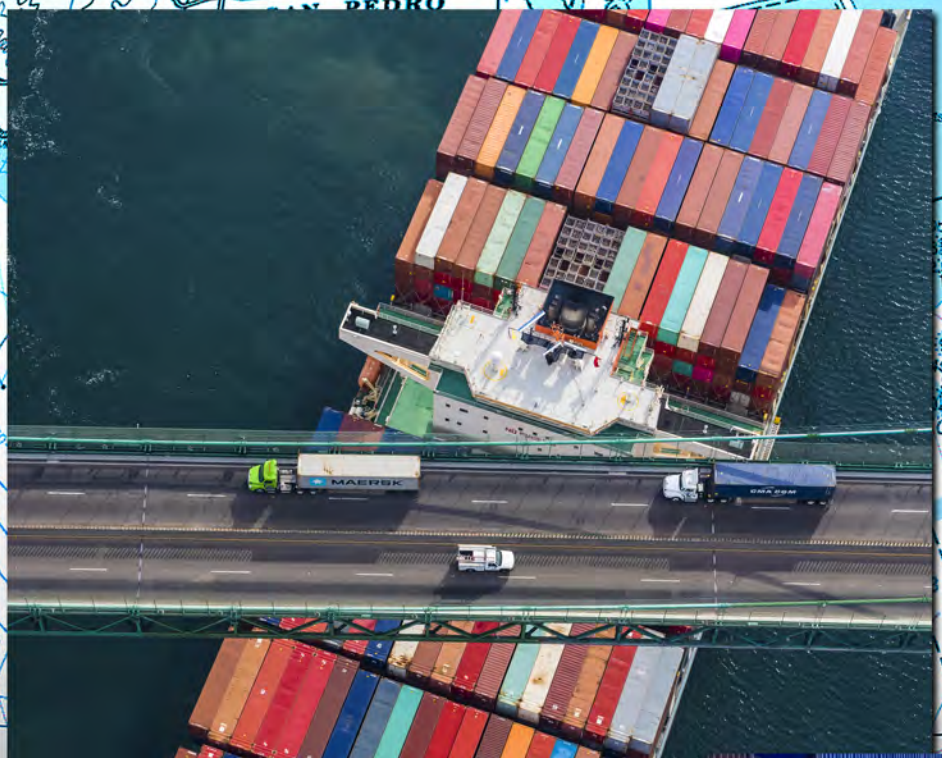
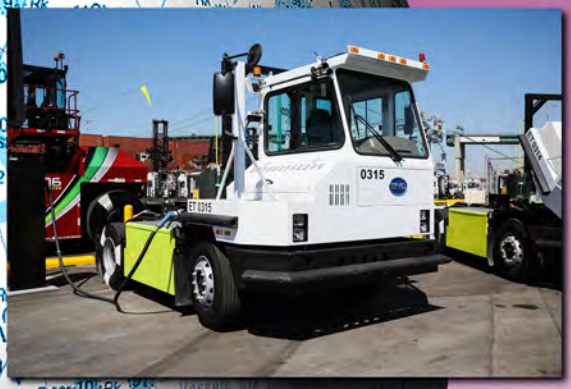
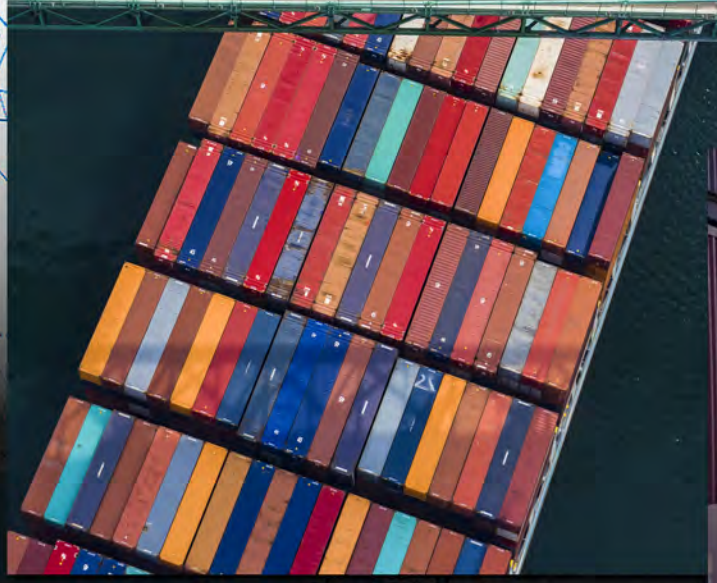
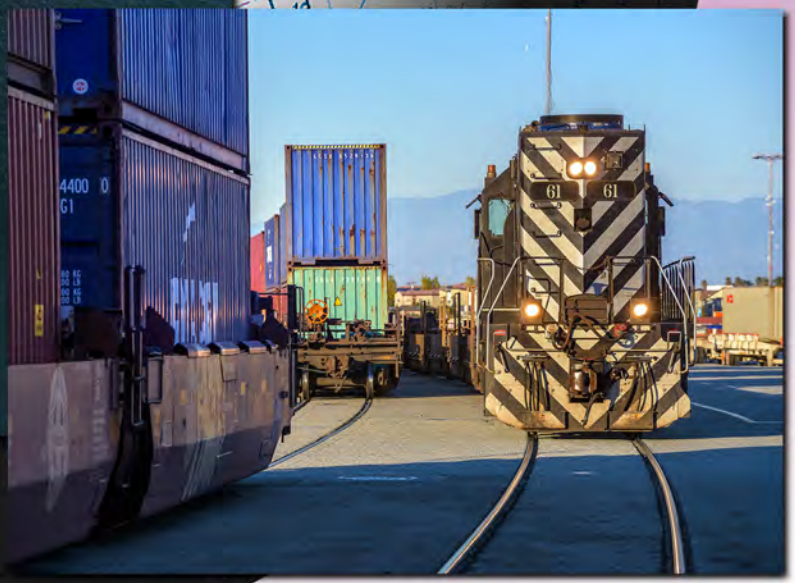
PORT OF LOS ANGELES
EMISSIONS INVENTORY HIGHLIGHTS - 2020

THE PORT
OF LOS ANGELES









APP# 201113-540 A
October 2021

Prepared by:
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FOREWORD

This document provides an overview of the air quality improvement efforts associated with the Port of Los Angeles (POLA) in reaching its goals as presented in the San Pedro Bay Ports Clean Air Action Plan (CAAP). This Port of Los Angeles Emissions Inventory Highlights document presents 2020 inventory findings, trends in emissions and cargo since 2005, CAAP measure progress, and upcoming highlights for 2021 and beyond. This document does not replace the detailed annual emissions reports; it compliments it by looking into specific topics of interest in greater detail in the context of trends and CAAP goals, in a reader-friendly format.

portoflosangeles.org/environment/studies_reports.asp

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Please note that due to rounding and decimal places shown in this document, on occasion, the totals and percentages may not add up.

Photos by Port of Los Angeles

Introduction

The Port of Los Angeles (POLA) Emissions Inventory Highlights document is published in conjunction with the annual emissions inventories. This document is intended to provide the key findings of the annual emissions inventory and tracks progress with the goals of the San Pedro Bay Ports Clean Air Action Plan (CAAP). The CAAP focuses on emissions of diesel particulate matter (DPM), oxides of nitrogen (NOx), sulfur oxides (SOx), and greenhouse gases (GHG).

In March 2006, a groundbreaking meeting occurred at the highest level between POLA, Port of Long Beach (POLB), and the South Coast Air Quality Management District (SCAQMD) where all parties expressed the need to work jointly toward solutions to reduce emissions from port-related operations. Shortly thereafter, the Ports also engaged the California Air Resources Board (CARB) and the United States Environmental Protection Agency Region 9 (EPA) in the spirit of cooperation to help the Ports develop the original 2006 San Pedro Bay Ports CAAP, the 2010 CAAP Update, and the 2017 CAAP Update.

As part of the 2010 CAAP Update, the Ports developed mass emissions and health-risk reduction standards in coordination with the CARB, EPA, and SCAQMD. These emissions reduction goals set the bar for performance for port-related emission sources and represent the Ports' "fair share" in reducing emissions in the South Coast Air Basin (the Basin).

THE PORT OF LOS ANGELES

The **San Pedro Bay Standards** are a statement of the Ports' commitments to significantly reduce the air quality impacts from port operations. Achievement of the goals listed below will require continued coordination with agency partners, diligent pursuit of all of the existing CAAP measures and aggressive action to seek out further emissions and health risk reductions from port-related sources from strategies that will emerge over time. The standards are relative to 2005 conditions.

Mass Emissions Reduction Standards -
By 2014, reduce emissions by 72% DPM, 22% NOx, & 93% SOx
By 2023, reduce emissions by 77% DPM, 59% NOx, & 93% SOx

Health Risk Reduction Standard - By 2020, reduce the population-weighted residential cancer risk of port-related DPM emissions by 85%.

In addition, the CAAP sets out various measures for ocean-going vessels (OGV), harbor craft (HC), cargo handling equipment (CHE), locomotives, and heavy-duty vehicles (HDV). Additional initiatives, such as the Technology Advancement Program (TAP) and the zero emissions effort, support POLA's progress at attaining and maintaining the standards into the future.

2020 was an unprecedented year as the COVID-19 pandemic (pandemic) impacted all sectors of society. The logistics chain was fundamentally affected with impacts starting at the end of first quarter 2020 and continuing on through 2021. The emissions inventory documents the results of these disruptions from an emissions perspective at the Port and insight is provided to the changes.

2017 CAAP Update - GHG Goals

The 2017 CAAP Update introduced two GHG goals that align with state and mayor goals for both cities. The **GHG Goals** include:

By 2030, reduce port-related GHG emissions to 40% below 1990
By 2050, reduce port-related GHG emission to 80% below 1990

https://cleanairactionplan.org/

Report Card

POLA developed a "Report Card" summary in 2009 which helps distill each current-year inventory and compare it to 2005, showing progress toward the CAAP goals. The report card has been effective in communicating a high-level understanding of emissions reduction progress to date, describing Port efficiency measured in emissions per twenty-foot equivalent units (TEUs), and showing pollutant emissions for the five emission source categories. Additional relevant information is also provided each year on the report card. The report cards are posted annually on the POLA website. *https://www.portoflosangeles.org/environment/air-quality/air-emissions-inventory*

SAN PEDRO BAY STANDARDS

The San Pedro Bay Standards establish the long-term emissions-reduction and health risk-reduction goals for the ports of Los Angeles and Long Beach. Emission Reduction Standards for DPM, NOx, and SOx have target years of 2014 and 2023 to support state ambient air quality goals. The Health Risk Reduction Standard has a target year of 2020 to align with California Air Resources Board's Goods Movement Emission Reduction Plan.

All reductions shown are compared to 2005 baseline levels.

CLEAN AIR ACTION PLAN (CAAP) GOALS

	2014	2023
DPM	72%	77%
NO_x	22%	59%
SO_x	93%	93%
	2020	
Health Risk	85%	

OVERALL EMISSIONS REDUCTIONS

Pollutant	%	tons
DPM	89%	766
$PM_{2.5}$	88%	774
PM_{10}	89%	908
NO_x	64%	10,289
SO_x	98%	4,722

EMISSIONS PER 10,000 TEU HANDLED REDUCTIONS

Pollutant	%	tons
DPM	91%	1.05
$PM_{2.5}$	90%	1.06
PM_{10}	91%	1.24
NO_x	71%	15.21
SO_x	98%	6.34

OCEAN-GOING VESSEL EMISSIONS REDUCTIONS

Pollutant	%	tons
DPM	93%	416
$PM_{2.5}$	90%	443
PM_{10}	91%	559
NO_x	45%	2,326
SO_x	98%	4,572

HEAVY-DUTY VEHICLE/CLEAN TRUCK EMISSIONS REDUCTIONS

Pollutant	%	tons
DPM	98%	242
$PM_{2.5}$	98%	232
PM_{10}	98%	242
NO_x	83%	5,232
SO_x	92%	41

HARBOR CRAFT EMISSIONS REDUCTIONS

Pollutant	%	tons
DPM	57%	31
$PM_{2.5}$	57%	29
PM_{10}	57%	31
NO_x	45%	597
SO_x	89%	5

RAIL EMISSIONS REDUCTIONS

Pollutant	%	tons
DPM	48%	28
$PM_{2.5}$	49%	26
PM_{10}	48%	28
NO_x	54%	926
SO_x	99%	97

CARGO-HANDLING EQUIPMENT EMISSIONS REDUCTIONS

Pollutant	%	tons
DPM	91%	49
$PM_{2.5}$	89%	45
PM_{10}	89%	48
NO_x	77%	1,207
SO_x	81%	7

CO_2 EQUIVALENT CHANGES

Source Type	%	tonnes
Ocean-Going Vessels	▼25%	▼68,991
Harbor Craft	▲6%	▲3,449
Cargo-Handling Equipment	▲23%	▲31,340
Rail	▼20%	▼16,214
Heavy-Duty Vehicles	▼16%	▼76,198
TOTAL	▼12%	▼126,613

▼ = reduction ▲ = increase

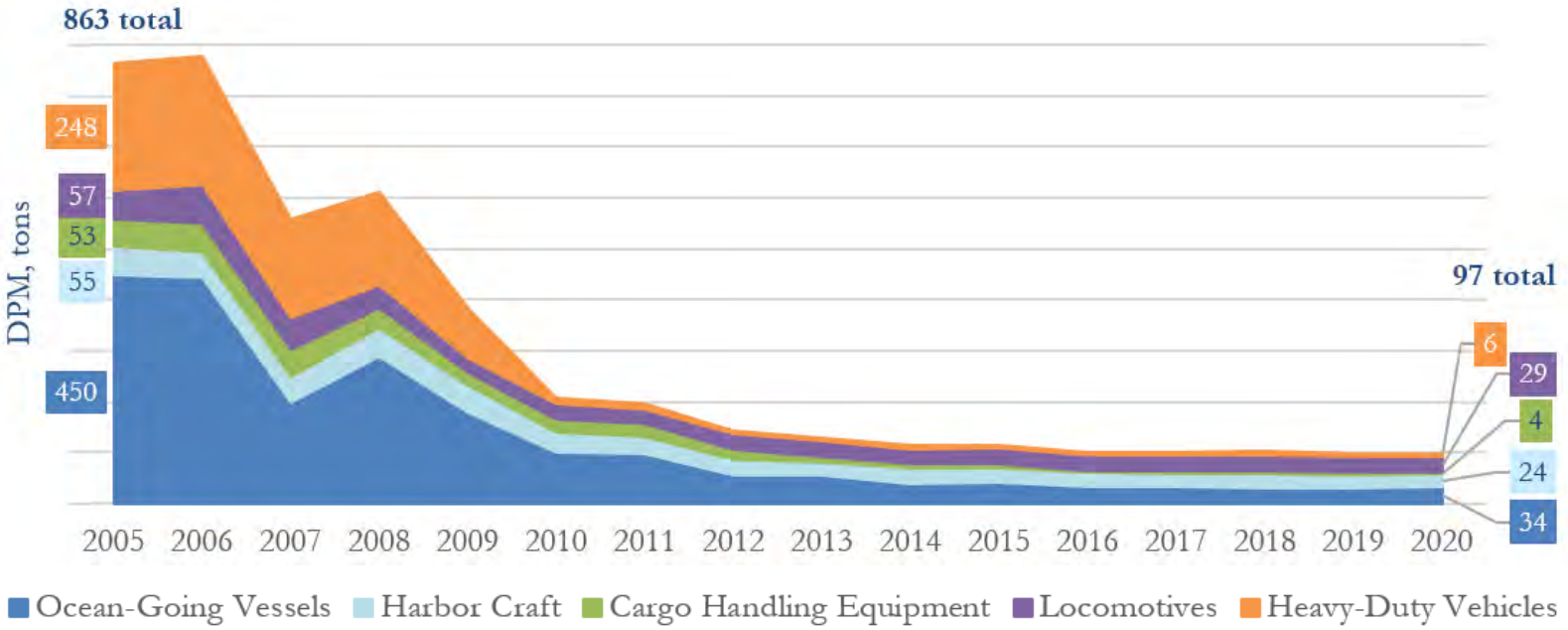
PRIMARY POLLUTANTS DEFINED:
DPM = Diesel Particulate Matter
NO_x = Oxides of Nitrogen
SO_x = Oxides of Sulfur
$PM_{2.5}$ = Particulate Matter less than 2.5 microns in diameter
PM_{10} = Particulate Matter less than 10 microns in diameter
CO_2 = Carbon Dioxide (A greenhouse gas contributor)

portofla.org/emissions-inventory

2005-2020 Emissions Inventory Trends

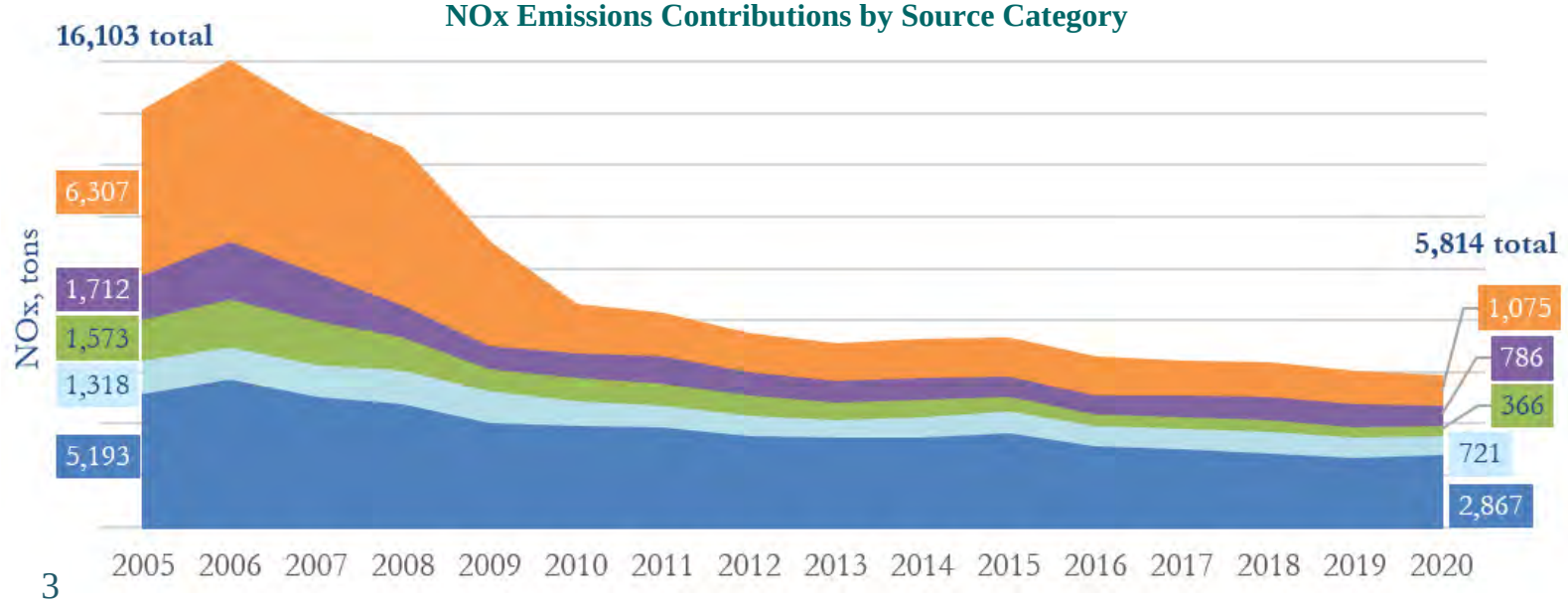
The POLA emissions inventory and CAAP focus on the reduction of DPM, NOx, and SOx as well as GHGs, reported in carbon dioxide equivalents (CO_2e). One of the primary focuses of the CAAP has been the continued reduction in emissions from each source category in the face of growing cargo throughput. The following figures illustrate the changes in port-related emissions contribution by source category between 2005 and 2020. Note the contributions by source category change overtime.

DPM Emissions Contributions by Source Category



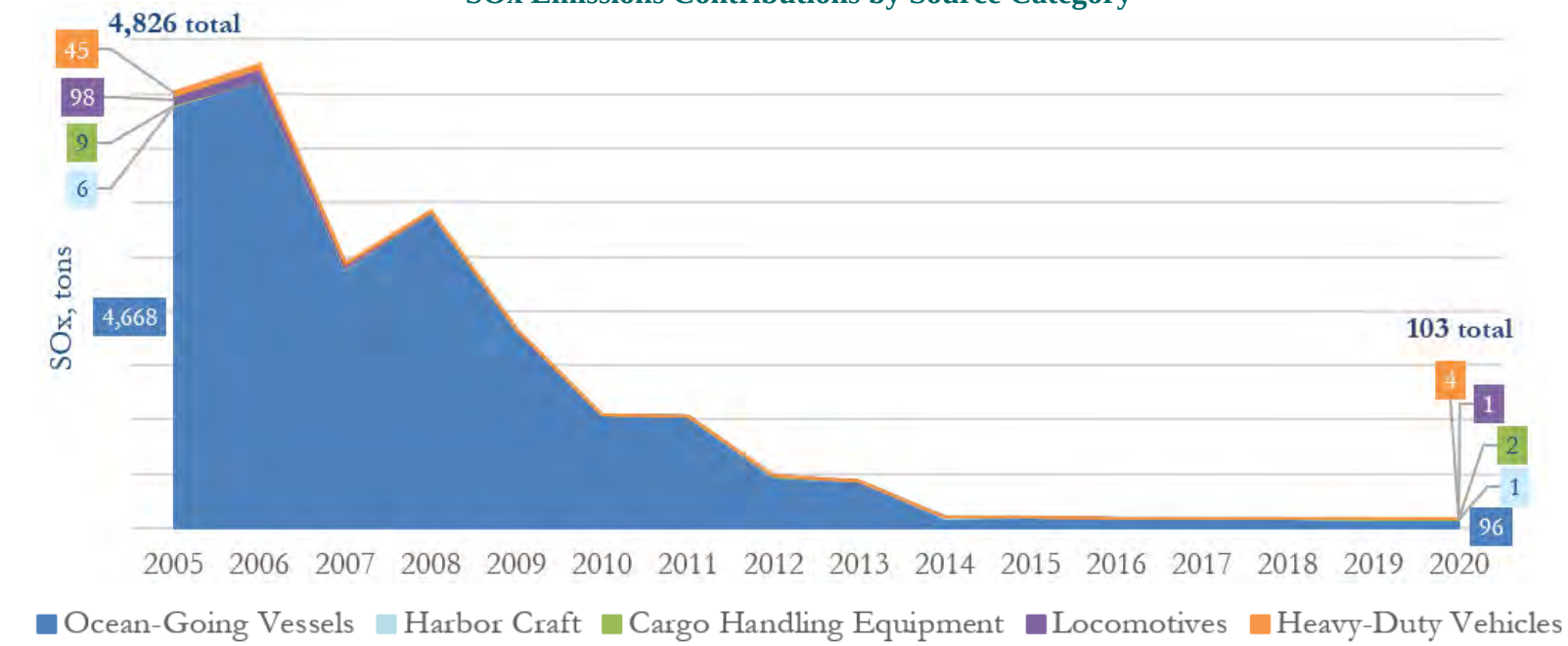
In 2005, DPM emissions were dominated by ships and trucks making up 698 tons or 81%, while cargo handling equipment, locomotives, and harbor craft made up 165 tons or 19%. In 2020, together rail and harbor craft emitted ***more*** DPM than ships, while CHE and truck DPM contributions were ***nearly eliminated***. These reductions have been accomplished through regulation and CAAP measures. From a technical and regulatory perspective, NOx is one of the more challenging pollutants to reduce. However, NOx has been reduced from 16,103 tons in 2005 to 5,814 tons in 2020 for a net reduction of 64%. In 2020, NOx emissions were reduced across all categories except ships; NOx emissions from ships increased due to disruptions from the COVID-19 pandemic to container ship operations resulting in extended times at anchorage in the last quarter of 2020.

NOx Emissions Contributions by Source Category



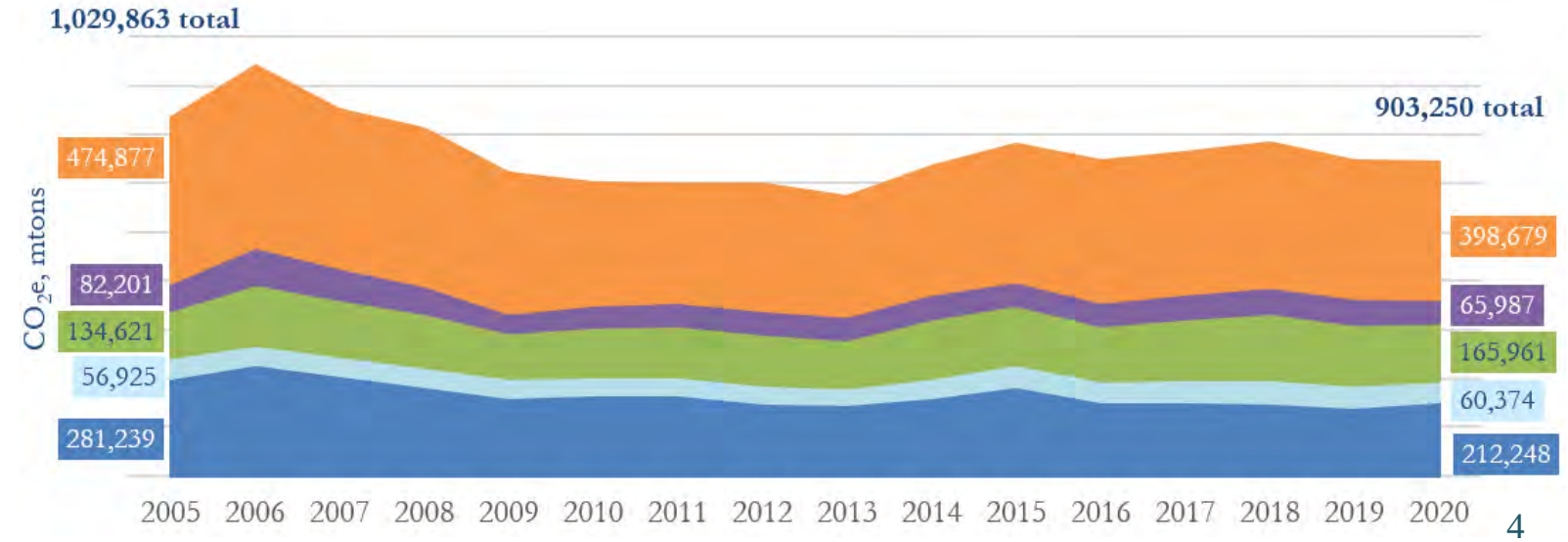
Total emissions for DPM, NOx, and SOx and emissions by source category are presented in the figures in tons. GHGs are reported in metric tons (mtons). Additional pollutants are included in the more detailed technical reports located at: *https://www.portoflosangeles.org/environment/air-quality/air-emissions-inventory*.

SOx Emissions Contributions by Source Category



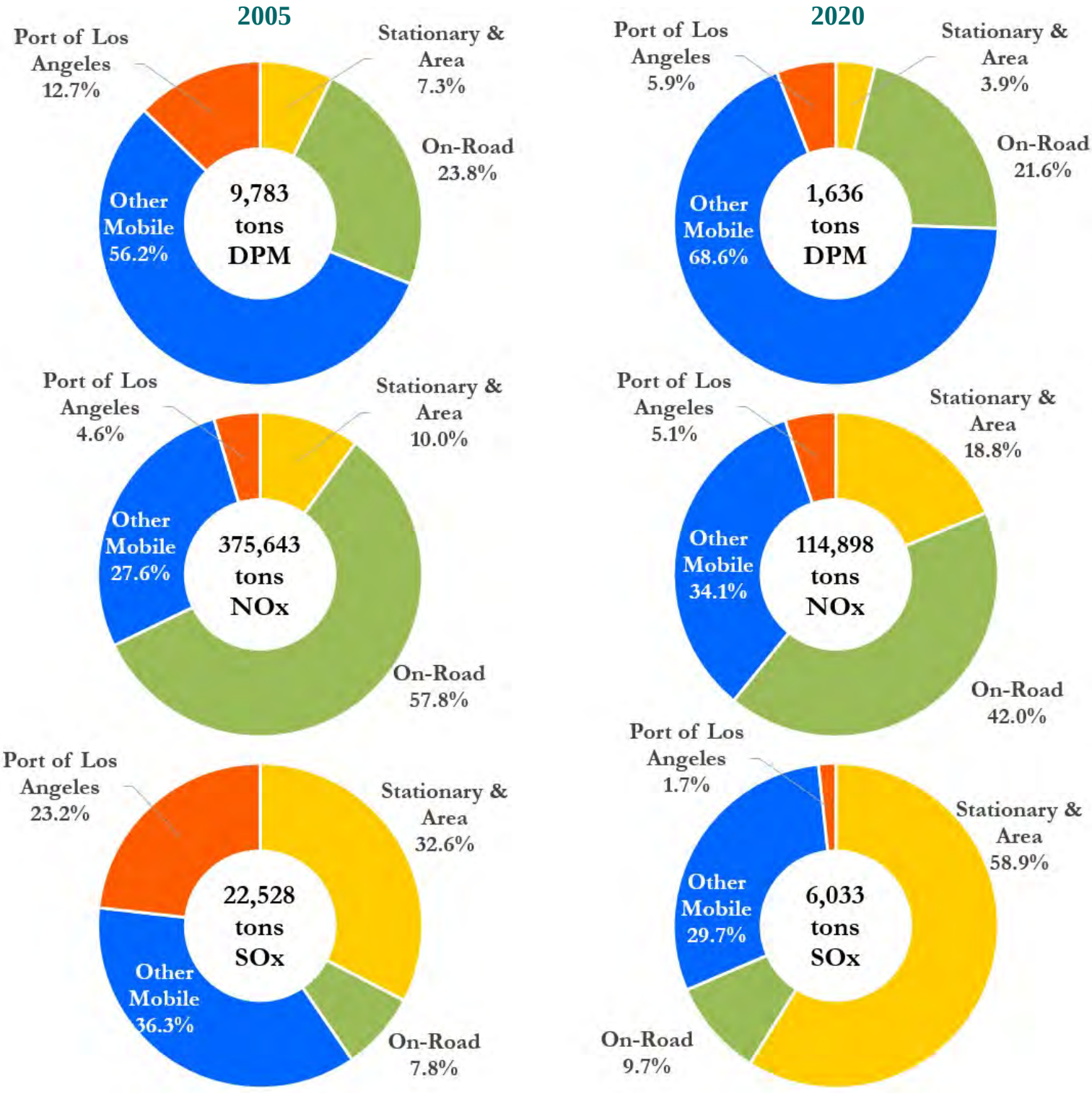
The efforts to reduce SOx have had dramatic success since 2005. Ships have always dominated SOx emissions due to their fuel's high sulfur content. CARB and EPA fuel regulations and CAAP programs like Environmental Ship Index incentives, vessel speed reduction, and operational efficiencies have reduced port-related SOx emissions by 98%. CO_2e emissions were roughly the same levels compared to 2019. Trucks continue to be the dominant source of CO_2e emissions with ships and cargo handling equipment coming in second and third. Ship-related 2020 CO_2e emissions increased compared to 2019 due to increased activities by container ships at the anchorages, longer stays at berth by container ships that could not get commissioned for shore power, and other operational impacts from the pandemic.

CO_2e Emissions Contributions by Source Category



2005 & 2020 Regional Emissions Contributions

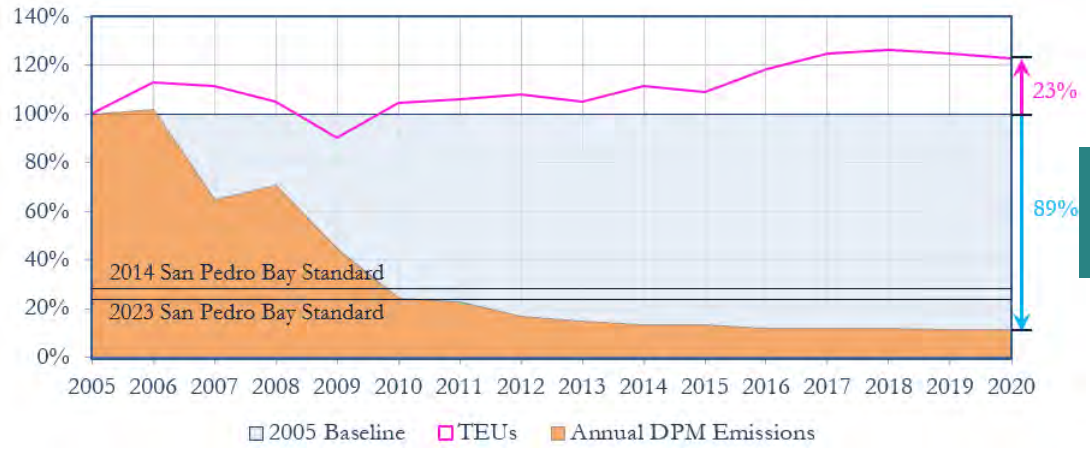
Illustrated below are the 2005 and 2020 percent pollutant contributions of port-related emissions relative to the total South Coast Air Basin emissions.



Basin-wide mass emissions have continued to be reduced from 2005 levels with DPM reduced by 83%, NOx reduced by 69%, and SOx reduced by 73%. When considering POLA-related contributions to the basin, DPM emissions have reduced by 53%, NOx emissions have slightly increased along with other mobile sources and stationary and area sources, and SOx emissions have reduced by 93%, since 2005. POLA-related contributions to basin-wide $PM_{2.5}$ and PM_{10} emissions are less than 1%.

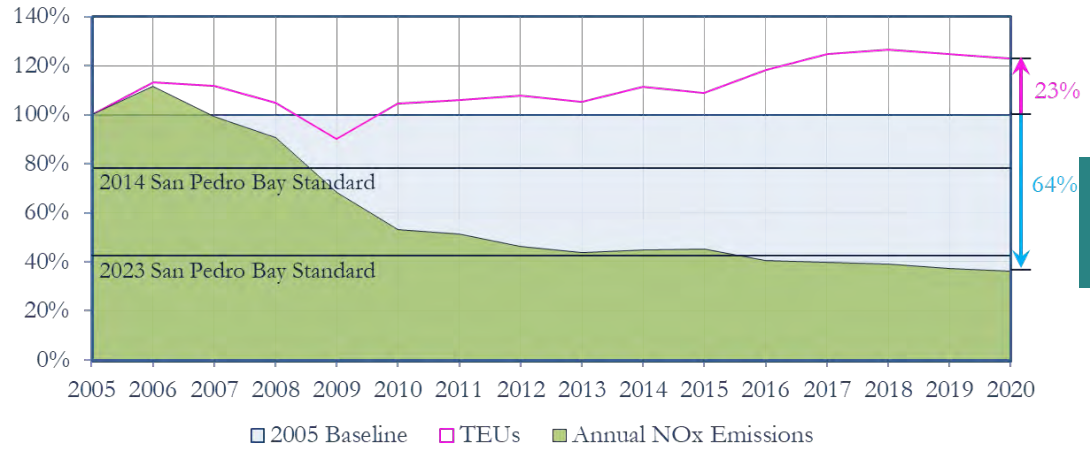
2005-2020 CAAP Progress

The figures below show the port-related trends for DPM, NOx, SOx, and CO_2e in relation to the CAAP standards and goals, along with cargo throughput measured in twenty-foot equivalent units (TEUs).



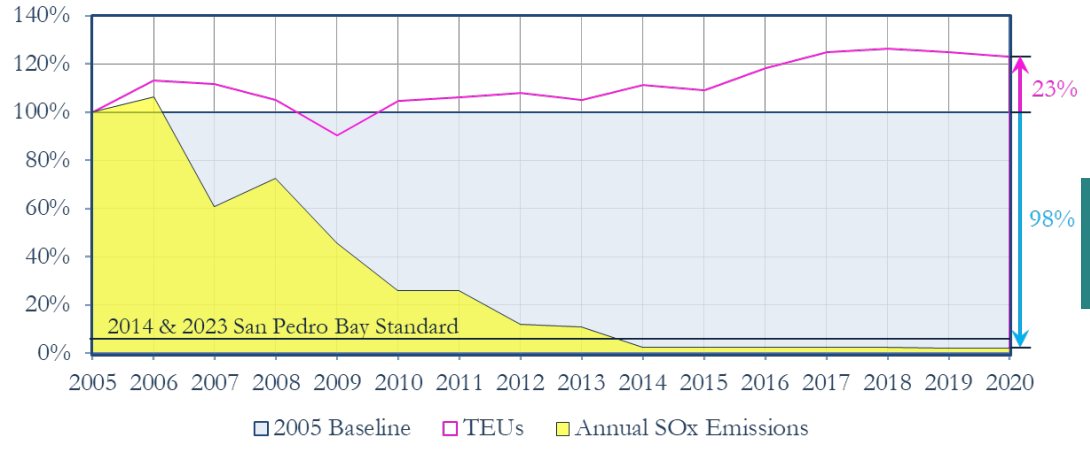
Port DPM Emissions

In 2020, emissions have reduced 89% while cargo increased 23%, compared to 2005 levels.



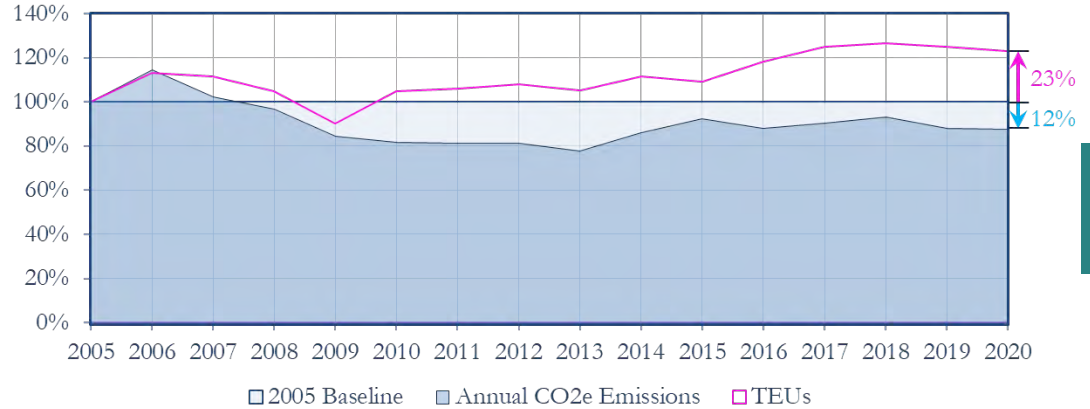
Port NOx Emissions

In 2020, emissions have reduced 64% while cargo increased 23%, compared to 2005 levels.



Port SOx Emissions

In 2020, emissions have reduced 98% while cargo increased 23%, compared to 2005 levels.



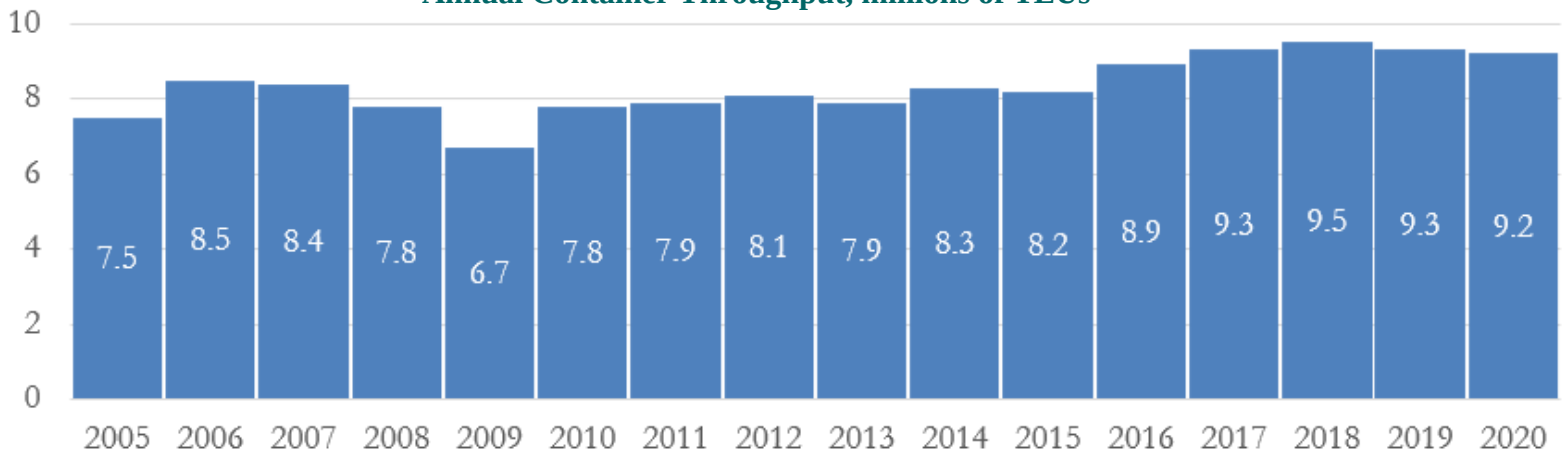
Port CO_2e Emissions

In 2020, emissions have reduced by 12% while cargo increased 23% compared to 2005 levels.

2005-2020 Cargo Growth

Cargo growth from 2005 to 2020 provides an overall activity context for the changes in emissions over time. Containers have long been the dominant cargo type at POLA. The following figure presents the changes in annual container cargo-related activity from 2005 to 2020 in millions of TEUs. Note that the pandemic impacted container throughput and ultimately ended the year just below 2019 levels.

Annual Container Throughput, millions of TEUs



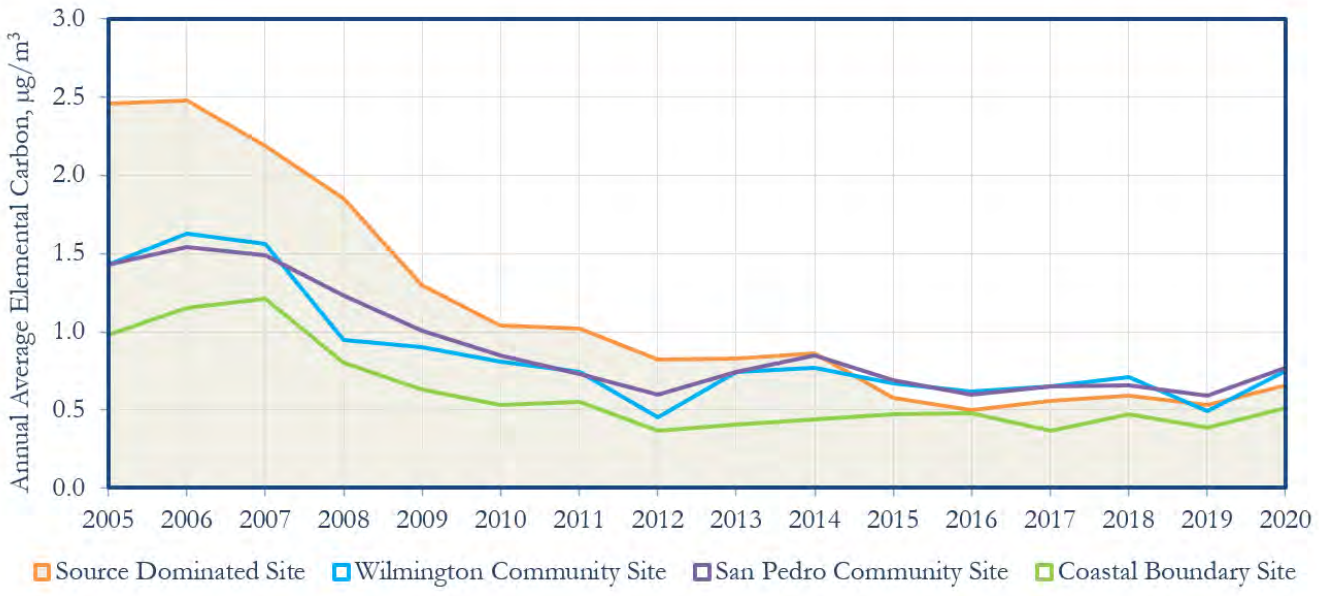
2005-2020 Air Monitoring

In addition to developing and publishing the annual emissions inventory as a means of tracking progress, the Port operates four air monitoring stations at locations around POLA. Elemental carbon is monitored as a surrogate for diesel-related emissions. The figure shows how the measured annual average elemental carbon concentration readings have reduced by 48-72%, which trends similarly with the DPM emissions inventory trends over the same period. The extraordinary wildfires in the Basin were likely responsible for the slight increase in elemental carbon in 2020.

POLA has four monitoring stations that started to collect elemental carbon data in 2005. These stations consist of the Coastal Boundary station, the Wilmington and San Pedro Community stations, and the Source Dominated station on Terminal Island in the middle of port-related operations. Please note that the Coastal Boundary station was temporarily taken offline in April 2020 due to construction at the wharf. For more information, visit:

monitoring.cleanairactionplan.org

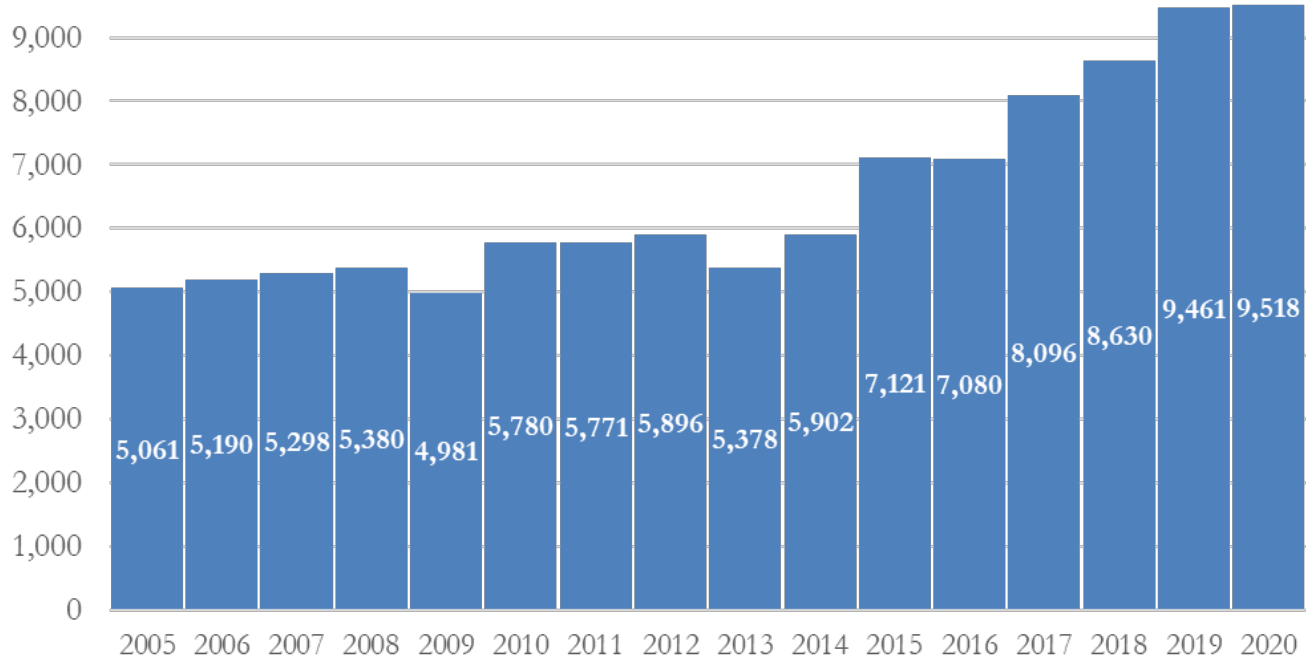
Port Air Monitoring Network, Elemental Carbon



2005-2020 Port-Related Efficiency Trends

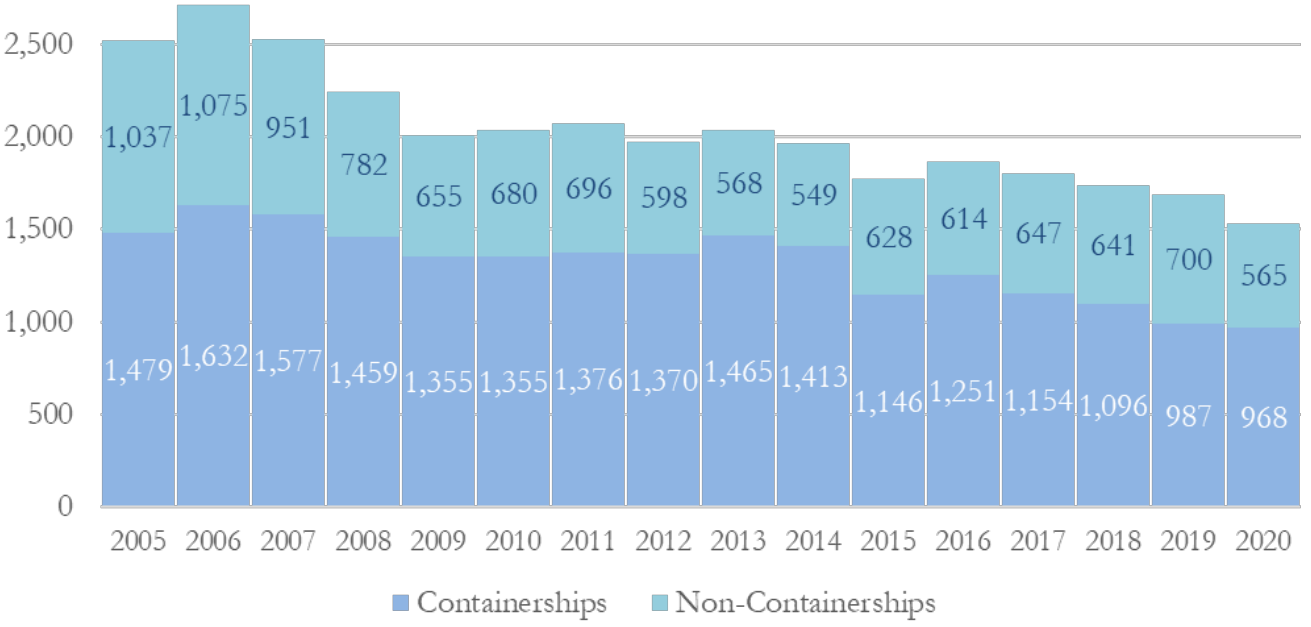
Port-related efficiency improvements significantly contribute to port-related emissions trends over time. The following figures illustrate the ongoing efficiency improvements observed related to container ship call density and the continued reduced number of arrivals of both container and non-container ships calling the port. The improvements in container density per arrival (in TEUs per arrival) have allowed for fewer, bigger container ships bringing 88% (nearly doubling) more cargo per arrival in 2020, compared to 2005. The container density increased slightly compared to 2019 levels, even with the disruptions caused by the pandemic.

Container Ship Call Density per Arrival, TEUs/arrival



Calls across most ship categories dropped in 2020 compared to 2019, with the exceptions being general cargo and integrated tug-barges.

Container & Non-Container Ship Arrivals



Observed Operational & Emission Impacts from the Pandemic

The pandemic has impacted all facets of life, commerce, and trade globally. Impacts from the pandemic started to affect POLA operations in March 2020, continued through the rest of the year, and continue through 2021. Of the five port emission source categories, ships were the most negatively impacted by the pandemic, with OGV emissions rising compared to 2019 levels.

The total number of ship calls by ship class were slightly down in 2020 compared to 2019 with the exception of integrated tug-barges (ITBs) and general cargo ships. Cargo throughputs for containers were slightly down. Cargo volumes in 2020 across autos, liquid bulk, and dry bulk were down 20-30% compared to 2019. Cruise passenger counts were impacted the most as the 2020 numbers were down to unprecedented levels with a reduction of 73% compared to 2019.

Container ships dominated POLA ship emissions, followed by cruise and tanker ships. These three ship classes typically makeup over 95% of OGV emissions at the port. The following sections compare monthly NOx emissions between 2019 and 2020 for these three ship classes.

Container Ships

For container ships calling POLA, spending time at an anchorage is not part of their normal business model. Typically, container ships in the anchorages indicate an operational disruption to the system. There have been three disruptions identified at POLA since 2005, which include: 2014-2015 due to the period of temporary congestion, January 2019 due to the lead up to US tariffs on Chinese goods, and 2020 and ongoing due to the pandemic.

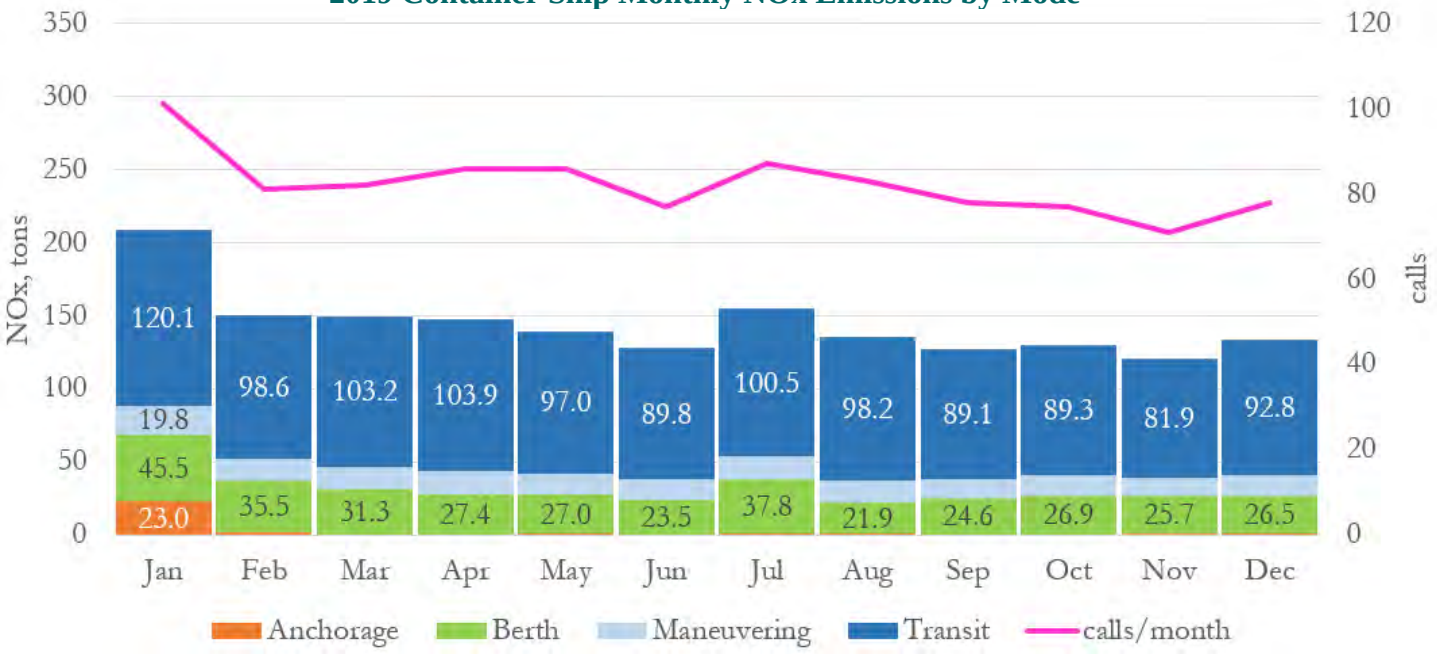
The progression of these disruptions are demonstrated in the 2019 and 2020 monthly emissions presented on the next page. In 2019, container ship operations in the anchorages were confined to January. In 2020, container ship operations in the anchorages were minimal through the third quarter of the year and then began to build up significantly in the last quarter of the year. In fact, in December, emissions at the anchorages were nearly the same as a typical month from all operational modes. This led to container ship monthly emissions to basically double.

Additionally, emissions at berth started to increase in the third quarter of 2020 and, similar to anchorage emissions, nearly doubled by the end of the year. Two factors have been identified that could explain these increases. First, commissioning of shore power equipment on ships newly arriving in service to POLA was impacted by the pandemic as restrictions were put in place to protect ship crews from exposure, key personnel to perform the commissionings were not able to travel to the ship, equipment failure repairs were delayed due to worker limitations on availability, and ship yards were delayed due to pandemic restrictions. Second, a limit was placed on the number of crews allowed to work on a ship. Through an agreement, up to four crews (gangs) are permitted to work on ships, no matter the size of the ship. This measure was put into place to ensure worker safety during the pandemic and to avoid terminal or port shut down due to the spread of COVID-19 among a significant number of workers. As a result of this agreement, dwell times at berth significantly increased in the fourth quarter of 2020. These two factors compound for ships that were not able to be commissioned for shore power.

There are undoubtably many additional unidentified factors contributing to the disruptions that result in container ship activity at anchorages. The 2020-2021 disruption is by far the most significant disruption to container ship operations at POLA and globally ever observed.

Container ship ***NOx emissions increased by 13%*** in 2020 compared to 2019, due to disruptions from the pandemic.

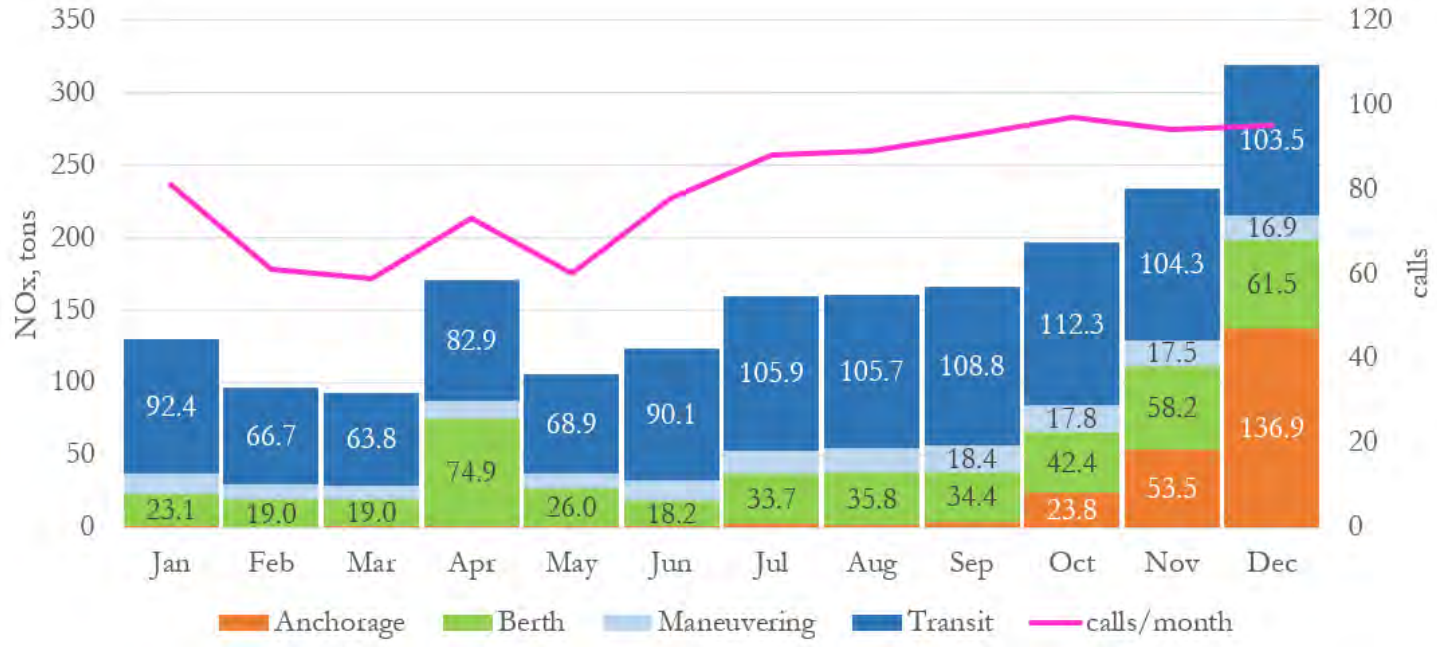
2019 Container Ship Monthly NOx Emissions by Mode



These two graphs illustrate container ship monthly NOx emissions for 2019 and 2020. Anchorage emissions in January 2019 were driven by cargo owners trying to get their goods into the US prior to sanctions on Chinese goods taking effect. By March 2019, normal operations resumed. Monthly container ship calls in 2019 typically ranged between 70 and just over 80 calls, with the exception of January which saw just over 100 calls.

The first quarter of 2020 saw container ship calls fall from 81 to 59. In the second quarter calls rose to nearly 80, and then continued to build through the second half of the year. The first half of 2020 saw monthly NOx emissions below average rates, with the exception of April, which was due to the initial impacts from the pandemic. The second half of 2020 saw monthly NOx emissions build from slightly over to more than double the average monthly rates. These rises were led primarily by increased emissions from the anchorages and at berth.

2020 Container Ship Monthly NOx Emissions by Mode



Observed Operational & Emission Impacts from the Pandemic

Cruise Ships

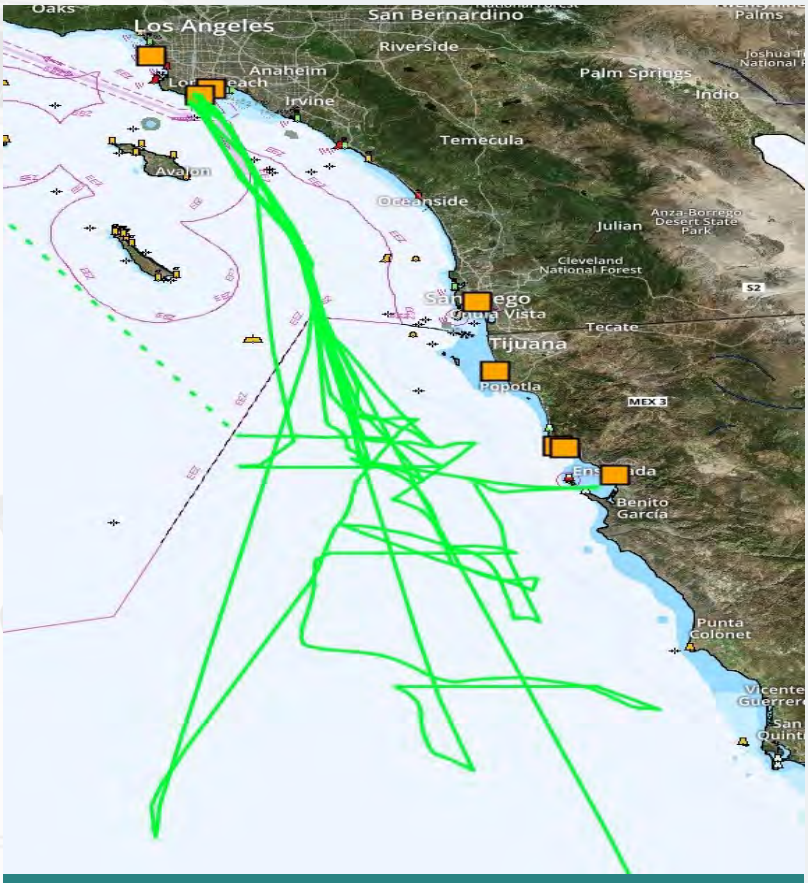
The events of 2020 relating to the operations of cruise ships was unique and unprecedented in scale and scope. The cruise season for POLA is generally from September through May each year. The 2020 cruise season had 127 scheduled calls and by mid-March 39 of the scheduled calls had been completed.

Everything changed on March 14, 2020, when the Centers for Disease Control and Prevention (CDC) issued a 'No Sail Order' for cruise ships due to the risk of introducing, transmitting, or spreading COVID-19. This effectively stopped all passenger operations and passengers onboard cruise ships were disembarked by mid-March. The period that followed and continues through 2021 is unprecedented.

As illustrated in the figures on the following page, March and April 2020 saw a period where several cruise ships were temporarily positioned at the San Pedro Bay anchorages and/or drifted off the Mexican coast while they awaited repositioning orders from their head offices. During this period these ships, which were not scheduled to call POLA, came to the port for reprovisioning of consumables related to the crews onboard and operation of the ships. Another flurry of activity occurred in July 2020, and October 2020 was a notable month for anchorage activity.

Since no passengers were onboard and activities were reduced to keep the crews safe, the auxiliary and boiler loads were reduced, which saved on fuel costs and helped to reduce the associated increases of emissions compared to 2019. A total increase of 21% in NOx emissions for cruise ships in 2020 was observed compared to 2019.

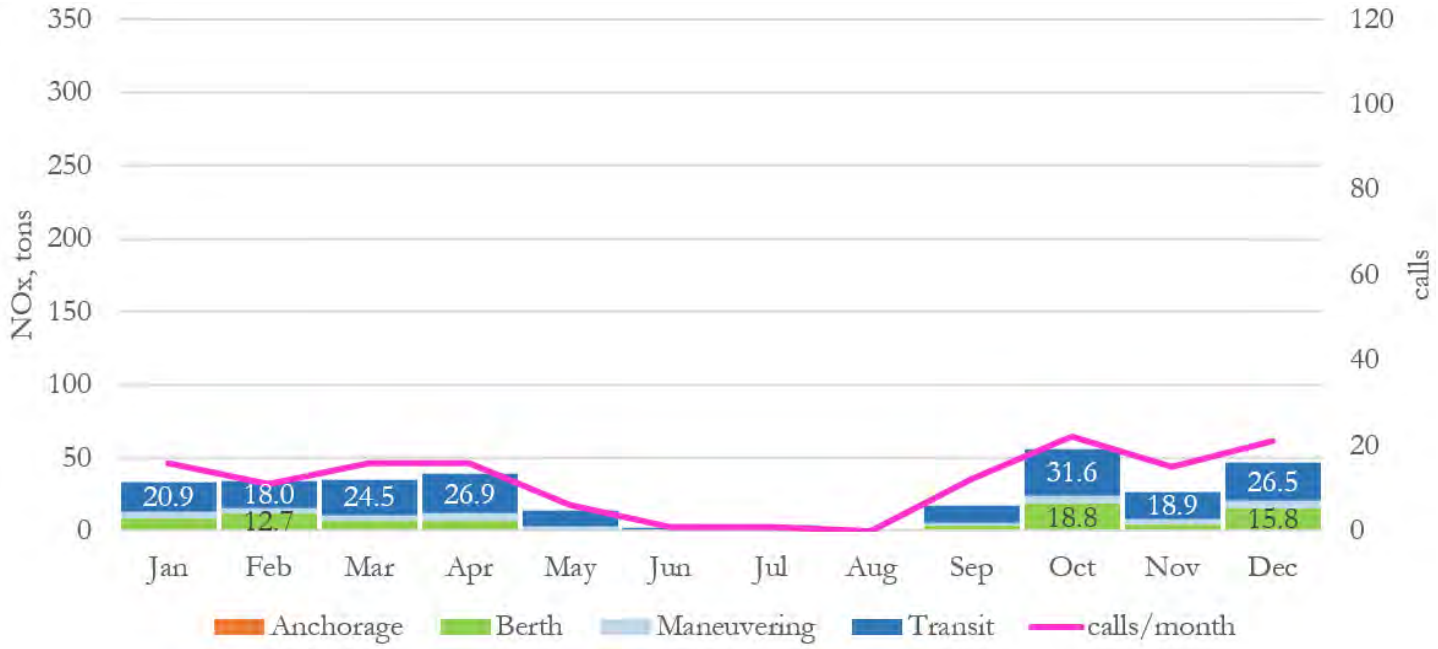
As of the publication of this report, cruise operations at POLA or globally have returned to pre-pandemic operational norms.



This image shows the ship track of a cruise ship that called POLA in April 2020. Note it is resupplying at POLA and Mexico, and drifts in Mexican waters.

Cruise ship ***NOx emissions increased by 21%*** in 2020 compared to 2019, due to disruptions from the pandemic.

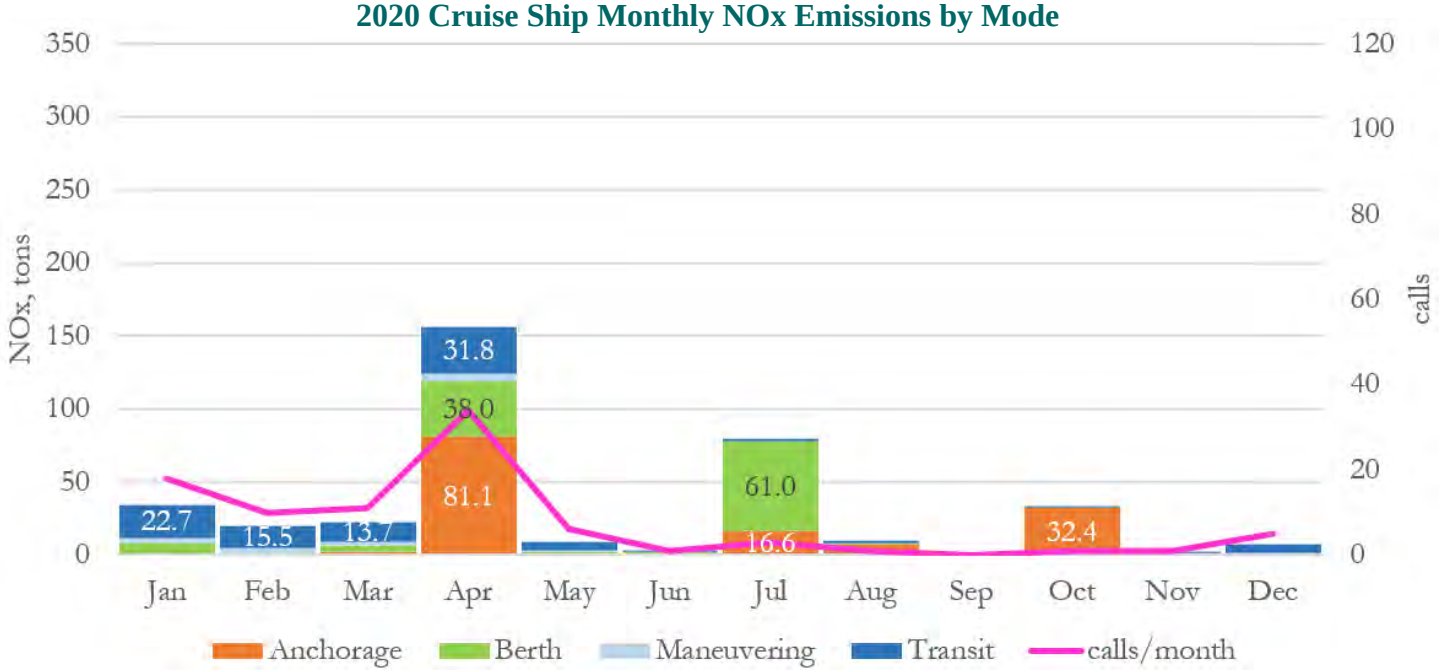
2019 Cruise Ship Monthly NOx Emissions by Mode



These two graphs illustrate cruise ship monthly NOx emissions for 2019 and 2020. The cruise season for POLA is typically between September and May. Cruise ships typically do not spend time in the anchorages as they are on tight and frequent sailing schedules as illustrated above in 2019.

The first quarter of 2020 had lower NOx emissions than the first quarter of 2019 and the 2020 cruise season was completely disrupted in mid-March by the 'No Sail Order' for cruise ships from the CDC. Only 39 of 127 or 30% of scheduled calls were completed prior to the order. From mid-March on, cruise activity was associated with unscheduled cruise ships calling POLA to reprovision perishables and consumables to keep the crews fed and safe, while in the process of being repositioned to wait out the pandemic. Several cruise ships floated off the Mexican coast and then came up to POLA for reprovisioning. These types of operations are unprecedented.

2020 Cruise Ship Monthly NOx Emissions by Mode



Observed Operational & Emission Impacts from the Pandemic

Tankers

Unlike container and cruise ships, tanker operations typically include time at the anchorages as a product of their business operations. Unlike container and cruise operations, tankers are typically not on a fixed rotation of ports which is also referred to as a liner operation. Tankers are typically spot chartered to move liquid bulk, feedstock, or finished cargoes to and from refinery and/or chemical plant terminals. Tanker operations were impacted by the pandemic in a completely different way than the other two operations.

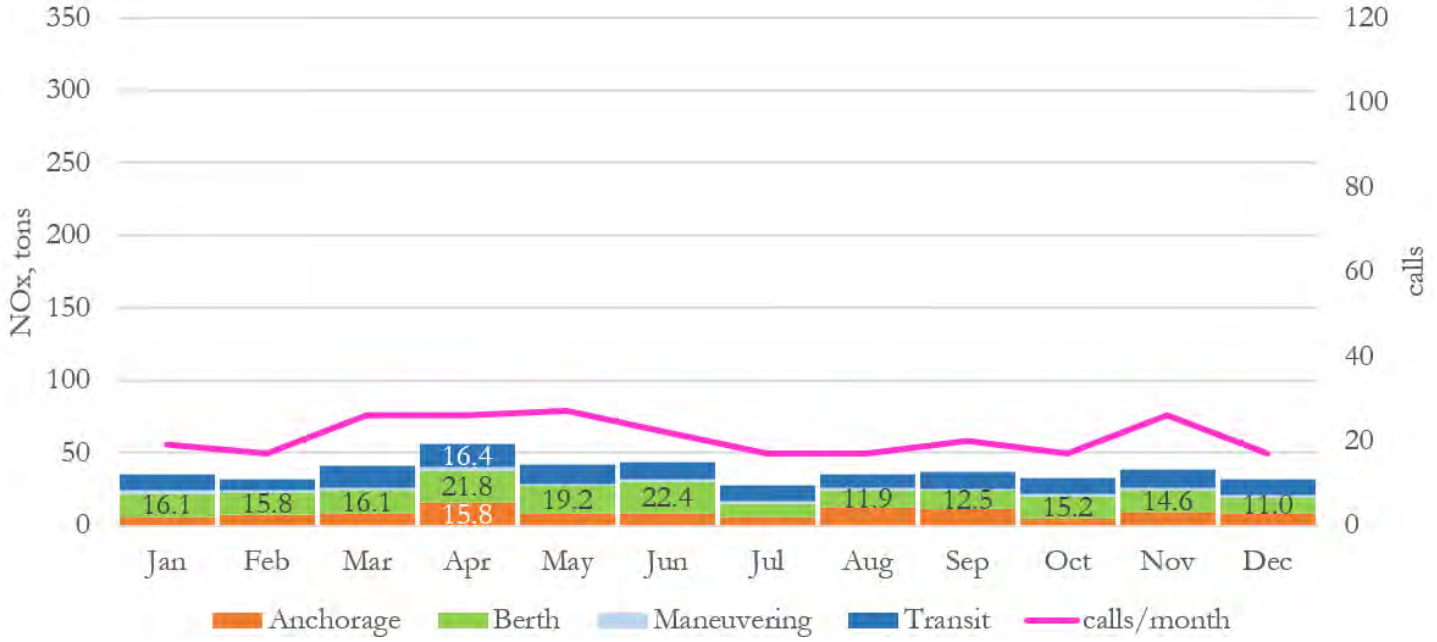
One of the key actions taken globally to prevent the spread of COVID-19 was 'lock downs' where people sheltered in their homes and apartments; travel in general was banned, which led to significant reductions in commuting as airlines were grounded, recreational activities stopped, and all forms of travel in general was curtailed or stopped. These lockdowns resulted in a sharp reduction in fuel/oil demand and by April 2020, prices inverted and went negative for the first time in history. The British Broadcasting Corporation (BBC) reported that this meant that oil producers were paying buyers to take their commodity off their hands because of fears that storage capacity would be reached in May 2020.

Read the article "US oil prices turn negative as demand dries up"
https://www.bbc.co.uk/news/business-52350082

As shown in the figures on the next page, 2019 tanker operations at POLA have anchorage NOx emissions across all months. Again, this is normal due to the tanker business model. In 2020, NOx emissions across all modes significantly decreased as demand for oil and fuel was impacted by lockdowns associated with the pandemic. POLA tanker calls in 2020 dropped by nearly 30% and cargo throughput was down by 23% compared to 2019 levels. The result was a reduction in all emissions across all modes for tankers compared to 2019. Tanker NOx emissions were down 33% compared to 2019 levels. These reductions in NOx and all emissions from tankers offset the increases in all emissions from cruise ships.

Tanker ***NOx emissions decreased by 33%*** in 2020 compared to 2019,
due to disruptions from the pandemic.

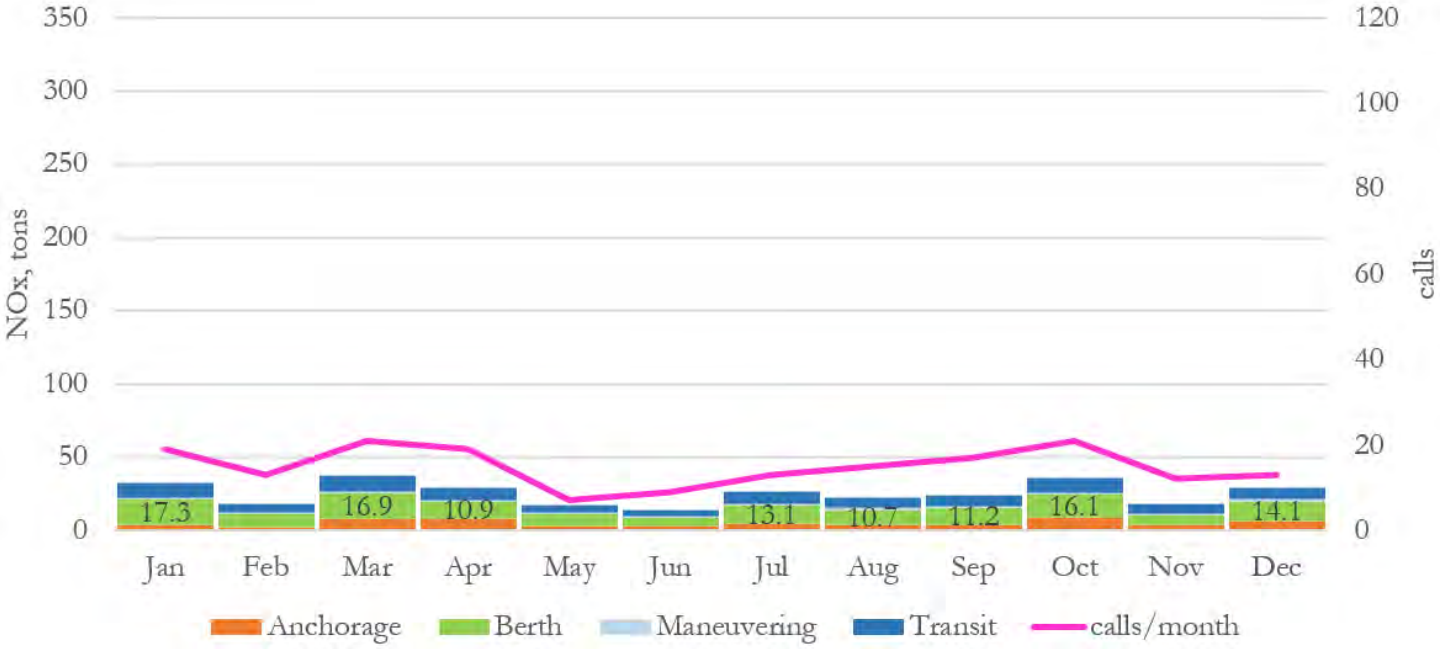
2019 Tanker Monthly NOx Emissions by Mode



These two graphs illustrate tanker monthly NOx emissions for 2019 and 2020. As seen above, the tanker or bulk liquid business model results in activities and emissions at the anchorages as these ships are typically not on liner services like container ships. Tankers typically emit less than 50 tons of NOx per month, which is one third that of container ships.

As seen below, tanker activity at POLA (and around the world) was impacted significantly from the global lockdowns associated with the pandemic. The result was a sharp fall in oil and fuel demand. In 2020, tanker calls at POLA dropped by nearly 30% and cargo throughput was down by 23% compared to 2019 levels. The result was a reduction in all emissions across all modes for tankers compared to 2019. Tanker NOx emissions were down 33% compared to 2019 levels. These reductions in NOx and across all emissions from tankers offset the increases in all emissions from cruise ships.

2020 Tanker Monthly NOx Emissions by Mode

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Looking Ahead

The COVID-19 pandemic is a once in a century tragic event that has completely disrupted all facets of life in the world, including trade, and it sets 2020-2021 apart from all previous years considered under the CAAP. In sharp contrast to the global recession in 2009, where trade significantly slowed leading up to the recession, the effects of the pandemic were abrupt and started in March and continue to change through 2021.

The conditions in 2021 form a 'perfect storm' of unprecedented supply chain disruptions and record cargo volumes. The immediate concern is the increased ship activities in the anchorages and specifically those of container ships. It is anticipated that the monthly emissions at anchorage will be significantly higher in 2021 compared to 2020 levels. Total port-related emissions are expected to increase across all pollutants and GHGs in 2021.

The disruptions across the goods movement supply chain are extremely complex and challenging, however the San Pedro Bay Ports are directly engaging supply chain stakeholders and the United States Department of Transportation to better understand these issues and develop measures to improve freight movement and reduce delays at the ports across all modes of cargo movement, including time at anchorage.

North America's leading seaport by container volume and cargo value, the Port of Los Angeles facilitated $259 billion in trade during 2020. San Pedro Bay port complex operations and commerce facilitate one in nine jobs across the counties of Los Angeles, Orange, Riverside, San Bernardino and Ventura. The Port of Los Angeles has remained open with all terminals operational throughout the COVID-19 pandemic.

For more information & the detailed technical report

https://www.portoflosangeles.org/environment/air-quality/air-emissions-inventory