mode**



Finally, the use of low-load adjustment factors for $SO_2$ and $CO_2$ were examined and are presented in Table 2-15. Using low-load factors for $SO_2$ increased overall $SO_2$ emissions by 3.5% (0.52 ton) and total $CO_2e$ emissions (the sum of exhaust and shore power) by 3.0% (745 tons). To be consistent with previous inventories, the results, trends, and implications of this inventory are based on emissions assuming no low-load adjustment factors for $SO_2$ and $CO_2$, and results with low-load adjustment factors for $SO_2$ and $CO_2$ is for disclosure purposes only.

**Table 2-15. Change in Emissions With and Without Low-Load Adjustments (tons)**

| Ship Type | Without Low-Load Adjustments | | With Low-Load Adjustments | |
|---|---|---|---|---|
| | $SO_2$ | $CO_2e$ | $SO_2$ | $CO_2e$ |
| Auto Carriers | 8.22 | 12,013 | 8.66 | 12,644 |
| Bulk Carriers | 0.09 | 133 | 0.09 | 138 |
| Container Ships | 2.24 | 4,675 | 2.31 | 4,773 |
| General Cargo | 0.39 | 567 | 0.39 | 579 |
| Passenger Ships | 4.26 | 7,414 | 4.26 | 7,414 |
| Total | 15.19 | 24,802 | 15.71 | 25,547 |
| *Change* | -- | -- | *+3.5%* | *+3.0%* |

# 3 Commercial 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 of San Diego (Port), summarizes the methods used to estimate CHC emissions in 2016, and presents the results of the emissions attributed to CHC. Note that emissions associated with charter fishing vessels were not included in the 2012 emission inventory because information to conduct the analysis was not available at the time of analysis.

## 3.1 Source Description

CHC engage in a wide variety of activities at the Port. They assist in moving ocean-going vessels (OGVs) around the harbor; move cargo and people into and out of the port 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 commercial harbor craft are U.S. Environmental Protection Agency (EPA) Category 1 or 2 vessels, vessels with diesel engines less than 30 liters per cylinder.[1] Table 3-1 lists CHC vessel types and their typical function within the Bay.[2]

Below is a description of each of the CHC types and of their activities at the Port. Note that while recreational vessels are included by EPA under CHC, recreational vessels including privately owned boats are not included here, but instead are discussed separately in Chapter 7.

### 3.1.1 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 and lumber barges to

[1] 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.

[2] Information adapted from EPA's 2009 *Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories*, available at: https://www.epa.gov/moves/current-methodologies-preparing-mobile-source-port-related-emission-inventories-final-report.

and from the Pacific Northwest. There were eight assist tugs, two tow or push boats, and five ocean-going tugs active at the Port in 2016.

**Table 3-1. Commercial Harbor Craft Vessel Types**

| Vessel | Description |
|---|---|
| Assist tugboats | Help OGVs maneuver in the harbor during arrival and departure 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 people and property. Excursion boats provide harbor cruises and whale watching. |
| Crew boats | Carry personnel and supplies to and from off-shore and in-harbor locations |
| Work boats | Include utility, inspection, survey, spill/response, research, mining, training, and construction |
| Government vessels | Belong to U.S. Coast Guard; U.S. Navy, Fish and Game; and fire, police, and harbor departments[3] |
| Commercial and Sport Fishing Vessels | Carry crew and/or passengers to fishing areas both within and outside 24 nautical miles of the Port |

### 3.1.2 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. The commercial fishing fleet varies in size due mainly to the specialization in geographic range and space requirements by type of catch of each vessel. 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 located out of North San Diego Bay including Fisherman's Landing, H&M Landing, or Point Loma Sport Fishing. Similar to commercial fishing, the sport fishing fleet varies in size depending on the location and range of the vessels. Generally, sport fishing vessels have greater engine power than commercial fishing vessels due to the demands of moving passengers and equipment.

[3] Note that US military operations are excluded here. Generally states cannot require emission reductions from federal vessels.

### 3.1.3 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 and B Street. Two companies primarily provide ferry and excursion services: San Diego Harbor Excursion (a.k.a. Flagship) and Hornblower Cruises and Events. Passenger ferries and excursion vessels rarely travel beyond 24 nautical miles (nm) from the Port.

### 3.1.4 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 and 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 OGVs approach the Bay, a San Diego pilot boat carries a Bay pilot that then boards OGVs in the vicinity of the Whistle Buoy to ensure safe navigation to the berthing location. Finally, a fuel barge (auxiliary engines only) and its associated work boat are considered in this category.

## 3.2 Data Collection and Activity

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.

In cases where information was missing, values were estimated based on a combination of vessel category averages from other vessels, Lloyd's data, web research on specific vessels, and default values from California Air Resources Board (ARB) models for CHC and barges/dredgers.[4] Of note is that the Automatic Identification System (AIS) data processed for OGV emissions (Chapter 2) also included various CHC. Thus, annual hours for those pieces included in the AIS data were determined from the AIS data. Furthermore, it was assumed all vessels are in compliance with ARB's Harbor Craft Rule. The Harbor Craft Rule sets forth a compliance schedule for vessels based on annual hours of operation and engine model year for all in-use, newly purchased, or replacement engines that operate within Regulated California Waters (e.g., 24 nm from shore) to meet the EPA's emission standards.[5] For example, a harbor craft with greater than or equal to 300 annual operating hours and a 2003 model year engine in

[4] Both models are available on the ARB website at: https://www.arb.ca.gov/msei/ordiesel.htm.

[5] *Commercial Harbor Craft Regulatory Activities* available at: https://www.arb.ca.gov/ports/marinevess/harborcraft.htm.

2017 would be required to meet the next compliance date, December 31, 2018, by repowering with Tier 2 or higher certified engines.[6] The compliance schedule runs through 2022.

Table 3-2 summarizes the activity metrics for the various types of vessels considered, including the equipment counts as well as average main and auxiliary engine model year, annual hours within 24 nm, and total horsepower from all engines. As shown, there were 169 harbor craft vessels included the fleet. All but eight vessels (two commercial fishing and six Port-owned vessels) are diesel powered. All activity values, and thus calculated emissions, are limited to 24 nm of the coast.

**Table 3-2. 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 | 8 | 2008 | 486 | 3,445 | 2004 | 3,180 | 76 |
| Ocean-Going Tug | 5 | 1998 | 478 | 3,260 | 2003 | 1,648 | 144 |
| Towboat | 2 | 2006 | 393 | 2,675 | 2000 | 855 | 227 |
| Crew/Supply | 1 | 2005 | 351 | 3,000 | 2015 | 932 | 420 |
| Ferry | 5 | 2009 | 2,032 | 806 | 2000 | 4,862 | 117 |
| Excursion | 13 | 2009 | 777 | 1,053 | 2009 | 2,253 | 404 |
| Work Boats | 1 | 2013 | 17 | 850 | 1987 | 18 | 132 |
| Pilot Boat | 1 | 2015 | 874 | 457 | 2012 | 2,974 | 30 |
| Barge | 1 | - | - | - | 2011 | 380 | 155 |
| Commercial Fishing | 63 | 2011 | 478 | 345 | 2013 | 478 | 34 |
| Charter Fishing | 55 | 2007 | 307 | 1,004 | 2009 | 1,435 | 130 |
| **Total** | **155** | **2008** | **788** | **940** | **2009** | **2,200** | **110** |

## 3.3 Emission Estimation Methodology

CHC emissions are estimated based on activity-based emission factors and activity profiles for each vessel. Emissions from diesel and gasoline CHC were estimated using Equation 1 for each vessel, which follows ARB's current approach for commercial harbor craft.[7]

[6] Except dredges, barges, and crew and supply vessels, which must meet a different compliance schedule. See https://www.arb.ca.gov/regact/2010/chc10/frochc931185.pdf for more information.

[7] As described in "Appendix C: Updates on the Emissions Inventory for Commercial Harbor Craft Operating in California," ARB, 2010. Available at: https://www.arb.ca.gov/regact/2010/chc10/appc.pdf.

Equation 1

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

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 (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 = Grams to short tons or metric tons conversion

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 changes (increases) due to wear on various parts of an engine. This is known as the "deterioration rate," which changes over time. The ARB 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. For example, ARB's *Off-Road In Use Equipment Regulation* recommends cumulative lifetime hours for diesel and propane equipment not exceed 12,000 hours. Because gasoline engines are rarely rebuilt, ARB 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 Equation 2.

Equation 2

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

Where EF = Deteriorated in-use emissions rate for each CHC for each criteria pollutant and greenhouse gas (GHG), in grams per bhp-hr
$EF_{zh}$ = zero-hour engine emission factor for each CHC fuel type for each criteria pollutant and GHG, grams per bhp-hr (ARB CHC model)
FCF = the fuel correction factor (as required) (ARB CHC model)
D = the horsepower and pollutant-specific engine deterioration factor (ARB CHC model)
A = the engine age (limited to 12,000 hours per ARB CHC model)
UL = the vessel- and engine-specific engine useful life (ARB CHC model)

The zero-hour engine emission factors and deterioration rates for hydrocarbons, carbon monoxide (CO), nitrogen oxide ($NO_X$), and particulate matter from diesel-powered equipment were obtained from ARB's CHC model. Zero-hour engine emission factors for sulfur dioxide ($SO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$) are from the 2013 Port of Long Beach inventory. Carbon dioxide ($CO_2$) emissions from are based on fuel consumption from the CHC model and the carbon content by fuel type from GREET.[8] Zero-hour engine emission factors for gasoline vessels are based on Pleasure Craft Model emission factors obtained from the ARB.[9] No deterioration was assumed for diesel $CO_2$, $SO_2$, $CH_4$, or $N_2O$, consistent with ARB guidance, and no deterioration for gasoline was assumed.

In terms of activity, main and auxiliary engine hours are based on usage information provided by the Port or based on “moving’ and “stopped” hours taken from the AIS data. For commercial fishing, vessel specifications (main engine power, auxiliary power, percent of time spent within 24 nm) were grouped based on the type of fishing (Seiner, Lobster/crab/spot prawn, Mixed Gillnetter, Albacore Troll, and Urchin) each vessel participates in.

The cumulative lifetime hours 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 2016 annual hours by the equipment age in years. As noted above, cumulative lifetime hours were limited to 12,000 hours for diesel 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 engine load factors are shown in Table 3-3 and were taken from the ARB’s CHC model and the Crew and Supply model for all but assist tugs, which are originally from the Port of Los Angeles and Port of Long Beach emission inventories and were also used in the Port’s 2012 emissions inventory. The load factors were applied to both fuel types.

[8] 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.

[9] Personal communication with David Chou of ARB on May 22, 2017.

**Table 3-3. Harbor Craft Load Factors**

| Vessel Type | Main Engine | Auxiliary Engine |
|---|---|---|
| Assist Tugs | 0.31 | 0.43 |
| Ocean-Going Tugs | 0.50 | 0.31 |
| Tow Boats | 0.68 | 0.43 |
| Crew and Supply | 0.45 | 0.43 |
| Excursion and Ferries | 0.42 | 0.43 |
| Work Boats | 0.45 | 0.43 |
| Pilot Vessels | 0.51 | 0.43 |
| Commercial Fishing | 0.27 | 0.43 |
| Sport Fishing | 0.52 | 0.43 |
| Others | 0.52 | 0.43 |

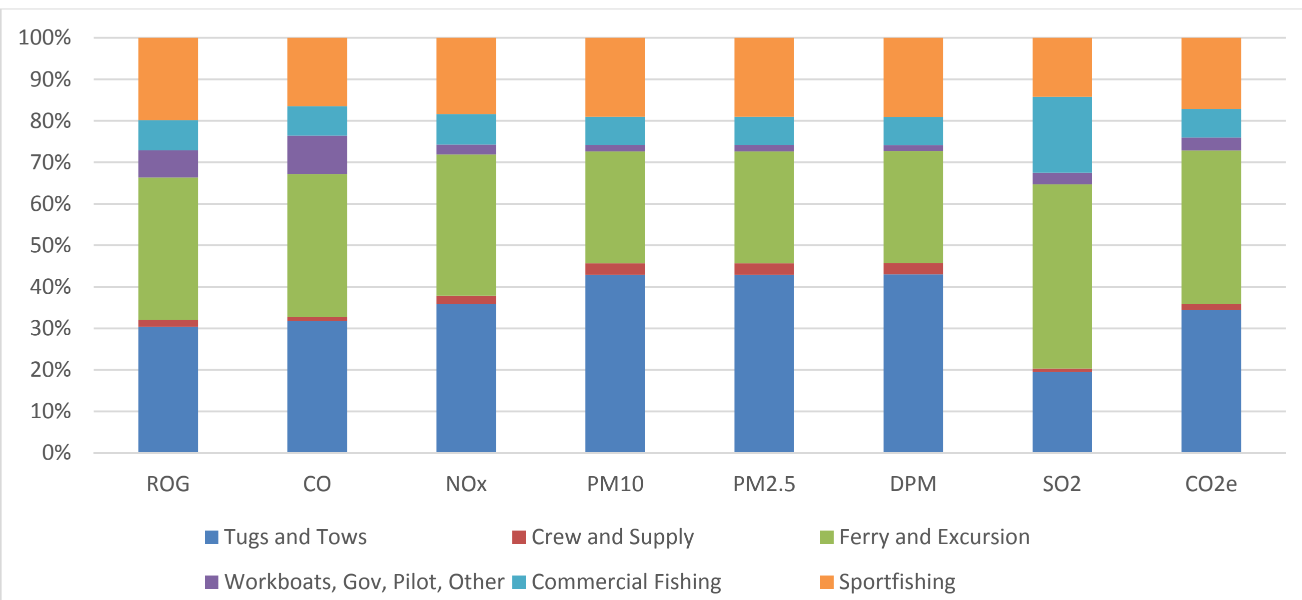
## 3.4 Results

CHC emissions calculated for 2016 for the Port are summarized in Table 3-4 by vessel type. Ferry and excursions, tugs, and charter fishing represent the biggest contributors of emissions within the CHC category. Figure 3-1 shows the relative contribution of each pollutant for each vessel type. As shown, approximately 27% to 44% of the Port 's total harbor craft emissions are attributed to ferries and excursions; 19 to 43% to tugs and towboats; 14 to 20% to sport fishing; 7 to 18% to commercial fishing; 1 to 9% to work boats, government, and others; and 1 to 3% to crew & supply vessels.

Table 3-4. Commercial Harbor Craft Emission Estimates (tons)

| Harbor Craft | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ (tons) | $CO_2e$ (MT) |
|---|---|---|---|---|---|---|---|---|---|
| Tugboats | 8.0 | 54.3 | 72.8 | 3.0 | 2.9 | 3.0 | 0.1 | 8,467 | 7,681 |
| Towboats | 1.3 | 9.5 | 13.1 | 0.4 | 0.4 | 0.4 | 0.0 | 1,450 | 1,315 |
| Crew & Supply | 0.5 | 1.9 | 4.7 | 0.2 | 0.2 | 0.2 | 0.0 | 421 | 382 |
| Ferry & Excursion | 10.5 | 69.1 | 81.4 | 2.1 | 2.1 | 2.1 | 0.2 | 10,651 | 9,662 |
| Work Boats & Government | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 5 | 4 |
| Pilot Boat | 0.1 | 1.0 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | 159 | 144 |
| Other | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 28 | 25 |
| Commercial Fishing | 2.2 | 14.2 | 17.6 | 0.5 | 0.5 | 0.5 | 0.1 | 1,996 | 1,811 |
| Sport Fishing | 6.1 | 33.0 | 44.0 | 1.5 | 1.5 | 1.5 | 0.1 | 4,933 | 4,476 |
| Total | 28.9 | 183.1 | 234.8 | 7.8 | 7.5 | 7.8 | 0.5 | 28,109 | 25,500 |

Figure 3-1. Relative Contribution of Pollutants by Harbor Craft Type



# 4 Cargo Handling Equipment

Cargo handling equipment (CHE) is used to support terminal activities and move cargo on and off ocean-going vessels (OGVs), harbor craft, rail, and trucks. A wide range of CHE types operate at the Port of San Diego (Port) due to 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, summarizes the methods used to estimate CHE emissions in 2016, and presents the results of the emissions attributed to CHE.

## 4.1 Source Description

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

## 4.2 Data Collection and Activity

Information on the number, types, and general operating activity of CHE was obtained from equipment operators through a San Diego Unified Port District (Port)-issued survey.[1] A total of 248 equipment pieces were reported through the surveys in 2016. Of these, 114 were not CHE and were excluded from the analysis, resulting in a 2016 CHE inventory of 134 pieces of equipment.[2] The CHE was grouped by equipment type categories consistent with California Air Resources Board (CARB) guidance and previous Port inventories. The majority of CHE operates at National City Marine Terminal (NCMT) (61 pieces) and Tenth Avenue Marine Terminal (TAMT) (46 pieces), with the remaining equipment located at Cruise Ship Terminal (CST) (27 pieces). However, most of the equipment located at NCMT (45 of the 61 pieces) is electric and not included in this inventory.

Table 4-1 summarizes the 2016 CHE inventory and average engine operating parameters by general equipment type. Engine year, horsepower, and annual operating hours for each equipment piece were obtained from the survey results, where available. In cases where information was missing from the survey responses, values were estimated based on category averages from CARB and professional judgment. Equipment categories used herein (e.g.,

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[1] Response included a Pasha Fleet Equipment Inventory Report, Port of San Diego CST equipment inventory, SSA Marine equipment list, and equipment summaries from Dole, Terminal Lift, CEMEX, and the Port.

[2] The 114 pieces of equipment that were excluded from the inventory comprised one non-motorized fuel trailer, nine vehicles that were not used in 2016, and 104 on-road vehicles.

Container Handling Equipment, Construction Equipment) are based on the equipment categories used by CARB.

**Table 4-1. Cargo Handling Equipment Characteristics**

| Equipment Category | Equipment Type | Number of Pieces | Average Engine Year | Average Annual Hours | Average Horsepower |
|---|---|---|---|---|---|
| Container Handling Equipment | Reach Stackers | 5 | 2011 | 212 | 346 |
| | Lifts | 1 | 2010 | 245 | 1,030 |
| | Top Handler | 1 | 2010 | 624 | 354 |
| Forklift | Forklift | 29 | 2006 | 709 | 134 |
| Yard Tractor | Yard Tractor | 17 | 2011 | 1,397 | 202 |
| Construction Equipment | Rail Loaders | 3 | 2002 | 63 | 138 |
| | Tractors | 1 | 2002 | 63 | 138 |
| | Lifts | 1 | 2002 | 63 | 138 |
| | Trailers | 4 | 2005 | 63 | 138 |
| General Industrial Equipment | Lighting | 3 | 2006 | 479 | 14 |
| | Cart | 3 | 2008 | 323 | 12 |
| | Trailer | 2 | 2008 | 479 | 40 |
| | Lift | 22 | 2003 | 465 | 41 |
| | Loader | 2 | 2001 | 240 | 265 |
| | Sweeper/Scrubber | 2 | 2001 | 359 | 37 |
| | Assorted pieces | 38 | 2005 | 466 | 33 |
| Overall Average | | 134 (total) | 2006 | 592 | 109 |

Table 4-2 presents the 2016 CHE inventory by fuel type. The majority of equipment (78 pieces) are electrically powered, followed by diesel-powered equipment (42 pieces).

**Table 4-2. Cargo Handling Equipment Count by Fuel Type**

| Equipment Category | Equipment Type | 4-Stroke Gasoline | Diesel | CNG or LPG | Electric, Solar, or Other non-emitting[a] |
|---|---|---|---|---|---|
| Container Handling Equipment | Reach Stackers | 0 | 4 | 0 | 1 |
| | Lifts | 0 | 1 | 0 | 0 |
| | Top Handler | 1 | 0 | 0 | 0 |
| Forklift | Forklift | 0 | 7 | 5 | 17 |
| Yard Tractor | Yard Tractor | 0 | 17 | 0 | 0 |
| Construction Equipment | Rail Loaders | 0 | 3 | 0 | 0 |
| | Tractors | 0 | 1 | 0 | 0 |
| | Lifts | 0 | 1 | 0 | 0 |
| | Trailers | 0 | 0 | 0 | 4 |
| General Industrial Equipment | Lighting | 0 | 3 | 0 | 0 |
| | Carts | 1 | 0 | 0 | 2 |
| | Trailer | 0 | 0 | 0 | 2 |
| | Lift | 1 | 1 | 0 | 20 |
| | Loader | 0 | 2 | 0 | 0 |
| | Sweeper/Scrubber | 0 | 2 | 0 | 0 |
| | Assorted pieces | 6 | 0 | 0 | 32 |
| Total | | 9 | 42 | 5 | 78 |
| *Percentage of Total* | | *7%* | *31%* | *4%* | *58%* |

Notes:
[a] Electrically powered equipment generates greenhouse gas emissions from consumption of electricity produced at regional power plants. Greenhouse gas emissions associated with electric CHE are included in the Port's Climate Action Plan 2016 Progress Report through aggregated electricity data obtained from San Diego Gas & Electric. As a result, emissions from electrically powered CHE are not included in this inventory and are not discussed further in this chapter.
CNG = compressed natural gas; LPG = liquefied petroleum gas

Table 4-3 presents the number of equipment pieces and energy consumption by fuel type and, for diesel equipment, by engine tier. As shown, diesel equipment makes up the majority of equipment and activity, and for diesel equipment, those pieces with higher tier engines (Tier 2 and above) make up the majority of activity and energy consumption.

**Table 4-3. Equipment Counts and Energy Consumption by Fuel and Engine Type**

| Fuel | Engine Tier | Equipment Count | % of total | Activity Hours (kw-hrs) | % of total |
|---|---|---|---|---|---|
| Diesel | Tier 0 | 4 | 7% | 18,100 | 0% |
| | Tier 1 | 8 | 14% | 83,482 | 2% |
| | Tier 2 | 7 | 13% | 1,200,530 | 32% |
| | Tier 3 | 4 | 7% | 151,555 | 4% |
| | Tier 4 | 19 | 34% | 1,920,082 | 52% |
| Gasoline | - | 9 | 16% | 153,754 | 4% |
| Propane/LPG/CNG | - | 5 | 9% | 182,344 | 5% |
| Total | - | 56 | 100% | 3,709,847 | 100% |

CNG = compressed natural gas; LPG = liquefied petroleum gas

## 4.3 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 equipment were estimated using Equation 1 for each piece of equipment. Total emissions are the sum of the estimate for Equation 1 over all equipment.

Equation 1

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

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

**Emission Factor (EF)**

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 changes (increases) due to 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. For example, CARB's *Off-Road In Use Equipment Regulation* recommends cumulative lifetime hours for diesel and propane equipment not exceed 12,000 hours. Because gasoline engines are rarely rebuilt, CARB does not recommend a cumulative lifetime hour cap for gasoline-powered equipment.

Emission factors were calculated according to Equation 2.

Equation 2

$$EF = (EF_{zh} + dr * CHrs) * FCF * CF$$

Where EF = Deteriorated in-use emissions rate for each CHE for each criteria pollutant and greenhouse gas (GHG), in grams per bhp-hr [3]
$EF_{zh}$ = zero-hour engine emission factor for each CHE fuel type for each criteria pollutant and GHG, grams per bhp-hr (see Table 4-4)
dr = deterioration rate for each CHE fuel type for each criteria pollutant (as required) (see Table 4-4)
CHrs = cumulative lifetime hours for each CHE piece (from survey)
FCF = fuel correction factor (as required)[4]
CF = control factor for each CHE piece (based on reported controls from survey)[5]

The zero-hour engine emission factors ($EF_{zh}$) and deterioration rates (dr) for total hydrocarbons, carbon monoxide (CO), nitrogen oxide ($NO_X$), and particulate matter from diesel-powered equipment were obtained from CARB's 2011 Cargo Handling Emissions Inventory (CHEI) Model.[6] Zero-hour engine emission factors and deterioration rates for total hydrocarbons, CO, $NO_X$, and particulate matter and zero-hour engine emission factors for carbon dioxide ($CO_2$) from gasoline and propane engines were taken from CARB's OFFROAD2007 model.[7] No deterioration was assumed for $CO_2$, sulfur dioxide ($SO_2$), methane ($CH_4$), or nitrous oxide ($N_2O$), consistent with CARB (2011) guidance. Zero-hour engine emission factors for $SO_2$ from all fuel types were estimated based on fuel consumption and $CO_2$ emissions from OFFROAD2007 and the carbon content by fuel type from GREET.[8] Zero-hour engine emission factors for $CH_4$ and

[3] Consistent with previous inventories, this inventory does not include starting and evaporative emissions.

[4] CARB's Cargo Handling Emissions Model and Documentation is available at CARB's *Mobile Source Emissions Inventory -- Off-Road Diesel Vehicles* page: https://www.arb.ca.gov/msei/ordiesel.htm.

[5] *Ibid*

[6] *Ibid*

[7] CARB's OFFROAD2007 model is available at the ARB's *Mobile Source Emissions Inventory -- Off-Road Diesel Vehicles* page: https://www.arb.ca.gov/msei/ordiesel.htm.

[8] 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.

$N_2O$ were calculated based on mobile source guidance from CARB for non-diesel engines[9] and fuel-based emission factors for construction equipment from U.S. Environmental Protection Agency (EPA) emission factors for gasoline construction equipment.[10] Zero-hour engine emission factors for $CH_4$ and $N_2O$ from propane engines were taken from the EPA's (2015) emission factors for liquefied petroleum gas Nonroad Vehicles.[11] Table 4-4 summarizes the primary sources for the zero-hour engine emission factors and deterioration rates for each pollutant and fuel type, as described above.

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 2016 annual hours by the equipment age in years. As noted above, cumulative lifetime hours were limited to 12,000 hours for diesel and propane (liquefied petroleum gas) equipment.

**Table 4-4. Sources for Zero-Hour Engine Emission Factors and Deterioration Rates**

| Fuel Type | Hydrocarbons | $NO_X$ | CO | PM | $CO_2$ | $SO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|---|---|---|---|---|
| *Zero-Hour Engine Emission Factors* | | | | | | | | |
| Gasoline | CARB's OFFROAD 2007 model | | | | CARB's OFFROAD 2007 | CARB's OFFROAD 2011 model and GREET | CARB's EMFAC model | |
| Diesel | CARB's CHEI Model | | | | | | | |
| CNG or LPG | CARB's OFFROAD 2007 | | | | | | EPA's Nonroad | |
| *Deterioration Rates* | | | | | | | | |
| Gasoline | CARB's OFFROAD2007 model | | | | No deterioration rates assumed, per CARB CHEI guidance | | | |
| Diesel | CARB's CHEI model | | | | | | | |
| CNG or LPG | CARB's OFFROAD2007 model | | | | | | | |

CNG = compressed natural gas; LPG = liquefied petroleum gas

Fuel correction factors were applied to the $NO_X$ and particulate matter emission rates from diesel engines to account for hydrocarbon and sulfur content differences between federal and California fuel. Fuel correction factors are not required for other pollutants or fuel types, consistent with CARB (2011) guidance.

Various emission control technologies have been installed on CHE, either voluntarily or in order to meet requirements of CARB's *Mobile Cargo Handling Equipment at Ports and Intermodal Rail*

[9] Based on guidance from *Mobile Source Emission Inventory -- EMFAC2011 Frequently Asked Questions* for heavy duty trucks, available at: https://www.arb.ca.gov/msei/emfac2011-faq.htm#emfac2011_web_db_qstn07.

[10] *Emission Factors for Greenhouse Gas Inventories*, Table 5, Available at: https://www.epa.gov/sites/production/files/2015-12/documents/emission-factors_nov_2015.pdf.

[11] *Ibid*

*Yards.* These emission control technologies include diesel oxidation catalysts and diesel particulate filters. Emission control factors from CARB's 2011 CHEI model were applied to equipment that was reported to have emission controls in the Port survey.

**Load Factor (LF)**

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's CHEI model, as shown in Table 4-5. The load factors were applied to all fuel types.

**Table 4-5. Cargo Handling Equipment Engine Load Factors**

| CHE Type | Load Factor |
|---|---|
| Container Handling Equipment | 0.59 |
| Forklift | 0.30 |
| Yard Tractor | 0.39 |
| Construction Equipment | 0.55 |
| Other General Industrial Equipment | 0.51 |

## 4.4 Results

Table 4-6 summaries the 2016 CHE emissions inventory by general equipment type. A summary of CHE emissions by terminal is presented in Table 4-7. CHE emissions by fuel type are presented in Table 4-8. Of particular note is that the majority of emissions (other than reactive organic gases) are generated at TAMT.

**Table 4-6. Cargo Handling Equipment Emission Estimates by Equipment Type (tons)**

| Equipment Type | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ (tons) | $CO_2e$ (MT) |
|---|---|---|---|---|---|---|---|---|---|
| Container Handling Equipment | 0.2 | 3.8 | 1.5 | 0.01 | <0.1 | <0.1 | 0.3 | 343 | 311 |
| Forklift | 1.4 | 9.7 | 8.0 | 0.4 | 0.4 | 0.4 | 0.4 | 796 | 722 |
| Yard Tractor | 0.8 | 2.5 | 3.1 | <0.1 | <0.1 | <0.1 | 0.8 | 1,179 | 1,070 |
| Construction Equipment | <0.1 | 0.1 | 0.2 | <0.1 | <0.1 | <0.1 | <0.1 | 15 | 14 |
| General Industrial Equipment | 1.9 | 10.1 | 0.9 | 0.1 | 0.1 | <0.1 | 0.1 | 74 | 67 |
| Total | 4.3 | 26.1 | 13.7 | 0.6 | 0.5 | 0.5 | 1.6 | 2,407 | 2,183 |

**Table 4-7. Cargo Handling Equipment Emission Estimates by Terminal (tons)**

| Terminal | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ (tons) | $CO_2e$ (MT) |
|---|---|---|---|---|---|---|---|---|---|
| CST | 0.1 | 1.0 | 0.2 | <0.1 | <0.1 | 0.0 | 0.0 | 20 | 18 |
| TAMT | 2.1 | 15.8 | 12.2 | 0.5 | 0.4 | 0.5 | 1.5 | 2,227 | 2,021 |
| NCMT | 2.1 | 9.3 | 1.2 | 0.1 | 0.1 | 0.1 | 0.1 | 160 | 145 |
| Total | 4.3 | 26.1 | 13.7 | 0.6 | 0.5 | 0.5 | 1.6 | 2,407 | 2,183 |

**Table 4-8. Cargo Handling Equipment Emission Estimates by Fuel (tons)**

| Type/Fuel | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ (tons) | $CO_2e$ (MT) |
|---|---|---|---|---|---|---|---|---|---|
| **CHE** | | | | | | | | | |
| Diesel | 1.9 | 7.1 | 11.1 | 0.5 | 0.4 | 0.5 | 1.4 | 2,059 | 1,868 |
| Gasoline | 0.1 | 3.4 | 0.4 | <0.1 | <0.1 | 0.0 | 0.1 | 119 | 108 |
| Propane | 0.3 | 5.5 | 1.01 | <0.1 | <0.1 | 0.0 | 0.0 | 140 | 127 |
| **OFFROAD** | | | | | | | | | |
| Diesel | 0.1 | 0.3 | 0.8 | <0.1 | <0.1 | <0.1 | 0.1 | 77 | 70 |
| Gasoline | 1.8 | 9.8 | 0.2 | <0.1 | <0.1 | 0.0 | <0.1 | 12 | 11 |
| Total | 4.3 | 26.1 | 13.7 | 0.6 | 0.5 | 0.5 | 1.6 | 2,407 | 2,183 |

Table 4-9 summarizes CHE characteristics at each terminal. As shown, while NCMT has the most pieces of CHE, these are smaller (51 horsepower) with fewer average annual hours (476 hours) for each piece relative to TAMT (181 horsepower, 792 hours). Thus, most equipment operating at NCMT is small and less emissions-intensive than equipment operating at TAMT. At CST, most equipment is electric; thus, criteria pollutant emissions are minor relative to the other terminals.

Based on information available at the time of analysis, the most recent air emissions inventory from 2012 estimated that the majority of equipment was operating at TAMT, whereas in this inventory we estimate that the majority of equipment is operating at NCMT. For this inventory, we obtained a detailed inventory of active equipment and equipment hours from terminal operators based on calendar year 2016 operations.

**Table 4-9. Summary of Cargo Handling Equipment Characteristics by Terminal**

| Terminal | Number of Pieces | Average Engine Year | Average Annual Hours | Average Horsepower | Percentage of CHE by Fuel Type | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Diesel | Gasoline | CNG/LNG | Electric |
| Overall Average | 134 | 2006 | 592 | 109 | 31% | 7% | 4% | 58% |
| TAMT | 46 | 2007 | 792 | 181 | 70% | 7% | 9% | 15% |
| NCMT | 61 | 2004 | 476 | 51 | 16% | 10% | 0% | 74% |
| CST | 27 | 2007 | 515 | 116 | 0% | 0% | 4% | 96% |

CNG = compressed natural gas; LPG = liquefied petroleum gas

Figure 4-1 shows the relative contribution of each pollutant for each equipment type. As shown, approximately 5 to 18% of the Port's total CHE emissions are attributed to container handling equipment, 28 to 80% to forklifts, 4 to 50% to yard tractors, 0 to 2% to construction equipment, and 3 to 45% to general industrial equipment. Figure 4-2 shows the relative contribution of each pollutant by terminal. As shown, approximately 50 to 93% of the Port's CHE emissions are attributed to activity at TAMT, 7 to 48% to activity at NCMT, and 0 to 4% to activity at CST.

**Figure 4-1. Relative Contribution of Pollutants by Equipment Type**

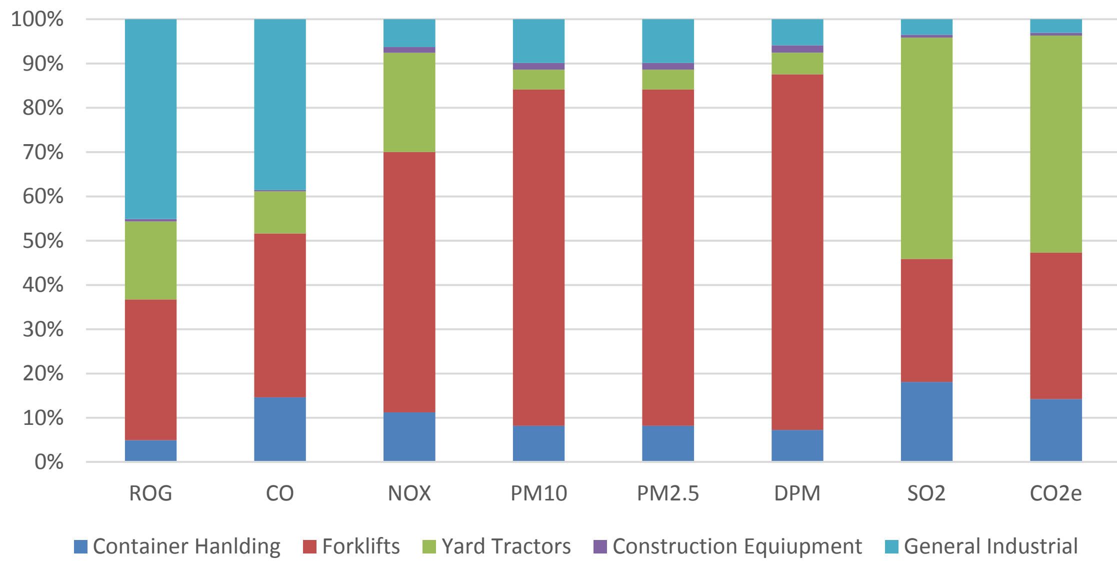
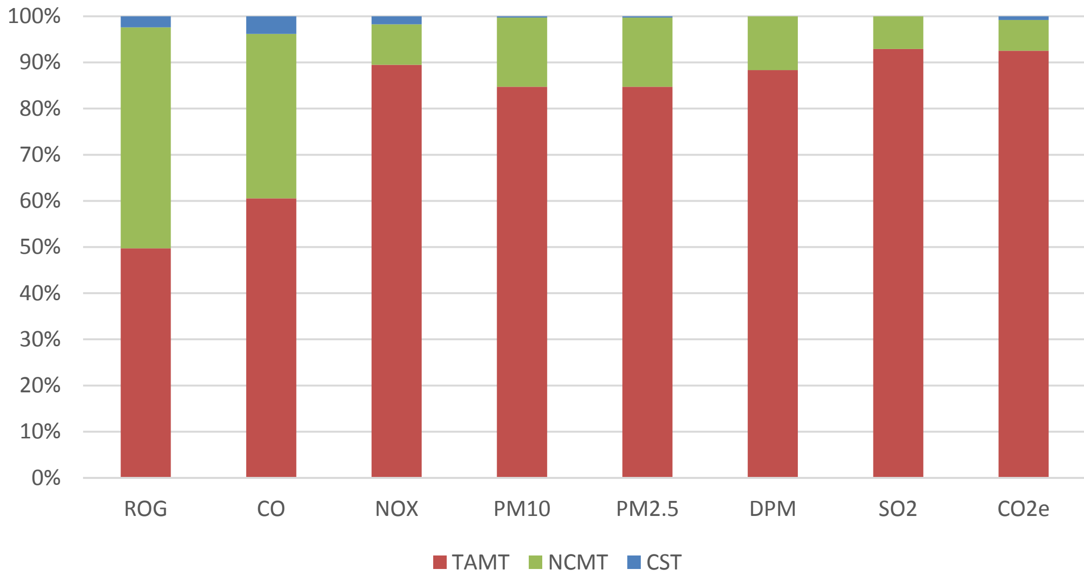


**Figure 4-2. Relative Contribution of Pollutants by Terminal**



# 5 Rail Locomotives

Rail locomotives carry freight cargo between the Port of San Diego (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 chapter describes the activity, emissions estimation methodologies, and results for rail locomotives that served the Port in 2016.

## 5.1 Source Description

Freight rail service at the Port is provided exclusively by Burlington Northern Santa Fe (BNSF) Railway. Freight movements are made to and from both Tenth Avenue Marine Terminal (TAMT) and National City Marine Terminal (NCMT) along the north-south BNSF right-of-way. Commodities moved by rail include automobiles moved in and out of NCMT as well as bulk and multi-purpose cargo moved in and out of TAMT, such as soda ash. Both TAMT and NCMT have on-site rail capabilities; there is no freight rail service to Cruise Ship Terminal (CST).

Rail activity is split between switching (or switch-duty) and regional travel (or line-haul). Line haul refers to the movement of cargo over long distances, which either initiates or terminates at the Port. Switching refers to the assembling and disassembling of trains and 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.

At NCMT, rail tracks used for auto train cars are on the terminal grounds, while the tracks that serve lumber yards, such as Dixieline, are located off the terminal next to the lumber yards. Dixieline is located east of the terminal along Tidelands Avenue in National City. In the case of automobile loading, trains arrive at NCMT and are broken into sections for vehicle loading and then reassembled upon departure. At TAMT, rail switching occurs when soda ash is delivered and switcher locomotives pull the cargo from the BNSF yard to the project site. All switching at NCMT is performed by the line-haul locomotives.

## 5.2 Data Collection and Activity

The methodology to estimate regional line haul (off-port) activity and on-site switching (on-port) activity differs, consistent with established protocols and available data. The method used to estimate each is described below.

### Regional Line Haul

Locomotives travel north-south between the Port and the Los Angeles 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 the 2006 and 2012 maritime air emissions inventories at the Port, as well as those conducted 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, distance that cargo traveled in the air basin, and average fuel consumption for line-haul locomotive travel. Total fuel consumption is converted to total horsepower-hours (hp-hrs) based on a fuel consumption conversion factor discussed below.

In summary, fuel consumption is calculated according to this general equation.

**Gallons of Diesel = Tons of Cargo x Distance Traveled x Fuel Efficiency**

In summary, hp-hrs are calculated according to this general equation.

**Hp-hrs = Gallons of Diesel x gallons per hp-hr**

A description of each of these variables is discussed below.

### Tons of Cargo

AT NCMT, there were 180,313 automobiles moved by rail within 13,184 railcars in 2016. 123,088 automobiles were moved outbound on 9,000 loaded railcars and 57,225 automobiles were moved inbound on 4,184 loaded railcars (total of 13,184 loaded railcars). These cars were moved in a mix of bi-level (67%) and tri-level (33%) railcars. To estimate gross-ton miles, it was assumed the average automobile weighs 1.54 tons based on the Port's cargo statistics, each empty railcar weighs 51.5 tons per the 2012 emissions inventory, and each locomotive weighs 214 tons per BNSF's 2015 financial information.

At TAMT, all soda ash is imported into the terminal by rail and exported by vessel. The U.S. Army Corps of Engineers reports all cargo movements in its *Waterborne Commerce of the United States* database.[1] Total tons of soda ash, or "metallic salt," moved into San Diego was obtained for multiple calendar years. Imported tons of soda ash has historically varied widely on a year-to-year basis, ranging from 2,223 tons in 2011 to 81,843 tons in 2015. 19,839 tons were imported in 2016. Annual tons of soda ash cargo between 2009 and 2016 are shown in Table 5-1. To estimate gross-ton miles, it was assumed that soda ash is transported to the terminal in steel-covered hopper cars equipped with a 110-ton nominal load, which allows for approximately 33 loaded railcars per train trip. Each empty hopper weighs 32 tons and each locomotive weighs 214 tons.

**Table 5-1. Soda Ash Activity by Year**

| Activity | 2016 | 2015 | 2014 | 2013 | 2012 | 2011 | 2010 | 2009 |
|---|---|---|---|---|---|---|---|---|
| Inbound Tons of Cargo | 19,839 | 81,843 | 54,176 | 24,653 | 37,128 | 2,223 | 17,250 | 20,299 |
| Inbound Carloads | 179 | 731 | 484 | 220 | 332 | 20 | 154 | 181 |

[1] U.S. Army Corps of Engineers data available at: http://www.navigationdatacenter.us/data/datawcus.htm

### 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 county Line), while TAMT cargo is 61.9 miles (from track mile 269.3 near the southeast edge of TAMT to 207.4 at the county line). This leads to an estimate of 134,174,775 ton-miles from NCMT and 2,334,559 ton-miles from TAMT.

### Fuel Efficiency

Regarding fuel efficiency, the 2012 emissions inventory estimated rail fuel consumption based on the intermodal train fuel consumption metric of 700.8 gross-ton miles (GTM)/gallon (without adjustments for grade)[2] from Gould and Niemeier.[3] This metric differs from the 753.0 GTM/gallon metric used in the 2006 inventory, which was taken directly from the Port of Long Beach inventory of the same year.

The inventories at the Ports of Los Angeles and Long Beach are based on system-wide efficiencies from both BNSF and Union Pacific (both BNSF and Union Pacific serve the Ports of Los Angeles and Long Beach). In 2016, both the Ports of Los Angeles and Long Beach used a fuel consumption metric of 1,006.4 GTM/gallon, which implies that significantly (44%) more cargo is moved per gallon of fuel consumed at the Ports of Los Angeles and Long Beach compared to the Port of San Diego. Using the same approach as the Ports of Los Angeles and Long Beach, the fuel consumption metric for BNSF-only (not including Union Pacific) for 2016 is 973.1 GTM/gallon. It is important to note that this 973.1 GTM/gallon figure, as well as the metrics used by the Ports of Los Angeles and Long Beach, are based on system-wide freight-rail efficiencies. BNSF carries a wide range of cargo throughout the nation, and this system-wide efficiency includes commodities such as coal, agricultural products, and consumer products. In particular, the transport of coal generally displays the best (highest) fuel efficiency for all commodities that BNSF transports, while the transport of automobiles (on auto racks) displays the worst fuel efficiency. The system-wide fuel efficiency metric is reasonable to use to represent rail activity at the Ports of Los Angeles and Long Beach because of the diverse cargo BNSF and Union Pacific transport to and from those ports. At the Port of San Diego, automobile transport makes up the vast majority of cargo movement by rail, so a lower fuel efficiency metric is sensible. In this light, to maintain consistency, the same fuel efficiency metric used in the 2012 inventory (700.8 GTM/gallon) is used here.

[2] Gross ton-mile is the sum of the total weight of all cargo, train cars, and locomotives, and the distance moved by a train.

[3] Gregory M. Gould and Deb A. Niemeier. 2011. *Spatial Assignment of Emissions Using a New Locomotive Emissions Model*. Department of Civil and Environmental Engineering, University of California, Davis.

**Gallons per Horsepower Hour Conversion**

The fuel consumption estimate was converted to hp-hr of usable power based on the fuel consumption conversion factor of 20.8 hp-hr/gallon. This 20.8 hp-hr/gallon conversion factor is based on the U.S. Environmental Protection Agency (EPA) rulemaking process for large line-haul Class 1 railroads.[4] This 20.8 multiplier is conservative because this number is based on a study for locomotives manufactured in the mid-1990s, and older locomotives would be expected to produce less useful work from each gallon of fuel than future (e.g., existing) locomotives. Regardless, this conversion factor is conservative and is used in other inventories, such as at the Ports of Los Angeles and Long Beach, so it is used here for the sake of consistency. As shown in Table 5-2, we estimate 3,982,356 hp-hr from NCMT and 69,291 hp-hr from TAMT, for a total of 4,051,647 hp-hr for line-haul activity.

[4] EPA *Emission Factors for Locomotives – Technical Highlights*, from April 2009

**Table 5-2. 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 | 180,313 | 1.54 | 277,682 | 18,243,709 | - | - |
| | Railcars | 13,184 | 51.5 | 678,976 | 44,608,723 | - | - |
| | Locomotives | 950 | 214 | 203,300 | 13,356,810 | - | - |
| | *Total* | - | - | 1,159,958 | 76,209,242 | 108,746 | 2,261,918 |
| Empty | Automobiles | 0 | 1.54 | 0 | 0 | - | - |
| | Railcars | 13,184 | 51.5 | 678,976 | 44,608,723 | - | - |
| | Locomotives | 950 | 214 | 203,300 | 13,356,810 | - | - |
| | *Total* | - | - | 882,276 | 57,965,533 | 82,713 | 1,720,438 |
| | **Total NCMT** | - | - | - | **134,174,775** | **191,459** | **3,982,356** |
| **TAMT** | | | | | | | |
| Loaded | Soda Ash | 179 | 111 | 19,839 | 1,228,034 | - | - |
| | Hoppers | 179 | 32 | 5,728 | 354,563 | - | - |
| | Locomotives | 15 | 214 | 3,210 | 198,699 | - | - |
| | Total | - | - | 28,777 | 5,247,387 | 2,542 | 52,870 |
| Empty | Soda Ash | 0 | 111 | 0 | 0 | - | - |
| | Hoppers | 442 | 32 | 5,728 | 354,563 | - | - |
| | Locomotives | 15 | 214 | 3,210 | 198,699 | - | - |
| | Total | - | - | 8,938 | 553,262 | 789 | 16,421 |
| | **Total TAMT** | - | - | - | **2,334,559** | **3,331** | **69,291** |
| **Total Overall** | | - | - | **2,079,949** | **163,509,334** | **194,791** | **4,051,647** |

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

[b] Gallons estimates based on ton-miles x 700.8 tons-miles per gallon

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

## 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 equation.

**Locomotive Hp-hr = Hours per Train x Number of Active Locomotives x Locomotive Power Rating x Load Factor**

A description of each of these variables is discussed below.

### Hours per Train and Number of Active Locomotives

An estimate of the amount of hours it takes to build, spot, and load trains at both TAMT and NCMT is shown in Table 5-3 and is based on personal communication with experts.[5] Note that the assumed 4.5 hours to build each train is less than the 7.5 hours assumed in the previous Port of San Diego inventories. To determine annual activity, it was assumed that there were 246 train-builds at NCMT based on 13,184 loaded railcars and 53.5 average railcars per train (50 railcars on weekdays and 71 railcars on Saturday). It was assumed there were 5 train-builds at TAMT based on 179 carloads (Table 5-1) and 33 cars per average train.

**Table 5-3. Locomotive Activity, On-Port Switching**

| Activity | Hours per Train | # of locomotives | HP per locomotive | Load Factor [a] | Locomotive HP-Hr | |
|---|---|---|---|---|---|---|
| | | | | | Per Train | Annual |
| Building Outbound Loaded Train | 2.0 | 4.0 | 4,400 | 9.0% | 3,185 | 784,766 |
| Spotting Inbound Empty Train | 1.5 | 2.0 | 4,400 | 9.0% | 1,194 | 294,287 |
| Spotting Inbound Loads | 1.0 | 2.0 | 4,400 | 9.0% | 796 | 196,192 |
| **Total at NCMT for Automobiles** | **4.5** | **-** | **-** | **-** | **5,175** | **1,275,245** |
| Inbound | 1.0 | 2.0 | 3,600 | 9.0% | 651 | 3,533 |
| Outbound | 1.0 | 2.0 | 3,600 | 9.0% | 651 | 3,533 |
| **Total at TAMT for Soda Ash** | **2.0** | **-** | **-** | **-** | **1,303** | **7,067** |

[a] Load factor is discussed below and shown in Table 5-4

[5] Personal communication with Jon Hoegemeier on November 1, 2015.

### 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.[6] Switch locomotives are smaller and are typically 2,000 hp or less. BNSF line-haul locomotives are equipped with 4,000 to 4,400 hp engines. For purposes of this analysis, 4,400 hp engines are assumed. The switcher used at TAMT is a Tier 0 GP-60 model equipped with a single 3,600 hp engine. This is larger than the typical switcher.

### Load Factor

A detailed description of throttle notch information from switching activity at TAMT and NCMT is not available. Therefore, throttle notch information for switching activity at TAMT and NCMT has been estimated based on switch-duty cycle averages from EPA's Regulatory Support Document (RSD). 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 from the 2012 inventory.[7] As shown in Table 5-4, the resulting load factor is 9.0%, which is multiplied by activity in Table 5-3 in order to estimate total in-use hp-hrs.

**Table 5-4. Load Factor for On-Port Switching**

| Notch | % of Full Power in Notch[a,b] | Time Fraction[c] | Weighted Power |
|---|---|---|---|
| Idle | 1.3% | 59.8% | 0.8% |
| 1 | 4.5% | 12.4% | 0.6% |
| 2 | 11.5% | 12.3% | 1.4% |
| 3 | 23.5% | 5.8% | 1.4% |
| 4 | 35.0% | 3.6% | 1.3% |
| 5 | 48.5% | 3.6% | 1.7% |
| 6 | 64.0% | 1.5% | 1.0% |
| 7 | 85.0% | 0.2% | 0.2% |
| 8 | 100.0% | 0.8% | 0.8% |
| **Weighted Load Factor** | | | **9.0%** |

Source:
[a] EPA RSD for notches 1 through 8 only. RSD shows no time fraction for Dynamic Braking, so it is not included.
[b] Percentage of full power in idle not shown in RSD; idle power calculated from Port of San Diego's 2012 Inventory.
[c] Time in notch from RSD, which matches 2012 rulemaking and 2012 inventory.

[6] *Locomotive Emission Standards – Regulatory Support Document*. EPA-420-R-98-101. April 1998.

[7] See Table 5-5 of the 2012 Maritime Air Emissions Inventory.

## 5.3 Emission Estimation Methodology

Locomotive emissions are calculated by using activity-based emission factors together with the activity presented in Section 5.2. Two sets of emissions factors were developed: one for BNSF line-haul locomotives and one for the switcher at TAMT.

Line haul emission factors are based in part on BNSF's Memorandum of Understanding (MOU) compliance data that is submitted annually to the California Air Resources Board (ARB), which summarizes the work (megawatt-hours [MWh]) and nitrogen oxide ($NO_X$) emissions rating (in grams per hp-hr [g/hp-hr]). 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, which is 5.1 g/hp-hr as of 2015, per the MOU with ARB and the South Coast Air Quality Management District. While emission factors for other pollutants are not provided, these compliance data can be used to assign other emissions factors based on EPA locomotive emission factors by tier from the 2008 Rulemaking. Emission factors for other emissions are based on the same activity (MWh sum by tier) as assumed in the $NO_X$ calculation. The EPA only provides tier-specific emission factors for hydrocarbons, particulate matter, and carbon monoxide (CO) in addition to $NO_X$ (which is already weighted per the MOU). Emission factor weighting for hydrocarbon, particulate matter, and CO emissions is provided in Table 5-5.

The weighted tier-specific emission factors shown in Table 5-5 are used to estimate emission factors for all pollutants included in this study. The reactive organic gas (ROG) emission factor estimate is based on a 1.053 total hydrocarbon to ROG conversion factor from the EPA rulemaking. Particulate matter is equal to particulate matter 10 microns or less in diameter (PM10), and particulate matter 2.5 microns or less in diameter (PM2.5) is assumed to be 97% of PM10. Diesel particulate matter (DPM) is assumed to equal PM10. Sulfur dioxide ($SO_2$) and carbon dioxide ($CO_2$) 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. Methane ($CH_4$) and nitrous oxide ($N_2O$) emission factors are taken from the Climate Registry default emission factors for $CH_4$ and $N_2O$, which are 0.038 g/hp-hr (based on 0.8 gram per gallon) and 0.013 g/hp-hr (based on 0.26 gram per gallon).[8] A summary of line-haul emission factors after weighting and after the above conversions is provided in Table 5-6.

[8] The Climate Registry, *2017 Default Emission Factors*, available at: https://www.theclimateregistry.org/wp-content/uploads/2017/05/2017-Climate-Registry-Default-Emission-Factors.pdf.

**Table 5-5. Line-Haul Emission Factor Weighting**

| Tier | BNSF Agreement Locomotive Compliance Summary Information [a] | | | Other Emission Factor Weighting [b] | | |
|---|---|---|---|---|---|---|
| | Sum of MWh | %MWh by Tier | $NO_X$ | Particulate Matter | Hydrocarbons | CO |
| Pre-Tier 0 | 15 | 0% | 13.0 | 0.32 | 0.48 | 1.28 |
| Tier 0 | 6,049 | 3% | 7.5 | 0.32 | 0.48 | 1.28 |
| Tier 1 | 77,662 | 35% | 6.2 | 0.32 | 0.47 | 1.28 |
| Tier 2 | 92,689 | 41% | 4.5 | 0.18 | 0.26 | 1.28 |
| Tier 3 | 46,425 | 21% | 4.3 | 0.08 | 0.13 | 1.28 |
| Tier 4 | 1,336 | 1% | 1.2 | 0.015 | 0.04 | 1.28 |
| Total | 224,176 | 100% | 5.1 | 0.21 | 0.31 | 1.28 |

[a] Based on BNSF's 2015 compliance data, available here: https://www.arb.ca.gov/railyard/1998agree/1998arch.htm#2015. Note that BNSF 2016 compliance data were not available at the time of analysis.
[b] Based on EPA Locomotive Exhaust Emissions Factors, available here: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100500B.PDF?Dockey=P100500B.PDF.

For switchers, the emissions factors are pulled directly from EPA compliance data for the GP-60 model. The EPA data provide switch-duty emission factors for hydrocarbons, CO, $NO_X$, and particulate matter. The ROG emission factor estimate is based on a 1.053 conversion factor from EPA rulemaking, particulate matter is equal to PM10, PM2.5 is assumed to be 97% of PM10, and DPM is assumed to equal PM10. $SO_2$ and greenhouse gas (GHG) emission factors are taken from the 2015 Port of Long Beach Inventory based on the EPA GHG inventory. A summary of all emission factors for line haul and the switcher is presented in Table 5-6.

**Table 5-6. Summary of Locomotive Emission Factors (g/hp-hr)**

| Locomotive Type | ROG | $NO_X$ | CO | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Line Haul | 0.33 | 5.1 | 1.28 | 0.21 | 0.20 | 0.21 | 0.09 | 491 | 0.038 | 0.013 |
| Switchers | 0.43 | 10.6 | 0.4 | 0.16 | 0.16 | 0.16 | 0.01 | 678 | 0.05 | 0.02 |

## 5.4 Results

Total regional and switching locomotive emissions for both cargo terminals for 2016 for the Port of San Diego are summarized in Table 5-7. Regional and switching locomotive emissions by terminal are summarized in Table 5-8. Of note is that the majority of locomotive activity and emissions is associated with automobile transport to and from NCMT. This is because most of the cargo at TAMT, which includes refrigerated containers, dry bulk goods (cement, bauxite, fertilizers), and various multi-purpose general cargo (generic “project cargo” as well as building and manufacturing materials), is not transported by rail, but instead by truck. Train activity at TAMT is essentially only associated with soda ash imports a few days a year, whereas automobile cargo is moved by both truck and rail at NCMT on a more frequent schedule.

**Table 5-7. Summary of Locomotive Emissions (tons)**

| Type | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ (tons) | $CO_2e$ (MT) |
|---|---|---|---|---|---|---|---|---|---|
| Line Haul | 1.46 | 5.7 | 23.0 | 0.94 | 0.91 | 0.94 | 0.40 | 2,215 | 2,009 |
| Switching | 0.46 | 1.8 | 7.3 | 0.30 | 0.29 | 0.30 | 0.13 | 702 | 637 |
| Total | 1.92 | 7.5 | 30.3 | 1.24 | 1.20 | 1.24 | 0.53 | 2,916 | 2,646 |

**Table 5-8. Summary of Locomotive Emissions by Terminal (tons)**

| Type | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ (tons) | CO2e (MT) |
|---|---|---|---|---|---|---|---|---|---|
| ***TAMT*** | ***0.03*** | ***0.1*** | ***0.5*** | ***0.02*** | ***0.02*** | ***0.02*** | ***0.01*** | ***42*** | ***39*** |
| Off-Port (regional) | 0.02 | 0.1 | 0.4 | 0.02 | 0.02 | 0.02 | 0.01 | 38 | 34 |
| On-Port (switching) | 0.00 | 0.0 | 0.1 | 0.00 | 0.00 | 0.00 | 0.00 | 5 | 4 |
| ***NCMT*** | ***1.89*** | ***7.4*** | ***29.8*** | ***1.22*** | ***1.18*** | ***1.22*** | ***0.52*** | ***2,874*** | ***2,607*** |
| Off-Port (regional) | 1.44 | 5.6 | 22.6 | 0.92 | 0.90 | 0.92 | 0.40 | 2,177 | 1,975 |
| On-Port (switching) | 0.46 | 1.8 | 7.2 | 0.30 | 0.29 | 0.30 | 0.13 | 697 | 632 |

Figure 5-1 shows the relative contribution of each pollutant by terminal. As shown, the majority of most pollutants is emitted by train activity associated with NCMT operations. Figure 5-2 shows the relative contribution of each pollutant by locomotive activity.

**Figure 5-1. Relative Contribution of Pollutants by Terminal**

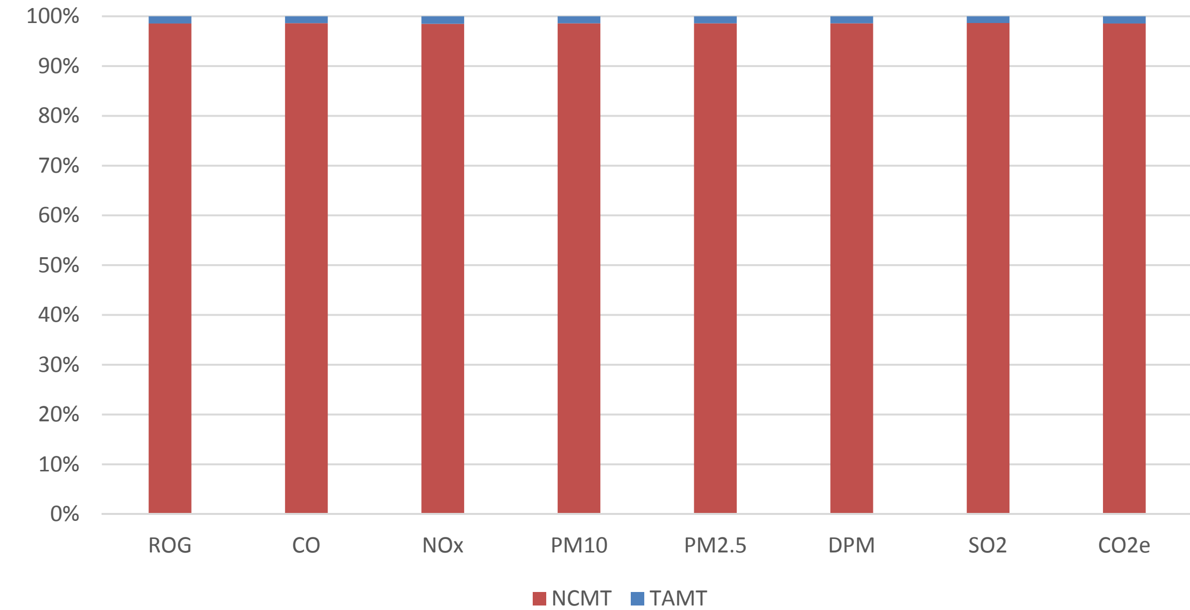
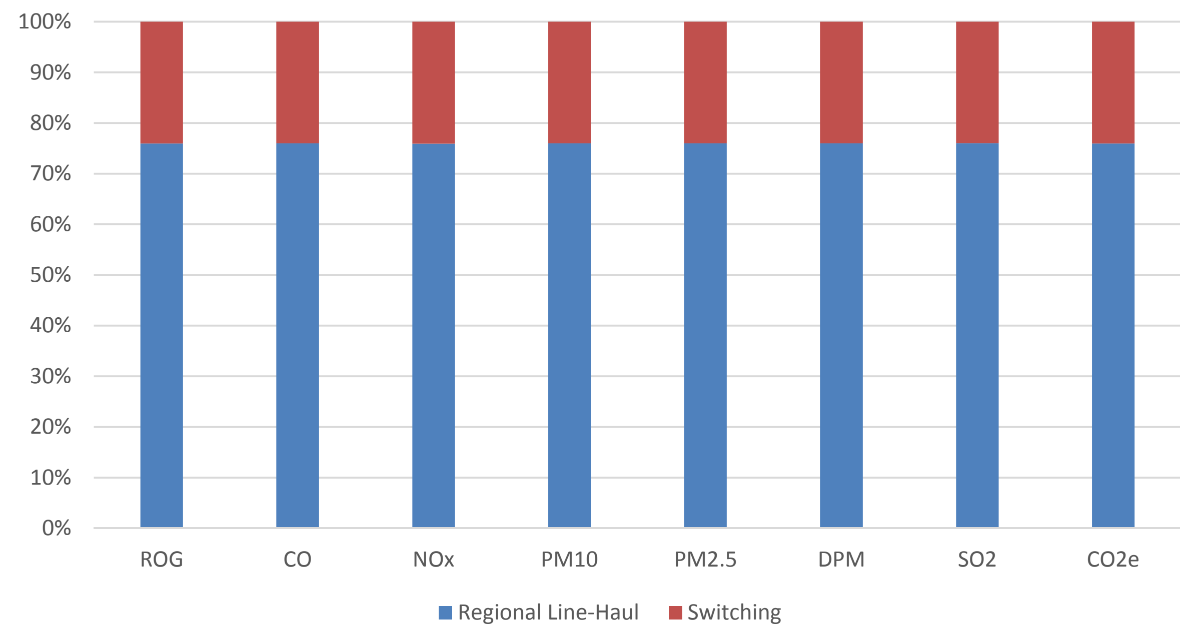



**Figure 5-2. Relative Contribution of Pollutants by Activity**



# 6 Heavy-Duty Trucks and On-Road Vehicles

On-road vehicles include: (1) heavy-duty trucks that are used to transport port-related cargo between National City Marine Terminal (NCMT) and Tenth Avenue Marine Terminal (TAMT) and local and regional destinations; (2) vehicle on-loading and off-loading at NCMT; and (3) passenger-related vehicles and deliveries related to cruise ship activity. This section describes heavy-duty truck and on-road vehicle activity operating at the Port of San Diego (Port), including activity assumptions and methodologies that were used to develop emission estimates. It also presents the results of the emissions inventory and includes a comparison to previous inventories.

## 6.1 Source Description

Heavy-duty trucks travel between NCMT and TAMT and local and regional destinations. At TAMT, trucks mainly consist of refrigerated container trucks, dry bulk and unibody trucks to move dry bulk (e.g., cement, bauxite, and fertilizers) and multi-purpose general cargo (e.g., windmill parts), as well as other miscellaneous deliveries. At NCMT, trucks mainly consist of car carriers, along with some flatbeds and trailers to move project (general) cargo, and material (parts) deliveries for automobile services.

In order to properly account for all emissions associated with truck travel, activity for truck trips is split geographically between the following activities:

- On-port moves, which include truck movement and idling within the terminal boundary as trucks move into position to pick up or drop off cargo
- Near-port moves, which include truck movement between the terminal gates and the freeway, or the final destination or origin for trips that do not travel on the freeway
- Off-port moves, which include truck movement on the regional freeway network between freeway access 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 loading onto trucks or rail. At the Cruise Ship Terminal (CST), vehicles associated with cruise ship activity include taxis, shuttle and charter vehicles, buses, and personal vehicles to move passengers and staff to and from the terminal. Furthermore, delivery trucks transport cruise ship cargo and supplies while vessels are berthed.

## 6.2 Data Collection and Activity

Information on the number of terminal truck trips and destinations by cargo type, delivery and passenger car visitation, and the volume of off-loaded automobiles was obtained from Port staff. Data collection and activity is described separately for terminal trucks, NCMT new car arrivals, and CST passengers below.

### 6.2.1 Terminal Trucks

For heavy-duty terminal trucks, the truck counts (one trip inbound and outbound for each gate count) and the distribution of trucks by destination was obtained from the Port. Truck trips and vehicle miles traveled (VMT) by destination were estimated based on travel distance, taking into account assumed speeds on the local and regional roadway network. At TAMT, refrigerated container and cold storage trucks primarily travel north toward Orange County along Interstate 5 or south to the National Distribution Center in National City. A smaller portion of the refrigerated truck traffic travels north toward Riverside County along Interstate 15 and east toward Imperial County along Interstate 8. For dry bulk and other general cargo, trip distributions vary by cargo type. For example, all cement arrives via Victorville and stays within the county, all fertilizer (other bulk) goes to a local distributor in National City, and bauxite is distributed regionally. 57,219 trucks visited TAMT in 2016. Truck counts are provided in Table 6-1.

At NCMT, all trucks travel to and from the terminal along Bay Marina Drive. A small share of car carrier trucks go directly to local dealerships in National City along Mile of Cars Way, while the majority of trucks travel up Interstate (I-) 5 and I-15 for regional distribution. Other trucks at NCMT include assorted general (project) cargo and auto processing part deliveries; a small share travel regionally, while most of the trucks originate and/or end in Miramar. 15,540 trucks visited NCMT in 2016. Truck counts are provided in Table 6-1.

Terminal truck activity is split between three distinct travel modes: on-site travel and idling within the terminal boundary (on-port), truck travel between the terminal and nearest freeway entrance (near-port), and travel between the freeway entrance and local and regional destinations (off-port regional). On-port distance and time duration per truck are taken directly from the 2012 inventory and presented in Tables 6-2 and 6-3. 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.

A description of the directions trucks from TAMT take on the local and regional transportation network is as follows:

- Trucks that deliver cargo to Orange County travel north on I-5 and are assumed to travel on Harbor Drive and access I-5 North via 28$^{th}$ Street.
- Trucks that deliver cargo to Miramar and Riverside travel north on I-15 and are assumed to travel on Harbor Drive and access I-15 via 32$^{nd}$ Street.
- Trucks that deliver cargo to Imperial County travel east on I-8 and are assumed to travel on Harbor Drive and access I-15 via 32$^{nd}$ Street.
- Trucks that deliver cargo to the National Distribution Center are assumed to travel on Harbor Drive to Tidelands Avenue to Bay Marina Drive.
- Trucks that deliver cargo to bulk destinations in National City are assumed to travel on Harbor Drive and access Main Street via 32$^{nd}$ Street.

A description of the directions trucks from NCMT take on the local and regional transportation network is as follows:

- All trucks that do not deliver cargo to Mile of Cars Way are assumed to travel north on both I-5 and I-15, and are assumed to travel on Bay Marina Drive and access I-5 directly off Bay Marina Drive.
- Trucks that travel directly to Mile of Cars Way in National City do not access the freeway but instead travel on Bay Marina Drive to Mile of Cars Way.

The distance traveled (in miles) within each travel leg was measured with geographic information systems (GIS). Speeds on local surface streets were taken from the 2012 inventory and match the posted speed limits, while freeway travel is based on an aggregate (average) travel speed from the California Air Resources Board's (CARB's) EMFAC database.

**Table 6-1. Terminal Truck Gate Counts by Type and Cargo**

| Truck Type | Counts | Cargo |
|---|---|---|
| **TAMT** | **57,219** | -- |
| Cold Storage | 4,784 | Refrigerated Containers |
| Container | 33,721 | Refrigerated Containers |
| Cement | 10,504 | Dry Bulk/Cement |
| Bauxite | 2,312 | Dry Bulk/Bauxite |
| Unibody | 2,256 | Other Dry Bulk |
| Miscellaneous | 3,642 | Miscellaneous (deliveries, etc.) |
| **NCMT** | **15,540** | -- |
| Car Carriers | 11,263 | Automobiles |
| PST | 3,288 | Automobiles |
| Parts | 823 | Material Deliveries |
| Bobtail/Flatbed | 166 | Project/General Cargo |

**Table 6-2. Heavy-Duty Truck Activity Assumptions at TAMT**

| Cargo | Activity or Direction | Travel Mileage or Idle Hours per Truck |
|---|---|---|
| **On-Port (within terminal boundary)** | | |
| All | Driving | 0.5 |
| All | Idling | 0.4 |
| **Near-Port (local roadway travel)** | | |
| Refrigerated Containers | 64% take Harbor Dr. to 28th to access I-5 | 2.5 |
| | 12% take Harbor Dr. to 32nd St to access I-15 | 3.0 |
| | 5% take Harbor Dr. to 32nd St to access I-15 to I-8 | 3.0 |
| | 19% Take Harbor Dr. to Tidelands Ave to Access National Distribution Center (local streets only) | 4.6 |
| Bauxite | 100% take Harbor Dr. to 32nd St to Access I-15 | 2.4 |
| Cement | 50% of trips are inbound delivery trips that access the terminal via 32nd street, Harbor Dr,. and I-15 | 2.4 |
| | 50% of trips are outbound trips that are assumed to take Harbor Dr. to 32nd Street to access I-15 for local deliveries | 2.4 |
| Other Dry Bulk | 89% of trips take Harbor Dr. to 32nd St and Main St to facility in National City | 5.2 |
| | 11% Take Harbor Dr. to 32nd St to access I-15 | 2.4 |
| Misc. (deliveries, etc.) | 99% take Harbor Drive to 32nd St to access I-15 for local origin/destination (assumed to be Miramar) | 2.4 |
| | 1% take Harbor Dr. to 28th to access I-5 (regional origin/destination assumed to be Long Beach) | 2.2 |
| **Off-Port (Regional highway travel)** | | |
| Refrigerated Containers | 64% take I-5 North to Orange County | 118 |
| | 12% take I-15 North to Riverside County | 113 |
| | 5% take I-8 East to Imperial County | 150 |
| | 19% go straight to National Distribution Center | - |
| Bauxite | 100% assumed to take I-15 to Riverside County | 113 |
| Cement | 50% inbound from Victorville/Riverside via I-15 | 113 |
| | 50% outbound for local deliveries via I-15 | 34 |
| other bulk | 89% goes to facility in National City | - |
| | 11% remainder is "other bulk", out for local deliveries, assumed to be Miramar | 34 |
| Misc. (deliveries, etc.) | 99% from local origin/destination, assumed to be Miramar | 34 |
| | 1% regional origin/destination, assumed to be Long Beach | 118 |

**Table 6-3. Heavy-Duty Truck Activity Assumptions at NCMT**

| Cargo | Activity or Direction | Travel Mileage or Idle Hours per Trip |
|---|---|---|
| **On-Port (within terminal boundary)** | | |
| All | Driving | 0.5 |
| All | Idling | 1.5 |
| **Near-Port (local roadways travel)** | | |
| Car carriers (local destination) | 10% of trucks take Bay Marina to access Mile of Cars Way | 1.8 |
| Car carriers and all general cargo and miscellaneous | 90% take Bay Marina to Access I-5 and I-15 north | 1.2 |
| **Off-Port (regional highway travel)** | | |
| Car carriers (regional destinations) | 90% take I-5 and I-15 to Riverside County | 114 |
| Miscellaneous and general cargo trucks | 99% goes to Miramar via I-5 and I-15 | 40 |
| Miscellaneous and general cargo trucks | 1% goes to Riverside County via I-5 and I-15 | 114 |

### 6.2.2 New Car Arrivals

At NCMT, imported cars are off-loaded and moved to parking locations at or near the terminal. Similar to the 2012 inventory, it was assumed that vehicles were driven a distance of 1.5 miles. In addition, because cars are on the vessels for multiple days and remain in the parking areas for multiple days, starting and evaporative hydrocarbon resting loss emissions are considered. It was assumed each off-loaded car cold starts on the vessel, and emits 1 hour of hot soak losses once the car is parked,[1] with time spent equally between resting and diurnal losses over the expected 10.9 days the average car remains parked.[2]

[1] *Hot soak emissions* are evaporative emissions that occur when vapors escape within 1 hour after the engine has been turned off. *Diurnal emissions* result from evaporation that occurs when the vehicle is not being operated and the ambient temperature is rising. *Resting loss emissions* are defined as losses when the vehicle has not been operated for at least an hour and the ambient temperature is either constant or decreasing.

[2] Based on the estimated Dwell Time from the National City Tank Farm EIR, Table ES-4.

It was further assumed that all vehicles off loaded are new light duty cars and trucks. Therefore, emissions are based on model year 2016 light-duty automobile (LDA), light-duty truck 1 (LDT1), and light-duty truck 2 (LDT2) rates from EMFAC2017. EMFAC2017 emissions rates are based on a 10-mile-per-hour travel speed and assume all cars are new (model year 2016). In 2016, there were a total of 430,356 new cars off-loaded at the NCMT.[3]

### 6.2.3 Cruise Ship Terminal

On-road vehicles associated with cruise ship calls include personal vehicles, for-hire taxis, shuttle buses, and delivery trucks. Based on information from the 2012 inventory, all shuttle buses and for-hire vehicles were assumed to travel between the airport and the CST (a round trip of 5.2 miles) and personal vehicles were assumed to make trips from the population center of San Diego County (a round trip of 27.5 miles). In addition, this inventory includes activity associated with cruise ship cargo and material deliveries, and the vehicle assumption differentiates between homeport calls (new passengers embark or disembark) and Port of Calls (no new passengers; cruise ship just on a stopover). Port of Calls only berth for a short time and do not accept new passengers, so deliveries are limited. Homeport calls drop off and receive a whole new group of passengers, so delivery trips are substantially higher. According to Port staff, there are a combined 10 delivery and bus trips for Port of Calls and 40 delivery and bus trips for homeport calls. Delivery truck travel distance was assumed to be the default vendor trip length in the California Emissions Estimator Model (CalEEMod) (one-way distance of 7.3 miles). The estimate of passengers per cruise ship call is based on 216,035 passengers over 74 calls during calendar year 2016. Table 6-4 below summarizes the activities for the CST. It was assumed that Port of Calls and homeport calls are the same except for delivery trucks, which are higher for homeport calls.

[3] CARB's On-Road Emission Factor Model is available at: https://www.arb.ca.gov/msei/categories.htm#onroad_motor_vehicles.

**Table 6-4. Vehicle Trips per Cruise Ship Call and Annual VMT**

| Type of Transportation | Vehicle Type | Passengers/ Vehicle | # of Vehicles | Passengers per Call | Miles/ R-Trip | VMT per Call | VMT Annually |
|---|---|---|---|---|---|---|---|
| **Port of Calls (35 calls)** | | | | | | | |
| Taxis | LDA | 3 | 233 | 699 | 5.2 | 1,212 | 42,406 |
| Shuttles | MDV | 7 | 44 | 306 | 5.2 | 229 | 8,008 |
| Charter | LDT1 | 4 | 73 | 291 | 5.2 | 380 | 13,286 |
| Buses | Motor Coach | 40 | 8 | 311 | 5.2 | 42 | 1,456 |
| POVs | LDA | 4 | 328 | 1,312 | 27.5 | 9,020 | 315,700 |
| *Total Passengers* | - | - | *686* | *2,919* | - | *10,882* | *380,856* |
| Box Deliveries | T7 Tractor | - | 2 | - | 7.3 | 14.6 | 511 |
| **Total Port of Calls** | **-** | **-** | **688** | **-** | **-** | **10,896** | **381,367** |
| **Homeport Calls (39 calls)** | | | | | | | |
| Taxis | LDA | 3 | 233 | 699 | 5.2 | 1,212 | 47,252 |
| Shuttles | MDV | 7 | 44 | 306 | 5.2 | 229 | 8,923 |
| Charter | LDT1 | 4 | 73 | 291 | 5.2 | 380 | 14,804 |
| Buses | Motor Coach | 40 | 8 | 311 | 5.2 | 42 | 1,622 |
| POVs | LDA | 4 | 328 | 1,312 | 27.5 | 9,020 | 351,780 |
| *Total Passengers* | - | - | *686* | *2,919* | - | *10,882* | *424,382* |
| Box Deliveries | T7 Tractor | **-** | 32 | **-** | 7.3 | 233.6 | 9,110 |
| **Total Homeport Calls** | **-** | **-** | **718** | **-** | **-** | **11,115** | **433,493** |

## 6.3 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. As discussed in Section 6.2 above, vehicle types are separated into heavy-duty trucks that serve the terminals; passenger vehicles, for-hire buses and shuttles, and material delivery trucks that serve the CST; and passenger vehicles that are off-loaded from vessels at NCMT. Emissions from each of these sources are calculated according to the following general equation:

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

Where E = Emissions, in tons or metric tons per year, from truck and on-road vehicle activity
EF = Emission factor for each vehicle type for each pollutant, in grams per mile for travel and grams per idle-hour for idling (see subsection below)
T = Number of each vehicle trips (see Section 6.2 above)
Mi = Mileage for each vehicle trip based on origin and destination (see Section 6.2 above)
Conv = Grams to short tons or metric tons conversion

Vehicle emissions from diesel engines can be classified in two types: running emissions and idling emissions. Running exhaust emissions are estimated based on the VMT, which is the product of the number of trips multiplied by the distance. Idling exhaust emissions are estimated based on the number of trips multiplied by time idling per trip. Moreover, the majority of passenger cars and trucks are gasoline powered. Gasoline vehicles also include evaporative loss emissions from the fuel storage and delivery system within vehicles. This occurs whether the vehicle is running or not and whether the ambient temperature is increasing or decreasing. The types of evaporative emissions processes are individually described below. Emission factors from EMFAC used in this analysis are provided in Table 6-5. Emissions are estimated based on emission factors from CARB's EMFAC2017 model.

**Table 6-5. On-Road Vehicle Emission Factors (grams per mile or grams per idle-hour)**

| Source | Speed or Activity | ROG | CO | $NO_x$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Terminal Trucks | Idle | 2.38 | 20.29 | 49.98 | 0.02 | 0.02 | 0.02 | 0.07 | 6,993 | 0.11 | 1.10 |
| | 10 | 1.02 | 3.23 | 12.14 | 0.05 | 0.05 | 0.05 | 0.03 | 3,230 | 0.05 | 0.51 |
| | 25 | 0.37 | 1.14 | 6.87 | 0.03 | 0.03 | 0.03 | 0.02 | 2,051 | 0.02 | 0.32 |
| | 35 | 0.21 | 0.63 | 5.58 | 0.03 | 0.03 | 0.03 | 0.02 | 1,712 | 0.01 | 0.27 |
| | 40 | 0.15 | 0.47 | 5.16 | 0.03 | 0.03 | 0.03 | 0.02 | 1,602 | 0.01 | 0.25 |
| | Aggregate | 0.33 | 1.02 | 6.59 | 0.04 | 0.04 | 0.04 | 0.02 | 1,942 | 0.02 | 0.31 |
| NCMT New Car Offloading | Aggregate | 0.02 | 0.72 | 0.03 | 0.01 | 0.01 | 0.00 | 0.01 | 521 | 0.01 | 0.00 |
| | Starting | 0.32 | 4.62 | 0.12 | 0.01 | 0.00 | 0.00 | 0.00 | 136 | 0.06 | 0.01 |
| | Hot Soak | 0.01 | - | - | - | - | - | - | - | - | - |
| | Resting | 0.002 | - | - | - | - | - | - | - | - | - |
| | Diurnal | 0.004 | - | - | - | - | - | - | - | - | - |
| Taxis/Cars | Aggregate | 0.03 | 1.10 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 310 | 0.01 | 0.01 |
| Shuttles | Aggregate | 0.05 | 1.68 | 0.21 | 0.00 | 0.00 | 0.00 | 0.00 | 485 | 0.01 | 0.02 |
| Charter | Aggregate | 0.08 | 2.52 | 0.26 | 0.00 | 0.00 | 0.00 | 0.00 | 363 | 0.02 | 0.02 |
| Buses | Aggregate | 0.48 | 1.51 | 7.99 | 0.23 | 0.22 | 0.23 | 0.02 | 1,646 | 0.02 | 0.26 |
| Deliveries | Aggregate | 0.40 | 1.40 | 7.61 | 0.22 | 0.21 | 0.22 | 0.01 | 1,516 | 0.02 | 0.24 |

## 6.4 Results

Table 6-6 summarizes the 2016 heavy-duty trucks and on-road vehicle inventory for each trip type and by terminal. As shown, the majority of emissions are from heavy-duty truck activity associated with cargo movement, with CST passenger travel composing the largest share of the non-goods movement trip types.

**Table 6-6. On-Road Vehicle Emission Estimates (tons)**

| Terminal | Source | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | CO2e (tons) | CO2e (MT) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Terminal Trucks** | | | | | | | | | | |
| TAMT | On-Terminal | 0.1 | 0.6 | 1.6 | <0.1 | <0.1 | <0.1 | <0.1 | 291 | 264 |
| | Near-Port | <0.1 | 0.1 | 1.1 | <0.1 | <0.1 | <0.1 | <0.1 | 346 | 314 |
| | Regional | 1.8 | 5.5 | 35.7 | 0.2 | 0.2 | 0.2 | 0.1 | 11,025 | 10,002 |
| NCMT | On-Terminal | 0.1 | 0.5 | 1.4 | <0.1 | <0.1 | <0.1 | <0.1 | 217 | 197 |
| | Near-Port | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 39 | 35 |
| | Regional | 0.6 | 1.7 | 11.1 | 0.1 | 0.1 | 0.1 | <0.1 | 3,436 | 3,117 |
| *Terminal Truck Total* | | *2.5* | *8.5* | *51.1* | *0.3* | *0.3* | *0.3* | *0.1* | *15,354* | *13,929* |
| **NCMT New Car Off-Loading** | | | | | | | | | | |
| *NCMT New Car Total* | | *0.6* | *2.7* | *0.1* | *<0.1* | *<0.1* | *<0.1* | *<0.1* | *437* | *397* |
| **Cruise Ship Terminal Passenger Travel** | | | | | | | | | | |
| | Taxis | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 31 | 28 |
| | Shuttles | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 9 | 8 |
| | Charter | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 11 | 10 |
| | Buses | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 6 | 5 |
| | Vehicles | <0.1 | 1.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 230 | 209 |
| | Deliveries | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 17 | 15 |
| *CST Passenger Total* | | *<0.1* | *1.0* | *0.2* | *<0.1* | *<0.1* | *<0.1* | *<0.1* | *304* | *276* |
| **Total** | | **3.1** | **12.3** | **51.4** | **0.3** | **0.3** | **0.3** | **0.1** | **16,095** | **14,601** |

Figure 6-3 shows the relative contribution of each pollutant by terminal. As shown, the majority of most pollutants is emitted by trucks from TAMT, with lesser amounts at NCMT and much less at CST.

Figure 6-4 shows the relative contribution of each pollutant by vehicle type (i.e., terminal trucks, car off-loading, and cruise ship passenger). As shown, the majority of vehicle-related emissions is from terminal truck travel associated with TAMT and NCMT operations, with lesser amounts associated with CST passengers (the sum of vehicles, shuttles, and deliveries) and car off-loading at NCMT.

**Figure 6-1. Relative Contribution of Pollutants by Terminal**

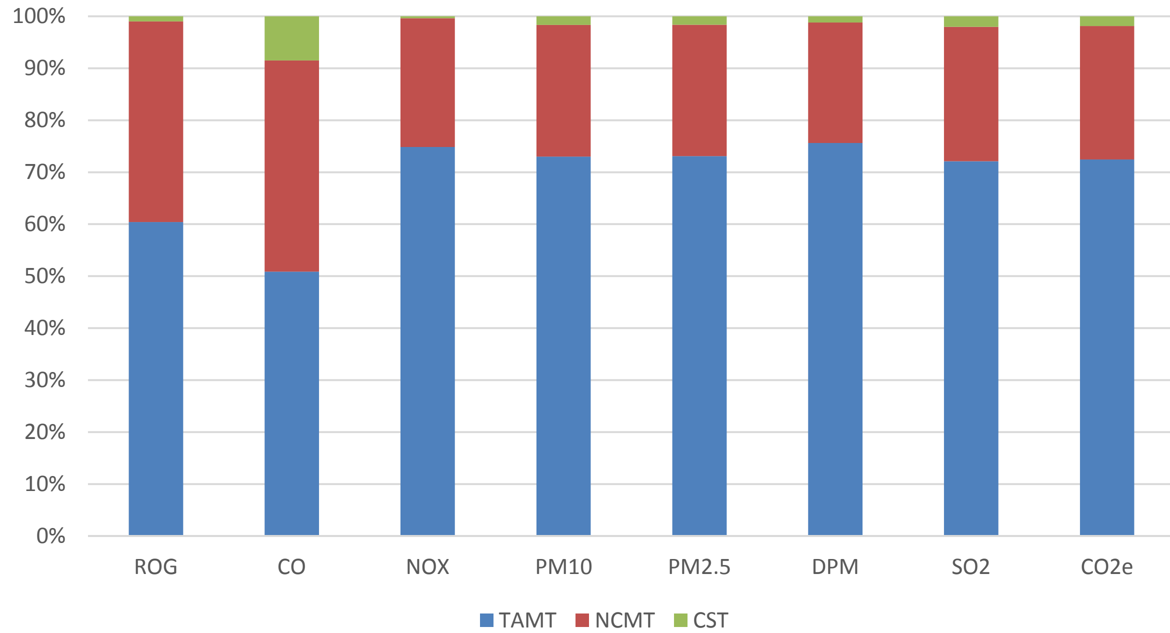
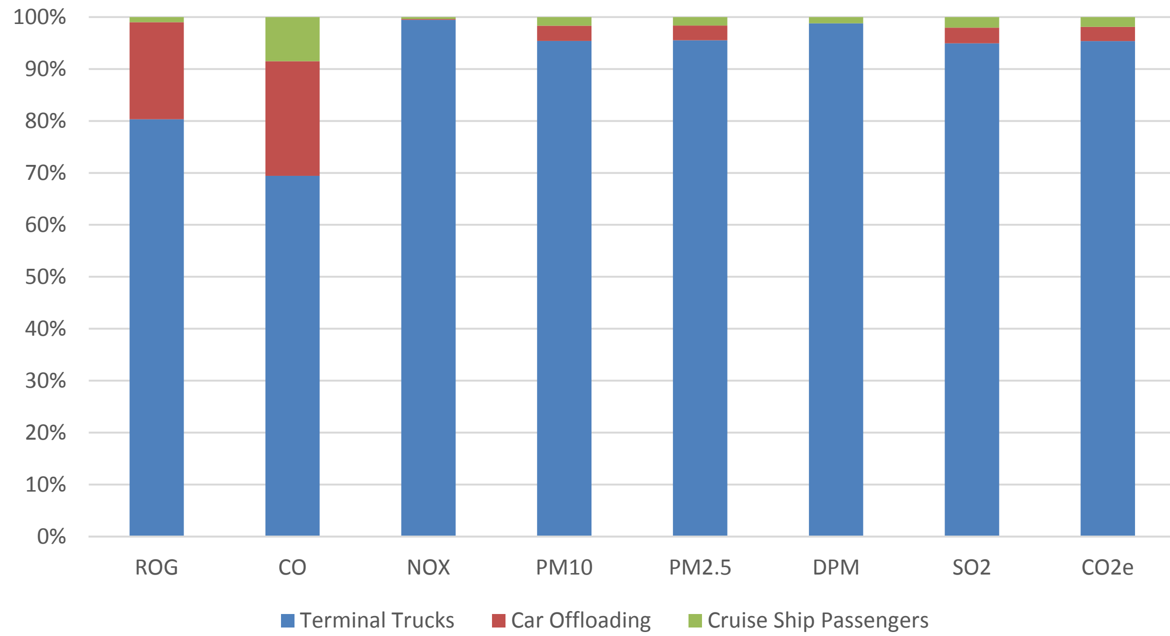



**Figure 6-2. Relative Contribution of Pollutants by Vehicle Type**



# 7 Recreational Boating

Recreational boats are non-commercial harbor craft that are used solely for personal enjoyment on San Diego Bay. These include a variety of gasoline- and diesel-powered vessels and spend the vast majority of their operating hours within the Bay. While recreational boating has not been included in previous Port of San Diego-wide air emission inventories, recreational boating greenhouse gas (GHG) emissions were included in the GHG emissions inventory within the San Diego Unified Port District's (Port's) Climate Action Plan (CAP), and an inventory of emissions in 2016 helps to serve as an update to the emission projections in the CAP. Moreover, recreational boating results in criteria pollutants that have never been fully quantified. This chapter describes activity and emission estimates for recreational boating at the Port in 2016.

## 7.1 Source Description

San Diego Bay has numerous marinas and yacht clubs as well as four public boat launch ramps. Recreational boating occurs from boats that are permanently in the water (i.e., docked at marinas throughout the Bay and region) and boats that are stored elsewhere and launched for day use only. The types of recreational boats include personal watercraft (jet skis), sailboats, jet boats, and yachts that are used for fishing, cruising, swimming, and water skiing. The majority of recreating boats are smaller gasoline-powered vessels that are used for a day at a time within the Bay, while some larger yachts dock and remain in the Bay for up to weeks at a time. While recreational boating is not associated with cargo movement, the prevalence of marinas and boating in the Bay is important in estimating the entirety of maritime emissions.

## 7.2 Data Collection and Activity

The Port obtained gasoline and diesel fuel sales from its three fuel docks (Harbor Island West Associates, High Seas Marine Enterprises, and Pearson Marine Fuels) for calendar year 2016. Various types of harbor craft fuel at the fuel docks, including commercial and sport fishing in addition to recreational boats. Two of the fuel docks—High Seas Marine Enterprises and Pearson Marine Fuels—are located on Shelter Island, directly adjacent to much of the commercial and sport fishing fleet that is anchored at Shelter Island. The other fuel dock—Harbor Island West Associates—is located at the western portion of Harbor Island. It was assumed that commercial and sport fishing vessels are the only commercial harbor craft that fuel at these docks. In addition, the Port-owned vessels operated by various departments or Harbor Police fuel at these docks. To ensure that Port -wide maritime emissions are not double-counted, estimated fuel consumption associated with these commercial fishing, sport fishing, and Port vessels were subtracted from the fuel dock sales. Based on communication with the Port, it was assumed all other commercial vessels (e.g., tugs, workboats, pilot vessels) have other fueling options that are likely more economical to their respective vessel fleets; therefore, these vessels fuel elsewhere and their fuel consumption is not included in the fuel dock sales per conversations with Port staff. A summary of the harbor craft fuel removed from the fuel sales is shown in Table 7-1. Harbor craft fuel to be removed is calculated by converting harbor craft carbon dioxide ($CO_2$) emission estimates to fuel consumption by dividing $CO_2$ emissions (in kilograms) by 8.61 kilograms per gallon for gasoline and 10.24 kilograms per gallon for diesel.

**Table 7-1. Adjustment for Commercial Harbor Craft Fuel**

| Source | Total $CO_2$ | Diesel $CO_2$ | Gasoline $CO_2$ | Gasoline (gallons)[c] | Diesel (gallons)[c] |
|---|---|---|---|---|---|
| Commercial Fishing[a] | 1,973 | 1,945 | 28.27 | 172,306 | 2,979 |
| Sport Fishing[a] | 4,877 | 4,877 | | 432,088 | - |
| Port Harbor Police[b] | - | - | - | 52,899 | 11,918 |
| **Total** | **-** | **-** | **-** | **657,292** | **14,897** |

[a] Commercial and sport fishing $CO_2$ estimates are described in Chapter 3, *Commercial Harbor Craft*.
[b] Harbor Police fuel consumption was obtained directly from the Port.
[c] Gasoline $CO_2$ converted to gallons based on 8.61 kilograms per gallon from GREET; diesel $CO_2$ converted to gallons based on 10.24 kilograms per gallon from GREET

Furthermore, the Bay contains four boat launch access points, which allow boaters to launch boats that are not docked at slips. According to the 2011 California Boater Survey,[1] a majority of recreational boaters surveyed obtain their fuel at a location other than a marina-based fuel dock. Therefore, in order to capture those boaters that burn fuel within the Bay but obtain their fuel outside of the Port's fuel docks, estimated fuel sales were scaled up to account for such fuels consumed but not purchased in the Bay. Based on the California Boater Survey, 37.2% of boaters fuel their boats at a marina fuel dock. Therefore, it is assumed that fuel dock sales, after adjusting for commercial harbor craft consumption, represent only 37.2% of the recreational boating fuel burned in the Bay. Note that the assumption here is that diesel fuel consumption is driven primarily by larger recreational boats, such as yachts, and that these boats are not launched from boat launch facilities. Therefore, this scaling does not occur for diesel fuel and only occurs for gasoline consumption. Table 7-2 summarizes recreational boating fuel consumption after removing harbor craft fuel consumption and after scaling up for these boat launch ramps.

[1] 2011 *California Boater Survey*, pg. 104, "Table 46. Usual Fuel Location." Available at: http://dbw.parks.ca.gov/pages/28702/files/FinalCABoatersReport_July2011_DG.pdf.

**Table 7-2. Recreational Boating Fuel Assumptions**

| Source | Gasoline (gallons) | Diesel (gallons) |
|---|---|---|
| Raw Fuel Dock Sales | 620,029 | 4,617,462 |
| Fuel Sales for Non-Recreational Boats[a] | 14,897 | 657,292 |
| *Subtotal - Recreational Boating Fuel Sales* | *605,132* | *3,960,169* |
| Estimated boat launch ramps sales purchased elsewhere[b] | 1,021,974 | N/A |
| Total - Recreational Boating Fuel Sales plus Boat Ramps | 1,627,106 | 3,960,169 |

[a] Non-recreational boats include the commercial fishing vessels, sport fishing vessels, and Harbor Police vessels, as presented in Table 7-1.
[b] Calculated assuming the 605,132 gallons of gasoline sold at fuel docks comprise only 37.2% of recreational boat gasoline consumption.

## 7.3 Emission Estimation Methodology

Recreational boating (pleasure craft) emissions are estimated based on fuel-based emission factors and fuel consumption. Unlike other sources of emissions covered in this analysis, characteristics regarding the size, type, and emissions profile of the recreational boating fleet that is active within the Bay is not known.

The ARB maintains the Pleasure Craft Emissions Model (PC Model[2]), which estimates activity (operation hours), population, fuel consumption, and emissions for various recreational boat (pleasure craft) types both statewide and at the sub-area (air basin, air district, and county) level. According to conversations with ARB staff, the PC Model includes US-flagged boats and allocates boats to the county level based on in-county registration. The PC Model produces criteria pollutant and $CO_2$ emission estimates based on activity hours. In order to provide an estimate of emissions, we first estimated emissions for those pollutants with fuel-based emissions factors, which include GHG emissions.

$CO_2$ emissions were estimated based on total adjusted fuel sales values shown in Table 7-2 (3,960,169 gallons of diesel and 1,627,106 gallons of gasoline). The $CO_2$ emission factor for gasoline and diesel fuel is based on fuel parameters from CA-GREET 2016 regarding gasoline and low-sulfur diesel fuel density and carbon content. Methane ($CH_4$) and nitrous oxide ($N_2O$) emissions were estimated based on fuel-based emission factors for ships and boats from The Climate Registry.[3]

[2] California Air Resources Board, *Recreational Watercraft Emissions Inventory Methodology*, November 2014.

[3] 2017 Default Emission Factor Update, available at: https://www.theclimateregistry.org/wp-content/uploads/2017/05/2017-Climate-Registry-Default-Emission-Factors.pdf.

For all criteria pollutants and diesel particulate matter (DPM), the PC Model was used. The PC Model estimates fuel consumption and activity for US-flagged recreational boats within San Diego County out to 24 nautical miles from the California baseline to produce emission estimates for reactive organic gas (ROG), nitrogen oxide ($NO_X$), carbon monoxide (CO), particulate matter, sulfur oxide ($SO_X$), and $CO_2$ emissions. To estimate criteria pollutants and DPM emissions, we determined the ratio of all pollutant emissions to $CO_2$ emissions by fuel type within the PC Model, and applied these ratios to the $CO_2$ emissions determined from fuel consumption. This approach allows inclusion of the fleet mix assumed in the ARB model to reflect recreational boating rulemaking along with fuel consumption specific to the Bay. Consistent with other sectors, we report only exhaust-based ROG emissions. Note that particulate matter 10 microns or less in diameter (PM10) from gasoline vessels is by default not considered DPM.

## 7.4 Results

An estimate of criteria pollutant and GHG emissions from recreational boating from 2016 is provided in Table 7-3. Based on this approach, gasoline recreational boating emissions of ROG, CO, PM10, and particulate matter 2.5 microns or less in diameter (PM2.5) are greater than from diesel vessels, while diesel boats produce more $NO_X$, DPM, and total GHGs. Note that gasoline recreational boating emissions include both 2- and 4-stroke and both carbureted and fuel-injected engines, and 2-stroke engines are responsible for much of the increased emissions of gasoline over diesel engines, particularly for ROG and CO. Gasoline is more volatile, which leads to higher ROG emissions and CO emission standards for gasoline (spark-ignition) are much higher than for diesel (compression-ignition).

Because emissions from recreational boating were not included in previous inventories, results cannot be compared to previous years.

**Table 7-3. Recreational Boating Emission Estimates (tons per year)**

| Fuel | ROG* | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2e$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Gasoline | 742.6 | 2,691.3 | 129.5 | 50.1 | 37.8 | - | 0.2 | 15,443 | 1.1 | 0.4 | 15,589 |
| Diesel | 90.7 | 135.6 | 306.1 | 6.8 | 5.2 | 6.8 | 0.2 | 44,696 | 0.3 | 2.0 | 45,288 |
| Total | 833.4 | 2,826.9 | 435.6 | 56.9 | 43.0 | 6.8 | 0.4 | 60,139 | 1.4 | 2.4 | 60,877 |

* ROG emissions only include exhaust. Evaporative emissions are not included.

# 8 Results and Discussion

This chapter summarizes emission results and discusses trends relative to previous inventories. Table 8-1 presents the emission results for the Port of San Diego (Port) 2016 maritime air emissions inventory. Table 8-2 presents the distribution of emissions for each pollutant and source category. As shown, either ocean-going vessels (OGVs) or harbor craft contribute the highest percentage for each pollutant. Note that emissions from recreational boating are not included in the results discussion below because emission estimates were not included in previous inventories.

**Table 8-1. Summary of 2016 Maritime Air Emission Inventory (tons)**

| Sector | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ (tons) | $CO_2e$ (MT) |
|---|---|---|---|---|---|---|---|---|---|
| Ocean-Going Vessels | 20 | 32 | 323 | 8 | 7 | 6 | 15 | 25,802 | 22,500 |
| Harbor Craft | 29 | 183 | 235 | 8 | 8 | 8 | <1 | 28,109 | 25,500 |
| Cargo Handling Equipment | 4 | 26 | 14 | 1 | 1 | 1 | 2 | 2,407 | 2,183 |
| Freight Rail | 2 | 8 | 30 | 1 | 1 | 1 | <1 | 2,916 | 2,646 |
| On-Road Vehicles | 3 | 12 | 51 | <1 | <1 | <1 | <1 | 16,095 | 14,601 |
| ***Total Emissions*** | ***59*** | ***261*** | ***653*** | ***17*** | ***17*** | ***16*** | ***18*** | ***74,330*** | ***67,431*** |

**Table 8-2. Percentage of Maritime Air Emission Inventory by Sector**

| Sector | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ |
|---|---|---|---|---|---|---|---|---|
| Ocean Going Vessels | 35% | 12% | **49%** | 43% | 42% | 38% | **85%** | 32% |
| Harbor Craft | **49%** | **70%** | 36% | **45%** | **46%** | **49%** | 3% | **38%** |
| Cargo Handling Equipment | 7% | 10% | 2% | 3% | 3% | 3% | 9% | 3% |
| Freight Rail | 3% | 3% | 5% | 7% | 7% | 8% | 3% | 4% |
| On-Road Vehicles | 5% | 5% | 8% | 2% | 2% | 2% | 1% | 22% |

Note: Maximum value for each pollutant shown in **bold**. Total may not add exactly to 100% due to rounding.

Maritime emissions occur within Port boundaries, within the San Diego Bay, and outside of both the Bay and Port boundaries. A summary of emissions at or near the terminals and away from the terminals is presented in Table 8-3.

Sources of emissions within the Port boundary and within the Bay include:

- OGV maneuvering and hoteling vessels
- Harbor craft activity within the harbor
- All cargo handling equipment (CHE) emissions
- Heavy-duty truck idling and movement at the terminals, along with all new car offloading

- Locomotive switching

Sources of emissions outside of the Port boundary and the Bay include:

- OGV transit within and outside the vessel speed reduction (VSR) zone, along with OGV anchorage
- Harbor craft activity outside of the harbor
- Heavy-duty truck movements between the terminal gates and first point of rest, along with all Cruise Ship Terminal passenger car activity
- Locomotive line-haul between the terminals and the county line

As shown, the majority of emissions (e.g., reactive organic gases [ROG], nitrogen oxide [$NO_X$], particulate matter, carbon dioxide equivalent [$CO_2e$]) occur within the Bay and near the terminals, primarily due to OGV maneuvering in the Bay and hoteling at the terminals, as well as commercial harbor craft activity in the Bay. The only pollutant with a greater share outside of the terminal area is sulfur dioxide ($SO_2$) emissions, which are dominated by OGV transit within and outside the VSR zone. This is because while regulations have been imposed at the international, federal, and state levels to reduce the sulfur content from all diesel-powered emissions sources, the fuel requirements for OGVs remain much higher (1,000 parts per million) than the requirements for other sources included in this analysis (15 parts per million). As such, sulfur emissions from OGV activity are much higher than other sources at the Port.

**Table 8-3. Distribution of Maritime Emissions between Inside and Outside the Terminal and Bay (tons)**

| Sector | Location | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ (tons) | $CO_2e$ (MT) |
|---|---|---|---|---|---|---|---|---|---|---|
| Ocean-Going Vessels | Near Terminals | **12** | **21** | **229** | **6** | **5** | **4** | <1 | **18,434** | **16,723** |
| | Outside Terminals | 8 | 11 | 94 | 2 | 2 | 2 | **15** | 6,368 | 5,777 |
| Commercial Harbor Craft | Near Terminals | **20** | **131** | **163** | **5** | **5** | **5** | <1 | **20,206** | **18,331** |
| | Outside Terminals | 9 | 52 | 72 | 2 | 2 | 2 | <1 | 7,903 | 7,169 |
| Cargo Handling Equipment | Near Terminals | **4** | **26** | **14** | **1** | **1** | **1** | **2** | **2,407** | **2,183** |
| | Outside Terminals | - | - | - | - | - | - | - | - | - |
| Freight Rail | Near Terminals | <1 | 2 | 7 | <1 | <1 | <1 | <1 | 702 | 637 |
| | Outside Terminals | **1** | **6** | **23** | **1** | **1** | **1** | <1 | **2,215** | **2,009** |
| On-Road Vehicles | Near Terminals | 1 | 4 | 3 | <1 | <1 | <1 | <1 | 946 | 858 |
| | Outside Terminals | **2** | **8** | **48** | <1 | <1 | <1 | <1 | **15,150** | **13,743** |
| Total Emissions | Near Terminals | 38 | 183 | 416 | 12 | 11 | 10 | 2 | 42,694 | 38,732 |
| | Outside Terminals | 21 | 78 | 237 | 6 | 5 | 6 | 16 | 31,635 | 28,699 |
| *Distribution of Total Emissions* | *Near Terminals* | ***64%*** | ***70%*** | ***64%*** | ***67%*** | ***67%*** | ***65%*** | *11%* | ***57%*** | ***57%*** |
| | *Outside Terminals* | *36%* | *30%* | *36%* | *33%* | *33%* | *35%* | ***89%*** | *43%* | *43%* |

Note: Maximum value for each pollutant by source shown in **bold**.

## 8.1 Efficiency of Emissions

One way to demonstrate, and track, the efficiency of cargo movements over time is to benchmark emissions by a meaningful output. In this case, emissions from all maritime sources (sum of all emissions included herein, including non-cargo-related sources such as sport fishing, charter fishing, ferries, and excursion vessels, but not including recreational boating) for the three inventory years (2016, 2012, and 2006) are benchmarked by the number of vessel calls. Table 8-4 presents pounds of emissions per vessel call for each of the years an inventory has been produced. As shown, 2016 saw more vessel calls than 2012 (420 versus 411) but cargo activity was generally more efficient and emitted fewer emissions per call. Overall, emissions per call are down for every emissions type since 2006 and for every pollutant type except carbon monoxide (CO) and carbon dioxide ($CO_2$) since 2012. For example, even though the number of vessel calls is up since 2012, $NO_X$ emissions are down, particularly due to regulations aimed at reducing $NO_X$ emissions from fuel combustion from all sources, and $SO_2$ and particulate matter emission are down due to fuel sulfur regulations.

**Table 8-4. Efficiency of Activity – Pounds of Emissions per Call by Year (all Maritime Emissions)**

| Year | Calls | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | 530 | 410 | 1,645 | 6,362 | 452 | 421 | 413 | 2,589 | 424,521 |
| 2012 | 411 | 329 | 983 | 4,068 | 139 | 129 | 134 | 204 | 318,165 |
| 2016 | 420 | 279 | 1,242 | 3,109 | 83 | 79 | 76 | 85 | 353,951 |

## 8.2 Comparison with Previous Years

A comparison among the 2006, 2012, and 2016 emission inventories by source category is provided below.

### 8.2.1 Ocean-Going Vessels

Comparisons of OGV emissions over time are shown in Table 8-5. The emissions generated by OGVs were lower for every pollutant in 2016 than in 2006, due in part to operational differences including a lower number of vessel calls as well as regulations aimed at reducing $NO_X$, particulate matter, and $SO_2$. Of significance, between 2016 and 2006, diesel particulate matter (DPM) decreased 92%, $NO_X$ decreased 56%, and $SO_2$ decreased 98%. Compared to the 2012 emissions inventory, all pollutants except CO and $CO_2e$ were lower in 2016 even though vessel calls were slightly higher. As a result of more vessel calls during 2016, greenhouse gas (GHG) emissions were approximately 10% higher in 2016 than during 2012. It should be noted that the 2012 inventory did not include anchorage emissions, which amounted to 12% (3,111 tons) of $CO_2e$ emissions in 2016, most of which (3,090 tons) were associated with auto carriers.

**Table 8-5. OGV Emissions Comparisons by Inventory Year (tons)**

| Year | Calls | $NO_X$ | DPM | PM10 | PM2.5 | ROG | CO | $SO_2$ | $CO_2e$ (tons) | $CO_2e$ (MT) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | 530 | 726.00 | 72.2 | 82.4 | 75.8 | 31.2 | 61.0 | 681.0 | 42,963 | 38,975 |
| 2016 | 420 | 322.74 | 6.12 | 7.56 | 6.95 | 20.35 | 31.68 | 15.19 | 25,802 | 22,500 |
| *Difference* | *-21%* | *-56%* | *-92%* | *-91%* | *-91%* | *-35%* | *-48%* | *-98%* | *-42%* | *-42%* |
| 2012 | 411 | 368.00 | 8.28 | 9.26 | 8.52 | 20.90 | 31.00 | 41.20 | 22,551 | 20,458 |
| 2016 | 420 | 322.74 | 6.12 | 7.56 | 6.95 | 20.35 | 31.68 | 15.19 | 25,802 | 22,500 |
| *Difference* | *+2%* | *-12%* | *-26%* | *-18%* | *-18%* | *-3%* | *+2%* | *-63%* | *+10%* | *+10%* |

Table 8-6 presents pounds of emissions per vessel per call for each of the years an inventory has been produced. As shown, 2016 had more vessel calls than 2012 but cargo activity (in terms of calls) was more efficient; thus, some emission types decreased. Overall, vessel emissions per call are down for every emissions type since 2006 and for every emission type except $CO_2e$ since 2012. For example, even though the number of vessel calls is up since 2012, $NO_X$ emissions are down, particularly due to regulations aimed at reducing $NO_X$ emissions from vessel engines, while $SO_X$ and particulate matter emissions are down due to fuel sulfur regulations.

**Table 8-6. Efficiency of Activity – Pounds of Emissions per Call by Year (just vessels)**

| Year | Calls | ROG | CO | $NO_X$ | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2e$ |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | 530 | 118 | 230 | 2,740 | 311 | 286 | 272 | 2,570 | 162,125 |
| 2012 | 411 | 102 | 151 | 1,791 | 45 | 41 | 40 | 200 | 109,737 |
| 2016 | 420 | 97 | 151 | 1,537 | 36 | 33 | 29 | 72 | 118,105 |

Another factor contributing to the reduction in vessel emissions is the continued implementation of the Port's shore power and VSR programs. Emission reductions associated with shore power in 2016 are presented in Table 8-7. As shown, shore power reduced emissions for every pollutant in 2016. Emission reductions associated with the VSR program in 2016 are presented in Table 8-8. As shown, compliance with the VSR program reduced emissions for every pollutant except for ROG, which increases slightly. Note that the reductions shown in Table 8-8 are based on average speed in the VSR zone.

**Table 8-7. Shore Power Emission Reductions by Ship Type (tons)**

| Vessel Type | $NO_X$ | DPM | PM10 | PM2.5 | ROG | CO | $SO_2$ | $CO_2e$ (tons) | $CO_2e$ (MT) |
|---|---|---|---|---|---|---|---|---|---|
| Container Ships | 63.72 | 1.50 | 1.20 | 1.26 | 4.08 | 6.44 | 2.19 | 2,047 | 1,857 |
| Passenger Ships | 26.15 | 0.56 | 0.45 | 0.47 | 1.25 | 1.76 | 0.82 | 893 | 811 |
| Total | 89.87 | 2.05 | 1.65 | 1.73 | 5.33 | 8.20 | 3.01 | 2,940 | 2,667 |

**Table 8-8. Vessel Speed Reduction Program Emission Reductions by Ship Type (tons)**

| Vessel Type | $NO_X$ | DPM | PM10 | PM2.5 | ROG | CO | $SO_2$ | $CO_2e$ (tons) | $CO_2e$ (MT) |
|---|---|---|---|---|---|---|---|---|---|
| Auto Carriers | 33.46 | 0.39 | 0.34 | 0.31 | -0.94 | 1.05 | 0.84 | 1,258 | 1,141 |
| Bulk Carriers | 0.88 | 0.01 | 0.01 | 0.01 | 0.03 | 0.07 | 0.02 | 34 | 31 |
| Container Ships | 8.98 | 0.14 | 0.13 | 0.12 | 0.22 | 0.51 | 0.22 | 353 | 320 |
| General Cargo | 2.97 | 0.05 | 0.04 | 0.05 | 0.12 | 0.24 | 0.08 | 117 | 106 |
| Passenger Ships | 15.86 | 0.25 | 0.23 | 0.21 | 0.05 | 0.17 | 0.44 | 908 | 824 |
| Total | 62.14 | 0.84 | 0.75 | 0.70 | -0.53 | 2.05 | 1.61 | 2,670 | 2,422 |

In addition, the size of vessels visiting the Port is changing. Table 8-9 shows a comparison of installed power (total propulsion power multiplied by calls), which is directly related to emissions (particularly fuel-based emissions, like CO and $CO_2$), and Table 8-10 provides a comparison of average hoteling time per call by ship type.

As can be seen in Table 8-9, since 2006, total installed power (the sum of all calls) has decreased 18% (from 11,407 megawatts [MW] in 2006 to 9,386 MW in 2016) but installed power of the average ship (per call) has increased (from 21.6 MW in 2006 to 22.3 MW in 2016) for all but bulk carriers. 2006 saw more calls than other years, and because the average vessel engine size was only slightly lower in 2006 than 2016, the total installed power (sum of all calls) was highest in 2006, particularly because the number of cruise ship calls (167) in 2006 was substantially higher than in both 2012 (86) and 2016 (74). Moreover, as shown in Table 8-10, the average hotel time per call was 41.0 hours, which is 12.9 hours longer than the average hotel time of 28.1 hours in 2016. As such, 2006 had more calls, more total installed power, and more time hoteling, which resulted in emissions that were substantially higher than subsequent inventories.

Since 2012, installed power has increased 14% (from 8,258 MW in 2012 to 9,386 MW in 2016), in particular due to the arrival of Dole's new vessels (26,160 kilowatt [kW] main engine) that are about 66% larger than the older fleet (15,189 kW main engine) and because there were more ship calls in 2016 than in 2012. On a per-call basis, installed power increased for each vessel type except bulk carriers. Overall, per-call power increased 11% relative to 2012. Moreover, as shown in Table 8-10, the average hotel time per call in 2012 was 25.5 hours, which is 2.6 hours shorter than the average hotel time of 28.1 hours in 2016. As such, 2012 had fewer calls, less total installed power, and less time hoteling, which resulted in emissions that were lower than 2016 for most pollutants.

**Table 8-9. Installed Power Comparisons (Total and Per Call Main Engine Megawatts)**

| Ship Type | Total Power All Calls | | | *Difference* | | Average Power Per Call | | | *Difference* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2016 | 2012 | 2006 | *2016/ 2012* | *2016/ 2006* | 2016 | 2012 | 2006 | *2016/ 2012* | *2016/ 2006* |
| Auto Carriers | 3,425 | 2,689 | 2,397 | *+27%* | *+43%* | 13.6 | 11.7 | 11.4 | *16%* | *19%* |
| Bulk Carriers | 44 | 92 | 206 | *-52%* | *-78%* | 7.4 | 7.7 | 7.6 | *-4%* | *-3%* |
| Container Ships | 1,402 | 796 | 991 | *+76%* | *+41%* | 22.3 | 15.0 | 11.0 | *48%* | *102%* |
| General Cargo | 222 | 213 | 237 | *+4%* | *-6%* | 8.9 | 6.9 | 7.2 | *29%* | *24%* |
| Passenger Ships | 4,293 | 4,468 | 7,556 | *-4%* | *-43%* | 58.0 | 51.9 | 45.2 | *12%* | *28%* |
| Tankers | - | - | 20 | - | - | - | - | 10.2 | - | - |
| Total | 9,386 | 8,258 | 11,407 | *+14%* | *-18%* | 22.3 | 20.1 | 21.6 | *11%* | *4%* |

*Container Ships* in 2006 includes both container ships and reefers. Installed power is main engine power only, just for comparative purposes.

**Table 8-10. Comparison of Calls and Hoteling Time Per Call by Ship Type**

| Ship Type | 2016 | | 2012 | | 2006 | |
|---|---|---|---|---|---|---|
| | Calls | Hotel Hrs per Call | Calls | Hotel Hrs per Call | Calls | Hotel Hrs per Call |
| Auto Carriers | 252 | 21.9 | 230 | 15.5 | 210 | 18.3 |
| Bulk Carriers | 6 | 50.6 | 12 | 82.0 | 25 | 342.1 |
| Container Ships | 63 | 63.5 | 53 | 62.0 | 91 | 58.5 |
| General Cargo | 25 | 41.2 | 29 | 54.3 | 35 | 51.0 |
| Passenger Ships | 74 | 12.1 | 87 | 12.5 | 167 | 13.2 |
| Tankers | -- | -- | -- | -- | 2 | 13.8 |
| Total | **420** | **28.1** | **411** | **25.5** | **530** | **41.0** |

*Container Ships* in 2006 includes both container ships and reefers.

### 8.2.2 Commercial Harbor Craft

Comparisons of commercial harbor craft emissions among the 2006, 2012, and 2016 inventories are shown in Table 8-11. As shown, estimates of all emissions except for CO and $CO_2e$ have decreased since 2006. Most notably, emissions of $NO_X$ and DPM are down 55% and 67%, respectively. Similarly, estimates of emissions of all pollutant types except for CO and $CO_2e$ have decreased since 2012. Therefore, even though the number of commercial harbor craft pieces included in the inventory has increased 58% since 2006 and 48% since 2012, emissions of key pollutants, including $NO_X$ and DPM, have decreased, particularly due to California Air Resources Board (CARB) efforts statewide through the Harbor Craft Rule requiring cleaner engine standards. Emissions of CO and $CO_2$ are based on fuel consumption, and engines that emit lower total hydrocarbons, $NO_x$, and DPM emissions do not necessarily consume less fuel. Therefore, CO and $CO_2$ emissions do not decrease.

Of note, harbor craft emission estimates include sport fishing activity during 2016. Sport fishing activity was included in the 2006 emission inventory but was not included in the 2012 emission inventory because information to conduct the analysis was not available at the time. Comparison of 2016 commercial harbor craft emissions without sport fishing against the 2006 (which did include sport fishing) and 2012 (which did not include sport fishing) inventories are shown in Table 8-12. As shown, estimates of all emissions follow a similar trend as shown in Table 8-11 except $CO_2e$ emissions, which show a small decrease since 2006 if sport fishing emissions are not included.

**Table 8-11. Commercial Harbor Craft Emission Estimates Compared to Previous Inventories (with Sport Fishing)**

| Year | CHC pieces | Emissions (tons per year) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | $NO_X$ | DPM | PM10 | PM2.5 | ROG | CO | $CO_2e$ |
| 2006 | 107 | 527.6 | 23.8 | 23.8 | 23.1 | 54.6 | 150.1 | 25,116 |
| 2016 | 155 | 234.8 | 7.8 | 7.8 | 7.5 | 28.9 | 183.1 | 28,109 |
| *Difference* | *45%* | *-55%* | *-67%* | *-67%* | *-67%* | *-47%* | *22%* | *12%* |
| 2012 | 114 | 362.4 | 14.8 | 14.8 | 14.4 | 40.1 | 136.3 | 23,387 |
| 2016 | 155 | 234.8 | 7.8 | 7.8 | 7.5 | 28.9 | 183.1 | 28,109 |
| *Difference* | *36%* | *-35%* | *-47%* | *-47%* | *-47%* | *-28%* | *34%* | *20%* |

CHC = commercial harbor craft

**Table 8-12. Commercial Harbor Craft Emission Estimates Compared to Previous Inventories (without Sport Fishing)**

| Year | CHC pieces | Emissions (tons per year) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | $NO_X$ | DPM | PM10 | PM2.5 | ROG | CO | $CO_2e$ |
| 2006 | 107 | 527.6 | 23.8 | 23.8 | 23.1 | 54.6 | 150.1 | 25,116 |
| 2016 | 100 | 190.8 | 6.3 | 6.3 | 6.1 | 22.8 | 150.1 | 23,175 |
| *Difference* | *-7%* | *-64%* | *-74%* | *-74%* | *-74%* | *-58%* | *0%* | *-8%* |
| 2012 | 114 | 362.4 | 14.8 | 14.8 | 14.4 | 40.1 | 136.3 | 23,387 |
| 2016 | 100 | 190.8 | 6.3 | 6.3 | 6.1 | 22.8 | 150.1 | 23,175 |
| *Difference* | *-12%* | *-47%* | *-58%* | *-58%* | *-58%* | *-43%* | *10%* | *-1%* |

CHC = commercial harbor craft

### 8.2.3 Cargo Handling Equipment

Comparisons of CHE emissions and activity among the 2006, 2012, and 2016 inventories are shown in Table 8-13. As shown, estimates of all emissions except for ROG are down since 2006. Most notably, emissions of $NO_X$ and DPM are down 59% and 42% respectively, while GHG emissions are down 36%. Since 2012, emissions of all pollutant types have increased, primarily because estimated total activity (expressed as horsepower-hours) has increased 33% since 2012.

**Table 8-13. Cargo Handling Equipment Emission Estimates Compared to Previous Inventories**

| Year | CHE Pieces | Total Hp-Hrs (million) | Emissions (tons per year) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | $NO_X$ | DPM | PM10 | PM2.5 | ROG | CO | $CO_2e$ |
| 2006 | 126 | 1,952 | 33.0 | 0.9 | 1.0 | 0.9 | 4.0 | 43.0 | 3,754 |
| 2016 | 134 | 1,154 | 13.7 | 0.5 | 0.6 | 0.5 | 4.3 | 26.1 | 2,407 |
| *Difference* | *+6%* | *-41%* | *-59%* | *-42%* | *-44%* | *-42%* | *+7%* | *-39%* | *-36%* |
| 2012 | 127 | 870 | 11.9 | 0.3 | 0.3 | 0.3 | 1.1 | 9.8 | 1,680 |
| 2016 | 134 | 1,154 | 13.7 | 0.5 | 0.6 | 0.5 | 4.3 | 26.1 | 2,407 |
| *Difference* | -6% | +33% | *+15%* | *+92%* | *+101%* | *+108%* | *+282%* | *+168%* | *+43%* |

## 8.2.4 Rail Locomotives

Comparisons of locomotive emissions among the 2006, 2012, and 2016 inventories are shown in Table 8-14. As indicated, estimates of all emissions in 2016 and 2012 have decreased since 2006. The 2016 results demonstrate a reduction of emissions of $NO_x$ and $CO_2e$ since 2012, but all other emissions show an increase. This is due to three primary factors: changes in activity, changes in emission factor estimates, and inclusion of switch-duty locomotive activity at Tenth Avenue Marine Terminal (TAMT).

- Regarding activity, line-haul fuel consumption increased an estimated 4% in 2016 (194,791 gallons) compared to 2012 (187,124 gallons), which is due to increased cargo throughput. However, despite this increase, estimated switching hours decreased 19% in 2016 (3,225 hours) compared to 2012 (3,990 hours) due to refined information regarding time to build each train. This led to the decrease in GHG emissions, in particular due to reduced switching time, which reduced total emissions from switching 307 tons of $CO_2e$.
- Meanwhile, locomotive emission factors used in the 2012 and 2016 analyses were from different sources. The 2012 inventory used U.S. Environmental Protection Agency emission factors based on nationwide average rates by tier along with the Burlington Northern Santa Fe (BNSF) fleet mix, which was assumed to be 90% Tier 2 and 10% Tier 1+ (e.g., remanufactured Tier 1). The 2016 inventory used emission factors and fleet mix by tier from the BNSF compliance reporting data, which is based on BNSF locomotive-specific emissions testing per the Memorandum of Understanding with South Coast Air Quality Management District and ARB. Table 8-15 presents emission factors used in the 2016, 2012, and 2006 emissions inventories. Emission factors are presented in both grams per gallon (g/gal) and grams per horsepower-hour (g/hp-hr) for comparative purposes. As shown, emission factor estimates for $NO_X$ did not change between 2012 and 2016, while particulate matter and total hydrocarbon emission factor estimates were higher in 2016 than in 2012. Therefore, because overall activity increased between 2012 and 2016, emissions increased for most pollutants in 2016.

- Lastly, previous inventories did not account for line-haul and switching activity associated with soda ash handling at TAMT. Moreover, half of the switching activity for soda ash at TAMT is performed by a GP60, which has different and sometimes higher emission factors. Overall, switching emissions decreased 30% despite the inclusion of soda ash and the switcher, due to the change in switching hours denoted above.

Note that soda ash activity at TAMT accounted for approximately 1% of activity and 1 to 2% of all rail emissions at the Port in 2016. Soda ash cargo movement was higher in both 2006 (24,355 tons) and 2012 (37,128 tons) than in 2016 (19,839 tons), but rail emissions from soda ash cargo movements in 2006 and 2012 were likely small and contributed a small percentage of overall emissions.

**Table 8-14. Rail Emission Estimates Compared to Previous Inventories**

| Year | Line-Haul Gallons | Switching Hours | Emissions (tons per year) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | $NO_X$ | DPM | PM10 | PM2.5 | ROG | CO | $CO_2e$ |
| 2006 | 235,297 | 3,510 | 61.4 | 2.2 | 2.2 | 1.9 | 3.1 | 8.9 | 3,085 |
| 2016 | 194,791 | 3,225 | 30.3 | 1.2 | 1.2 | 1.2 | 1.9 | 7.5 | 2,646 |
| *Difference* | *-17%* | *-8%* | *-51%* | *-44%* | *-44%* | *-37%* | *-37%* | *-15%* | *-14%* |
| 2012 | 187,124 | 3,990 | 31.9 | 1.1 | 1.1 | 1.1 | 1.9 | 6.4 | 2,896 |
| 2016 | 194,791 | 3,225 | 30.3 | 1.2 | 1.2 | 1.2 | 1.9 | 7.5 | 2,646 |
| *Difference* | *+4%* | *-19%* | *-5%* | *+9%* | *+9%* | *+14%* | *+3%* | *+17%* | *-9%* |

**Table 8-15. Line-Haul Emission Factor Estimates Compared to Previous Inventories**

| Year and Type | g/gallon | | | | | g/hp-hr | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $NO_X$ | PM | THC | CO | $CO_2$ | $NO_X$ | PM | THC | CO | $CO_2$ |
| 2016 Inventory - Line Haul | 107.0 | 4.4 | 6.5 | 26.6 | 10,217 | 5.1 | 0.21 | 0.31 | 1.28 | 491 |
| 2016 Inventory - Switcher | 220.5 | 3.3 | 8.5 | 8.3 | 14,102 | 10.6 | 0.16 | 0.41 | 0.40 | 678 |
| 2012 Inventory - Line Haul | 107.0 | 3.8 | 5.5 | 26.6 | 10,217 | 5.1 | 0.18 | 0.26 | 1.28 | 491 |
| 2006 Inventory - Line Haul | 183.7 | 6.4 | 10.3 | 26.7 | 10,070 | 8.8 | 0.31 | 0.49 | 1.28 | 483 |

Emission factors are converted from g/hp-hr to g/gallon using a fuel consumption conversion factor of 20.8 hp-hr/gal, and vice versa.
THC = total hydrocarbons

## 8.2.5 Heavy-Duty Trucks and On-Road Vehicles

Comparisons with truck and vehicle emissions against the 2006 and 2012 inventories are shown in Table 8-16. As shown, estimates of all emissions are lower than in 2006. Most notably, emissions of $NO_X$ and DPM have decreased 85% and 97%, respectively, while GHG emissions have decreased 52%. Since 2012, emissions of particulate matter 10 microns or less in diameter (PM10), particulate matter 2.5 microns or less in diameter (PM2.5), and DPM have decreased, while GHG emissions have increased, primarily due to an increase in activity and associated fuel consumption. As shown, the number of truck trips was 17% higher in 2016 than 2012 but remains 45% lower than 2006.

**Table 8-16. Truck and Vehicle Emission Estimates Compared to Previous Inventories**

| Year | Truck Trips | Emissions (tons per year) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | $NO_X$ | DPM | PM10 | PM2.5 | ROG | CO | $CO_2e$ |
| 2006 | 133,090 | 337.80 | 10.60 | 9.80 | 10.50 | 13.79 | 175.90 | 37,233 |
| 2016 | 72,759 | 51.38 | 0.27 | 0.28 | 0.27 | 3.15 | 12.27 | 16,095 |
| *Difference* | *-45%* | *-85%* | *-97%* | *-97%* | *-97%* | *-77%* | *-93%* | *-52%* |
| 2012 | 62,238 | 61.60 | 3.09 | 3.11 | 2.43 | 3.70 | 18.11 | 14,573 |
| 2016 | 72,759 | 51.38 | 0.27 | 0.28 | 0.27 | 3.15 | 12.27 | 16,095 |
| *Difference* | *+17%* | *-17%* | *-91%* | *-91%* | *-89%* | *-15%* | *-32%* | *+10%* |

Since 2006, emissions have decreased primarily because trucks that visit the Port are cleaner and emit fewer emissions for a given level of activity than in previous years, which is due to the Port's Clean Truck Program and the state's Drayage Truck Rule and Truck & Bus Rule. Table 8-17 summarizes emission rates (in grams per vehicle miles traveled [VMT]) for heavy-duty trucks that visit the Port for various years based on EMFAC2017 output. As shown, emission rates for $NO_X$ have decreased 73% since 2006 and 66% since 2012, and emission rates for PM10/DPM have decreased 96% since 2006 and 86% since 2012. Both the Drayage Truck Rule and Truck & Bus Rule are expected to be fully implemented by 2023, after which 100% of trucks that visit the Port will be model year 2010 and newer. As shown, NOx and PM10/DPM emission rates are expected to trend downwards through 2025 relative to 2016 conditions then remain relatively steady through 2050. Thus, through 2025, $NO_X$ and PM10/DPM emission rates from trucks that visit the Port will continue to decline.

Note that $CO_2$ rates have only marginally decreased since 2006. The two major regulations that have been implemented to improve truck fuel economy and reduce GHG emissions have yet to be fully implemented. These regulations—the Phase 1 truck standards, which are underway and affect model years 2014 through 2018, and Phase 2 truck standards, which affect model years 2019 through 2027—have yet to be fully implemented, so $CO_2$ emission rates have yet to display the dramatic decline displayed for other pollutants (e.g., $NO_X$ and DPM). Over time, $CO_2$ rates for a given level of activity (per VMT) will decline, particularly beyond year 2020. As shown, emission rates for $CO_2$ are expected to decrease 41% by 2050 relative to 2016 conditions.

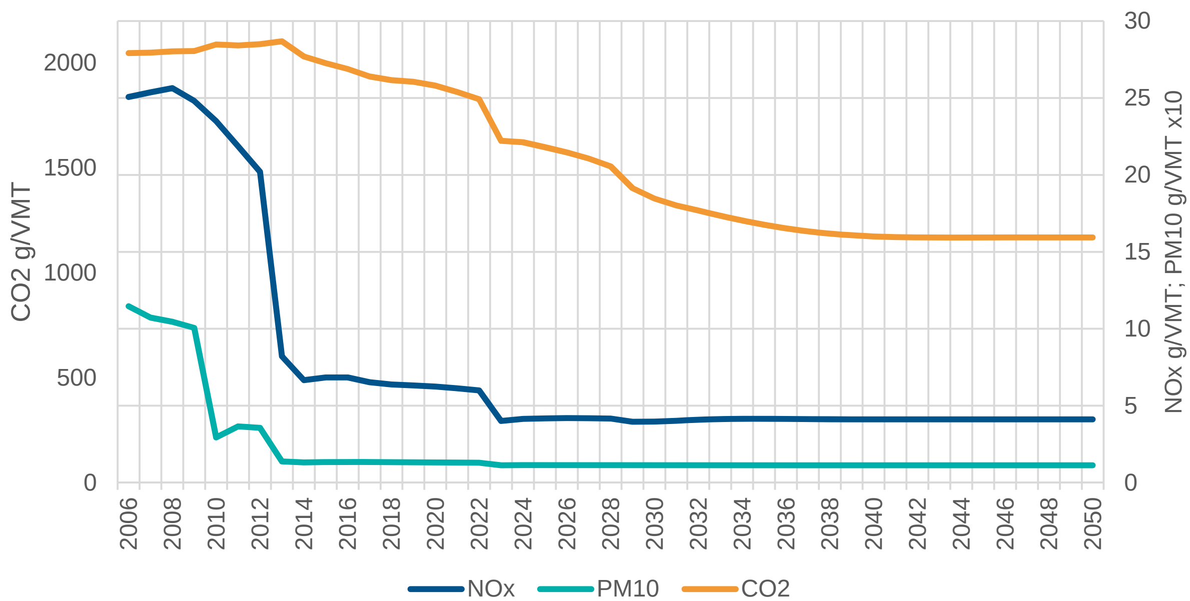
Figure 8-1 shows this the downward trend in truck emission factors through 2050.

**Table 8-17. Truck Emission Factors for Various Years (grams per VMT)**

| Year | ROG | $NO_x$ | CO | PM10 | PM2.5 | DPM | $SO_2$ | $CO_2$ |
|---|---|---|---|---|---|---|---|---|
| 2006 | 3.60 | 24.49 | 8.18 | 1.04 | 0.99 | 1.04 | 0.18 | 2,012 |
| 2012 | 0.89 | 19.60 | 2.08 | 0.26 | 0.25 | 0.26 | 0.02 | 2,053 |
| 2016 | 0.33 | 6.59 | 1.02 | 0.04 | 0.04 | 0.04 | 0.02 | 1,942 |
| 2020 | 0.25 | 6.02 | 0.90 | 0.03 | 0.03 | 0.03 | 0.02 | 1,863 |
| 2025 | 0.03 | 3.99 | 0.42 | 0.02 | 0.02 | 0.02 | 0.01 | 1,576 |
| 2030 | 0.03 | 3.79 | 0.40 | 0.01 | 0.01 | 0.01 | 0.01 | 1,335 |
| 2035 | 0.03 | 3.95 | 0.41 | 0.02 | 0.01 | 0.02 | 0.01 | 1,210 |
| 2040 | 0.03 | 3.92 | 0.41 | 0.02 | 0.01 | 0.02 | 0.01 | 1,155 |
| 2045 | 0.03 | 3.92 | 0.41 | 0.02 | 0.01 | 0.02 | 0.01 | 1,150 |
| 2050 | 0.03 | 3.92 | 0.41 | 0.02 | 0.01 | 0.02 | 0.01 | 1,151 |
| *Change in Emission Factors Over Time* | | | | | | | | |
| 2016 relative to 2006 | -91% | -73% | -88% | -96% | -96% | -96% | -90% | -3% |
| 2016 relative to 2012 | -63% | -66% | -51% | -86% | -86% | -86% | -5% | -5% |
| 2050 relative to 2016 | -91% | -40% | -60% | -58% | -58% | -58% | -41% | -41% |

Emission rates based on “T7 Other Port” rates in EMFAC2017 operating in San Diego County based on aggregated speed profiles.

**Figure 8-1. Truck Emission Rates over Time (grams per VMT)**




Emission estimates from on-road vehicles associated with cruise ship calls have also changed since 2006. The 2006 inventory assumed longer trip lengths for all trip types (e.g., taxis, shuttles) that were updated with reduced trip lengths in the 2012 inventory. The 2016 inventory assumes the same trip lengths as the 2012 inventory as well as additional “delivery” trips that were not included in previous inventories. Emission estimates associated with cruise ship passengers were much higher in 2006 than in more recent inventories in 2012 and 2016. This, combined with the fact that there were far fewer cruise ship calls in 2016 (74) and 2012 (87) than in 2006 (167), results in a reduction in emission estimates associated with cruise ship passenger travel.

# Appendix A
## *Vessel Information*

## Vessel Information

| LR/IMO# | LLOYDNAM | MMSI | TYPE | KEEL LAY | MAIN_KW | DESIGN | DESIGNATIO | DISP | MAIN_ENGIN | CATEGORY | AUX_KW | LL_FLAG | SPEED | Cars/TEUS/Pass | DWT_CATEGO | DWT_RANGE | OPERATOR | PNOx EF | ANOx EF | T Aux LF | M Aux LF | H Aux LF | A Aux LF | Boil Load | CI_Time | CI_kWh | Aux Load (kW) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8513467 | DOLE CALIFORNIA | 311642000 | CONTAINER | 1985 | 15189 | Sulzer | 7RTA68 | 726.3 | SSD | 3 | 7220 | BAH | 20.00 | 910 | 1 | < 1000 TEU | Transfrut Express Ltd | 17.0 | 13.8 | 0.13 | 0.50 | 0.35 | 0.13 | 241 | 323.4 | 808,417 | 2500 |
| 8513479 | DOLE ECUADOR | 311588000 | CONTAINER | 1985 | 15189 | Sulzer | 7RTA68 | 726.3 | SSD | 3 | 7220 | BAH | 20.00 | 910 | 1 | < 1000 TEU | Transfrut Express Ltd | 17.0 | 13.8 | 0.13 | 0.50 | 0.35 | 0.13 | 241 | 191.9 | 479,750 | 2500 |
| 8520680 | TRIANON | 257429000 | AUTO | 1986 | 9003 | B&W | 6S60MCE | 648.0 | SSD | 3 | 3100 | NIS | 18.00 | 5828 | 4 | C 5000 - 6000 | Wallenius Wilhelmsen Logistics | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 8602579 | TRINIDAD | 257448000 | AUTO | 1986 | 9000 | B&W | 6S60MCE | 648.0 | SSD | 3 | 3100 | NIS | 18.00 | 5858 | 4 | C 5000 - 6000 | Wallenius Wilhelmsen Logistics | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 8606056 | GMT ASTRO | 373817000 | AUTO | 1986 | 10000 | B&W | 6L60MC | 549.7 | SSD | 3 | 2040 | PAN | 18.50 | 5348 | 4 | C 5000 - 6000 | Doriko Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 8608054 | AUTO ATLAS | 353698000 | AUTO | 1987 | 9445 | B&W | 6S60MCE | 648.0 | SSD | 3 | 2250 | PAN | 18.00 | 6400 | 5 | C 6000 - 7000 | Korea Line Corp | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 8608066 | AUTO BANNER | 355997000 | AUTO | 1987 | 9445 | B&W | 6S60MCE | 648.0 | SSD | 3 | 2250 | PAN | 18.00 | 6400 | 5 | C 6000 - 7000 | Korea Line Corp | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 8608078 | MORNING MERCATOR | 257717000 | AUTO | 1987 | 9445 | B&W | 6S60MC | 648.0 | SSD | 3 | 2250 | NIS | 18.00 | 6400 | 5 | C 6000 - 7000 | Hoegh Autoliners AS | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 8612251 | ATLAS HIGHWAY | 636008621 | AUTO | 1986 | 10298 | B&W | 8S60MCE | 648.0 | SSD | 3 | 2340 | LIB | 20.90 | 4857 | 3 | C 4000 - 5000 | Kawasaki Kisen Kaisha Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 8613188 | STRAITS VOYAGER | 533052100 | AUTO | 1987 | 8606 | B&W | 6S60MCE | 648.0 | SSD | 3 | 2160 | MAL | 18.40 | 3830 | 2 | C 3000 - 4000 | NYK Line | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 8709119 | GMT POLARIS | 351552000 | AUTO | 1987 | 8871 | B&W | 6L60MCE | 549.7 | SSD | 3 | 1740 | PAN | 18.00 | 3500 | 2 | C 3000 - 4000 | Hyundai Glovis Co Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 8712324 | QUEEN ACE | 355861000 | AUTO | 1987 | 11694 | Mitsubishi | 7UEC60LS | 622.0 | SSD | 3 | 2508 | PAN | 18.50 | 6400 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 8900335 | DOLE COSTA RICA | 311641000 | CONTAINER | 1990 | 15188 | Sulzer | 7RTA68 | 726.3 | SSD | 3 | 6320 | BAH | 20.00 | 910 | 1 | < 1000 TEU | Transfrut Express Ltd | 17.0 | 13.8 | 0.13 | 0.50 | 0.35 | 0.13 | 241 | | | 2500 |
| 8913514 | JINSEI MARU | 431174000 | AUTO | 1989 | 12357 | Mitsubishi | 7UEC60LS | 622.0 | SSD | 3 | 3190 | JPN | 19.20 | 5582 | 4 | C 5000 - 6000 | NYK Line | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 8916267 | HOJIN | 431165000 | AUTO | 1989 | 12175 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 3090 | VAN | 19.25 | 5980 | 4 | C 5000 - 6000 | NYK Line | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 8919257 | MAASDAM | 244958000 | PASSENGER | 1992 | 34560 | Sulzer | 12ZAV40S | 70.4 | MSD-ED | 3 | 0 | NTH | 20.00 | 1613 | 2 | P 1500 - 2000 | Holland America Line NV | 13.2 | 13.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | | | |
| 9047996 | HARMONY ACE | 357376000 | AUTO | 1992 | 10813 | Mitsubishi | 7UEC60LA | 537.2 | SSD | 3 | 2568 | PAN | 19.00 | 5500 | 4 | C 5000 - 6000 | Mitsui OSK Lines Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9051375 | COUGAR ACE | 563329000 | AUTO | 1992 | 11695 | Mitsubishi | 7UEC60LS | 622.0 | SSD | 3 | 2400 | SNG | 18.60 | 6400 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9051818 | PEARL ACE | 355754000 | AUTO | 1993 | 11475 | B&W | 6L60MC | 549.7 | SSD | 3 | 2400 | PAN | 18.50 | 4800 | 3 | C 4000 - 5000 | Mitsui OSK Lines Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9066667 | CRYSTAL SYMPHONY | 309168000 | PASSENGER | 1994 | 36330 | Sulzer | 9ZAL40S | 70.4 | MSD-ED | 3 | 0 | BAH | 21.00 | 1010 | 1 | P < 1500 | Crystal Cruises Inc | 13.2 | 13.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | | | |
| 9070462 | K. ASIAN BEAUTY | 374100000 | AUTO | 1994 | 10371 | B&W | 6L60MC | 549.7 | SSD | 3 | 2340 | PAN | 18.00 | 4363 | 3 | C 4000 - 5000 | Hyundai Glovis Co Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9070474 | ASIAN GLORY | 235007790 | AUTO | 1994 | 10368 | B&W | 6L60MC | 549.7 | SSD | 3 | 2340 | GBI | 18.60 | 4363 | 3 | C 4000 - 5000 | Hyundai Glovis Co Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9078830 | PEGASUS HIGHWAY | 353910000 | AUTO | 1994 | 13578 | B&W | 8S60MC | 648.0 | SSD | 3 | 2500 | PAN | 18.50 | 5008 | 4 | C 5000 - 6000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9078842 | ARCADIA HIGHWAY | 354342000 | AUTO | 1994 | 13578 | B&W | 8S60MC | 648.0 | SSD | 3 | 2400 | PAN | 20.00 | 5008 | 4 | C 5000 - 6000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9102992 | VEENDAM | 246506000 | PASSENGER | 1994 | 33924 | Sulzer | 12ZAV40S | 70.4 | MSD-ED | 3 | 0 | NTH | 20.00 | 1613 | 2 | P 1500 - 2000 | Holland America Line NV | 13.2 | 13.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | 15.6 | 58,824 | |
| 9103180 | CAMELLIA ACE | 636015709 | AUTO | 1994 | 11695 | Mitsubishi | 7UEC60LS | 622.0 | SSD | 3 | 2400 | LIB | 18.60 | 6400 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9104005 | GRAND PRINCESS | 310327000 | PASSENGER | 1996 | 69900 | Sulzer | 16ZAV40S | 70.4 | MSD-ED | 3 | 0 | BER | 22.50 | 3300 | 5 | P 3000 - 3500 | Princess Cruise Lines Ltd | 13.2 | 13.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | 14.3 | 131,728 | |
| 9122942 | GLOVIS COMET | 440269000 | AUTO | 1996 | 14314 | B&W | 7S60MC | 648.0 | SSD | 3 | 3690 | MAI | 20.10 | 6460 | 5 | C 6000 - 7000 | Hyundai Glovis Co Ltd | 16.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9122966 | ASIAN VISION | 441992000 | AUTO | 1996 | 14314 | B&W | 7S60MC | 648.0 | SSD | 3 | 3540 | KRS | 20.10 | 6460 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 16.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9126819 | DISNEY WONDER | 308457000 | PASSENGER | 1997 | 57670 | Sulzer | 16ZAV40S | 70.4 | MSD-ED | 3 | 0 | BAH | 21.50 | 2834 | 4 | P 2500 - 3000 | Magical Cruise Co Ltd | 13.2 | 13.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | 5.1 | 38,848 | |
| 9138525 | DON QUIJOTE | 564753000 | AUTO | 1997 | 16358 | B&W | 8S60MC | 648.0 | SSD | 3 | 4478 | SNG | 20.50 | 5873 | 4 | C 5000 - 6000 | Wallenius Wilhelmsen Logistics | 16.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9141807 | WORLD ODYSSEY | 311000410 | PASSENGER | 1997 | 12320 | MaK | 8M32 | 38.6 | MSD-ED | 3 | 0 | BAH | 20.00 | 613 | 1 | P < 1500 | Semester at Sea | 13.2 | 13.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | | | |
| 9153551 | EURO SPIRIT | 636010789 | AUTO | 1997 | 11416 | B&W | 8S50MC | 375.0 | SSD | 3 | 2640 | LIB | 18.00 | 4055 | 3 | C 4000 - 5000 | Nissan Motor Car Carrier | 16.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9156462 | INSIGNIA | 538001663 | PASSENGER | 1997 | 18600 | Wartsila | 12V32 | 28.1 | MSD-ED | 2 | 0 | MAI | 18.00 | 702 | 1 | P < 1500 | Oceania Cruises Inc | 13.2 | 13.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | | | |
| 9156474 | REGATTA | 538001664 | PASSENGER | 1998 | 18600 | Wartsila | 12V32 | 28.1 | MSD-ED | 2 | 0 | MAI | 18.00 | 824 | 1 | P < 1500 | Oceania Cruises Inc | 13.2 | 13.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | | | |
| 9156527 | ZAANDAM | 246442000 | PASSENGER | 1998 | 43200 | Sulzer | 12ZAV40S | 70.4 | MSD-ED | 3 | 0 | NTH | 22.00 | 1440 | 1 | P < 1500 | Holland America Line NV | 13.2 | 13.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | | | |
| 9158276 | AQUARIUS LEADER | 431305000 | AUTO | 1997 | 14123 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 3300 | PAN | 19.30 | 5980 | 4 | C 5000 - 6000 | NYK Line | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9169316 | GRAND CHOICE | 357247000 | AUTO | 1998 | 12357 | Mitsubishi | 7UEC60LS | 622.0 | SSD | 3 | 2760 | PAN | 19.20 | 4373 | 3 | C 4000 - 5000 | Cido Car Carrier Service Co | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9174490 | LIBRA LEADER | 431314000 | AUTO | 1998 | 14121 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 3600 | PAN | 19.30 | 5980 | 4 | C 5000 - 6000 | NYK Line | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9176606 | ASIAN EMPIRE | 440114000 | AUTO | 1998 | 14314 | B&W | 7S60MC | 648.0 | SSD | 3 | 3540 | KRS | 20.10 | 7645 | 6 | C > 7000 | EUKOR Car Carriers Inc | 16.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9177040 | DRESDEN | 210280000 | AUTO | 1999 | 11060 | B&W | 7S50MC-C | 392.7 | SSD | 3 | 2760 | CYP | 19.50 | 4632 | 3 | C 4000 - 5000 | Siem Car Carriers AS | 16.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9177428 | GREEN RIDGE | 369326000 | AUTO | 1997 | 14123 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 3300 | USA | 18.53 | 6340 | 5 | C 6000 - 7000 | NYK Line | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9181558 | LEO LEADER | 357682000 | AUTO | 1998 | 14123 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 3300 | PAN | 19.30 | 5980 | 4 | C 5000 - 6000 | NYK Line | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9181560 | GREEN COVE | 338657000 | AUTO | 1998 | 14123 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 3300 | USA | 19.30 | 5980 | 4 | C 5000 - 6000 | LMS Shipmanagement Inc | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9182356 | COMET ACE | 351757000 | AUTO | 1999 | 10592 | Mitsubishi | 8UEC52LS | 392.9 | SSD | 3 | 2646 | PAN | 18.90 | 3600 | 2 | C 3000 - 4000 | Mitsui OSK Lines Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9187899 | SIRENA | 538006842 | PASSENGER | 1997 | 18596 | Wartsila | 12V32 | 28.1 | MSD-ED | 2 | 0 | MAI | 18.00 | 824 | 1 | P < 1500 | Oceania Cruises Inc | 13.2 | 13.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | | | |
| 9188037 | AMSTERDAM | 244370000 | PASSENGER | 1998 | 55216 | Sulzer | 16ZAV40S | 70.4 | MSD-ED | 3 | 0 | NTH | 21.00 | 1738 | 2 | P 1500 - 2000 | Holland America Line NV | 13.2 | 13.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | 31.7 | 150,604 | |
| 9189421 | CELEBRITY INFINITY | 249048000 | PASSENGER | 1999 | 70742 | GE Marine | LM2500+ | 0.0 | GT-ED | GT | 0 | MTA | 24.00 | 2450 | 3 | P 2000 - 2500 | Celebrity Cruises Inc | 5.7 | 5.7 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | | | |
| 9192363 | STAR PRINCESS | 310361000 | PASSENGER | 1999 | 63360 | Sulzer | 16ZAV40S | 70.4 | MSD-ED | 3 | 0 | BER | 22.00 | 3300 | 5 | P 3000 - 3500 | Princess Cruise Lines Ltd | 13.2 | 13.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | 2.8 | 23,848 | |
| 9207388 | PALMELA | 351340000 | AUTO | 1999 | 14121 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 2880 | PAN | 20.00 | 5080 | 4 | C 5000 - 6000 | Kansai Steamship Co Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9209506 | TRIUMPH ACE | 352062000 | AUTO | 1999 | 14123 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 3150 | PAN | 20.00 | 6043 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9209518 | MERIDIAN ACE | 431221000 | AUTO | 1999 | 14123 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 3156 | PAN | 19.00 | 6043 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 17.0 | 13.8 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9210139 | SEVEN SEAS MARINER | 311622000 | PASSENGER | 2000 | 33600 | Wartsila | 12V38 | 53.9 | MSD-ED | 3 | 0 | BAH | 19.50 | 730 | 1 | P < 1500 | Regent Seven Seas Cruises Inc | 12.2 | 12.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | | | |
| 9218131 | NORWEGIAN SUN | 311109000 | PASSENGER | 1999 | 49212 | MAN | 7L58/64 | 169.1 | MSD-ED | 3 | 0 | BAH | 20.00 | 2450 | 3 | P 2000 - 2500 | NCL Bahamas Ltd | 13.2 | 13.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | | | |
| 9223980 | TAMARITA | 257512000 | BULK | 2001 | 7800 | B&W | 6S50MC | 375.0 | SSD | 3 | 1320 | NIS | 14.50 | 0 | 4 | 45,000 - 90,000 | Ugland Bulk Transport AS | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 132 | | | |
| 9226891 | WESTERDAM | 244128000 | PASSENGER | 2002 | 75140 | Sulzer | 16ZAV40S | 70.4 | MSD-ED | 3 | 0 | NTH | 22.00 | 2250 | 3 | P 2000 - 2500 | Holland America Line NV | 12.2 | 12.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | 84.8 | 514,536 | |
| 9226906 | ARCADIA | 310459000 | PASSENGER | 2002 | 63360 | Sulzer | 16ZAV40S | 70.4 | MSD-ED | 3 | 0 | BER | 22.00 | 2388 | 3 | P 2000 - 2500 | Carnival Plc | 12.2 | 12.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | | | |
| 9230115 | NOORDAM | 246028000 | PASSENGER | 2004 | 75140 | Sulzer | 16ZAV40S | 70.4 | MSD-ED | 3 | 0 | NTH | 22.00 | 1918 | 2 | P 1500 - 2000 | Holland America Line NV | 12.2 | 12.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | 7.0 | 45,566 | |
| 9233167 | JEAN ANNE | 367003380 | AUTO | 2000 | 11060 | B&W | 7S50MC-C | 392.7 | SSD | 3 | 2760 | USA | 20.00 | 4300 | 3 | C 4000 - 5000 | Pasha Group | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9236846 | ORIENTE SHINE | 355900000 | BULK | 2000 | 7081 | Mitsubishi | 6UEC52LA | 339.8 | SSD | 3 | 1200 | PAN | 14.00 | 0 | 2 | 25,000 - 35,000 | Rainbow Maritime Co Ltd | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 132 | | | |
| 9243461 | BALTIC HIGHWAY | 353729000 | AUTO | 2001 | 16358 | B&W | 8S60MC | 648.0 | SSD | 3 | 2760 | PAN | 20.00 | 4004 | 3 | C 4000 - 5000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9243473 | CARIBBEAN HIGHWAY | 352218000 | AUTO | 2001 | 13480 | B&W | 8S60MC | 648.0 | SSD | 3 | 2760 | PAN | 20.00 | 4004 | 3 | C 4000 - 5000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9247572 | GRAND PIONEER | 352935000 | AUTO | 2001 | 14162 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 2880 | PAN | 20.00 | 6402 | 5 | C 6000 - 7000 | Cido Car Carrier Service Co | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9250220 | MEDITERRANEAN HIGHWAY | 354203000 | AUTO | 2001 | 13940 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3600 | PAN | 20.00 | 6043 | 5 | C 6000 - 7000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9252216 | HEROIC ACE | 352915000 | AUTO | 2002 | 14160 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 2850 | PAN | 20.00 | 6182 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9252228 | SPLENDID ACE | 355294000 | AUTO | 2003 | 14160 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 2850 | PAN | 20.00 | 6182 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9256389 | HANSA FREYBURG | 253436000 | CONTAINER | 2002 | 15785 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 3600 | LUX | 19.50 | 1740 | 2 | 1000 - 2000 TEU | Leonhardt & Blumberg Reederei | 16.0 | 12.2 | 0.13 | 0.50 | 0.35 | 0.13 | 325 | | | 920 |
| 9267663 | GRAND EAGLE | 357347000 | AUTO | 2002 | 14169 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 4800 | PAN | 19.80 | 6402 | 5 | C 6000 - 7000 | Cido Car Carrier Service Co | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9267687 | PROGRESS ACE | 353514000 | AUTO | 2002 | 14160 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 3000 | PAN | 20.00 | 6287 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9267699 | PROMINENT ACE | 356181000 | AUTO | 2003 | 14161 | Mitsubishi | 8UEC60LS | 622.0 | SSD | 3 | 3000 | PAN | 20.00 | 6287 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9267924 | ONYX ARROW | 311918000 | AUTO | 2005 | 15540 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 4350 | BAH | 20.40 | 6658 | 4 | C 5000 - 6000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9273894 | VIRGO LEADER | 356577000 | AUTO | 2003 | 15540 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 4280 | PAN | 20.00 | 5415 | 4 | C 5000 - 6000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9277826 | AMBER ARROW | 311695000 | AUTO | 2003 | 15540 | Sulzer | 7RTA62U | 649.1 | SSD | 3 | 4410 | BAH | 20.20 | 6658 | 5 | C 6000 - 7000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9279331 | CCNI ANDINO | 351828000 | AUTO | 2002 | 14280 | B&W | 7S60MC | 648.0 | SSD | 3 | 4800 | PAN | 19.80 | 6402 | 5 | C 6000 - 7000 | Cido Car Carrier Service Co | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9282742 | OKTEM AKSOY | 249806000 | BULK | 2003 | 7796 | B&W | 6S50MC | 375.0 | SSD | 3 | 1500 | MTA | 14.30 | 0 | 4 | 45,000 - 90,000 | Akmar Shipping & Trading SA | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 132 | | | |
| 9283863 | CAPRICORNUS LEADER | 564902000 | AUTO | 2004 | 15540 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 4280 | SNG | 20.00 | 5415 | 4 | C 5000 - 6000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9283875 | PHOENIX LEADER | 354899000 | AUTO | 2004 | 15540 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 4280 | PAN | 20.00 | 5415 | 4 | C 5000 - 6000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9283887 | SAGITTARIUS LEADER | 354410000 | AUTO | 2004 | 15540 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 4280 | PAN | 20.00 | 5415 | 4 | C 5000 - 6000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |

# Vessel Information

| LR/IMO# | LLOYDNAM | MMSI | TYPE | KEEL LAY | MAIN_KW | DESIGN | DESIGNATIO | DISP | MAIN_ENGIN | CATEGORY | AUX_KW | LL_FLAG | SPEED | Cars/TEUs/Pass | DWT_CATEGO | DWT_RANGE | OPERATOR | PNOx EF | ANOx EF | T Aux LF | M Aux LF | H Aux LF | A Aux LF | Boil Load | CI_Time | CI_kWh | Aux Load (kW) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9284776 | GRAND PAVO | 352879000 | AUTO | 2004 | 14280 | B&W | 7S60MC | 648.0 | SSD | 3 | 2880 | PAN | 19.80 | 6402 | 5 | C 6000 - 7000 | Cido Car Carrier Service Co | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9293399 | CROWN PRINCESS | 310500000 | PASSENGER | 2004 | 67220 | Wartsila | 12V46 | 96.4 | MSD-ED | 3 | 0 | BER | 22.50 | 3782 | 6 | P 3500 - 4000 | Princess Cruise Lines Ltd | 12.2 | 12.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | 49.5 | 475,664 | |
| 9293521 | MIRACULOUS ACE | 319149000 | AUTO | 2005 | 15100 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3600 | CAY | 20.50 | 6141 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9293636 | DIAMOND HIGHWAY | 354487000 | AUTO | 2003 | 14315 | Mitsubishi | 7UEC60LSII | 650.3 | SSD | 3 | 3000 | PAN | 20.65 | 6354 | 5 | C 6000 - 7000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9293648 | PARADISE ACE | 352142000 | AUTO | 2004 | 12170 | Mitsubishi | 7UEC60LSII | 650.3 | SSD | 3 | 3000 | PAN | 20.65 | 6354 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9293650 | LIBERTY ACE | 353039000 | AUTO | 2004 | 14315 | Mitsubishi | 7UEC60LSII | 650.3 | SSD | 3 | 3000 | PAN | 20.65 | 6354 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9294343 | SHANGHAI HIGHWAY | 371318000 | AUTO | 2005 | 12500 | B&W | 7S60ME-C | 678.6 | SSD | 3 | 2280 | PAN | 20.00 | 5036 | 4 | C 5000 - 6000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9303194 | GRAND ORION | 371798000 | AUTO | 2004 | 14280 | B&W | 7S60MC | 648.0 | SSD | 3 | 2880 | PAN | 19.80 | 6402 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9303209 | GRAND NEPTUNE | 371964000 | AUTO | 2004 | 14280 | B&W | 7S60MC | 648.0 | SSD | 3 | 2880 | PAN | 19.80 | 6402 | 5 | C 6000 - 7000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9308807 | CSAV RIO GRANDE | 636015992 | AUTO | 2006 | 14220 | B&W | 9S50MC-C | 392.7 | SSD | 3 | 2850 | LIB | 20.00 | 4943 | 3 | C 4000 - 5000 | CSAV | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9308883 | CEPHEUS LEADER | 372056000 | AUTO | 2004 | 15540 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3375 | PAN | 20.00 | 5374 | 4 | C 5000 - 6000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9309605 | BLUE OCEAN | 371073000 | GENERAL | 2005 | 7061 | Mitsubishi | 6UEC52LA | 339.8 | SSD | 3 | 960 | PAN | 14.70 | 0 | 2 | 25,000 - 35,000 | Toko Kaiun Kaisha Ltd | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9312169 | BBC NEBRASKA | 304724000 | GENERAL | 2003 | 5400 | MaK | 6M43 | 88.6 | MSD | 3 | 1885 | ABB | 15.50 | 665 | 1 | < 25,000 | Heino Winter GmbH & Co KG | 12.2 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9323780 | COLORADO HIGHWAY | 371641000 | AUTO | 2005 | 11620 | B&W | 6S60MC-C | 678.6 | SSD | 3 | 2400 | PAN | 20.00 | 4300 | 3 | C 4000 - 5000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9325180 | CSAV RIO NEVADO | 636015994 | AUTO | 2006 | 14220 | B&W | 9S50MC-C | 392.7 | SSD | 3 | 2850 | LIB | 20.00 | 4943 | 3 | C 4000 - 5000 | CSAV | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9325221 | GRAND RUBY | 372399000 | AUTO | 2004 | 14280 | B&W | 7S60MC | 648.0 | SSD | 3 | 3840 | PAN | 19.80 | 6402 | 5 | C 6000 - 7000 | Cido Car Carrier Service Co | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9325233 | GRAND SAPPHIRE | 372516000 | AUTO | 2004 | 14280 | B&W | 7S60MC | 648.0 | SSD | 3 | 3840 | PAN | 19.80 | 6400 | 5 | C 6000 - 7000 | Cido Car Carrier Service Co | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9325776 | WESTERN HIGHWAY | 372548000 | AUTO | 2004 | 11000 | Mitsubishi | 8UEC50LSII | 382.9 | SSD | 3 | 2760 | PAN | 20.00 | 3893 | 2 | C 3000 - 4000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9327748 | TARIFA | 309847000 | AUTO | 2006 | 15539 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 4500 | BAH | 20.40 | 6658 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9329461 | MORNING CELLO | 565599000 | AUTO | 2007 | 14342 | B&W | 7S60MC | 648.0 | SSD | 3 | 3750 | SNG | 20.50 | 6500 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9334234 | GRAND VICTORY | 370011000 | AUTO | 2007 | 14280 | B&W | 7S60MC | 648.0 | SSD | 3 | 2880 | PAN | 19.80 | 6402 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9335965 | POSEIDON LEADER | 432624000 | AUTO | 2004 | 16360 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3375 | JPN | 20.15 | 6324 | 5 | C 6000 - 7000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9336050 | MORNING CONDUCTOR | 355596000 | AUTO | 2007 | 14342 | B&W | 7S60MC | 648.0 | SSD | 3 | 3750 | PAN | 20.50 | 6500 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9338620 | SWALLOW ACE | 309509000 | AUTO | 2007 | 15540 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3900 | BAH | 20.00 | 6237 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9338632 | SOUTHERN HIGHWAY | 356580000 | AUTO | 2007 | 10999 | Mitsubishi | 8UEC50LSII | 382.9 | SSD | 3 | 2760 | PAN | 20.00 | 3893 | 2 | C 3000 - 4000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9338711 | MORNING CATHERINE | 354076000 | AUTO | 2007 | 15540 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3872 | PAN | 21.90 | 6502 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9338826 | SWAN ACE | 309369000 | AUTO | 2007 | 15540 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 2925 | BAH | 20.00 | 6237 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9338838 | SWIFT ACE | 311004900 | AUTO | 2007 | 15130 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3900 | BAH | 20.00 | 6237 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9338852 | SUNSHINE ACE | 311015100 | AUTO | 2008 | 15820 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 3000 | BAH | 20.00 | 5220 | 4 | C 5000 - 6000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9338864 | SUNLIGHT ACE | 311018600 | AUTO | 2008 | 15820 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 3000 | BAH | 20.00 | 5220 | 4 | C 5000 - 6000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9339806 | GRAND HERO | 372857000 | AUTO | 2004 | 14280 | B&W | 7S60MC | 648.0 | SSD | 3 | 3840 | PAN | 19.80 | 6402 | 5 | C 6000 - 7000 | Cido Car Carrier Service Co | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9339818 | GREEN BAY | 338009000 | AUTO | 2004 | 14280 | B&W | 7S60MC | 648.0 | SSD | 3 | 3090 | USA | 19.80 | 6402 | 5 | C 6000 - 7000 | LCI Shipholdings Inc | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9339820 | GEORGIA HIGHWAY | 432629000 | AUTO | 2004 | 11935 | B&W | 8S50MC-C | 392.7 | SSD | 3 | 4276 | JPN | 20.45 | 6135 | 5 | C 6000 - 7000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9340570 | GRAND CHAMPION | 372613000 | AUTO | 2004 | 14280 | B&W | 7S60MC | 648.0 | SSD | 3 | 3090 | PAN | 19.80 | 6402 | 5 | C 6000 - 7000 | Hoegh Autoliners AS | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9357315 | GOLIATH LEADER | 308369000 | AUTO | 2007 | 15539 | B&W | 7S60ME-C | 678.6 | SSD | 3 | 4500 | BAH | 20.50 | 6658 | 5 | C 6000 - 7000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9357327 | GARNET LEADER | 309905000 | AUTO | 2007 | 15820 | B&W | 7S60ME-C | 678.6 | SSD | 3 | 4500 | BAH | 20.50 | 6658 | 5 | C 6000 - 7000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9363948 | LAVENDER ACE | 353332000 | AUTO | 2008 | 15090 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3300 | BAH | 20.65 | 6287 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9363950 | CLOVER ACE | 636017062 | AUTO | 2008 | 15090 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3300 | BAH | 20.65 | 6287 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9370367 | SPLENDEUR | 354988000 | GENERAL | 2006 | 6250 | Mitsubishi | 6UEC52LA | 339.8 | SSD | 3 | 951 | PAN | 14.30 | 0 | 2 | 25,000 - 35,000 | Toko Kaiun Kaisha Ltd | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9372327 | ANDROMEDA SPIRIT | 372945000 | AUTO | 2006 | 11560 | Mitsubishi | 8UEC50LSII | 382.9 | SSD | 3 | 2625 | PAN | 19.90 | 3205 | 2 | C 3000 - 4000 | Nissan Motor Car Carrier | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9378450 | NIEUW AMSTERDAM | 246648000 | PASSENGER | 2008 | 64000 | MaK | 8M43C | 88.6 | MSD-ED | 3 | 0 | NTH | 21.90 | 2106 | 3 | P 2000 - 2500 | Holland America Line NV | 12.2 | 12.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | | | |
| 9378462 | RUBY PRINCESS | 310567000 | PASSENGER | 2006 | 67200 | Wartsila | 12V46C | 96.4 | MSD-ED | 3 | 0 | BER | 22.50 | 3575 | 6 | P 3500 - 4000 | Princess Cruise Lines Ltd | 12.2 | 12.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | 53.1 | 509,348 | |
| 9381249 | CYGNUS LEADER | 372747000 | AUTO | 2006 | 16360 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3300 | PAN | 19.30 | 5415 | 4 | C 5000 - 6000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9381392 | HHL VOLGA | 636092366 | GENERAL | 2007 | 5400 | MaK | 6M43 | 88.6 | MSD | 3 | 1885 | LIB | 15.50 | 665 | 1 | < 25,000 | Hansa Heavy Lift GmbH | 12.2 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9385154 | ORIENT DREAM | 370677000 | BULK | 2008 | 6840 | Mitsubishi | 6UEC45LSE | 292.6 | SSD | 3 | 864 | PAN | 14.40 | 0 | 2 | 25,000 - 35,000 | Orient Line KK | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 132 | | | |
| 9388716 | GUARDIAN LEADER | 311003400 | AUTO | 2007 | 15819 | B&W | 7S60ME-C | 678.6 | SSD | 3 | 4500 | BAH | 20.00 | 6658 | 5 | C 6000 - 7000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9391567 | GENTLE LEADER | 311003300 | AUTO | 2007 | 16660 | B&W | 7S60ME-C | 678.6 | SSD | 3 | 4500 | BAH | 21.00 | 6658 | 5 | C 6000 - 7000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9391579 | SERENITY ACE | 311002800 | AUTO | 2007 | 15820 | B&W | 7S60ME-C | 678.6 | SSD | 3 | 4200 | BAH | 20.00 | 6658 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9391581 | CSCC ASIA | 311003200 | AUTO | 2007 | 15820 | B&W | 7S60ME-C | 678.6 | SSD | 3 | 4500 | BAH | 20.00 | 6658 | 5 | C 6000 - 7000 | China Shipping Car Carrier Inc | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9395630 | VIOLET ACE | 311008600 | AUTO | 2009 | 13560 | B&W | 6S60MC-C | 678.6 | SSD | 3 | 4800 | BAH | 19.80 | 4914 | 3 | C 4000 - 5000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9396127 | STAR KIRKENES | 257310000 | GENERAL | 2009 | 11300 | B&W | 5S60MC-C | 678.6 | SSD | 3 | 3450 | NIS | 16.00 | 1453 | 4 | 45,000 - 90,000 | Grieg Star Shipping AS | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9396153 | STAR KVARVEN | 257661000 | GENERAL | 2009 | 11300 | B&W | 5S60MC-C | 678.6 | SSD | 3 | 3450 | NIS | 16.00 | 1453 | 4 | 45,000 - 90,000 | Grieg Star Shipping AS | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9397987 | AQUAMARINE ACE | 319310000 | AUTO | 2007 | 14315 | Mitsubishi | 7UEC60LSII | 650.3 | SSD | 3 | 3300 | CAY | 20.65 | 6334 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9398905 | COSTA LUMINOSA | 247257900 | PASSENGER | 2007 | 64000 | MaK | 12M43C | 88.6 | MSD-ED | 3 | 0 | ITL | 21.60 | 2826 | 4 | P 2500 - 3000 | Costa Crociere SpA | 12.2 | 12.2 | 0.13 | 0.13 | 0.12 | 0.12 | 1393 | | | |
| 9402706 | APOLLON LEADER | 370508000 | AUTO | 2008 | 14315 | Mitsubishi | 7UEC60LSII | 650.3 | SSD | 3 | 3300 | PAN | 20.65 | 6341 | 5 | C 6000 - 7000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9402756 | JUPITER LEADER | 563876000 | AUTO | 2008 | 11620 | B&W | 6S60MC-C | 678.6 | SSD | 3 | 2548 | SNG | 20.00 | 4318 | 3 | C 4000 - 5000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9403281 | BERGAMOT ACE | 319740000 | AUTO | 2008 | 11440 | B&W | 8S50MC | 375.0 | SSD | 3 | 2400 | CAY | 20.00 | 3518 | 2 | C 3000 - 4000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9409481 | SANDERLING ACE | 319913000 | AUTO | 2006 | 15130 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 3900 | CAY | 20.65 | 6237 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9419759 | GLOVIS CARDINAL | 538005237 | AUTO | 2008 | 14280 | B&W | 6S60MC-C | 678.6 | SSD | 3 | 3900 | MAI | 20.40 | 6700 | 5 | C 6000 - 7000 | Hyundai Glovis Co Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9421116 | BBC JADE | 305097000 | GENERAL | 2006 | 6000 | MaK | 6M43 | 88.6 | MSD | 3 | 2290 | ABB | 15.00 | 684 | 1 | < 25,000 | BBC Chartering & Logistic GmbH | 12.2 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9426350 | DIONYSOS LEADER | 432722000 | AUTO | 2008 | 15544 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3375 | JPN | 20.00 | 5374 | 4 | C 5000 - 6000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9426362 | DAEDALUS LEADER | 432729000 | AUTO | 2008 | 15544 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3375 | JPN | 20.00 | 5374 | 4 | C 5000 - 6000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9432892 | TRIUMPH | 636016206 | AUTO | 2007 | 14220 | B&W | 9S50MC-C | 392.7 | SSD | 3 | 2850 | LIB | 20.00 | 4943 | 3 | C 4000 - 5000 | Eastern Pacific Shipping UK | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9435818 | HOHEBANK | 305134000 | CONTAINER | 2006 | 9600 | MAN | 8L48/60B | 108.6 | MSD | 3 | 3820 | ABB | 18.80 | 957 | 1 | < 1000 TEU | MSC Mediterranean Shipping Co | 12.2 | 12.2 | 0.13 | 0.50 | 0.35 | 0.13 | 241 | | | 720 |
| 9436953 | BBC KWIATKOWSKI | 305240000 | GENERAL | 2007 | 4320 | MaK | 9M32C | 38.6 | MSD | 3 | 1920 | ABB | 15.00 | 532 | 1 | < 25,000 | BBC Chartering & Logistic GmbH | 12.2 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9437050 | BARBARA | 255805796 | CONTAINER | 2008 | 40040 | Sulzer | 7RT-flex96C | 1809.6 | SSD | 3 | 18600 | POR | 25.00 | 5301 | 6 | 5000 - 6000 TEU | MSC Mediterranean Shipping Co | 16.0 | 12.2 | 0.13 | 0.50 | 0.35 | 0.13 | 577 | | | |
| 9441556 | HERITAGE LEADER | 311040700 | AUTO | 2010 | 14280 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 5220 | BAH | 20.50 | 6500 | 5 | C 6000 - 7000 | NYK Line | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9441570 | HEROIC LEADER | 311052700 | AUTO | 2011 | 14280 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 5100 | BAH | 20.00 | 6500 | 5 | C 6000 - 7000 | NYK Line | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9441594 | GLOVIS CARAVEL | 311054300 | AUTO | 2012 | 15820 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 5100 | BAH | 20.50 | 6500 | 5 | C 6000 - 7000 | Hyundai Glovis Co Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9441609 | MORNING CLASSIC | 311072300 | AUTO | 2012 | 14280 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 5100 | BAH | 20.50 | 6500 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9445394 | G POSEIDON | 354149000 | AUTO | 2010 | 19040 | B&W | 8S60ME-C | 678.6 | SSD | 3 | 3780 | PAN | 20.00 | 8011 | 6 | C > 7000 | Doriko Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9445409 | GLOVIS SOLOMON | 538005856 | AUTO | 2010 | 19040 | B&W | 8S60ME-C | 678.6 | SSD | 3 | 4050 | MAI | 20.00 | 8011 | 6 | C > 7000 | Hyundai Glovis Co Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9464455 | CRONUS LEADER | 370661000 | AUTO | 2008 | 15540 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3300 | PAN | 19.30 | 5415 | 4 | C 5000 - 6000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9473250 | CLIPPER NEW YORK | 311063500 | GENERAL | 2009 | 8580 | B&W | 6S50MC | 375.0 | SSD | 3 | 1920 | BAH | 16.00 | 903 | 1 | < 25,000 | Thorco Shipping A/S | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9477830 | MORNING CECILIE | 370869000 | AUTO | 2008 | 15540 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3000 | PAN | 19.50 | 6502 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9477921 | DEMETER LEADER | 352714755 | AUTO | 2008 | 16360 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3300 | PAN | 20.00 | 5415 | 4 | C 5000 - 6000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9481049 | VIKING AMBER | 563255000 | AUTO | 2008 | 11060 | B&W | 7S50ME-C | 392.7 | SSD | 3 | 2910 | SNG | 18.00 | 4200 | 3 | C 4000 - 5000 | Gram & Co AS | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9481051 | VIKING CORAL | 564893000 | AUTO | 2009 | 11060 | B&W | 7S50ME-C | 392.7 | SSD | 3 | 2910 | SNG | 18.00 | 4200 | 3 | C 4000 - 5000 | Kawasaki Kisen Kaisha Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |

## Vessel Information

| LR/IMO# | LLOYDNAM | MMSI | TYPE | KEEL LAY | MAIN_KW | DESIGN | DESIGNATIO | DISP | MAIN_ENGIN | CATEGORY | AUX_KW | LL_FLAG | SPEED | Cars/TEUS/Pass | DWT_CATEGO | DWT_RANGE | OPERATOR | PNOx EF | ANOx EF | T Aux LF | M Aux LF | H Aux LF | A Aux LF | Boil Load | CI_Time | CI_kWh | Aux Load (kW) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9491886 | PASSERO | 236111887 | AUTO | 2008 | 14220 | B&W | 9S50MC-C | 392.7 | SSD | 3 | 2850 | GIB | 21.00 | 4900 | 3 | C 4000 - 5000 | TB Marine-Hamburg GmbH | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9498365 | AAL SINGAPORE | 538004441 | GENERAL | 2009 | 11640 | Sulzer | 7RT-flex50 | 402.5 | SSD | 3 | 2934 | MAI | 16.80 | 2029 | 2 | 25,000 - 35,000 | Austral Asia Line BV | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9498456 | AAL MELBOURNE | 538004942 | GENERAL | 2009 | 11640 | Sulzer | 7RT-flex50 | 402.5 | SSD | 3 | 2850 | MAI | 16.80 | 2029 | 2 | 25,000 - 35,000 | Austral Asia Line BV | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9498482 | AAL NEWCASTLE | 538005442 | GENERAL | 2009 | 11640 | Sulzer | 7RT-flex50 | 402.5 | SSD | 3 | 2850 | MAI | 16.80 | 2029 | 2 | 25,000 - 35,000 | Austral Asia Line BV | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9498597 | SELENE LEADER | 431224000 | AUTO | 2008 | 14280 | B&W | 7S60MC | 648.0 | SSD | 3 | 2940 | PAN | 19.80 | 6430 | 5 | C 6000 - 7000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9505900 | VENUS SPIRIT | 636015032 | AUTO | 2010 | 12210 | B&W | 6S60MC-C | 678.6 | SSD | 3 | 2400 | LIB | 20.00 | 5007 | 4 | C 5000 - 6000 | Nissan Motor Car Carrier | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9506722 | OCEAN FREEDOM | 367503980 | GENERAL | 2008 | 9960 | Sulzer | 6RT-flex50 | 402.5 | SSD | 3 | 2280 | USA | 17.50 | 985 | 1 | < 25,000 | Intermarine LLC | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9508380 | BBC SEINE | 305590000 | GENERAL | 2008 | 7860 | B&W | 6S46MC-C | 321.1 | SSD | 3 | 1800 | ABB | 15.00 | 958 | 1 | < 25,000 | BBC Chartering & Logistic GmbH | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9509401 | JUPITER SPIRIT | 636015173 | AUTO | 2010 | 12210 | B&W | 6S60MC-C | 678.6 | SSD | 3 | 2400 | LIB | 20.00 | 5007 | 4 | C 5000 - 6000 | Nissan Motor Car Carrier | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9514999 | VIKING OCEAN | 566613000 | AUTO | 2009 | 11060 | B&W | 7S50ME-C | 392.7 | SSD | 3 | 3300 | SNG | 18.00 | 4200 | 3 | C 4000 - 5000 | Gram & Co AS | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9515008 | VIKING SEA | 566614000 | AUTO | 2012 | 11060 | B&W | 7S50ME-C | 392.7 | SSD | 3 | 3300 | SNG | 18.00 | 4200 | 3 | C 4000 - 5000 | Mitsui OSK Lines Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9515474 | IRIS ACE | 319392000 | AUTO | 2010 | 12640 | B&W | 8S50MC-C | 392.7 | SSD | 3 | 2940 | CAY | 20.00 | 4064 | 3 | C 4000 - 5000 | Mitsui OSK Lines Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9519092 | SINCERITY ACE | 351690000 | AUTO | 2008 | 15100 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3600 | PAN | 20.00 | 5221 | 4 | C 5000 - 6000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9519121 | TRITON ACE | 371862000 | AUTO | 2008 | 16360 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3000 | PAN | 19.50 | 6502 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9531715 | BESS | 372995000 | AUTO | 2008 | 14280 | B&W | 7S60MC | 648.0 | SSD | 3 | 2850 | PAN | 19.80 | 6402 | 5 | C 6000 - 7000 | Wallenius Wilhelmsen Logistics | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9531753 | HERCULES LEADER | 432803000 | AUTO | 2008 | 15544 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3375 | JPN | 20.60 | 6331 | 5 | C 6000 - 7000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9536818 | GAIA LEADER | 566300000 | AUTO | 2008 | 15540 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3375 | SNG | 20.50 | 6331 | 5 | C 6000 - 7000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9536959 | DELHI HIGHWAY | 355488000 | AUTO | 2010 | 14280 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 3375 | PAN | 20.45 | 6135 | 5 | C 6000 - 7000 | Kawasaki Kisen Kaisha Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9539169 | ANTARES LEADER | 432810000 | AUTO | 2010 | 14315 | Mitsubishi | 7UEC60LSII | 650.3 | SSD | 3 | 3300 | JPN | 20.65 | 6341 | 5 | C 6000 - 7000 | NYK Line | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9539171 | ALTAIR LEADER | 432817000 | AUTO | 2010 | 14315 | Mitsubishi | 7UEC60LSII | 650.3 | SSD | 3 | 3300 | JPN | 20.65 | 6341 | 5 | C 6000 - 7000 | NYK Line | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9539183 | OPAL ACE | 319058000 | AUTO | 2010 | 14315 | Mitsubishi | 7UEC60LSII | 650.3 | SSD | 3 | 3600 | CAY | 20.65 | 6312 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9542283 | AZALEA ACE | 636015228 | AUTO | 2010 | 11900 | Mitsubishi | 8UEC50LSII | 382.9 | SSD | 3 | 2625 | LIB | 20.00 | 3505 | 2 | C 3000 - 4000 | Mitsui OSK Lines Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9542295 | GARDENIA ACE | 636015370 | AUTO | 2010 | 11900 | Mitsubishi | 8UEC50LSII | 382.9 | SSD | 3 | 2625 | LIB | 20.00 | 3505 | 2 | C 3000 - 4000 | Mitsui OSK Lines Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9553103 | TRITON LEADER | 357795000 | AUTO | 2008 | 15540 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3000 | PAN | 19.50 | 6502 | 5 | C 6000 - 7000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9553115 | THEMIS LEADER | 371965000 | AUTO | 2008 | 15540 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3300 | PAN | 20.00 | 5415 | 4 | C 5000 - 6000 | NYK Line | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9561253 | TRANQUIL ACE | 319013600 | AUTO | 2008 | 15813 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 3000 | CAY | 20.00 | 5219 | 4 | C 5000 - 6000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9561265 | ELEGANT ACE | 319015800 | AUTO | 2008 | 15130 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 3000 | CAY | 20.20 | 5219 | 4 | C 5000 - 6000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9561289 | MERMAID ACE | 355139000 | AUTO | 2008 | 15130 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 3000 | PAN | 20.65 | 6233 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 16.0 | 12.2 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9563706 | BBC AMBER | 305717000 | GENERAL | 2008 | 8280 | B&W | 6S46MC-C | 321.1 | SSD | 3 | 2470 | ABB | 17.50 | 985 | 1 | < 25,000 | BBC Chartering & Logistic GmbH | 16.0 | 12.2 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9563744 | BBC RUBY | 305908000 | GENERAL | 2012 | 8280 | B&W | 6S46MC-C8 | 321.1 | SSD | 3 | 3000 | ABB | 17.50 | 987 | 1 | < 25,000 | Bockstiegel Reederei GmbH & Co | 14.4 | 10.5 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9565558 | CAPE TOWN HIGHWAY | 372031000 | AUTO | 2010 | 13200 | B&W | 7S60ME-C8 | 678.6 | SSD | 3 | 3900 | PAN | 20.00 | 6249 | 5 | C 6000 - 7000 | Kawasaki Kisen Kaisha Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9565560 | DALIAN HIGHWAY | 357694000 | AUTO | 2010 | 13200 | B&W | 7S60ME-C8 | 678.6 | SSD | 3 | 4050 | PAN | 20.00 | 6249 | 5 | C 6000 - 7000 | Kawasaki Kisen Kaisha Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9574054 | MORNING CHRISTINA | 371140000 | AUTO | 2010 | 13260 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3300 | PAN | 20.00 | 6237 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9574066 | CANADIAN HIGHWAY | 352718000 | AUTO | 2010 | 13260 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3600 | PAN | 20.00 | 6215 | 5 | C 6000 - 7000 | Kawasaki Kisen Kaisha Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9574080 | MORNING CRYSTAL | 371706000 | AUTO | 2010 | 13260 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3300 | PAN | 20.00 | 6215 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9574092 | MORNING CARA | 355768000 | AUTO | 2010 | 13260 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3300 | PAN | 20.00 | 6215 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9574107 | DOVER HIGHWAY | 432824000 | AUTO | 2010 | 13260 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3600 | JPN | 20.00 | 6215 | 5 | C 6000 - 7000 | Kawasaki Kisen Kaisha Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9584059 | NEPTUNE ACE | 311045300 | AUTO | 2010 | 15130 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 3000 | BAH | 20.00 | 6172 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9584891 | WESTERN KOBE | 538004655 | BULK | 2011 | 8630 | B&W | 6S50MC-C | 392.7 | SSD | 3 | 1500 | MAI | 14.50 | 0 | 4 | 45,000 - 90,000 | IMECS Co Ltd | 14.4 | 10.5 | 0.17 | 0.45 | 0.10 | 0.17 | 132 | | | |
| 9590589 | GLOVIS CENTURY | 373599000 | AUTO | 2011 | 13560 | B&W | 6S60MC-C8 | 678.6 | SSD | 3 | 3600 | PAN | 20.50 | 6100 | 5 | C 6000 - 7000 | Hyundai Glovis Co Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9590591 | GLOVIS CHALLENGE | 373260000 | AUTO | 2011 | 13570 | B&W | 6S60MC-C8 | 678.6 | SSD | 3 | 6000 | PAN | 20.50 | 6500 | 5 | C 6000 - 7000 | Hyundai Glovis Co Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9591052 | MERCURY ACE | 370644000 | AUTO | 2010 | 16360 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3600 | PAN | 20.00 | 6109 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9593866 | STAR LIMA | 257844000 | GENERAL | 2012 | 10780 | B&W | 5S60ME-C8 | 678.6 | SSD | 3 | 2595 | NIS | 15.50 | 1411 | 4 | 45,000 - 90,000 | Grieg Star AS | 14.4 | 10.5 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9593880 | STAR LOUISIANA | 538006859 | GENERAL | 2012 | 10780 | B&W | 5S60ME-C8 | 678.6 | SSD | 3 | 2595 | NIS | 15.50 | 1411 | 4 | 45,000 - 90,000 | Grieg Star AS | 14.4 | 10.5 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9593892 | STAR LOFOTEN | 258011000 | GENERAL | 2013 | 10780 | B&W | 5S60ME-C8 | 678.6 | SSD | 3 | 2595 | NIS | 15.50 | 1411 | 4 | 45,000 - 90,000 | Grieg Star AS | 14.4 | 10.5 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9603790 | STAR LOEN | 258008000 | GENERAL | 2013 | 10780 | B&W | 5S60ME-C8 | 678.6 | SSD | 3 | 2595 | NIS | 15.50 | 1411 | 4 | 45,000 - 90,000 | Grieg Star AS | 14.4 | 10.5 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9608403 | DA DE | 413478240 | GENERAL | 2013 | 9960 | B&W | 6S50ME-C8 | 392.7 | SSD | 3 | 2100 | CHR | 15.50 | 1035 | 2 | 25,000 - 35,000 | COSCOL | 14.4 | 10.5 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9610391 | SUPREME ACE | 357147000 | AUTO | 2010 | 15130 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 3750 | PAN | 20.60 | 6163 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9610406 | VICTORIOUS ACE | 356541000 | AUTO | 2010 | 15820 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 3750 | PAN | 20.00 | 6163 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9616840 | STAR LYSEFJORD | 258005000 | GENERAL | 2013 | 10780 | B&W | 5S60ME-C8 | 678.6 | SSD | 3 | 2595 | NIS | 15.50 | 1411 | 4 | 45,000 - 90,000 | Grieg Star AS | 14.4 | 10.5 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9619684 | MARJORIE C | 367641230 | AUTO | 2011 | 19040 | B&W | 8S60ME-C8 | 678.6 | SSD | 3 | 4600 | USA | 20.00 | 1100 | 1 | C < 3000 | Pasha Hawaii Holdings LLC | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9620683 | MORNING CLAIRE | 373398000 | AUTO | 2010 | 15090 | B&W | 7S60MC-C | 678.6 | SSD | 3 | 3375 | PAN | 20.60 | 6257 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9624237 | GALAXY ACE | 636015819 | AUTO | 2010 | 15100 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3600 | LIB | 20.00 | 6400 | 5 | C 6000 - 7000 | Mitsui OSK Lines Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9633185 | MORNING CINDY | 353647000 | AUTO | 2010 | 13260 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3300 | PAN | 20.00 | 6215 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9641833 | WISDOM ACE | 352044000 | AUTO | 2010 | 15100 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3390 | PAN | 20.65 | 5198 | 4 | C 5000 - 6000 | Mitsui OSK Lines Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9644043 | GLOBAL ARC | 370413000 | BULK | 2011 | 6200 | Mitsubishi | 6UEC45LSE | 292.6 | SSD | 3 | 1170 | PAN | 14.30 | 0 | 2 | 25,000 - 35,000 | United Ocean Ship Mgmt Pte Ltd | 14.4 | 10.5 | 0.17 | 0.45 | 0.10 | 0.17 | 132 | | | |
| 9663295 | MORNING CAPO | 538005232 | AUTO | 2013 | 16660 | B&W | 7S60ME-C8 | 678.6 | SSD | 3 | 5640 | MAI | 20.40 | 6600 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9672416 | GENIUS HIGHWAY | 311000102 | AUTO | 2013 | 15820 | B&W | 7S60ME-C | 678.6 | SSD | 3 | 4860 | BAH | 20.50 | 6500 | 5 | C 6000 - 7000 | Kawasaki Kisen Kaisha Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9675585 | MORNING CHERRY | 357076000 | AUTO | 2013 | 12240 | Mitsubishi | 8UEC60LSII | 650.3 | SSD | 3 | 3300 | PAN | 20.00 | 6215 | 5 | C 6000 - 7000 | EUKOR Car Carriers Inc | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9676864 | ARIES LEADER | 370681000 | AUTO | 2013 | 13750 | B&W | 7S60ME-C | 678.6 | SSD | 3 | 3920 | PAN | 20.00 | 5793 | 4 | C 5000 - 6000 | NYK Line | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9676876 | PISCES LEADER | 353987000 | AUTO | 2013 | 13750 | B&W | 7S60ME-C | 678.6 | SSD | 3 | 3920 | PAN | 20.00 | 5793 | 4 | C 5000 - 6000 | NYK Line | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9680853 | PERLA DEL CARIBE | 338789000 | CONTAINER | 2014 | 25191 | B&W | 8L70ME-C8-GI | 908.2 | SSD | 3 | 5220 | USA | 22.00 | 3100 | 4 | 3000 - 4000 TEU | Totem Ocean Trailer Express | 14.4 | 10.5 | 0.13 | 0.50 | 0.35 | 0.13 | 492 | | | 1136 |
| 9690535 | HERMES LEADER | 311000188 | AUTO | 2014 | 18760 | B&W | 7G60ME-C9 | 788.9 | SSD | 3 | 7560 | BAH | 16.50 | 7700 | 6 | C > 7000 | NYK Line | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9700574 | RISING SUN | 357977000 | GENERAL | 2014 | 6000 | Mitsubishi | 6UEC45LSE-Eco | 307.0 | SSD | 3 | 1200 | PAN | 14.00 | 0 | 2 | 25,000 - 35,000 | Toko Kaiun Kaisha Ltd | 14.4 | 10.5 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |
| 9703057 | DOLE PACIFIC | 311000414 | CONTAINER | 2015 | 26160 | B&W | 8L70ME-C8 | 908.2 | SSD | 3 | 12400 | BAH | 19.50 | 1540 | 2 | 1000 - 2000 TEU | Dole Ocean Cargo Express Inc | 14.4 | 10.5 | 0.13 | 0.50 | 0.35 | 0.13 | 325 | 1226.4 | 1,839,600 | 1500 |
| 9703069 | DOLE ATLANTIC | 311000415 | CONTAINER | 2015 | 26160 | B&W | 8L70ME-C8 | 908.2 | SSD | 3 | 12400 | BAH | 19.50 | 1540 | 2 | 1000 - 2000 TEU | Dole Ocean Cargo Express Inc | 14.4 | 10.5 | 0.13 | 0.50 | 0.35 | 0.13 | 325 | 854.3 | 1,281,400 | 1500 |
| 9703071 | DOLE CARIBBEAN | 311000416 | CONTAINER | 2015 | 26160 | B&W | 8L70ME-C8 | 908.2 | SSD | 3 | 12400 | BAH | 19.50 | 1540 | 2 | 1000 - 2000 TEU | Dole Ocean Cargo Express Inc | 14.4 | 10.5 | 0.13 | 0.50 | 0.35 | 0.13 | 325 | 538.2 | 807,250 | 1500 |
| 9707003 | GLOVIS CRYSTAL | 538006102 | AUTO | 2014 | 12560 | B&W | 6S60ME-C8 | 678.6 | SSD | 3 | 5640 | MAI | 19.90 | 6612 | 5 | C 6000 - 7000 | Hyundai Glovis Co Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9749594 | GLOVIS SPRING | 538006886 | AUTO | 2015 | 16660 | B&W | 7S60ME-C8 | 678.6 | SSD | 3 | 4500 | MAI | 20.00 | 7400 | 6 | C > 7000 | Hyundai Glovis Co Ltd | 14.4 | 10.5 | 0.15 | 0.45 | 0.26 | 0.15 | 351 | | | |
| 9760653 | CEBU ISLAND | 374077000 | GENERAL | 2014 | 6250 | Mitsubishi | 6UEC45LSE-EcoB2 | 307.0 | SSD | 3 | 1320 | PAN | 14.70 | 0 | 3 | 35,000 - 45,000 | Toko Kaiun Kaisha Ltd | 14.4 | 10.5 | 0.17 | 0.45 | 0.10 | 0.17 | 135 | | | |

# Appendix B
# *Vessel Activity Data*

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

| | | | | | Transit | | VSR | | Maneuver | | Hotel | Anchor | Calls | | | Transit | | VSR | | Maneuver | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MMSI** | **IMO** | **VESSNAME** | **FLAG** | **SHIPTYPE** | **Time** | **Dist** | **Time** | **Dist** | **Time** | **Dist** | **Time** | **Time** | **ENT** | **CLR** | **Serv Spd** | **Ave Spd** | **Ave LF** | **Ave Spd** | **Ave LF** | **Ave Spd** | **Ave LF** | **Terminal** |
| 257429000 | 8520680 | TRIANON | Norway | AUTO | 0.198 | 2.568 | 3.202 | 34.017 | 2.508 | 19.892 | 9.331 | 0.000 | 1 | 1 | 18.00 | 12.97 | 0.31 | 10.62 | 0.17 | 7.93 | 0.07 | NCMT |
| 257448000 | 8602579 | TRINIDAD | Norway | AUTO | 0.000 | 0.000 | 2.821 | 27.625 | 2.138 | 18.554 | 132.548 | 15.169 | 1 | 1 | 18.00 | - | - | 9.79 | 0.13 | 8.68 | 0.09 | NCMT |
| 373817000 | 8606056 | GMT ASTRO | Panama | AUTO | 0.491 | 6.294 | 11.602 | 90.869 | 7.548 | 58.942 | 33.530 | 185.733 | 3 | 3 | 18.50 | 12.82 | 0.27 | 7.83 | 0.06 | 7.81 | 0.06 | NCMT |
| 353698000 | 8608054 | AUTO ATLAS | Panama | AUTO | 0.000 | 0.000 | 4.298 | 37.685 | 5.116 | 39.604 | 74.133 | 24.798 | 2 | 2 | 18.00 | - | - | 8.77 | 0.10 | 7.74 | 0.07 | NCMT |
| 355997000 | 8608066 | AUTO BANNER | Panama | AUTO | 1.115 | 14.960 | 15.468 | 111.686 | 7.227 | 57.042 | 48.981 | 177.736 | 3 | 3 | 18.00 | 13.42 | 0.34 | 7.22 | 0.05 | 7.89 | 0.07 | NCMT |
| 257717000 | 8608078 | MORNING MERCATOR | Norway | AUTO | 0.342 | 4.665 | 2.711 | 31.724 | 2.598 | 20.214 | 22.405 | 0.000 | 1 | 1 | 18.00 | 13.64 | 0.36 | 11.70 | 0.23 | 7.78 | 0.07 | NCMT |
| 636008621 | 8612251 | ATLAS HIGHWAY | Liberia | AUTO | 0.188 | 2.850 | 3.313 | 32.770 | 2.391 | 19.689 | 8.962 | 0.000 | 1 | 1 | 20.90 | 15.16 | 0.31 | 9.89 | 0.09 | 8.23 | 0.05 | NCMT |
| 533052100 | 8613188 | MV STRAITS VOYAGER | Malaysia | AUTO | 0.000 | 0.000 | 4.048 | 26.279 | 2.576 | 20.327 | 17.772 | 0.000 | 1 | 1 | 18.40 | - | - | 6.49 | 0.04 | 7.89 | 0.06 | NCMT |
| 351552000 | 8709119 | GMT POLARIS | Panama | AUTO | 0.804 | 11.139 | 4.524 | 50.154 | 4.563 | 38.130 | 28.906 | 0.000 | 2 | 2 | 18.00 | 13.85 | 0.38 | 11.09 | 0.19 | 8.36 | 0.08 | NCMT |
| 355861000 | 8712324 | QUEEN ACE | Panama | AUTO | 0.000 | 0.000 | 3.338 | 23.285 | 2.486 | 19.779 | 22.394 | 118.106 | 1 | 1 | 18.50 | - | - | 6.98 | 0.04 | 7.96 | 0.07 | NCMT |
| 431165000 | 8916267 | HOJIN | Japan | AUTO | 11.900 | 44.570 | 14.746 | 55.009 | 2.757 | 20.110 | 11.295 | 0.000 | 1 | 1 | 19.25 | 3.75 | 0.02 | 3.73 | 0.02 | 7.29 | 0.04 | NCMT |
| 357376000 | 9047996 | HARMONY ACE | Panama | AUTO | 0.000 | 0.000 | 10.912 | 98.132 | 9.851 | 76.090 | 53.204 | 165.084 | 4 | 4 | 19.00 | - | - | 8.99 | 0.09 | 7.72 | 0.06 | NCMT |
| 563329000 | 9051375 | COUGAR ACE | Singapore | AUTO | 0.050 | 0.604 | 3.196 | 31.417 | 2.585 | 19.662 | 18.557 | 0.000 | 1 | 1 | 18.60 | 12.08 | 0.23 | 9.83 | 0.12 | 7.61 | 0.06 | NCMT |
| 355754000 | 9051818 | PEARL ACE | Panama | AUTO | 2.475 | 29.925 | 12.012 | 118.530 | 7.684 | 58.880 | 27.418 | 0.000 | 3 | 3 | 18.50 | 12.09 | 0.23 | 9.87 | 0.12 | 7.66 | 0.06 | NCMT |
| 374100000 | 9070462 | K.ASIAN BEAUTY | Panama | AUTO | 0.497 | 7.215 | 4.154 | 49.114 | 4.290 | 36.708 | 38.296 | 0.000 | 2 | 2 | 18.00 | 14.52 | 0.43 | 11.82 | 0.23 | 8.56 | 0.09 | NCMT |
| 235007790 | 9070474 | ASIAN GLORY | United Kingdom | AUTO | 0.426 | 6.295 | 7.773 | 71.214 | 4.671 | 38.379 | 21.664 | 53.803 | 2 | 2 | 18.60 | 14.78 | 0.41 | 9.16 | 0.10 | 8.22 | 0.07 | NCMT |
| 353910000 | 9078830 | PEGASUS HIGHWAY | Panama | AUTO | 0.000 | 0.000 | 4.656 | 41.632 | 2.237 | 18.504 | 4.958 | 0.000 | 1 | 1 | 18.50 | - | - | 8.94 | 0.09 | 8.27 | 0.07 | NCMT |
| 354342000 | 9078842 | ARCADIA HIGHWAY | Panama | AUTO | 0.243 | 3.452 | 2.595 | 31.254 | 2.308 | 18.178 | 10.255 | 0.000 | 1 | 1 | 20.00 | 14.21 | 0.29 | 12.04 | 0.18 | 7.88 | 0.05 | NCMT |
| 636015709 | 9103180 | CAMELLIA ACE | Liberia | AUTO | 1.260 | 15.576 | 6.658 | 53.392 | 2.477 | 19.961 | 6.950 | 0.000 | 1 | 1 | 18.60 | 12.36 | 0.24 | 8.02 | 0.07 | 8.06 | 0.07 | NCMT |
| 440269000 | 9122942 | GLOVIS COMET | South Korea | AUTO | 0.706 | 11.394 | 3.290 | 36.809 | 2.551 | 19.920 | 14.353 | 0.000 | 1 | 1 | 20.10 | 16.14 | 0.43 | 11.19 | 0.14 | 7.81 | 0.05 | NCMT |
| 441992000 | 9122966 | ASIAN VISION | South Korea | AUTO | 0.000 | 0.000 | 10.189 | 63.995 | 4.757 | 38.474 | 29.928 | 34.600 | 2 | 2 | 20.10 | - | - | 6.28 | 0.03 | 8.09 | 0.05 | NCMT |
| 564753000 | 9138525 | DON QUIJOTE | Singapore | AUTO | 0.000 | 0.000 | 2.508 | 30.107 | 2.399 | 18.505 | 20.286 | 0.000 | 1 | 1 | 20.50 | - | - | 12.00 | 0.17 | 7.71 | 0.04 | NCMT |
| 636010789 | 9153551 | EURO SPIRIT | Liberia | AUTO | 1.661 | 19.537 | 12.620 | 114.872 | 7.066 | 55.308 | 68.784 | 32.917 | 3 | 3 | 18.00 | 11.76 | 0.23 | 9.10 | 0.11 | 7.83 | 0.07 | NCMT |
| 431305000 | 9158276 | AQUARIUS LEADER | Japan | AUTO | 0.000 | 0.000 | 3.045 | 25.783 | 2.251 | 18.387 | 30.096 | 0.000 | 1 | 1 | 19.30 | - | - | 8.47 | 0.07 | 8.17 | 0.06 | NCMT |
| 357247000 | 9169316 | GRAND CHOICE | Panama | AUTO | 0.000 | 0.000 | 1.436 | 15.747 | 2.232 | 18.230 | 14.326 | 0.000 | 1 | 1 | 19.20 | - | - | 10.97 | 0.15 | 8.17 | 0.06 | NCMT |
| 431314000 | 9174490 | LIBRA LEADER | Japan | AUTO | 0.250 | 3.257 | 3.191 | 34.947 | 2.236 | 18.626 | 10.319 | 0.000 | 1 | 1 | 19.30 | 13.03 | 0.25 | 10.95 | 0.15 | 8.33 | 0.07 | NCMT |
| 440114000 | 9176606 | ASIAN EMPIRE | South Korea | AUTO | 0.000 | 0.000 | 1.451 | 15.357 | 2.227 | 18.565 | 10.566 | 0.000 | 1 | 1 | 20.10 | - | - | 10.58 | 0.12 | 8.34 | 0.06 | NCMT |
| 210280000 | 9177040 | DRESDEN | Cyprus | AUTO | 0.413 | 5.993 | 2.643 | 30.547 | 2.078 | 18.402 | 5.335 | 0.000 | 1 | 1 | 19.50 | 14.51 | 0.34 | 11.56 | 0.17 | 8.86 | 0.08 | NCMT |
| 369326000 | 9177428 | GREEN RIDGE | United States | AUTO | 0.000 | 0.000 | 2.244 | 16.014 | 2.312 | 17.879 | 10.695 | 0.000 | 1 | 1 | 18.53 | - | - | 7.14 | 0.05 | 7.73 | 0.06 | NCMT |
| 357682000 | 9181558 | LEO LEADER | Panama | AUTO | 0.477 | 7.618 | 3.672 | 43.740 | 3.913 | 24.497 | 18.088 | 29.951 | 0 | 1 | 19.30 | 15.97 | 0.47 | 11.91 | 0.19 | 6.26 | 0.03 | NCMT |
| 338657000 | 9181560 | GREEN COVE | United States | AUTO | 0.203 | 3.439 | 4.355 | 48.999 | 4.042 | 30.232 | 21.608 | 0.000 | 2 | 2 | 19.30 | 16.94 | 0.56 | 11.25 | 0.16 | 7.48 | 0.05 | NCMT |
| 351757000 | 9182356 | COMET ACE | Panama | AUTO | 6.130 | 37.336 | 11.081 | 106.018 | 7.649 | 58.131 | 23.477 | 0.000 | 3 | 3 | 18.90 | 6.09 | 0.03 | 9.57 | 0.11 | 7.60 | 0.05 | NCMT |
| 351340000 | 9207388 | PALMELA | Panama | AUTO | 1.202 | 16.978 | 6.556 | 65.401 | 2.043 | 18.395 | 55.958 | 13.104 | 1 | 1 | 20.00 | 14.12 | 0.29 | 9.98 | 0.10 | 9.00 | 0.08 | NCMT |
| 352062000 | 9209506 | TRIUMPH ACE | Panama | AUTO | 0.000 | 0.000 | 1.752 | 15.913 | 2.272 | 18.589 | 10.782 | 0.000 | 1 | 1 | 20.00 | - | - | 9.08 | 0.08 | 8.18 | 0.06 | NCMT |
| 431221000 | 9209518 | MERIDIAN ACE | Japan | AUTO | 0.534 | 7.507 | 3.127 | 34.358 | 2.499 | 19.750 | 15.137 | 0.000 | 1 | 1 | 19.00 | 14.06 | 0.33 | 10.99 | 0.16 | 7.90 | 0.06 | NCMT |
| 367003380 | 9233167 | JEAN ANNE | United States | AUTO | 0.000 | 0.000 | 37.618 | 414.389 | 58.103 | 475.639 | 981.047 | 0.000 | 26 | 26 | 20.00 | - | - | 11.02 | 0.14 | 8.19 | 0.06 | NCMT |
| 353729000 | 9243461 | BALTIC HIGHWAY | Panama | AUTO | 0.192 | 2.948 | 2.671 | 31.272 | 2.539 | 20.278 | 4.299 | 0.000 | 1 | 1 | 20.00 | 15.35 | 0.37 | 11.71 | 0.17 | 7.99 | 0.05 | NCMT |
| 352218000 | 9243473 | CARIBBEAN HIGHWAY | Panama | AUTO | 0.145 | 2.193 | 3.152 | 31.535 | 2.097 | 17.939 | 15.561 | 0.000 | 1 | 1 | 20.00 | 15.12 | 0.36 | 10.00 | 0.10 | 8.55 | 0.06 | NCMT |
| 352935000 | 9247572 | GRAND PIONEER | Panama | AUTO | 0.532 | 9.344 | 11.724 | 112.560 | 7.650 | 58.371 | 73.734 | 39.103 | 3 | 3 | 20.00 | 17.56 | 0.56 | 9.60 | 0.09 | 7.63 | 0.05 | NCMT |
| 354203000 | 9250220 | MEDITERRANEANHIGHWAY | Panama | AUTO | 0.200 | 3.387 | 4.704 | 36.144 | 2.553 | 19.786 | 60.536 | 39.189 | 1 | 1 | 20.00 | 16.94 | 0.50 | 7.68 | 0.05 | 7.75 | 0.05 | NCMT |
| 352915000 | 9252216 | HEROIC ACE | Panama | AUTO | 1.139 | 13.281 | 13.819 | 114.767 | 7.209 | 56.963 | 41.917 | 136.485 | 3 | 3 | 20.00 | 11.66 | 0.16 | 8.31 | 0.06 | 7.90 | 0.05 | NCMT |
| 355294000 | 9252228 | SPLENDID ACE | Panama | AUTO | 19.795 | 33.767 | 45.733 | 121.397 | 2.553 | 20.006 | 17.140 | 0.000 | 1 | 1 | 20.00 | 1.71 | 0.02 | 2.65 | 0.02 | 7.84 | 0.05 | NCMT |
| 357347000 | 9267663 | GRAND EAGLE | Panama | AUTO | 3.916 | 32.688 | 23.357 | 128.458 | 6.991 | 56.120 | 54.787 | 0.000 | 3 | 3 | 19.80 | 8.35 | 0.06 | 5.50 | 0.02 | 8.03 | 0.05 | NCMT |
| 353514000 | 9267687 | PROGRESS ACE | Panama | AUTO | 0.449 | 6.372 | 4.397 | 48.516 | 2.683 | 19.572 | 13.114 | 0.000 | 1 | 1 | 20.00 | 14.19 | 0.29 | 11.03 | 0.14 | 7.29 | 0.04 | NCMT |
| 356181000 | 9267699 | PROMINENT ACE | Panama | AUTO | 0.000 | 0.000 | 7.726 | 54.797 | 4.716 | 37.109 | 31.991 | 185.788 | 2 | 2 | 20.00 | - | - | 7.09 | 0.04 | 7.87 | 0.05 | NCMT |
| 356577000 | 9273894 | VIRGO LEADER | Panama | AUTO | 1.007 | 9.604 | 21.282 | 58.997 | 2.803 | 20.009 | 11.851 | 0.000 | 1 | 1 | 20.00 | 9.54 | 0.09 | 2.77 | 0.02 | 7.14 | 0.04 | NCMT |
| 311695000 | 9277826 | AMBER ARROW | Bahamas | AUTO | 0.254 | 3.581 | 2.937 | 33.870 | 2.657 | 19.591 | 9.150 | 0.000 | 1 | 1 | 20.20 | 14.10 | 0.28 | 11.53 | 0.15 | 7.37 | 0.04 | NCMT |
| 351828000 | 9279331 | GRAND AURORA | Panama | AUTO | 0.157 | 2.114 | 2.872 | 31.536 | 2.609 | 19.723 | 21.747 | 0.000 | 1 | 1 | 19.80 | 13.46 | 0.26 | 10.98 | 0.14 | 7.56 | 0.05 | NCMT |
| 564902000 | 9283863 | CAPRICORNUS LEADER | Singapore | AUTO | 0.070 | 1.141 | 5.393 | 47.150 | 2.499 | 19.218 | 12.047 | 19.702 | 1 | 1 | 20.00 | 16.30 | 0.45 | 8.74 | 0.07 | 7.69 | 0.05 | NCMT |
| 354899000 | 9283875 | PHOENIX LEADER | Panama | AUTO | 0.921 | 13.862 | 3.846 | 37.489 | 2.649 | 19.838 | 10.493 | 0.000 | 1 | 1 | 20.00 | 15.05 | 0.35 | 9.75 | 0.10 | 7.49 | 0.04 | NCMT |
| 354410000 | 9283887 | SAGITTARIUS LEADER | Panama | AUTO | 0.000 | 0.000 | 2.251 | 21.033 | 2.449 | 19.941 | 12.048 | 0.000 | 1 | 1 | 20.00 | - | - | 9.34 | 0.08 | 8.14 | 0.06 | NCMT |
| 352879000 | 9284776 | GRAND PAVO | Panama | AUTO | 12.563 | 29.129 | 4.145 | 50.934 | 2.116 | 18.379 | 9.343 | 0.000 | 1 | 1 | 19.80 | 2.32 | 0.00 | 12.29 | 0.20 | 8.69 | 0.07 | NCMT |
| 319149000 | 9293521 | MIRACULOUS ACE | Cayman Islands | AUTO | 0.000 | 0.000 | 3.257 | 30.000 | 2.651 | 19.690 | 22.341 | 0.000 | 1 | 1 | 20.50 | - | - | 9.21 | 0.07 | 7.43 | 0.04 | NCMT |
| 354487000 | 9293636 | DIAMOND HIGHWAY | Panama | AUTO | 0.300 | 3.030 | 4.482 | 34.834 | 2.129 | 18.003 | 18.776 | 81.528 | 1 | 1 | 20.65 | 10.10 | 0.10 | 7.77 | 0.04 | 8.46 | 0.06 | NCMT |
| 352142000 | 9293648 | PARADISE ACE | Panama | AUTO | 0.000 | 0.000 | 2.140 | 19.301 | 2.422 | 19.677 | 19.876 | 0.000 | 1 | 1 | 20.65 | - | - | 9.02 | 0.07 | 8.12 | 0.05 | NCMT |
| 353039000 | 9293650 | LIBERTY ACE | Panama | AUTO | 0.751 | 10.385 | 2.892 | 33.054 | 2.599 | 19.787 | 17.004 | 0.000 | 1 | 1 | 20.65 | 13.83 | 0.25 | 11.43 | 0.14 | 7.61 | 0.04 | NCMT |
| 371318000 | 9294343 | SHANGHAI HIGHWAY | Panama | AUTO | 0.206 | 3.799 | 3.847 | 40.857 | 2.739 | 19.596 | 33.126 | 124.799 | 1 | 1 | 20.00 | 18.44 | 0.64 | 10.62 | 0.12 | 7.15 | 0.04 | NCMT |
| 371798000 | 9303194 | GRAND ORION | Panama | AUTO | 0.556 | 7.195 | 10.094 | 94.364 | 4.589 | 37.976 | 27.366 | 0.000 | 2 | 2 | 19.80 | 12.94 | 0.23 | 9.35 | 0.09 | 8.28 | 0.06 | NCMT |
| 371964000 | 9303209 | GRAND NEPTUNE | Panama | AUTO | 0.948 | 8.603 | 4.704 | 36.174 | 2.411 | 19.447 | 10.189 | 0.000 | 1 | 1 | 19.80 | 9.07 | 0.08 | 7.69 | 0.05 | 8.07 | 0.06 | NCMT |
| 636015992 | 9308807 | CSAV RIO GRANDE | Liberia | AUTO | 0.606 | 9.797 | 5.151 | 63.938 | 4.716 | 36.983 | 25.039 | 0.000 | 2 | 2 | 20.00 | 16.17 | 0.43 | 12.41 | 0.20 | 7.84 | 0.05 | NCMT |
| 372056000 | 9308883 | CEPHEUS LEADER | Tunisia | AUTO | 0.661 | 10.198 | 3.285 | 34.061 | 2.547 | 20.100 | 33.344 | 0.000 | 1 | 1 | 20.00 | 15.43 | 0.38 | 10.37 | 0.11 | 7.89 | 0.05 | NCMT |
| 371641000 | 9323780 | COLORADO HIGHWAY | Panama | AUTO | 0.151 | 2.430 | 3.015 | 33.193 | 2.423 | 19.893 | 5.364 | 0.000 | 1 | 1 | 20.00 | 16.09 | 0.43 | 11.01 | 0.14 | 8.21 | 0.06 | NCMT |
| 636015994 | 9325180 | CSAV RIO NEVADO | Liberia | AUTO | 0.148 | 2.316 | 7.159 | 78.635 | 7.462 | 59.642 | 24.955 | 0.000 | 3 | 3 | 20.00 | 15.65 | 0.39 | 10.98 | 0.14 | 7.99 | 0.05 | NCMT |
| 372399000 | 9325221 | GRAND RUBY | Tunisia | AUTO | 1.137 | 17.470 | 9.157 | 84.114 | 4.517 | 36.941 | 111.712 | 195.794 | 2 | 2 | 19.80 | 15.36 | 0.38 | 9.19 | 0.08 | 8.18 | 0.06 | NCMT |
| 372516000 | 9325233 | GRAND SAPPHIRE | Tunisia | AUTO | 0.000 | 0.000 | 2.810 | 25.371 | 2.274 | 18.420 | 9.618 | 0.000 | 1 | 1 | 19.80 | - | - | 9.03 | 0.08 | 8.10 | 0.06 | NCMT |
| 372548000 | 9325776 | WESTERN HIGHWAY | Tunisia | AUTO | 0.000 | 0.000 | 2.550 | 26.633 | 2.205 | 18.638 | 5.344 | 0.000 | 1 | 1 | 20.00 | - | - | 10.44 | 0.12 | 8.45 | 0.06 | NCMT |
| 309847000 | 9327748 | TARIFA | Bahamas | AUTO | 0.520 | 7.761 | 26.563 | 91.700 | 2.633 | 19.494 | 43.315 | 0.000 | 1 | 1 | 20.40 | 14.93 | 0.32 | 3.45 | 0.02 | 7.40 | 0.04 | NCMT |
| 565599000 | 9329461 | MORNING CELLO | Singapore | AUTO | 0.000 | 0.000 | 1.540 | 18.940 | 2.451 | 19.903 | 9.358 | 0.000 | 1 | 1 | 20.50 | - | - | 12.30 | 0.18 | 8.12 | 0.05 | NCMT |
| 370011000 | 9334234 | GRAND VICTORY | Panama | AUTO | 1.435 | 17.011 | 15.534 | 111.323 | 2.222 | 18.468 | 33.126 | 21.051 | 1 | 1 | 19.80 | 11.85 | 0.18 | 7.17 | 0.04 | 8.31 | 0.06 | NCMT |

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

| | | | | | Transit | | VSR | | Maneuver | | Hotel | Anchor | Calls | | | Transit | | VSR | | Maneuver | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MMSI | IMO | VESSNAME | FLAG | SHIPTYPE | Time | Dist | Time | Dist | Time | Dist | Time | Time | ENT | CLR | Serv Spd | Ave Spd | Ave LF | Ave Spd | Ave LF | Ave Spd | Ave LF | Terminal |
| 432624000 | 9335965 | POSEIDON LEADER | Japan | AUTO | 0.786 | 12.042 | 3.398 | 35.941 | 2.650 | 19.792 | 10.206 | 0.000 | 1 | 1 | 20.15 | 15.32 | 0.36 | 10.58 | 0.12 | 7.47 | 0.04 | NCMT |
| 355596000 | 9336050 | MORNING CONDUCTOR | Panama | AUTO | 0.105 | 1.778 | 5.098 | 54.954 | 2.399 | 18.840 | 9.404 | 0.000 | 1 | 1 | 20.50 | 16.93 | 0.46 | 10.78 | 0.12 | 7.85 | 0.05 | NCMT |
| 309509000 | 9338620 | SWALLOW ACE | Bahamas | AUTO | 0.000 | 0.000 | 4.409 | 24.994 | 2.292 | 18.407 | 12.290 | 73.051 | 1 | 1 | 20.00 | - | - | 5.67 | 0.02 | 8.03 | 0.05 | NCMT |
| 356580000 | 9338632 | SOUTHERN HIGHWAY | Panama | AUTO | 0.000 | 0.000 | 3.829 | 29.760 | 2.544 | 18.729 | 4.465 | 0.000 | 1 | 1 | 20.00 | - | - | 7.77 | 0.05 | 7.36 | 0.04 | NCMT |
| 354076000 | 9338711 | MORNING CATHERINE | Panama | AUTO | 0.000 | 0.000 | 2.491 | 30.520 | 2.553 | 20.085 | 35.249 | 0.000 | 1 | 1 | 21.90 | - | - | 12.25 | 0.14 | 7.87 | 0.04 | NCMT |
| 309369000 | 9338826 | SWAN ACE | Bahamas | AUTO | 0.291 | 2.941 | 3.163 | 31.265 | 2.345 | 19.738 | 7.453 | 0.000 | 1 | 1 | 20.00 | 10.11 | 0.11 | 9.88 | 0.10 | 8.42 | 0.06 | NCMT |
| 311004900 | 9338838 | SWIFT ACE | Bahamas | AUTO | 30.285 | 22.577 | 25.502 | 65.244 | 2.500 | 18.287 | 15.754 | 0.000 | 1 | 1 | 20.00 | 0.75 | 0.02 | 2.56 | 0.02 | 7.31 | 0.04 | NCMT |
| 311015100 | 9338852 | SUNSHINE ACE | Bahamas | AUTO | 0.384 | 4.179 | 5.068 | 40.789 | 2.243 | 18.546 | 45.902 | 140.105 | 1 | 1 | 20.00 | 10.88 | 0.13 | 8.05 | 0.05 | 8.27 | 0.06 | NCMT |
| 311018600 | 9338864 | SUNLIGHT ACE | Bahamas | AUTO | 0.940 | 10.711 | 3.264 | 32.744 | 2.445 | 18.420 | 14.252 | 0.000 | 1 | 1 | 20.00 | 11.39 | 0.15 | 10.03 | 0.10 | 7.53 | 0.04 | NCMT |
| 372857000 | 9339806 | GRAND HERO | Tunisia | AUTO | 0.000 | 0.000 | 4.342 | 20.463 | 2.262 | 18.635 | 31.483 | 65.864 | 1 | 1 | 19.80 | - | 0.02 | 4.71 | 0.02 | 8.24 | 0.06 | NCMT |
| 338009000 | 9339818 | GREEN BAY | United States | AUTO | 0.000 | 0.000 | 1.960 | 15.638 | 2.009 | 11.787 | 35.304 | 0.000 | 1 | 1 | 19.80 | - | - | 7.98 | 0.05 | 5.87 | 0.02 | NCMT |
| 432629000 | 9339820 | GEORGIA HIGHWAY | Japan | AUTO | 0.592 | 5.173 | 20.537 | 42.658 | 2.701 | 19.614 | 17.997 | 0.000 | 1 | 1 | 20.45 | 8.74 | 0.06 | 2.08 | 0.02 | 7.26 | 0.04 | NCMT |
| 372613000 | 9340570 | GRAND CHAMPION | Tunisia | AUTO | 8.786 | 9.344 | 12.575 | 68.436 | 5.050 | 38.203 | 38.501 | 90.563 | 2 | 2 | 19.80 | 1.06 | 0.00 | 5.44 | 0.02 | 7.56 | 0.05 | NCMT |
| 308369000 | 9357315 | GOLIATH LEADER | Bahamas | AUTO | 0.455 | 5.825 | 3.249 | 33.243 | 2.650 | 20.211 | 10.792 | 0.000 | 1 | 1 | 20.50 | 12.80 | 0.20 | 10.23 | 0.10 | 7.63 | 0.04 | NCMT |
| 309905000 | 9357327 | GARNET LEADER | Bahamas | AUTO | 1.212 | 11.728 | 19.299 | 54.783 | 2.651 | 19.991 | 18.400 | 0.000 | 1 | 1 | 20.50 | 9.68 | 0.09 | 2.84 | 0.02 | 7.54 | 0.04 | NCMT |
| 353332000 | 9363948 | LAVENDER ACE | Panama | AUTO | 2.205 | 27.578 | 17.769 | 151.956 | 10.580 | 77.360 | 69.769 | 227.984 | 4 | 4 | 20.65 | 12.51 | 0.18 | 8.55 | 0.06 | 7.31 | 0.04 | NCMT |
| 636017062 | 9363950 | CLOVER ACE | Liberia | AUTO | 0.000 | 0.000 | 2.921 | 22.616 | 2.194 | 18.575 | 23.400 | 20.240 | 1 | 1 | 20.65 | - | - | 7.74 | 0.04 | 8.47 | 0.06 | NCMT |
| 372945000 | 9372327 | ANDROMEDA SPIRIT | Tunisia | AUTO | 0.900 | 15.913 | 3.039 | 38.731 | 2.450 | 19.896 | 10.001 | 0.000 | 1 | 1 | 19.90 | 17.68 | 0.58 | 12.74 | 0.22 | 8.12 | 0.06 | NCMT |
| 372747000 | 9381249 | CYGNUS LEADER | Tunisia | AUTO | 4.593 | 8.697 | 7.430 | 67.451 | 5.086 | 40.072 | 82.597 | 0.000 | 2 | 2 | 19.30 | 1.89 | 0.00 | 9.08 | 0.09 | 7.88 | 0.06 | NCMT |
| 311003400 | 9388716 | GUARDIAN LEADER | Bahamas | AUTO | 0.780 | 11.147 | 3.788 | 38.796 | 2.485 | 20.007 | 18.713 | 57.262 | 1 | 1 | 20.00 | 14.29 | 0.30 | 10.24 | 0.11 | 8.05 | 0.05 | NCMT |
| 311003300 | 9391567 | GENTLE LEADER | Bahamas | AUTO | 0.522 | 8.198 | 3.796 | 40.838 | 2.456 | 19.470 | 12.941 | 51.300 | 1 | 1 | 21.00 | 15.70 | 0.34 | 10.76 | 0.11 | 7.93 | 0.04 | NCMT |
| 311002800 | 9391579 | SERENITY ACE | Bahamas | AUTO | 0.864 | 10.384 | 3.201 | 33.493 | 2.242 | 18.254 | 11.498 | 0.000 | 1 | 1 | 20.00 | 12.02 | 0.18 | 10.46 | 0.12 | 8.14 | 0.06 | NCMT |
| 311003200 | 9391581 | CSCC ASIA | Bahamas | AUTO | 0.455 | 6.170 | 4.016 | 42.992 | 4.563 | 36.530 | 39.426 | 0.000 | 2 | 2 | 20.00 | 13.56 | 0.26 | 10.71 | 0.13 | 8.01 | 0.05 | NCMT |
| 311008600 | 9395630 | VIOLET ACE | Bahamas | AUTO | 2.837 | 39.434 | 20.764 | 238.903 | 9.023 | 75.128 | 43.518 | 0.000 | 4 | 4 | 19.80 | 13.90 | 0.28 | 11.51 | 0.16 | 8.33 | 0.06 | NCMT |
| 319310000 | 9397987 | AQUAMARINE ACE | Cayman Islands | AUTO | 0.000 | 0.000 | 5.246 | 39.042 | 4.494 | 38.147 | 49.340 | 18.750 | 2 | 2 | 20.65 | - | - | 7.44 | 0.04 | 8.49 | 0.06 | NCMT |
| 370508000 | 9402706 | APOLLON LEADER | Panama | AUTO | 1.707 | 22.251 | 8.959 | 98.782 | 4.411 | 38.674 | 53.106 | 0.000 | 2 | 2 | 20.65 | 13.04 | 0.21 | 11.03 | 0.13 | 8.77 | 0.06 | NCMT |
| 563876000 | 9402756 | JUPITER LEADER | Singapore | AUTO | 57.423 | 73.522 | 2.222 | 17.874 | 2.337 | 19.697 | 19.302 | 0.000 | 1 | 1 | 20.00 | 1.28 | 0.00 | 8.04 | 0.05 | 8.43 | 0.06 | NCMT |
| 319740000 | 9403281 | BERGAMOT ACE | Cayman Islands | AUTO | 0.594 | 7.619 | 3.753 | 36.224 | 2.849 | 20.133 | 7.856 | 0.000 | 1 | 1 | 20.00 | 12.83 | 0.22 | 9.65 | 0.09 | 7.07 | 0.04 | NCMT |
| 319913000 | 9409481 | SANDERLING ACE | Cayman Islands | AUTO | 0.244 | 3.293 | 4.915 | 48.341 | 5.184 | 40.190 | 50.462 | 0.000 | 2 | 2 | 20.65 | 13.50 | 0.23 | 9.84 | 0.09 | 7.75 | 0.04 | NCMT |
| 538005237 | 9419759 | GLOVIS CARDINAL | Marshall Island | AUTO | 10.617 | 20.302 | 8.119 | 43.818 | 2.244 | 18.902 | 12.221 | 82.152 | 1 | 1 | 20.40 | 1.91 | 0.00 | 5.40 | 0.02 | 8.42 | 0.06 | NCMT |
| 432722000 | 9426350 | DIONYSOS LEADER | Japan | AUTO | 0.433 | 6.343 | 7.612 | 82.397 | 4.574 | 38.504 | 18.816 | 127.770 | 2 | 2 | 20.00 | 14.65 | 0.32 | 10.82 | 0.13 | 8.42 | 0.06 | NCMT |
| 432729000 | 9426362 | DAEDALUS LEADER | Japan | AUTO | 0.222 | 3.388 | 2.866 | 31.942 | 2.587 | 20.024 | 8.243 | 0.000 | 1 | 1 | 20.00 | 15.26 | 0.37 | 11.15 | 0.14 | 7.74 | 0.05 | NCMT |
| 636016206 | 9432892 | TRIUMPH | Liberia | AUTO | 0.299 | 4.167 | 3.306 | 33.082 | 2.312 | 18.264 | 10.843 | 0.000 | 1 | 1 | 20.00 | 13.94 | 0.28 | 10.01 | 0.10 | 7.90 | 0.05 | NCMT |
| 311040700 | 9441556 | HERITAGE LEADER | Bahamas | AUTO | 0.501 | 7.172 | 4.389 | 39.768 | 2.390 | 19.578 | 12.962 | 145.507 | 1 | 1 | 20.50 | 14.32 | 0.28 | 9.06 | 0.07 | 8.19 | 0.05 | NCMT |
| 311052700 | 9441570 | HEROIC LEADER | Bahamas | AUTO | 0.647 | 10.581 | 5.143 | 54.372 | 2.678 | 19.626 | 27.930 | 78.158 | 1 | 1 | 20.00 | 16.35 | 0.45 | 10.57 | 0.12 | 7.33 | 0.04 | NCMT |
| 311054300 | 9441594 | GLOVIS CARAVEL | Bahamas | AUTO | 1.767 | 19.635 | 8.352 | 83.756 | 4.797 | 37.906 | 25.819 | 0.000 | 2 | 2 | 20.50 | 11.11 | 0.13 | 10.03 | 0.10 | 7.90 | 0.05 | NCMT |
| 311072300 | 9441609 | MORNING CLASSIC | Bahamas | AUTO | 1.340 | 9.806 | 18.797 | 58.947 | 2.302 | 18.604 | 22.899 | 0.000 | 1 | 1 | 20.50 | 7.32 | 0.04 | 3.14 | 0.02 | 8.08 | 0.05 | NCMT |
| 354149000 | 9445394 | G POSEIDON | Panama | AUTO | 0.000 | 0.000 | 2.545 | 17.348 | 2.444 | 20.209 | 86.924 | 69.362 | 1 | 1 | 20.00 | - | - | 6.82 | 0.03 | 8.27 | 0.06 | NCMT |
| 538005856 | 9445409 | GLOVIS SOLOMON | Marshall Island | AUTO | 0.000 | 0.000 | 13.843 | 35.590 | 2.260 | 17.948 | 11.288 | 131.769 | 1 | 1 | 20.00 | - | 0.02 | 2.57 | 0.02 | 7.94 | 0.05 | NCMT |
| 370661000 | 9464455 | CRONUS LEADER | Panama | AUTO | 0.000 | 0.000 | 2.387 | 24.087 | 2.639 | 19.979 | 18.410 | 0.000 | 1 | 1 | 19.30 | - | - | 10.09 | 0.12 | 7.57 | 0.05 | NCMT |
| 370869000 | 9477830 | MORNING CECILIE | Panama | AUTO | 0.000 | 0.000 | 11.419 | 92.308 | 6.748 | 55.001 | 41.908 | 100.723 | 3 | 3 | 19.50 | - | - | 8.08 | 0.06 | 8.15 | 0.06 | NCMT |
| 352745000 | 9477921 | DEMETER LEADER | Panama | AUTO | 0.060 | 0.992 | 5.101 | 43.983 | 2.565 | 19.739 | 19.067 | 49.524 | 1 | 1 | 20.00 | 16.53 | 0.46 | 8.62 | 0.07 | 7.70 | 0.05 | NCMT |
| 563255000 | 9481049 | VIKING AMBER | Singapore | AUTO | 0.302 | 4.114 | 2.954 | 33.230 | 2.876 | 19.939 | 13.215 | 0.000 | 1 | 1 | 18.00 | 13.62 | 0.36 | 11.25 | 0.20 | 6.93 | 0.05 | NCMT |
| 564893000 | 9481051 | VIKING CORAL | Singapore | AUTO | 0.150 | 2.089 | 2.952 | 31.587 | 2.243 | 18.476 | 6.303 | 0.000 | 1 | 1 | 18.00 | 13.93 | 0.38 | 10.70 | 0.17 | 8.24 | 0.08 | NCMT |
| 218820000 | 9491886 | PASSERO | Germany | AUTO | 1.652 | 19.468 | 1.570 | 16.512 | 2.135 | 18.094 | 21.444 | 0.000 | 1 | 1 | 21.00 | 11.78 | 0.15 | 10.52 | 0.10 | 8.47 | 0.05 | NCMT |
| 431224000 | 9498597 | SELENE LEADER | Japan | AUTO | 0.839 | 8.672 | 9.520 | 48.356 | 2.377 | 19.750 | 19.797 | 0.000 | 1 | 1 | 19.80 | 10.34 | 0.12 | 5.08 | 0.02 | 8.31 | 0.06 | NCMT |
| 636015032 | 9505900 | VENUS SPIRIT | Liberia | AUTO | 0.554 | 5.325 | 7.094 | 53.641 | 2.453 | 19.370 | 22.645 | 0.000 | 1 | 1 | 20.00 | 9.61 | 0.09 | 7.56 | 0.04 | 7.90 | 0.05 | NCMT |
| 636015173 | 9509401 | JUPITER SPIRIT | Liberia | AUTO | 0.694 | 8.590 | 4.159 | 37.043 | 2.853 | 20.209 | 8.091 | 0.000 | 1 | 1 | 20.00 | 12.38 | 0.19 | 8.91 | 0.07 | 7.08 | 0.04 | NCMT |
| 566613000 | 9514999 | VIKING OCEAN | Singapore | AUTO | 0.647 | 11.115 | 5.979 | 65.827 | 5.021 | 38.833 | 14.891 | 22.757 | 2 | 2 | 18.00 | 17.18 | 0.72 | 11.01 | 0.19 | 7.73 | 0.07 | NCMT |
| 566614000 | 9515008 | VIKING SEA | Singapore | AUTO | 0.794 | 9.751 | 3.050 | 34.184 | 2.414 | 18.804 | 9.336 | 0.000 | 1 | 1 | 18.00 | 12.28 | 0.26 | 11.21 | 0.20 | 7.79 | 0.07 | NCMT |
| 319392000 | 9515474 | IRIS ACE | Cayman Islands | AUTO | 0.554 | 7.846 | 3.443 | 33.952 | 2.871 | 20.040 | 15.934 | 0.000 | 1 | 1 | 20.00 | 14.16 | 0.29 | 9.86 | 0.10 | 6.98 | 0.03 | NCMT |
| 351690000 | 9519092 | SINCERITY ACE | Panama | AUTO | 1.500 | 15.950 | 9.494 | 83.993 | 4.184 | 37.238 | 15.574 | 0.000 | 2 | 2 | 20.00 | 10.63 | 0.12 | 8.85 | 0.07 | 8.90 | 0.07 | NCMT |
| 371862000 | 9519121 | TRITON ACE | Panama | AUTO | 0.178 | 2.164 | 5.549 | 57.599 | 5.420 | 37.178 | 90.896 | 0.000 | 2 | 2 | 19.50 | 12.16 | 0.20 | 10.38 | 0.12 | 6.86 | 0.04 | NCMT |
| 372995000 | 9531715 | BESS | Tunisia | AUTO | 0.000 | 0.000 | 3.403 | 19.319 | 2.467 | 20.066 | 20.388 | 70.075 | 1 | 1 | 19.80 | - | - | 5.68 | 0.02 | 8.13 | 0.06 | NCMT |
| 432803000 | 9531753 | HERCULES LEADER | Japan | AUTO | 0.861 | 8.872 | 4.320 | 31.447 | 2.445 | 19.974 | 33.357 | 0.000 | 1 | 1 | 20.60 | 10.30 | 0.10 | 7.28 | 0.04 | 8.17 | 0.05 | NCMT |
| 566300000 | 9536818 | GAIA LEADER | Singapore | AUTO | 1.150 | 9.982 | 3.844 | 33.776 | 2.615 | 20.171 | 22.691 | 0.000 | 1 | 1 | 20.50 | 8.68 | 0.06 | 8.79 | 0.06 | 7.71 | 0.04 | NCMT |
| 355488000 | 9536959 | DELHI HIGHWAY | Panama | AUTO | 0.307 | 4.646 | 2.849 | 31.616 | 2.144 | 18.630 | 14.506 | 0.000 | 1 | 1 | 20.45 | 15.13 | 0.33 | 11.10 | 0.13 | 8.69 | 0.06 | NCMT |
| 432810000 | 9539169 | ANTARES LEADER | Japan | AUTO | 2.997 | 14.244 | 39.399 | 77.786 | 3.578 | 27.915 | 110.552 | 0.000 | 2 | 2 | 20.65 | 4.75 | 0.02 | 1.97 | 0.02 | 7.80 | 0.04 | NCMT |
| 432817000 | 9539171 | ALTAIR LEADER | Japan | AUTO | 13.865 | 11.744 | 4.853 | 37.974 | 2.542 | 19.897 | 20.104 | 0.000 | 1 | 1 | 20.65 | 0.85 | 0.00 | 7.82 | 0.04 | 7.83 | 0.04 | NCMT |
| 319058000 | 9539183 | OPAL ACE | Cayman Islands | AUTO | 0.000 | 0.000 | 2.599 | 20.274 | 2.229 | 18.208 | 9.319 | 0.000 | 1 | 1 | 20.65 | - | - | 7.80 | 0.04 | 8.17 | 0.05 | NCMT |
| 636015228 | 9542283 | AZALEA ACE | Liberia | AUTO | 1.092 | 16.395 | 9.212 | 82.484 | 4.641 | 38.302 | 11.298 | 0.000 | 2 | 2 | 20.00 | 15.01 | 0.35 | 8.95 | 0.07 | 8.25 | 0.06 | NCMT |
| 636015370 | 9542295 | GARDENIA ACE | Liberia | AUTO | 1.093 | 11.249 | 6.804 | 55.067 | 2.231 | 18.462 | 3.575 | 0.000 | 1 | 1 | 20.00 | 10.29 | 0.11 | 8.09 | 0.05 | 8.28 | 0.06 | NCMT |
| 357795000 | 9553103 | TRITON LEADER | Panama | AUTO | 0.000 | 0.000 | 2.447 | 20.784 | 2.488 | 19.688 | 18.179 | 0.000 | 1 | 1 | 19.50 | - | - | 8.49 | 0.07 | 7.91 | 0.05 | NCMT |
| 371965000 | 9553115 | THEMIS LEADER | Panama | AUTO | 0.000 | 0.000 | 5.886 | 57.036 | 4.451 | 36.418 | 219.993 | 0.000 | 2 | 2 | 20.00 | - | - | 9.69 | 0.09 | 8.18 | 0.06 | NCMT |
| 319013600 | 9561253 | TRANQUIL ACE | Cayman Islands | AUTO | 0.000 | 0.000 | 2.300 | 18.265 | 2.651 | 19.690 | 9.841 | 0.000 | 1 | 1 | 20.00 | - | - | 7.94 | 0.05 | 7.43 | 0.04 | NCMT |
| 319015800 | 9561265 | ELEGANT ACE | Cayman Islands | AUTO | 0.781 | 14.111 | 4.044 | 40.553 | 2.503 | 19.238 | 17.533 | 83.634 | 1 | 1 | 20.20 | 18.07 | 0.59 | 10.03 | 0.10 | 7.69 | 0.05 | NCMT |
| 355139000 | 9561289 | MERMAID ACE | Panama | AUTO | 0.000 | 0.000 | 5.104 | 27.327 | 2.651 | 19.784 | 20.750 | 0.000 | 1 | 1 | 20.65 | - | 0.02 | 5.35 | 0.02 | 7.46 | 0.04 | NCMT |
| 372031000 | 9565558 | CAPE TOWN HIGHWAY | Tunisia | AUTO | 0.193 | 2.672 | 4.106 | 32.731 | 2.150 | 18.607 | 7.293 | 0.000 | 1 | 1 | 20.00 | 13.84 | 0.27 | 7.97 | 0.05 | 8.65 | 0.07 | NCMT |
| 357694000 | 9565560 | DALIAN HIGHWAY | Panama | AUTO | 0.459 | 5.399 | 6.708 | 65.030 | 4.706 | 38.622 | 15.502 | 0.000 | 2 | 2 | 20.00 | 11.76 | 0.17 | 9.69 | 0.09 | 8.21 | 0.06 | NCMT |

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

| | | | | | Transit | | VSR | | Maneuver | | Hotel | Anchor | Calls | | | Transit | | VSR | | Maneuver | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MMSI** | **IMO** | **VESSNAME** | **FLAG** | **SHIPTYPE** | **Time** | **Dist** | **Time** | **Dist** | **Time** | **Dist** | **Time** | **Time** | **ENT** | **CLR** | **Serv Spd** | **Ave Spd** | **Ave LF** | **Ave Spd** | **Ave LF** | **Ave Spd** | **Ave LF** | **Terminal** |
| 371140000 | 9574054 | MORNING CHRISTINA | Panama | AUTO | 0.000 | 0.000 | 2.017 | 20.876 | 2.634 | 19.687 | 9.351 | 0.000 | 1 | 1 | 20.00 | - | - | 10.35 | 0.11 | 7.47 | 0.04 | NCMT |
| 352718000 | 9574066 | CANADIAN HIGHWAY | Panama | AUTO | 0.443 | 7.152 | 3.826 | 37.027 | 2.532 | 19.621 | 9.902 | 100.151 | 1 | 1 | 20.00 | 16.14 | 0.43 | 9.68 | 0.09 | 7.75 | 0.05 | NCMT |
| 371706000 | 9574080 | MORNING CRYSTAL | Panama | AUTO | 0.146 | 2.495 | 4.195 | 48.603 | 2.252 | 18.209 | 21.251 | 0.000 | 1 | 1 | 20.00 | 17.09 | 0.51 | 11.59 | 0.16 | 8.09 | 0.05 | NCMT |
| 355768000 | 9574092 | MORNING CARA | Panama | AUTO | 0.364 | 6.056 | 5.583 | 52.900 | 2.325 | 18.631 | 23.185 | 43.025 | 1 | 1 | 20.00 | 16.64 | 0.47 | 9.48 | 0.09 | 8.01 | 0.05 | NCMT |
| 432824000 | 9574107 | DOVER HIGHWAY | Japan | AUTO | 0.396 | 5.810 | 7.882 | 58.417 | 5.195 | 39.997 | 37.146 | 129.219 | 2 | 2 | 20.00 | 14.67 | 0.32 | 7.41 | 0.04 | 7.70 | 0.05 | NCMT |
| 311045300 | 9584059 | NEPTUNE ACE | Bahamas | AUTO | 0.649 | 10.685 | 3.043 | 34.507 | 2.154 | 18.353 | 22.364 | 0.000 | 1 | 1 | 20.00 | 16.46 | 0.46 | 11.34 | 0.15 | 8.52 | 0.06 | NCMT |
| 373599000 | 9590589 | GLOVIS CENTURY | Panama | AUTO | 0.000 | 0.000 | 3.145 | 20.280 | 2.603 | 19.715 | 31.090 | 67.642 | 1 | 1 | 20.50 | - | - | 6.45 | 0.03 | 7.57 | 0.04 | NCMT |
| 373260000 | 9590591 | GLOVIS CHALLENGE | Panama | AUTO | 0.195 | 2.973 | 4.263 | 36.790 | 2.448 | 19.878 | 35.451 | 43.239 | 1 | 1 | 20.50 | 15.25 | 0.34 | 8.63 | 0.06 | 8.12 | 0.05 | NCMT |
| 370644000 | 9591052 | MERCURY ACE | Panama | AUTO | 0.443 | 6.871 | 9.200 | 79.878 | 4.679 | 37.554 | 24.364 | 43.095 | 2 | 2 | 20.00 | 15.51 | 0.38 | 8.68 | 0.07 | 8.03 | 0.05 | NCMT |
| 357147000 | 9610391 | SUPREME ACE | Panama | AUTO | 0.262 | 2.701 | 14.052 | 89.418 | 7.846 | 59.275 | 32.223 | 10.430 | 3 | 3 | 20.60 | 10.31 | 0.10 | 6.36 | 0.02 | 7.55 | 0.04 | NCMT |
| 356541000 | 9610406 | VICTORIOUS ACE | Panama | AUTO | 0.242 | 2.678 | 10.953 | 41.787 | 2.404 | 18.528 | 22.299 | 23.594 | 1 | 1 | 20.00 | 11.07 | 0.14 | 3.82 | 0.02 | 7.71 | 0.05 | NCMT |
| 367641230 | 9619684 | MARJORIE C. | United States | AUTO | 2.225 | 30.007 | 14.887 | 179.524 | 14.212 | 109.686 | 175.704 | 0.000 | 6 | 6 | 20.00 | 13.49 | 0.25 | 12.06 | 0.18 | 7.72 | 0.05 | NCMT |
| 373398000 | 9620683 | MORNING CLAIRE | Panama | AUTO | 0.000 | 0.000 | 6.212 | 51.317 | 5.238 | 40.052 | 49.215 | 47.255 | 2 | 2 | 20.60 | - | - | 8.26 | 0.05 | 7.65 | 0.04 | NCMT |
| 636015819 | 9624237 | GALAXY ACE | Liberia | AUTO | 0.845 | 12.127 | 4.749 | 36.376 | 2.099 | 18.501 | 44.055 | 35.353 | 1 | 1 | 20.00 | 14.35 | 0.30 | 7.66 | 0.05 | 8.81 | 0.07 | NCMT |
| 353647000 | 9633185 | MORNING CINDY | Panama | AUTO | 8.952 | 8.762 | 5.657 | 48.557 | 2.454 | 18.683 | 10.400 | 0.000 | 1 | 1 | 20.00 | 0.98 | 0.00 | 8.58 | 0.07 | 7.61 | 0.05 | NCMT |
| 352044000 | 9641833 | WISDOM ACE | Panama | AUTO | 0.502 | 6.022 | 4.633 | 48.417 | 2.155 | 18.483 | 31.709 | 0.000 | 1 | 1 | 20.65 | 12.00 | 0.16 | 10.45 | 0.11 | 8.58 | 0.06 | NCMT |
| 538005232 | 9663295 | MORNING CAPO | Marshall Island | AUTO | 3.173 | 6.730 | 13.149 | 50.435 | 2.298 | 18.455 | 19.548 | 0.000 | 1 | 1 | 20.40 | 2.12 | 0.02 | 3.84 | 0.02 | 8.03 | 0.05 | NCMT |
| 311000102 | 9672416 | GENIUS HIGHWAY | Bahamas | AUTO | 0.109 | 1.709 | 3.154 | 36.015 | 2.271 | 18.041 | 21.182 | 22.215 | 1 | 1 | 20.50 | 15.68 | 0.37 | 11.42 | 0.14 | 7.94 | 0.05 | NCMT |
| 357076000 | 9675585 | MORNING CHERRY | Panama | AUTO | 1.203 | 15.131 | 6.389 | 71.610 | 4.875 | 38.342 | 19.081 | 0.000 | 2 | 2 | 20.00 | 12.58 | 0.20 | 11.21 | 0.14 | 7.87 | 0.05 | NCMT |
| 370681000 | 9676864 | ARIES LEADER | Panama | AUTO | 0.200 | 2.401 | 3.195 | 33.589 | 2.273 | 18.862 | 6.389 | 0.000 | 1 | 1 | 20.00 | 12.01 | 0.18 | 10.51 | 0.12 | 8.30 | 0.06 | NCMT |
| 353987000 | 9676876 | PISCES LEADER | Panama | AUTO | 44.592 | 72.049 | 5.656 | 52.607 | 2.145 | 18.183 | 6.850 | 0.000 | 1 | 1 | 20.00 | 1.62 | 0.00 | 9.30 | 0.08 | 8.48 | 0.06 | NCMT |
| 311000188 | 9690535 | HERMES LEADER | Bahamas | AUTO | 1.296 | 13.323 | 13.243 | 76.314 | 2.853 | 20.336 | 67.878 | 41.346 | 1 | 1 | 16.50 | 10.28 | 0.20 | 5.76 | 0.04 | 7.13 | 0.07 | NCMT |
| 538006102 | 9707003 | GLOVIS CRYSTAL | Marshall Island | AUTO | 0.000 | 0.000 | 3.345 | 17.137 | 2.541 | 20.157 | 21.509 | 44.450 | 1 | 1 | 19.90 | - | 0.02 | 5.12 | 0.02 | 7.93 | 0.05 | NCMT |
| 538006886 | 9749594 | GLOVIS SPRING | Marshall Island | AUTO | 0.000 | 0.000 | 4.526 | 13.232 | 1.594 | 10.350 | 74.000 | 38.567 | 1 | 1 | 20.00 | - | 0.02 | 2.92 | 0.02 | 6.49 | 0.03 | NCMT |
| 257512000 | 9223980 | TAMARITA | Norway | BULK | 0.505 | 5.974 | 5.170 | 43.238 | 2.348 | 12.684 | 38.800 | 3.447 | 0 | 1 | 14.50 | 11.83 | 0.45 | 8.36 | 0.16 | 5.40 | 0.04 | TAMT |
| 355900000 | 9236846 | ORIENTE SHINE | Panama | BULK | 0.597 | 7.672 | 3.702 | 35.042 | 1.754 | 11.801 | 35.743 | 0.000 | 1 | 1 | 14.00 | 12.85 | 0.64 | 9.47 | 0.25 | 6.73 | 0.09 | TAMT |
| 249806000 | 9282742 | OKTEM AKSOY | Malta | BULK | 0.755 | 10.054 | 6.145 | 41.780 | 2.483 | 12.379 | 92.912 | 8.658 | 1 | 1 | 14.30 | 13.32 | 0.66 | 6.80 | 0.09 | 4.99 | 0.03 | TAMT |
| 370677000 | 9385154 | 030 | Panama | BULK | 0.335 | 4.303 | 3.243 | 35.251 | 2.965 | 12.832 | 19.187 | 22.202 | 1 | 1 | 14.40 | 12.84 | 0.58 | 10.87 | 0.35 | 4.33 | 0.02 | TAMT |
| 538004655 | 9584891 | INDIGO CEFIRO | Marshall Island | BULK | 0.308 | 3.429 | 5.150 | 36.339 | 2.057 | 12.198 | 102.257 | 2.049 | 1 | 1 | 14.50 | 11.13 | 0.37 | 7.06 | 0.09 | 5.93 | 0.06 | TAMT |
| 370413000 | 9644043 | GLOBAL ARC | Panama | BULK | 0.738 | 7.927 | 4.155 | 35.880 | 1.591 | 11.870 | 14.453 | 0.000 | 1 | 1 | 14.30 | 10.74 | 0.35 | 8.64 | 0.18 | 7.46 | 0.12 | TAMT |
| 311642000 | 8513467 | DOLE CALIFORNIA | Bahamas | CONTAINER | 0.000 | 0.000 | 8.389 | 78.149 | 8.132 | 59.302 | 337.057 | 0.000 | 5 | 5 | 20.00 | - | - | 9.32 | 0.08 | 7.29 | 0.04 | TAMT |
| 311588000 | 8513479 | DOLE ECUADOR | Bahamas | CONTAINER | 0.000 | 0.000 | 8.748 | 77.319 | 8.556 | 58.748 | 257.545 | 0.000 | 5 | 5 | 20.00 | - | - | 8.84 | 0.07 | 6.87 | 0.03 | TAMT |
| 311641000 | 8900335 | DOLE COSTA RICA | Bahamas | CONTAINER | 0.000 | 0.000 | 13.009 | 123.541 | 14.191 | 94.490 | 383.600 | 0.000 | 8 | 8 | 20.00 | - | - | 9.50 | 0.09 | 6.66 | 0.03 | TAMT |
| 253436000 | 9256389 | HANSA FREYBURG | Luxembourg | CONTAINER | 0.000 | 0.000 | 5.298 | 52.382 | 4.897 | 34.884 | 223.109 | 0.000 | 3 | 3 | 19.50 | - | - | 9.89 | 0.11 | 7.12 | 0.04 | TAMT |
| 305134000 | 9435818 | HOHEBANK | Singapore | CONTAINER | 0.000 | 0.000 | 1.611 | 19.533 | 1.556 | 12.161 | 13.388 | 0.000 | 1 | 1 | 18.80 | - | - | 12.12 | 0.22 | 7.82 | 0.06 | TAMT |
| 338789000 | 9680853 | PERLA DEL CARIBE | United States | CONTAINER | 0.000 | 0.000 | 0.603 | 7.746 | 1.391 | 7.335 | 50.492 | 0.000 | 0 | 1 | 22.00 | - | - | 12.85 | 0.16 | 5.27 | 0.02 | TAMT |
| 311000414 | 9703057 | DOLE PACIFIC | Bahamas | CONTAINER | 0.000 | 0.000 | 26.223 | 272.768 | 30.059 | 208.683 | 1295.610 | 0.000 | 18 | 18 | 19.50 | - | - | 10.40 | 0.12 | 6.94 | 0.04 | TAMT |
| 311000415 | 9703069 | DOLE ATLANTIC | Bahamas | CONTAINER | 0.000 | 0.000 | 20.698 | 199.106 | 21.883 | 154.086 | 875.284 | 0.000 | 13 | 13 | 19.50 | - | - | 9.62 | 0.10 | 7.04 | 0.04 | TAMT |
| 311000416 | 9703071 | DOLE CARIBBEAN | Bahamas | CONTAINER | 0.000 | 0.000 | 15.187 | 140.123 | 14.558 | 107.516 | 563.946 | 0.000 | 9 | 9 | 19.50 | - | - | 9.23 | 0.09 | 7.39 | 0.04 | TAMT |
| 371073000 | 9309605 | BLUE OCEAN | Panama | GENERAL | 1.312 | 13.899 | 7.642 | 62.087 | 1.861 | 11.670 | 16.291 | 0.000 | 1 | 1 | 14.70 | 10.59 | 0.31 | 8.12 | 0.14 | 6.27 | 0.06 | TAMT |
| 304724000 | 9312169 | BBC NEBRASKA | Antigua and Bar | GENERAL | 0.033 | 0.449 | 2.759 | 32.280 | 1.520 | 11.436 | 7.078 | 0.000 | 1 | 1 | 15.50 | 13.61 | 0.56 | 11.70 | 0.35 | 7.52 | 0.09 | TAMT |
| 354988000 | 9370367 | SPLENDEUR | Panama | GENERAL | 0.239 | 2.534 | 3.925 | 34.400 | 1.777 | 12.411 | 23.567 | 0.000 | 1 | 1 | 14.30 | 10.60 | 0.34 | 8.76 | 0.19 | 6.98 | 0.10 | TAMT |
| 636092366 | 9381392 | HHL VOLGA | Liberia | GENERAL | 0.257 | 2.609 | 3.199 | 32.989 | 1.886 | 12.030 | 16.865 | 0.000 | 1 | 1 | 15.50 | 10.15 | 0.23 | 10.31 | 0.24 | 6.38 | 0.06 | TAMT |
| 257310000 | 9396127 | STAR KIRKENES | Norway | GENERAL | 0.953 | 11.182 | 3.217 | 33.973 | 1.935 | 12.474 | 51.197 | 0.000 | 1 | 1 | 16.00 | 11.73 | 0.32 | 10.56 | 0.24 | 6.45 | 0.05 | TAMT |
| 257661000 | 9396153 | STAR KVARVEN | Norway | GENERAL | 0.563 | 7.829 | 3.457 | 36.399 | 1.754 | 11.949 | 20.251 | 0.000 | 1 | 1 | 16.00 | 13.91 | 0.54 | 10.53 | 0.23 | 6.81 | 0.06 | TAMT |
| 305097000 | 9421116 | BBC JADE | Singapore | GENERAL | 0.145 | 1.707 | 1.405 | 15.056 | 2.571 | 13.859 | 162.650 | 0.000 | 1 | 1 | 15.00 | 11.77 | 0.40 | 10.72 | 0.30 | 5.39 | 0.04 | TAMT |
| 305240000 | 9436953 | BBC KWIATKOWSKI | Singapore | GENERAL | 0.000 | 0.000 | 1.753 | 15.698 | 1.503 | 11.784 | 21.698 | 0.000 | 1 | 1 | 15.00 | - | - | 8.95 | 0.18 | 7.84 | 0.12 | TAMT |
| 311063500 | 9473250 | CLIPPER NEW YORK | Bahamas | GENERAL | 0.000 | 0.000 | 1.491 | 16.136 | 1.539 | 12.347 | 10.873 | 0.000 | 1 | 1 | 16.00 | - | - | 10.82 | 0.25 | 8.02 | 0.10 | TAMT |
| 538004441 | 9498365 | AAL SINGAPORE | Marshall Island | GENERAL | 0.995 | 15.493 | 2.406 | 27.799 | 1.886 | 12.190 | 39.616 | 0.000 | 1 | 1 | 16.80 | 15.57 | 0.65 | 11.55 | 0.27 | 6.46 | 0.05 | TAMT |
| 538004942 | 9498456 | AAL MELBOURNE | Marshall Island | GENERAL | 0.000 | 0.000 | 2.439 | 26.080 | 1.740 | 12.931 | 31.414 | 0.000 | 1 | 1 | 16.80 | - | - | 10.69 | 0.21 | 7.43 | 0.07 | TAMT |
| 538005442 | 9498482 | AAL NEWCASTLE | Marshall Island | GENERAL | 2.545 | 27.146 | 5.102 | 50.586 | 1.678 | 12.278 | 28.977 | 0.000 | 1 | 1 | 16.80 | 10.67 | 0.21 | 9.91 | 0.17 | 7.32 | 0.07 | TAMT |
| 367503980 | 9506722 | OCEAN FREEDOM | United States | GENERAL | 0.224 | 3.547 | 2.466 | 31.910 | 1.647 | 12.032 | 38.007 | 0.000 | 1 | 1 | 17.50 | 15.83 | 0.61 | 12.94 | 0.33 | 7.31 | 0.06 | TAMT |
| 305590000 | 9508380 | BBC SEINE | Singapore | GENERAL | 0.000 | 0.000 | 1.292 | 14.853 | 1.642 | 12.593 | 23.451 | 0.000 | 1 | 1 | 15.00 | - | - | 11.50 | 0.37 | 7.67 | 0.11 | TAMT |
| 305717000 | 9563706 | BBC AMBER | Singapore | GENERAL | 0.000 | 0.000 | 2.244 | 15.024 | 1.712 | 12.230 | 69.532 | 0.000 | 1 | 1 | 17.50 | - | - | 6.70 | 0.05 | 7.14 | 0.06 | TAMT |
| 305908000 | 9563744 | BBC RUBY | Singapore | GENERAL | 0.189 | 2.613 | 3.755 | 32.754 | 1.567 | 11.700 | 44.286 | 20.850 | 1 | 1 | 17.50 | 13.83 | 0.41 | 8.72 | 0.10 | 7.47 | 0.06 | TAMT |
| 257844000 | 9593866 | STAR LIMA | Norway | GENERAL | 0.277 | 3.161 | 3.156 | 31.584 | 2.317 | 12.551 | 95.257 | 0.000 | 1 | 1 | 15.50 | 11.41 | 0.33 | 10.01 | 0.22 | 5.42 | 0.04 | TAMT |
| 538006859 | 9593880 | STAR LOUISIANA | Marshall Island | GENERAL | 1.762 | 18.913 | 10.172 | 87.419 | 3.921 | 24.772 | 90.821 | 0.000 | 2 | 2 | 15.50 | 10.73 | 0.27 | 8.59 | 0.14 | 6.32 | 0.06 | TAMT |
| 258011000 | 9593892 | STAR LOFOTEN | Norway | GENERAL | 0.984 | 11.048 | 3.287 | 34.688 | 1.834 | 12.813 | 90.772 | 0.000 | 1 | 1 | 15.50 | 11.23 | 0.31 | 10.55 | 0.26 | 6.99 | 0.08 | TAMT |
| 258008000 | 9603790 | STAR LOEN | Norway | GENERAL | 0.209 | 2.605 | 3.148 | 32.755 | 1.793 | 12.155 | 78.659 | 0.000 | 1 | 1 | 15.50 | 12.46 | 0.43 | 10.41 | 0.25 | 6.78 | 0.07 | TAMT |
| 413478240 | 9608403 | DA DE | China | GENERAL | 0.000 | 0.000 | 1.614 | 16.246 | 2.870 | 14.228 | 11.539 | 0.000 | 1 | 1 | 15.50 | - | - | 10.07 | 0.23 | 4.96 | 0.03 | TAMT |
| 258005000 | 9616840 | STAR LYSEFJORD | Norway | GENERAL | 0.903 | 10.463 | 3.051 | 33.450 | 1.788 | 11.407 | 11.707 | 0.000 | 1 | 1 | 15.50 | 11.59 | 0.34 | 10.96 | 0.29 | 6.38 | 0.06 | TAMT |
| 357977000 | 9700574 | RISING SUN | Panama | GENERAL | 0.000 | 0.000 | 3.204 | 31.351 | 1.704 | 12.384 | 22.251 | 0.000 | 1 | 1 | 14.00 | - | - | 9.78 | 0.28 | 7.27 | 0.12 | TAMT |
| 374077000 | 9760653 | CEBU ISLAND | Panama | GENERAL | 0.000 | 0.000 | 1.554 | 15.186 | 1.939 | 11.823 | 24.307 | 0.000 | 1 | 1 | 14.70 | - | - | 9.77 | 0.24 | 6.10 | 0.06 | TAMT |
| 244958000 | 8919257 | MAASDAM | Netherlands | PASSENGER | 0.000 | 0.000 | 3.425 | 49.537 | 2.871 | 18.375 | 17.266 | 0.000 | 2 | 2 | 20.00 | - | - | 14.46 | 0.26 | 6.40 | 0.02 | CST |
| 309168000 | 9066667 | CRYSTAL SYMPHONY | Bahamas | PASSENGER | 0.000 | 0.000 | 3.040 | 37.934 | 2.797 | 18.523 | 73.039 | 0.000 | 2 | 2 | 21.00 | - | - | 12.48 | 0.14 | 6.62 | 0.02 | CST |
| 246506000 | 9102992 | VEENDAM | Netherlands | PASSENGER | 0.000 | 0.000 | 3.768 | 51.009 | 4.394 | 28.143 | 30.872 | 0.000 | 3 | 3 | 20.00 | - | - | 13.54 | 0.21 | 6.40 | 0.02 | CST |
| 310327000 | 9104005 | GRAND PRINCESS | Bermuda | PASSENGER | 0.000 | 0.000 | 10.262 | 108.105 | 10.547 | 66.208 | 72.508 | 0.000 | 7 | 7 | 22.50 | - | - | 10.53 | 0.07 | 6.28 | 0.02 | CST |
| 308457000 | 9126819 | DISNEY WONDER | Bahamas | PASSENGER | 0.629 | 7.667 | 8.093 | 86.782 | 4.350 | 28.441 | 35.031 | 0.000 | 3 | 3 | 21.50 | 12.19 | 0.13 | 10.72 | 0.09 | 6.54 | 0.02 | CST |
| 311000410 | 9141807 | WORLD ODYSSEY | Bahamas | PASSENGER | 0.000 | 0.000 | 4.779 | 47.628 | 4.393 | 28.274 | 98.442 | 0.000 | 3 | 3 | 20.00 | - | - | 9.97 | 0.09 | 6.44 | 0.02 | CST |

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

| | | | | | Transit | | VSR | | Maneuver | | Hotel | Anchor | Calls | | | Transit | | VSR | | Maneuver | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MMSI | IMO | VESSNAME | FLAG | SHIPTYPE | Time | Dist | Time | Dist | Time | Dist | Time | Time | ENT | CLR | Serv Spd | Ave Spd | Ave LF | Ave Spd | Ave LF | Ave Spd | Ave LF | Terminal |
| 538001663 | 9156462 | INSIGNIA | Marshall Island | PASSENGER | 0.565 | 5.450 | 3.141 | 31.397 | 1.292 | 9.477 | 8.380 | 0.000 | 1 | 1 | 18.00 | 9.65 | 0.11 | 10.00 | 0.12 | 7.34 | 0.05 | CST |
| 538001664 | 9156474 | REGATTA | Marshall Island | PASSENGER | 1.232 | 13.565 | 5.858 | 67.143 | 2.432 | 18.712 | 20.997 | 0.000 | 2 | 2 | 18.00 | 11.01 | 0.16 | 11.46 | 0.18 | 7.69 | 0.05 | CST |
| 246442000 | 9156527 | ZAANDAM | Netherlands | PASSENGER | 0.592 | 11.010 | 5.095 | 68.659 | 2.784 | 19.062 | 20.266 | 0.000 | 2 | 2 | 22.00 | 18.60 | 0.42 | 13.48 | 0.16 | 6.85 | 0.02 | CST |
| 538006842 | 9187899 | SIRENA | Marshall Island | PASSENGER | 0.853 | 10.411 | 2.666 | 33.836 | 1.299 | 9.844 | 10.749 | 0.000 | 1 | 1 | 18.00 | 12.21 | 0.21 | 12.69 | 0.24 | 7.58 | 0.05 | CST |
| 244370000 | 9188037 | AMSTERDAM | Netherlands | PASSENGER | 1.522 | 16.952 | 10.135 | 125.235 | 6.404 | 47.475 | 52.191 | 0.000 | 5 | 5 | 21.00 | 11.14 | 0.10 | 12.36 | 0.14 | 7.41 | 0.03 | CST |
| 249048000 | 9189421 | CELEBRITY INFINITY | Malta | PASSENGER | 0.841 | 11.960 | 9.614 | 109.603 | 6.135 | 37.345 | 52.850 | 0.000 | 4 | 4 | 24.00 | 14.22 | 0.14 | 11.40 | 0.07 | 6.09 | 0.02 | CST |
| 310361000 | 9192363 | STAR PRINCESS | Bermuda | PASSENGER | 0.000 | 0.000 | 1.388 | 15.529 | 1.759 | 9.672 | 9.550 | 0.000 | 1 | 1 | 22.00 | - | - | 11.19 | 0.09 | 5.50 | 0.02 | CST |
| 311622000 | 9210139 | SEVEN SEAS MARINER | Bahamas | PASSENGER | 0.257 | 3.938 | 2.624 | 34.343 | 1.608 | 9.945 | 10.290 | 0.000 | 1 | 1 | 19.50 | 15.32 | 0.33 | 13.09 | 0.21 | 6.18 | 0.02 | CST |
| 311109000 | 9218131 | NORWEGIAN SUN | Bahamas | PASSENGER | 0.235 | 3.315 | 4.275 | 63.763 | 4.116 | 28.296 | 33.264 | 0.000 | 3 | 3 | 20.00 | 14.11 | 0.24 | 14.92 | 0.29 | 6.87 | 0.03 | CST |
| 244128000 | 9226891 | WESTERDAM | Netherlands | PASSENGER | 0.797 | 11.379 | 22.067 | 259.456 | 19.866 | 118.765 | 130.518 | 0.000 | 13 | 13 | 22.00 | 14.28 | 0.19 | 11.76 | 0.11 | 5.98 | 0.02 | CST |
| 310459000 | 9226906 | ARCADIA | Bermuda | PASSENGER | 0.252 | 3.521 | 2.675 | 34.186 | 1.554 | 9.621 | 8.542 | 0.000 | 1 | 1 | 22.00 | 13.97 | 0.18 | 12.78 | 0.14 | 6.19 | 0.02 | CST |
| 246028000 | 9230115 | NOORDAM | Netherlands | PASSENGER | 0.240 | 3.569 | 2.557 | 36.043 | 1.711 | 9.732 | 9.580 | 0.000 | 1 | 1 | 22.00 | 14.87 | 0.21 | 14.10 | 0.18 | 5.69 | 0.02 | CST |
| 310500000 | 9293399 | CROWN PRINCESS | Bermuda | PASSENGER | 11.343 | 151.312 | 19.159 | 233.198 | 13.639 | 88.271 | 94.983 | 0.000 | 9 | 9 | 22.50 | 13.34 | 0.14 | 12.17 | 0.11 | 6.47 | 0.02 | CST |
| 246648000 | 9378450 | NIEUW AMSTERDAM | Netherlands | PASSENGER | 0.197 | 3.693 | 2.317 | 35.962 | 1.327 | 8.943 | 9.769 | 0.000 | 1 | 1 | 21.90 | 18.75 | 0.43 | 15.52 | 0.25 | 6.74 | 0.02 | CST |
| 310567000 | 9378462 | RUBY PRINCESS | Bermuda | PASSENGER | 0.174 | 2.635 | 12.541 | 146.063 | 12.555 | 76.277 | 79.776 | 0.000 | 8 | 8 | 22.50 | 15.14 | 0.21 | 11.65 | 0.10 | 6.08 | 0.02 | CST |
| 247257900 | 9398905 | COSTA LUMINOSA | Italy | PASSENGER | 0.000 | 0.000 | 1.563 | 15.805 | 1.546 | 9.346 | 13.200 | 0.000 | 1 | 1 | 21.60 | - | - | 10.11 | 0.07 | 6.05 | 0.02 | CST |

# Appendix C
# *Commercial Harbor Craft Information*

**Commerical Harbor Craft characteristics**

| Vessel Characteristics | | | Engine Stats | | | | | | | AIS Hours | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vessel type | # Prop | Prop make and model | Prop MY | Prop HP | Prop retrofit type / repower | Main engine annual usage (reported) | # Aux | Aux HP | Aux annual usage (reported) | Out of Port:Moving | Out of Port:Stopped | In Port:Moving | In Port:Stopped | AE MY |
| Tug - Assist | 2 | | 1996 | 900 | 2010 | 350 | 1 | 35 | 350 | 41.3 | 12.6 | 296.0 | 1730.7 | 1987 |
| Tug - Assist | 2 | | 1992 | 900 | 2010 | 380 | 1 | 35 | 380 | 44.9 | 13.7 | 321.4 | 1879.1 | 1987 |
| Tug - Assist | 2 | | 1990 | 470 | 2007 | 100 | 0 | 106 | 100 | 11.8 | 3.6 | 84.6 | 494.5 | 1986 |
| Tug - Ocean | 2 | | 1978 | 2200 | 2007 | 1300 | 2 | 60 | 1300 | 425.4 | 0.3 | 344.3 | 423.2 | 1987 |
| Towboat | 2 | | 1971 | 2200 | 2008 | 1160 | 2 | 220 | 1160 | 250.4 | 0.1 | 354.1 | 892.0 | 1983 |
| Tug - Assist | 2 | | 1974 | 900 | 2005 | 410 | 1 | 40 | 410 | 48.4 | 14.8 | 346.8 | 2027.4 | 1987 |
| Tug - Assist | 2 | | 1966 | 810 | 1987 | 200 | 0 | 106 | 200 | 23.6 | 7.2 | 169.2 | 989.0 | 1986 |
| Tug - Assist | 2 | | 2015 | 600 | N/A | 120 | 0 | 106 | 120 | 14.2 | 4.3 | 101.5 | 593.4 | 1986 |
| Towboat | 2 | Detroit Series 60 Diesels | 2004 | 475 | | 182.37 | 1 | 13 | 213 | 131.9 | 0.0 | 50.5 | 30.6 | 1987 |
| Tug - Ocean | 1 | | 1944 | 1600 | 1969 | 455.116 | | 106 | 4694 | 262.5 | 0.1 | 192.7 | 4239.3 | 1986 |
| Tug - Assist | 2 | Caterpiller 3516 DITA | 2013 | 4400 | 2014 | 1200 | 2 | 107 | 8057 | 15.6 | 0.0 | 958.8 | 7082.6 | 1987 |
| Tug - Assist | 2 | Caterpiller 3516 B | 2009 | 4800 | 2014 | 1200 | 2 | 141 | 8109 | 15.4 | 0.1 | 1394.6 | 6698.9 | 1986 |
| Tug - Ocean | 2 | EMD 16-645-E2 | 1971 | 1950 | | 17.84 | 2 | 133 | 77 | 11.1 | 0.0 | 6.8 | 58.8 | 1986 |
| Tug - Ocean | 2 | MDEC 16V2000 | 1993 | 2200 | | 44.60 | 2 | 101 | 192 | 27.6 | 0.0 | 17.0 | 147.1 | 1987 |
| Tug - Ocean | 2 | Cummins | 2010 | 1000 | 2010 | 3000 | 2 | 67 | 1300 | 703.7 | 0.2 | 400.2 | 977.7 | 1987 |
| Crew/Supply | 4 | | 1979 | 750 | 2005 | 620 | 2 | 210 | 620 | 251.9 | 223.3 | 98.7 | 357.8 | 1995 |
| Excursion | 2 | Cat C-32 | 2011 | 850 | | 693 | 2 | 456 | 578 | 4.9 | 7.6 | 433.2 | 868.2 | 1991 |
| Excursion | 2 | Scania DI16-42M | 2007 | 525 | | 3366 | 2 | 483 | 2244 | 27.4 | 0.1 | 2077.8 | 1867.6 | 1991 |
| Excursion | 2 | Cat C-32 | 2011 | 1000 | | 618 | 2 | 221 | 2058 | 453.9 | 0.1 | 1126.6 | 991.6 | 1991 |
| Excursion | 2 | Scania DI16-42M | 2009 | 350 | | 600 | 2 | 74 | 500 | 0.0 | 0.0 | 603.3 | 597.4 | 1991 |
| Excursion | 2 | John Deere 1668 | 2015 | 205 | | 618 | 1 | 74 | 1236 | 0.0 | 0.0 | 678.6 | 785.8 | 1991 |
| Excursion | 2 | Detroit 6-71 | 1986 | 240 | | 315 | 2 | 240 | 262 | 6.1 | 0.0 | 121.6 | 348.1 | 1991 |
| Excursion | 2 | Detroit 6-71 | 1968 | 200 | | 435 | 1 | 40 | 715 | 0.0 | 0.0 | 381.1 | 662.5 | 1991 |
| Ferry | 2 | Cummins/QSA9 | 2011 | 405 | | 5289 | 2 | 80 | 5443 | 0.0 | 0.0 | 2681.8 | 3008.4 | 1991 |
| Ferry | 1 | Volvo Tamol 31 | 2004 | 100 | | 1800 | 0 | 25 | 0 | 268.8 | 196.6 | 1334.6 | 3175.9 | 1991 |
| Excursion | 2 | CAT/C-12 | 2011 | 375 | | 1779 | 2 | 80 | 2054 | 495.3 | 0.2 | 584.5 | 7227.5 | 1991 |
| Excursion | 2 | Scania/T1 | 2017 | 350 | | 1546 | 2 | 266 | 3266 | 0.0 | 0.0 | 8.6 | 189.8 | 1991 |
| Excursion | 2 | Detroit/S70 | 2004 | 425 | | 580 | 2 | 402 | 1793 | 0.1 | 0.0 | 289.3 | 4125.7 | 1991 |
| Excursion | 2 | Detroit/BV92T1 | 1987 | 500 | | 187 | 2 | 80 | 215 | 27.9 | 20.4 | 138.6 | 329.9 | 1991 |
| Excursion | 2 | Detroit/S70 | 2010 | 425 | | 2580 | 2 | 266 | 2922 | 0.0 | 0.0 | 2648.4 | 1163.0 | 1991 |
| Ferry | 1 | John Deere/6.8LT | 2012 | 205 | | 2013 | 0 | 25 | 0 | 300.6 | 219.9 | 1492.5 | 3551.8 | 1991 |
| Ferry | 1 | Cummins/6B | 2002 | 210 | | 1225 | 0 | 25 | 0 | 182.9 | 133.8 | 908.3 | 2161.4 | 1991 |
| Excursion | 2 | | 2014 | 1400 | | | 0 | 25 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 1991 |
| Ferry | 1.875 | | 1994 | 1444 | | 2990.00 | 2 | 212 | 4694 | 0.0 | 0.0 | 2990.0 | 1704.0 | 1991 |

**Commerical and Sport Fishing Vessel characteristics**

| | Engine Stats | | | | | | | | | | | AIS Hours | | | | | | General Activity Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vessel type | # Prop | Prop make and model | Prop MY | Prop HP | Propulsion (main) engine retrofit type / repower | Main hours | # Aux | Aux HP | Aux hours | % time outside 24nm (*100) | Vessel/Slip Size (ft) | Out of Port:Moving | Out of Port:Stopped | In Port:Moving | In Port:Stopped | Year Built | Gross Tonnage | Classification or Vessel Type/Geographic Usage |
| Commerical Fishing | 1 | | 1983 | 320 | | 1163 | 0.6 | 64 | 1163 | 60 | 122 | 292.83 | 80.35 | 92.02 | 0.00 | | | Seiner |
| Commerical Fishing | 1 | | 1983 | 320 | 2010 | 1163 | 0.6 | 64 | 1163 | 60 | 80 | 107.96 | 91.94 | 16.41 | 208.39 | | | Seiner |
| Commerical Fishing | 1 | | 1983 | 320 | 2010 | 1163 | 0.6 | 64 | 1163 | 60 | 118 | 688.22 | 63.01 | 194.09 | 264.54 | | | Seiner |
| Commerical Fishing | 1 | | 1983 | 320 | 2007 | 1163 | 4 | 64 | 1163 | 60 | 118 | 824.15 | 61.83 | 190.83 | 243.06 | | | Seiner |
| Commerical Fishing | 1 | | 1983 | 320 | 2010 | 1163 | 0.6 | 64 | 1163 | 60 | 76 | 451.80 | 28.87 | 51.02 | 73.98 | | | Seiner |
| Commerical Fishing | 1 | | 1983 | 392 | | 1483 | 0.5 | 24 | 1483 | 44 | 33 | 522.77 | 143.44 | 164.27 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 1 | | 1983 | 392 | | 1483 | 0.5 | 24 | 1483 | 44 | 22 | 522.77 | 143.44 | 164.27 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 1 | | 1983 | 392 | | 1483 | 0.5 | 24 | 1483 | 44 | 42 | 522.77 | 143.44 | 164.27 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 1 | 5.7L Mericruiser Gasoline | 1983 | 350 | | 300 | 0 | 5.531625 | 300 | 0 | 25 | 188.84 | 51.82 | 59.34 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 1 | | 1983 | 338 | | 902 | 0.3 | 71 | 902 | 48 | 25 | 295.25 | 81.01 | 92.78 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | | 1983 | 392 | | 1483 | 0.5 | 24 | 1483 | 44 | 30 | 522.77 | 143.44 | 164.27 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 0 | | 1983 | 254.6875 | 2009 | 0 | 0 | 5.531625 | 0 | 0 | 32 | 0.00 | 0.00 | 0.00 | 0.00 | | | Lobster/crab/spot prawn**boat has been for sale. Did not operate |
| Commerical Fishing | 1 | Detroit 471 | 1983 | 450 | | 5000 | 0 | 24 | 5000 | 95 | 30 | 157.37 | 43.18 | 49.45 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 1 | Cummins 6cyl | 1983 | 350 | | 400 | 0 | 97 | 400 | 0 | 34 | 251.79 | 69.09 | 79.12 | 0.00 | | | Gillnetter |
| Commerical Fishing | 1 | Cat C-12 | 1983 | 700 | | 300 | 1 | 26.8 | 300 | 98 | 46 | 3.78 | 1.04 | 1.19 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | | 1983 | 320 | | 1163 | 0.6 | 64 | 1163 | 60 | 58 | 292.83 | 80.35 | 92.02 | 0.00 | | | Seiner |
| Commerical Fishing | 1 | | 1983 | 338 | | 902 | 0.3 | 71 | 902 | 48 | 49 | 295.25 | 81.01 | 92.78 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | | 1983 | 338 | | 902 | 0.3 | 71 | 902 | 48 | 43 | 295.25 | 81.01 | 92.78 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | Cummins QSP 6.7L | 1983 | 305 | | 1100 | 0 | 71 | 1100 | 25 | 31 | 519.32 | 142.49 | 163.19 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | Detroit 471 | 1983 | 451 | | 0 | 0.5 | 97 | 0 | 0 | 36 | 0.00 | 0.00 | 0.00 | 0.00 | | | Gillnetter |
| Commerical Fishing | 1 | | 1983 | 345 | | 1488 | 1 | 45 | 1488 | 74 | 47 | 243.53 | 66.82 | 76.53 | 0.00 | | | Albacore Troll |
| Commerical Fishing | 0 | | 1983 | 308.6 | | 0 | 0 | 36.5472 | 0 | 0 | 42 | 0.00 | 0.00 | 0.00 | 0.00 | | | lobster/crab/spot prawn**should not be considered. Operates out of Oceanside |
| Commerical Fishing | 1 | Detroit 513 | 1983 | 140 | | 800 | 0 | 71 | 800 | 0 | 22 | 503.58 | 138.17 | 158.24 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | | 1983 | 200 | | 100 | 0 | 24 | 100 | 0 | 32 | 62.95 | 17.27 | 19.78 | 0.00 | | | Urchin |
| Commerical Fishing | 1 | Cummins Millenium | 1983 | 300 | | 1200 | 1 | 15 | 1200 | 25 | 45 | 566.53 | 155.45 | 178.02 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 1 | Cummins QSZ 5.9L | 1983 | 355 | | 1000 | 0 | 24 | 1000 | 50 | 31 | 314.74 | 86.36 | 98.90 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 2 | Cat 3208 (2 engines) | 1983 | 225 | | 750 | 0 | 45 | 750 | 0 | 50 | 472.11 | 129.54 | 148.35 | 0.00 | | | Albacore Troll |
| Commerical Fishing | 1 | | 1983 | 338 | | 902 | 0.3 | 71 | 902 | 48 | 29 | 295.25 | 81.01 | 92.78 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | Cummins QSM11 | 1983 | 610 | | 600 | 2 | 28.81 | 600 | 95 | 44 | 18.88 | 5.18 | 5.93 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 1 | | 1983 | 392 | | 1483 | 0.5 | 24 | 1483 | 44 | 38 | 522.77 | 143.44 | 164.27 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 1 | | 1983 | 283 | | 1100 | 0.5 | 97 | 1100 | 56 | 31 | 304.67 | 83.60 | 95.74 | 0.00 | | | gillnetter |
| Commerical Fishing | 1 | Yamaha F gasoline outboard | 1983 | 200 | | 100 | 0 | 24 | 100 | 0 | 19 | 62.95 | 17.27 | 19.78 | 0.00 | | | Urchin |
| Commerical Fishing | 1 | Volvo Penta | 1983 | 150 | | 20 | 0.3 | 71 | 20 | 0 | 25 | 12.59 | 3.45 | 3.96 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | | 1983 | 392 | 2013 | 1483 | 1 | 24 | 1483 | 44 | 42 | 522.77 | 143.44 | 164.27 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 1 | Cummins A55 | 1983 | 230 | | 1500 | 1 | 45 | 1500 | 90 | 51 | 94.42 | 25.91 | 29.67 | 0.00 | | | Gillnetter |
| Commerical Fishing | 1 | | 1983 | 338 | | 902 | 0.3 | 71 | 902 | 48 | 51 | 295.25 | 81.01 | 92.78 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | | 1983 | 392 | | 1483 | 0.5 | 24 | 1483 | 44 | 30 | 522.77 | 143.44 | 164.27 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 1 | Detroit 8v71 | 1983 | 300 | 2010 | 400 | 1 | 40.2 | 400 | 50 | 43 | 125.90 | 34.54 | 39.56 | 0.00 | | | Gillnetter |
| Commerical Fishing | 1 | | 1983 | 283 | | 1100 | 0.5 | 97 | 1100 | 56 | 40 | 304.67 | 83.60 | 95.74 | 0.00 | | | Gillnetter |
| Commerical Fishing | 1 | | 1983 | 283 | | 1100 | 0.5 | 97 | 1100 | 56 | 40 | 304.67 | 83.60 | 95.74 | 0.00 | | | Gillnetter |
| Commerical Fishing | 1 | Detroit | 1983 | 120 | | 2000 | 0 | 71 | 2000 | 50 | 35 | 629.48 | 172.72 | 197.80 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | Cat 6cyl | 1983 | 150 | | 0 | 0 | 71 | 0 | 0 | 32 | 0.00 | 0.00 | 0.00 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | Johnson and Tower 671 | 1983 | 485 | | 300 | 0 | 71 | 300 | 50 | 36 | 94.42 | 25.91 | 29.67 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | | 1983 | 338 | | 902 | 0.3 | 71 | 902 | 48 | 32 | 295.25 | 81.01 | 92.78 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | Cummins B59 Series | 1983 | 250 | | 900 | 0 | 71 | 900 | 0 | 27 | 566.53 | 155.45 | 178.02 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | Caterpiller C-18 Cat | 1983 | 1005 | | 1000 | 1 | 42.88 | 1000 | 80 | 65 | 133.05 | 8.92 | 14.50 | 554.41 | | | Mixed |
| Commerical Fishing | 1 | Caterpiller 3406 | 1983 | 325 | | 2000 | 3 | 32.86666667 | 2000 | 99 | 73 | 12.59 | 3.45 | 3.96 | 0.00 | | | Albacore Troll |
| Commerical Fishing | 1 | | 1983 | 345 | | 1488 | 1 | 45 | 1488 | 74 | 80 | 243.53 | 66.82 | 76.53 | 0.00 | | | Albacore Troll |
| Commerical Fishing | 1 | | 1983 | 345 | | 1488 | 1 | 45 | 1488 | 74 | 63 | 243.53 | 66.82 | 76.53 | 0.00 | | | Albacore Troll |
| Commerical Fishing | 1 | | 1964 | 659 | | 1488 | 2 | 54 | 1488 | 74 | 78 | 14.37 | 0.00 | 8.07 | 1843.36 | | | Albacore Troll |
| Commerical Fishing | 1 | | 1983 | 345 | 2010 | 1488 | 2 | 45 | 1488 | 74 | 58 | 243.53 | 66.82 | 76.53 | 0.00 | | | Albacore Troll |
| Commerical Fishing | 2 | | 1983 | 345 | 2010 | 1488 | 1 | 45 | 1488 | 74 | 57 | 243.53 | 66.82 | 76.53 | 0.00 | | | Albacore Troll |
| Commerical Fishing | 1 | | 1983 | 320 | | 1163 | 0.6 | 64 | 1163 | 60 | 65 | 292.83 | 80.35 | 92.02 | 0.00 | | | Seiner |
| Commerical Fishing | 1 | Detroit V871 | 1983 | 285 | | 4000 | 1 | 60.3 | 4000 | 98.5 | 58 | 37.77 | 10.36 | 11.87 | 0.00 | | | Gillnetter |
| Commerical Fishing | 1 | | 1983 | 392 | | 1483 | 0.5 | 24 | 1483 | 44 | 24 | 522.77 | 143.44 | 164.27 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 1 | 471 Detroit | 1983 | 80 | | 300 | 0 | 97 | 300 | 0 | 30 | 188.84 | 51.82 | 59.34 | 0.00 | | | Gillnetter |
| Commerical Fishing | 1 | John Deere 6068 | 1983 | 285 | 2013 | 800 | 0 | 24 | 800 | 0 | 35 | 503.58 | 138.17 | 158.24 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 1 | | 1983 | 338 | | 902 | 0.3 | 71 | 902 | 48 | 42 | 295.25 | 81.01 | 92.78 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | | 1983 | 345 | | 1488 | 1 | 45 | 1488 | 74 | 60 | 243.53 | 66.82 | 76.53 | 0.00 | | | Albacore Troll |
| Commerical Fishing | 1 | | 1983 | 345 | | 1488 | 1 | 45 | 1488 | 74 | 71 | 243.53 | 66.82 | 76.53 | 0.00 | | | Albacore Troll |
| Commerical Fishing | 1 | 6068 John Deere 6.1L | 1983 | 201 | | 2500 | 1 | 44.22 | 2500 | 30 | 42 | 1101.59 | 302.26 | 346.16 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | Caterpillar 3306 | 1983 | 235 | | 1800 | 1 | 68 | 1800 | 99 | 52 | 11.33 | 3.11 | 3.56 | 0.00 | | | Albacore Troll |
| Commerical Fishing | 1 | | 1983 | 283 | | 1100 | 0.5 | 97 | 1100 | 56 | 56 | 304.67 | 83.60 | 95.74 | 0.00 | | | Gillnetter |
| Commerical Fishing | 1 | V671 Detroit | 1983 | 210 | | 1000 | 1 | 88.44 | 1000 | 99 | 38 | 6.29 | 1.73 | 1.98 | 0.00 | | | Mixed |
| Commerical Fishing | 1 | | 1983 | 250 | | 1483 | 0.5 | 24 | 1483 | 44 | 37 | 522.77 | 143.44 | 164.27 | 0.00 | | | Lobster/crab/spot prawn |
| Commerical Fishing | 1 | Cummins 505 | 1983 | 250 | | 1400 | 1 | 40.2 | 1400 | 99 | 51 | 8.81 | 2.42 | 2.77 | 0.00 | | | Albacore Troll |
| Commerical Fishing | 1 | | 1983 | 345 | | 1488 | 1 | 45 | 1488 | 74 | 90 | 3.58 | 0.00 | 1.78 | 879.27 | | | Albacore Troll |
| Sport Fishing | 1 | | 2007 | 1800 | | 594 | 1.625 | 52.30769231 | 1376 | | 41.6 | 3.96 | 0.00 | 10.56 | 66.99 | 1959 | 29 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1 | | 2000 | 835 | 2006 | 594 | 1 | 52.30769231 | 1376 | | 80 | 261.06 | 0.00 | 100.23 | 1751.30 | 1979 | 87 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2000 | 395.480226 | 2009 | 190 | 1 | 48.66666667 | 3115 | | 80 | 1259.58 | 893.99 | 475.98 | 3731.41 | 1984 | 99 | Vessel Type Typically Operates Entirely w/in 24nmi |
| Sport Fishing | 1.77 | | 2007 | 1016.949153 | | 1344 | 2 | 200 | 1784 | | 62.2 | 45.00 | 12.00 | 22.00 | 10.00 | 1979 | 66 | Vessel only arrives/departs in San Diego |
| Sport Fishing | 1 | | 2000 | 835 | 2010 | 594 | 1 | 52.30769231 | 1376 | | 79.7 | 180.00 | 48.00 | 88.00 | 304.00 | 1968 | 92 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 85 | 36.35 | 0.00 | 27.48 | 1154.85 | 1961 | 92 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 52.7 | 180.00 | 48.00 | 88.00 | 304.00 | 1978 | 53 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1 | | 2000 | 835 | 2006 | 594 | 1 | 52.30769231 | 1376 | | 82.2 | 41.22 | 0.00 | 66.71 | 1715.48 | 1944 | 99 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1 | | 2010 | 835 | 2010 | 594 | 1 | 52.30769231 | 1376 | | 56.2 | 180.00 | 48.00 | 88.00 | 304.00 | 1973 | 49 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1 | | 2000 | 835 | 2006 | 594 | 1 | 52.30769231 | 1376 | | 78 | 1.55 | 0.00 | 30.99 | 816.14 | 1970 | 93 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1 | | 2000 | 835 | 2010 | 594 | 1 | 52.30769231 | 1376 | | 56.5 | 180.00 | 48.00 | 88.00 | 304.00 | 1964 | 67 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 1988 | 1016.949153 | | 1344 | 2 | 200 | 1784 | | 109.1 | 78.62 | 14.90 | 78.45 | 1328.94 | 1989 | 98 | Vessel only arrives/departs in San Diego |
| Sport Fishing | 1.77 | | 2007 | 1016.949153 | | 1344 | 2 | 200 | 1784 | | 81.6 | 22.50 | 4.10 | 16.27 | 43.58 | 1985 | 92 | Vessel only arrives/departs in San Diego |
| Sport Fishing | 1.77 | | 1975 | 1016.949153 | | 1344 | 2 | 200 | 1784 | | 103.7 | 50.89 | 0.00 | 76.01 | 641.35 | 1975 | 99 | Vessel only arrives/departs in San Diego |
| Sport Fishing | 1.77 | | 2007 | 1016.949153 | | 1344 | 2 | 200 | 1784 | | 82.8 | 45.00 | 12.00 | 22.00 | 10.00 | 1986 | 97 | Vessel only arrives/departs in San Diego |
| Sport Fishing | 1.77 | | 2007 | 1016.949153 | | 1344 | 2 | 200 | 1784 | | 84.4 | 138.27 | 10.73 | 60.80 | 3852.60 | 1970 | 96 | Vessel only arrives/departs in San Diego |
| Sport Fishing | 1.77 | | 2007 | 1016.949153 | | 1344 | 2 | 200 | 1784 | | 80.8 | 40.06 | 4.14 | 17.08 | 247.68 | 1989 | 99 | Vessel only arrives/departs in San Diego |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 42.8 | 180.00 | 48.00 | 88.00 | 304.00 | 1957 | 22 | Vessel Operates in and out of 24 nmi |

**Commerical and Sport Fishing Vessel characteristics**

| | Engine Stats | | | | | | | | | | | AIS Hours | | | | | | General Activity Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vessel type | # Prop | Prop make and model | Prop MY | Prop HP | Propulsion (main) engine retrofit type / repower | Main hours | # Aux | Aux HP | Aux hours | % time outside 24nm (*100) | Vessel/Slip Size (ft) | Out of Port:Moving | Out of Port:Stopped | In Port:Moving | In Port:Stopped | Year Built | Gross Tonnage | Classification or Vessel Type/Geographic Usage |
| Sport Fishing | 2 | | 2000 | 417.5 | 2009 | 594 | 1 | 52.30769231 | 1376 | | 55 | 180.00 | 48.00 | 88.00 | 304.00 | 1966 | 49 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2007 | 1016.949153 | | 1344 | 2 | 200 | 1784 | | 37.9 | 45.00 | 12.00 | 22.00 | 10.00 | 1989 | 10 | Vessel only arrives/departs in San Diego |
| Sport Fishing | 2 | | 2000 | 417.5 | 2010 | 594 | 1.625 | 52.30769231 | 1376 | | 74 | 228.87 | 8.70 | 319.96 | 2982.08 | 1980 | 99 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 82.5 | 224.92 | 0.12 | 68.63 | 806.16 | 1944 | 99 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 70.6 | 201.24 | 0.69 | 69.39 | 2503.24 | 1988 | 95 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 37.4 | 180.00 | 48.00 | 88.00 | 304.00 | 1954 | 20 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 53 | 127.55 | 2.15 | 38.30 | 4112.03 | 1979 | 33 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 48.9 | 180.00 | 48.00 | 88.00 | 304.00 | 1970 | 45 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 51.6 | 180.00 | 48.00 | 88.00 | 304.00 | 1950 | 38 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 79.5 | 448.56 | 2.28 | 201.96 | 2997.50 | 1968 | 96 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 3 | | 1982 | 666 | | 1344 | 2 | 100 | 1784 | | 91.3 | 71.87 | 4.09 | 59.77 | 1009.91 | 1982 | 99 | Vessel only arrives/departs in San Diego |
| Sport Fishing | 1 | | 2000 | 835 | 2010 | 594 | 1 | 52.30769231 | 1376 | | 62 | 180.00 | 48.00 | 88.00 | 304.00 | 1965 | 73 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 0 | 91.35 | 0.00 | 50.76 | 423.91 | 0 | 0 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1 | | 2000 | 835 | 2008 | 594 | 1 | 52.30769231 | 1376 | | 85.4 | 184.03 | 0.92 | 46.87 | 256.50 | 1984 | 99 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 71.4 | 16.28 | 0.00 | 2.52 | 6.82 | 1966 | 98 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2007 | 395.480226 | | 190 | 1 | 48.66666667 | 3115 | | 76 | 1228.07 | 1159.72 | 505.85 | 4417.27 | 2003 | 56 | Vessel Type Typically Operates Entirely w/in 24nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 44.9 | 180.00 | 48.00 | 88.00 | 304.00 | 1976 | 37 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2007 | 1016.949153 | | 1344 | 2 | 200 | 1784 | | 81.4 | 69.49 | 31.87 | 50.67 | 668.90 | 1976 | 99 | Vessel only arrives/departs in San Diego |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 73 | 169.61 | 50.06 | 55.64 | 641.06 | 1992 | 86 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 57.4 | 180.00 | 48.00 | 88.00 | 304.00 | 1959 | 33 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 0 | 1259.58 | 893.99 | 475.98 | 3731.41 | 0 | 0 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 62 | 323.38 | 2.69 | 81.59 | 4075.27 | 1977 | 74 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 56 | 180.00 | 48.00 | 88.00 | 304.00 | 1981 | 68 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 0 | 180.00 | 48.00 | 88.00 | 304.00 | 0 | 0 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2007 | 395.480226 | | | 1 | 48.66666667 | | | 49.1 | | | | | 1934 | 34 | Vessel Type Typically Operates Entirely w/in 24nmi |
| Sport Fishing | 1.77 | | 2007 | 395.480226 | | 190 | 1 | 48.66666667 | 3115 | | 62.5 | 123.00 | 33.00 | 60.00 | 2795.00 | 1959 | 48 | Vessel Type Typically Operates Entirely w/in 24nmi |
| Sport Fishing | 3 | | 2000 | 278.3333333 | 2006 | 594 | 2 | 52.30769231 | 1376 | | 62 | 180.00 | 48.00 | 88.00 | 304.00 | 1978 | 67 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1 | | 2000 | 835 | 2006 | 594 | 1 | 52.30769231 | 1376 | | 32.8 | 180.00 | 48.00 | 88.00 | 304.00 | 1986 | 17 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 0 | 180.00 | 48.00 | 88.00 | 304.00 | 0 | 0 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1 | | 2000 | 835 | 2006 | 594 | 1 | 52.30769231 | 1376 | | 79.7 | 165.03 | 0.00 | 71.79 | 3255.96 | 1963 | 91 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 0 | 180.00 | 48.00 | 88.00 | 304.00 | 0 | 14 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 46.5 | 180.00 | 48.00 | 88.00 | 304.00 | 1978 | 40 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 57.4 | 180.00 | 48.00 | 88.00 | 304.00 | 1960 | 39 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 2 | | 2000 | 417.5 | 2009 | 594 | 1.625 | 52.30769231 | 1376 | | 60.3 | 180.00 | 48.00 | 88.00 | 304.00 | 1961 | 69 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 48.4 | 180.00 | 48.00 | 88.00 | 304.00 | 1974 | 32 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 58.3 | 180.00 | 48.00 | 88.00 | 304.00 | 1978 | 43 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 0 | 180.00 | 48.00 | 88.00 | 304.00 | 0 | 0 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2010 | 471.7514124 | | 594 | 1.625 | 52.30769231 | 1376 | | 51.6 | 180.00 | 48.00 | 88.00 | 304.00 | 1973 | 41 | Vessel Operates in and out of 24 nmi |
| Sport Fishing | 1.77 | | 2007 | 395.480226 | | | 1 | 48.66666667 | | | 27.2 | | | | | 1980 | 8 | Vessel Type Typically Operates Entirely w/in 24nmi |

# Appendix D
# *Cargo Handling Equipment Information*

**Cargo Handling Equipment Data**

| Equipment Type | No. of Equipment | Engine Model | Engine Model Year | Engine Retrofit Type / Repower | Chassis Make / Model | Chassis Model Year | Fuel Type | Annual Hours of Operation | Cumulative Hours on Engine | Engine Rated HP | Fuel Consumption/CHE (gal/yr) | Exhaust Controls / After-Treatment Device | Control Tech | Terminal | type | type | Equip Name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRAILER | 1 | | 2006 | | Wacker Portable Light Tower | 2006 | Diesel | 478.975639 | 4789.75639 | 14 | | No | NONE | TAMT | Other General Industrial Equipment | Offroad | Lighting |
| TRAILER | 1 | | 2006 | | Wacker Portable Light Tower | 2006 | Diesel | 478.975639 | 4789.75639 | 14 | | No | NONE | TAMT | Other General Industrial Equipment | Offroad | Lighting |
| TRAILER | 1 | | 2006 | | Wacker Portable Light Tower | 2006 | Diesel | 478.975639 | 4789.75639 | 14 | | No | NONE | TAMT | Other General Industrial Equipment | Offroad | Lighting |
| STANDARD | 1 | | 2008 | | Yamaha Drive Electric Cart | 2008 | Electric | 478.975639 | 3831.805112 | 13 | | No | NONE | TAMT | Other General Industrial Equipment | Offroad | Cart |
| ATVS | 1 | | 2008 | | Taylor Dunn B-200 Electric Utility | 2008 | Electric | 478.975639 | 3831.805112 | 13 | | No | NONE | TAMT | Other General Industrial Equipment | Offroad | Cart |
| TRAILER | 1 | | 2008 | | Decatur OnSite 350 Radar Trailer | 2008 | Solar | 478.975639 | 3831.805112 | 40.29384155 | | No | NONE | TAMT | Other General Industrial Equipment | Offroad | Trailer |
| TRAILER | 1 | | 2008 | | Decatur OnSite 350 Radar Trailer | 2008 | Solar | 478.975639 | 3831.805112 | 40.29384155 | | No | NONE | TAMT | Other General Industrial Equipment | Offroad | Trailer |
| LIFT | 1 | | 2010 | | Gottwald HMK300 Mobile Harbor Crane | 2003 | Diesel | 244.6 | 3179.8 | 1030 | | No | NONE | TAMT | Container Handling Equipment | CHE | Lift |
| FRK | 1 | | 2014 | | HELI H2000-30 / CPYD30-TY5 Forklift | 2014 | Propane | 1409.089626 | 2818.179253 | 61.5 | | No | NONE | TAMT | Forklift | CHE | Forklifts |
| Aerial lift | 1 | | 1994 | | JLG/80HX | 1994 | Diesel | 240 | 5280 | 70 | | | NONE | TAMT | Other General Industrial Equipment | Offroad | Lift |
| Forklift | 1 | | 1993 | | Caterpillar/V55B | 1976 | Diesel | 100 | 4000 | 70 | | | NONE | TAMT | Forklift | CHE | Forklifts |
| Forklift | 1 | | 1993 | | Lull/844 | 198 | Diesel | 100 | 181800 | 109 | | | NONE | TAMT | Forklift | CHE | Forklifts |
| Rubber TireLoader | 1 | | 1997 | | Caterpillar/972 | 1997 | Diesel | 240 | 4560 | 265 | | | NONE | TAMT | Other General Industrial Equipment | Offroad | Loader |
| Rubber TireLoader | 1 | | 2004 | | Caterpillar/972G | 2004 | Diesel | 240 | 2880 | 265 | | | NONE | TAMT | Other General Industrial Equipment | Offroad | Loader |
| Sweeper/Scrubber | 1 | | 1999 | | Tennant/6500D | 1999 | Diesel | 240 | 4080 | 34 | | | NONE | TAMT | Other General Industrial Equipment | Offroad | Sweeper/Scrubber |
| Reach Stacker | 1 | Cummins N-14 | 2009 | Thermocat DPF 145/12 | Fantuzzi | 2001 | Diesel | 25 | 9498.6 | 400 | 87.5 | yes | DPF (A) | TAMT | Container Handling Equipment | CHE | Reach Stackers |
| Reach Stacker | 1 | Cummins M-11 | 2008 | Thermocat DPF 145/12 | Fantuzzi | 2001 | Diesel | 25 | 9481.1 | 330 | 87.5 | yes | DPF (A) | TAMT | Container Handling Equipment | CHE | Reach Stackers |
| Forklift | 1 | Cummins 5.9L | 2010 | Level 3 | Taylor | 1985 | Diesel | 50 | 7648 | 170 | 50 | yes | DPF (A) | TAMT | Forklift | CHE | Forklifts |
| Forklift | 1 | Chevrolet | 2003 | | Yale | | Propane | 50 | 650 | 149.2085198 | 520 | | NONE | TAMT | Forklift | CHE | Forklifts |
| Reach Stacker | 1 | Siemans | 2010 | | Fantuzzi | 1999 | Electric | 0 | 0 | 354.340673 | | | NONE | TAMT | Container Handling Equipment | CHE | Reach Stackers |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| HUSTLER | 1 | 7CEXH0408BAC | 2011 | | CAPACITY TJ5000 | 2007 | DIESEL | 1487 | 13383 | 200 | | | NONE | TAMT | Yard Tractor | CHE | Yard Tractor |
| REACH STACKER | 1 | OSM11-C | 2010 | | TAYLOR RS9968 | 2002 | DIESEL | 710 | 9940 | 330 | | | NONE | TAMT | Container Handling Equipment | CHE | Reach Stackers |
| REACH STACKER | 1 | TAD1170VE | 2016 | | TEREX 45 TONES | 2016 | DIESEL | 300 | 0 | 315 | | | NONE | TAMT | Container Handling Equipment | CHE | Reach Stackers |
| FORKLIFT | 1 | | 2004 | | HYSTER H80XM | 2004 | PROPANE | 84 | 1008 | 103 | | | NONE | TAMT | Forklift | CHE | Forklifts |
| Hydraulic Power Lift | 1 | | 2015 | No | Stanley GT23 | 2015 | Gas | 400 | 400 | 23 | | | NONE | TAMT | Other General Industrial Equipment | Offroad | Lift |
| Forklift | 1 | | 2016 | No | HELI CPYD30-TY5 | 2016 | Diesel | 25 | 0 | 149.2085198 | | | NONE | TAMT | Forklift | CHE | Forklifts |
| Golf Cart | 1 | | 2007 | No | Yamaha ??? | 2003 | Gas | 10 | 130 | 8.9 | | | NONE | TAMT | Other General Industrial Equipment | Offroad | Cart |
| Forklift SWL 8,000 - 55,000 lbs | 15 | | 2003 | | | 2003 | Diesel | 1409.089626 | 18318.16514 | 149.2085198 | | | NONE | TAMT | Forklift | CHE | Forklifts |
| Forklift | 2 | | 2003 | | | 2003 | Propane | 1409.089626 | 18318.16514 | 149.2085198 | | | NONE | TAMT | Forklift | CHE | Forklifts |
| Forklift SWL 3,800 - 8,000 | 0 | | 2003 | | | 2003 | Electric | 1409.089626 | 18318.16514 | 149.2085198 | | | NONE | TAMT | Forklift | CHE | Forklifts |
| Top-Handler SWL 80,000 | 1 | | 2010 | | | 2010 | Gas | 623.9872612 | 3743.923567 | 354.340673 | | | NONE | TAMT | Container Handling Equipment | CHE | Top Handler |
| Pallet Jacks | 4 | | 2003 | | | 2003 | Electric | 1409.089626 | 18318.16514 | 149.2085198 | | | NONE | TAMT | Forklift | CHE | Forklifts |
| STANDARD | 1 | | 2008 | | Yamaha Drive Electric Cart | 2008 | Electric | | 0 | | | No | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Hyster Model H165E6Tf | 1 | | 2003 | | Hyster Model H165E6Tf | 2003 | Diesel | 1409.089626 | 18318.16514 | 149.2085198 | | | NONE | NCMT | Forklift | CHE | Forklifts |
| John Deere - Gator TX | 1 | | 2007 | | John Deere Gator TX | 2007 | Gas | 478.975639 | 4310.780751 | 13 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Segway | 1 | | 2008 | | Segway | 2008 | Electric | 478.975639 | 3831.805112 | 2 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Segway | 1 | | 2008 | | Segway | 2008 | Electric | 478.975639 | 3831.805112 | 2 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Rail Loader (yellow) | 1 | | 2002 | | Rail Loader | 2002 | Diesel | 63.13186295 | 883.8460813 | 137.5 | | | NONE | NCMT | Construction Equipment | Offroad | Rail Loader (yellow) |
| Rail Loader (yellow) | 1 | | 2002 | | Rail Loader | 2002 | Diesel | 63.13186295 | 883.8460813 | 137.5 | | | NONE | NCMT | Construction Equipment | Offroad | Rail Loader (yellow) |
| Rail Loader (yellow) | 1 | | 2002 | | Rail Loader | 2002 | Diesel | 63.13186295 | 883.8460813 | 137.5 | | | NONE | NCMT | Construction Equipment | Offroad | Rail Loader (yellow) |
| Red Hyster Fork Lift | 1 | | 2003 | | Hyster | 2003 | Diesel | 1409.089626 | 18318.16514 | 41 | | | NONE | NCMT | Forklift | CHE | Forklifts |
| Polaris Ranger | 1 | | 2008 | | Polaris Ranger | 2008 | Gas | 478.975639 | 3831.805112 | | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Caterpillar TC60B 6T FL | 1 | | 2002 | | Caterpillar TC60B 6T FL | 1995 | Diesel | 63.13186295 | 1325.769122 | 137.5 | | | NONE | NCMT | Construction Equipment | Offroad | ractors/Loaders/Backhoe |
| John Deere - Gator TS | 1 | | 2007 | | John Deere - Gator TS | 2007 | Gas | 478.975639 | 4310.780751 | 13 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Polaris 700 Twin Ranger crew | 1 | | 2008 | | Polaris 700 Twin Ranger crew | 2008 | Gas | 478.975639 | 3831.805112 | 13 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| 5K Mitsu. FL /1.5t Clark FI E | 1 | | 2002 | | 5K Mitsu. FL /1.5t Clark FI E | 1987 | Diesel | 63.13186295 | 1830.824026 | 137.5 | | | NONE | NCMT | Construction Equipment | Offroad | Ind Forklist |
| Capacity Yard Hustler | 1 | | 2011 | | Capacity Yard Hustler | 1997 | Diesel | 718.8659567 | 13658.45318 | 220.1086957 | | | NONE | NCMT | Yard Tractor | CHE | Yard Tractor |
| Magnum Tractor Hustler | 1 | | 2011 | | Magnum Tractor Hustler | 1994 | Diesel | 718.8659567 | 15815.05105 | 220.1086957 | | | NONE | NCMT | Yard Tractor | CHE | Yard Tractor |
| Tennet Sweeper 800 Series | 1 | | 2003 | | Tennet Sweeper 800 Series | 2003 | Diesel | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Sweeper/Scrubber |
| 2- Post lift | 1 | | 2003 | | Y2KI0A | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| 2- Post lift | 1 | | 2003 | | BW-7 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| 2- Post lift | 1 | | 2003 | | W509OA | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| 2- Post lift | 1 | | 2003 | | W509OA | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| 2- Post lift | 1 | | 2003 | | W509OA | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| 2- Post lift | 1 | | 2003 | | W509OA | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| 2- Post lift | 1 | | 2003 | | W509OA | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| 2- Post lift | 1 | | 2003 | | Y2KIOA | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| 2- Post lift | 1 | | 2003 | | W509OA | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| 2- Post lift | 1 | | 2003 | | Y2KIOA | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| 2- Post lift | 1 | | 2003 | | BW-7 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| 2- Post lift | 1 | | 2003 | | Y2KIOA | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| 2- Post lift | 1 | | 2003 | | Y2KIOA | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| AC Service Machine | 1 | | 2003 | | 347002K | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Air Compressor | 1 | | 2003 | | T302475N5 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Car Wash Long Tunnel | 1 | | 2003 | | N/A | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Car Wash Short Tunnel | 1 | | 2003 | | N/A | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Compactor | 1 | | 2003 | | 60IID | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |

**Cargo Handling Equipment Data**

| Equipment Type | No. of Equipment | Engine Model | Engine Model Year | Engine Retrofit Type / Repower | Chassis Make / Model | Chassis Model Year | Fuel Type | Annual Hours of Operation | Cumulative Hours on Engine | Engine Rated HP | Fuel Consumption/CHE (gal/yr) | Exhaust Controls / After-Treatment Device | Control Tech | Terminal | type | type | Equip Name |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Compactor | 1 | | 2003 | | EA30485HDS | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Portable Compressor | 1 | | 2003 | | ES20 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Portable Compressor | 1 | | 2003 | | QX2X/ES20 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Portable Compressor | 1 | | 2003 | | ES20 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Portable Compressor | 1 | | 2003 | | Predator/R420 | 2003 | Gas | 478.975639 | 6226.683307 | 14 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Atlas Air Compressor | 1 | | 2003 | | KT10V12034 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Atlas Air Compressor | 1 | | 2003 | | KT10V12034 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Atlas Air Compressor | 1 | | 2003 | | GA18PA | 2003 | Electric | 478.975639 | 6226.683307 | 25 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Falcon Air Compressor | 1 | | 2003 | | B-2 Falcon | 2003 | Electric | 478.975639 | 6226.683307 | 5 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Scissor Lift | 1 | | 2003 | | TC-25 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| Scissor Lift | 1 | | 2003 | | TC-25 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| Scissor Lift | 1 | | 2003 | | TC-25 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| Scissor Lift | 1 | | 2003 | | TC-25 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| Scissor Lift | 1 | | 2003 | | TC-25 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| Tire Balancer | 1 | | 2003 | | 1025S | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Tire Machine | 1 | | 2003 | | 10430 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Tire Balancer | 1 | | 2003 | | LS8153 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Tire Machine | 1 | | 2003 | | 9024-E | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Tire Machine | 1 | | 2003 | | IC4KOCC | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Tire Balancer | 1 | | 2003 | | GSP9712 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Tire Machine | 1 | | 2003 | | TC3250 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Tire Balancer | 1 | | 2003 | | GSP9712 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Hyster Forklift 18726 | 1 | | 2003 | | E502 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| Hyster Forklift N40ZR-16.5 | 1 | | 2003 | | N40ZR-16.5 | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | Lift |
| Lincoln Welder machine | 1 | | 2003 | | 10,000 plus | 2003 | Electric | 478.975639 | 6226.683307 | 40.29384155 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| Ranger Lincoln Electric | 1 | | 2003 | | 305G | 2003 | Gas | 478.975639 | 6226.683307 | 23 | | | NONE | NCMT | Other General Industrial Equipment | Offroad | assorteds |
| STANDARD | 1 | | 2008 | | Yamaha Drive Electric Cart | 2008 | Electric | 478.975639 | 3831.805112 | 40.29384155 | | No | NONE | CST | Other General Industrial Equipment | Offroad | assorteds |
| STANDARD | 1 | | 2008 | | Yamaha Drive Electric Cart | 2008 | Electric | 478.975639 | 3831.805112 | 40.29384155 | | No | NONE | CST | Other General Industrial Equipment | Offroad | assorteds |
| ATVS | 1 | | 2008 | | Taylor Dunn B-200 Electric Utility | 2008 | Electric | 478.975639 | 3831.805112 | 40.29384155 | | No | NONE | CST | Other General Industrial Equipment | Offroad | assorteds |
| STANDARD | 1 | | 2005 | | Sunray Electric Utility | 2005 | Electric | 478.975639 | 5268.732029 | 40.29384155 | | No | NONE | CST | Other General Industrial Equipment | Offroad | assorteds |
| TRAILER | 1 | | 2005 | | Quixote Message Board Trailer | 2005 | Solar | 63.13186295 | 694.4504924 | 137.5 | | No | NONE | CST | Construction Equipment | Offroad | Trailer |
| TRAILER | 1 | | 2005 | | Quixote Message Board Trailer | 2005 | Solar | 63.13186295 | 694.4504924 | 137.5 | | No | NONE | CST | Construction Equipment | Offroad | Trailer |
| TRAILER | 1 | | 2004 | | Wanco WVT3-S(A) Message Board | 2004 | Solar | 63.13186295 | 757.5823554 | 137.5 | | No | NONE | CST | Construction Equipment | Offroad | Trailer |
| TRAILER | 1 | | 2004 | | Wanco WVT3-S(A) Message Board | 2004 | Solar | 63.13186295 | 757.5823554 | 137.5 | | No | NONE | CST | Construction Equipment | Offroad | Trailer |
| STANDARD | 1 | | 2012 | | Polaris GEM e6 Electric Cart | 2012 | Electric | 478.975639 | 1915.902556 | 40.29384155 | | No | NONE | CST | Other General Industrial Equipment | Offroad | assorteds |
| FRK | 1 | | 2003 | | Komatsu 6000LB | 2003 | Propane | 1409.089626 | 18318.16514 | 60 | | No | NONE | CST | Forklift | CHE | Forklifts |
| Forklift | 1 | | 2007 | | Caterpillar | 2007 | Electric | 48 | 432 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Forklift | 1 | | 2007 | | Caterpillar | 2007 | Electric | 48 | 432 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Forklift | 1 | | 2007 | | Caterpillar | 2007 | Electric | 48 | 432 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Forklift | 1 | | 2007 | | Caterpillar | 2007 | Electric | 48 | 432 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Forklift | 1 | | 2007 | | Caterpillar | 2007 | Electric | 48 | 432 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Forklift | 1 | | 2007 | | Caterpillar | 2007 | Electric | 48 | 432 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Forklift | 1 | | 2004 | | Caterpillar | 2004 | Electric | 48 | 576 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Forklift | 1 | | 2004 | | Caterpillar | 2004 | Electric | 48 | 576 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Forklift | 1 | | 2004 | | Caterpillar | 2004 | Electric | 48 | 576 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Pallet Jack | 1 | | 2013 | | Jungheinrich | 2013 | Electric | 1409.089626 | 4227.268879 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Pallet Jack | 1 | | 2013 | | Jungheinrich | 2013 | Electric | 1409.089626 | 4227.268879 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Pallet Jack | 1 | | 2013 | | Jungheinrich | 2013 | Electric | 1409.089626 | 4227.268879 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Pallet Jack | 1 | | 2013 | | Jungheinrich | 2013 | Electric | 1409.089626 | 4227.268879 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Pallet Jack | 1 | | 2013 | | Jungheinrich | 2013 | Electric | 1409.089626 | 4227.268879 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Pallet Jack | 1 | | 2013 | | Jungheinrich | 2013 | Electric | 1409.089626 | 4227.268879 | 149.2085198 | | | NONE | CST | Forklift | CHE | Forklifts |
| Elec Cart | 1 | | 2005 | | EZ GO | 2005 | Electric | 478.975639 | 5268.732029 | 40.29384155 | | | NONE | CST | Other General Industrial Equipment | Offroad | assorteds |
| Elec Cart | 1 | | 2005 | | EZ GO | 2005 | Electric | 478.975639 | 5268.732029 | 40.29384155 | | | NONE | CST | Other General Industrial Equipment | Offroad | assorteds |