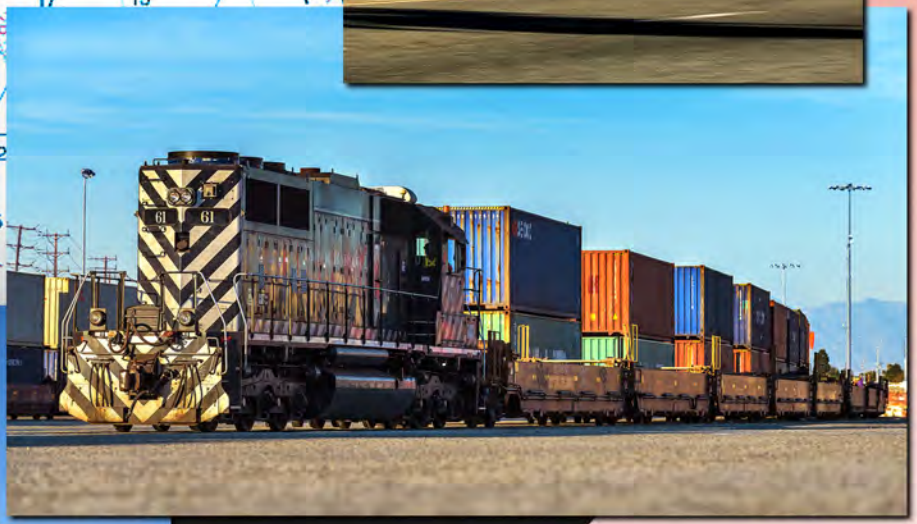
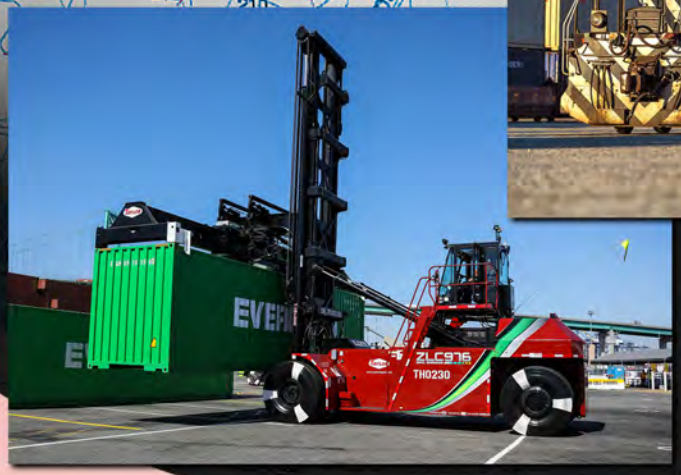
PORT OF LOS ANGELES
EMISSIONS INVENTORY HIGHLIGHTS - 2019

THE PORT
OF LOS ANGELES





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STARCREST CONSULTING GROUP, LLC

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 2019 inventory findings, trends in emissions and cargo since 2005, CAAP measure progress, and upcoming highlights for 2020 and beyond. This document does not replace the detailed annual emissions reports; it draws information from these documents and reports progress in the context of the CAAP goals in a reader-friendly format.

portoflosangeles.org/environment/studies_reports.asp

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Photos by Port of Los Angeles

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

The world's first zero-emissions top handlers, unveiled in fall 2019 as part of a pre-commercial demonstration project at the Port of Los Angeles, are now being used in daily operations at the Everport Container Terminal.

"We are pleased with performance results that we are receiving from drivers, mechanics and Everport management as the equipment is tested daily in real-world conditions," said Port of Los Angeles Executive Director Gene Seroka. "We are doing everything possible to advance commercially feasible solutions to meet our goal of transitioning all cargo-handling equipment to zero emissions by 2030."

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 coordination with our 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.

The challenges of the CAAP are not only reaching the most aggressive reduction targets of any port, but maintaining the standards while the Port continues to grow. POLA is leading with solutions and investing today in technologies that will ensure that growth can be accomplished without significant impact on the surrounding communities and environment.

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** are:

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

As identified in the San Pedro Bay Ports Clean Air Action Plan (CAAP), 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 GOALS

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

OVERALL REDUCTIONS

Pollutant	%	tons
DPM	87%	767
$PM_{2.5}$	86%	702
PM_{10}	87%	821
NO_x	62%	10,034
SO_x	98%	4,874
Health Risk	*%*	
(DPM used as a surrogate for health risk)	*87%*	

EMISSIONS PER 10,000 TEU HANDLED REDUCTIONS

Pollutant	%	tons
DPM	89%	1.06
$PM_{2.5}$	88%	0.97
PM_{10}	89%	1.13
NO_x	69%	15.04
SO_x	98%	6.54

OCEAN-GOING VESSEL EMISSIONS REDUCTIONS

Pollutant	%	tons
DPM	91%	425
$PM_{2.5}$	88%	379
PM_{10}	90%	480
NO_x	48%	2,552
SO_x	98%	4,723

HEAVY-DUTY VEHICLE/CLEAN TRUCK EMISSIONS REDUCTIONS

Pollutant	%	tons
DPM	97%	239
$PM_{2.5}$	96%	229
PM_{10}	96%	239
NO_x	78%	4,925
SO_x	92%	41

HARBOR CRAFT EMISSIONS REDUCTIONS

Pollutant	%	tons
DPM	54%	29
$PM_{2.5}$	54%	27
PM_{10}	54%	29
NO_x	43%	563
SO_x	89%	5

RAIL EMISSIONS REDUCTIONS

Pollutant	%	tons
DPM	44%	25
$PM_{2.5}$	45%	24
PM_{10}	44%	25
NO_x	48%	830
SO_x	99%	97

CARGO-HANDLING EQUIPMENT EMISSIONS REDUCTIONS

Pollutant	%	tons
DPM	91%	48
$PM_{2.5}$	87%	44
PM_{10}	88%	47
NO_x	74%	1,163
SO_x	80%	7

CO_2 EQUIVALENT CHANGES BY SOURCE TYPE

Source Type	%	tonnes
Ocean-Going Vessels	▼33%	▼96,004
Harbor Craft	▲7%	▲3,959
Cargo-Handling Equipment	▼32%	▼42,643
Rail	▼13%	▼10,837
Heavy-Duty Vehicles	▼20%	▼96,862
TOTAL	▼15%	▼157,102

▼ = 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_{2e} = Carbon Dioxide Equivalent (describes greenhouse gases in a single number)

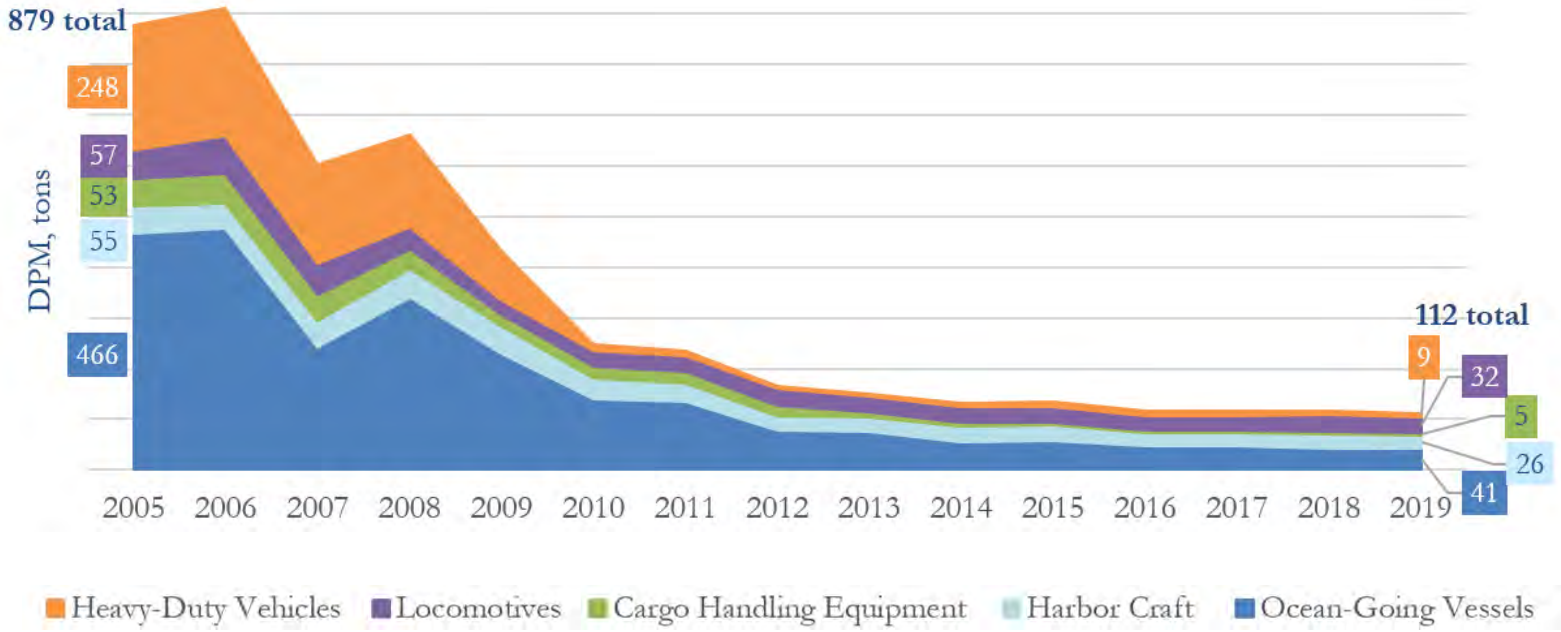
portofla.org/emissions-inventory

2020-0443

2005-2019 Emission Inventory Trends

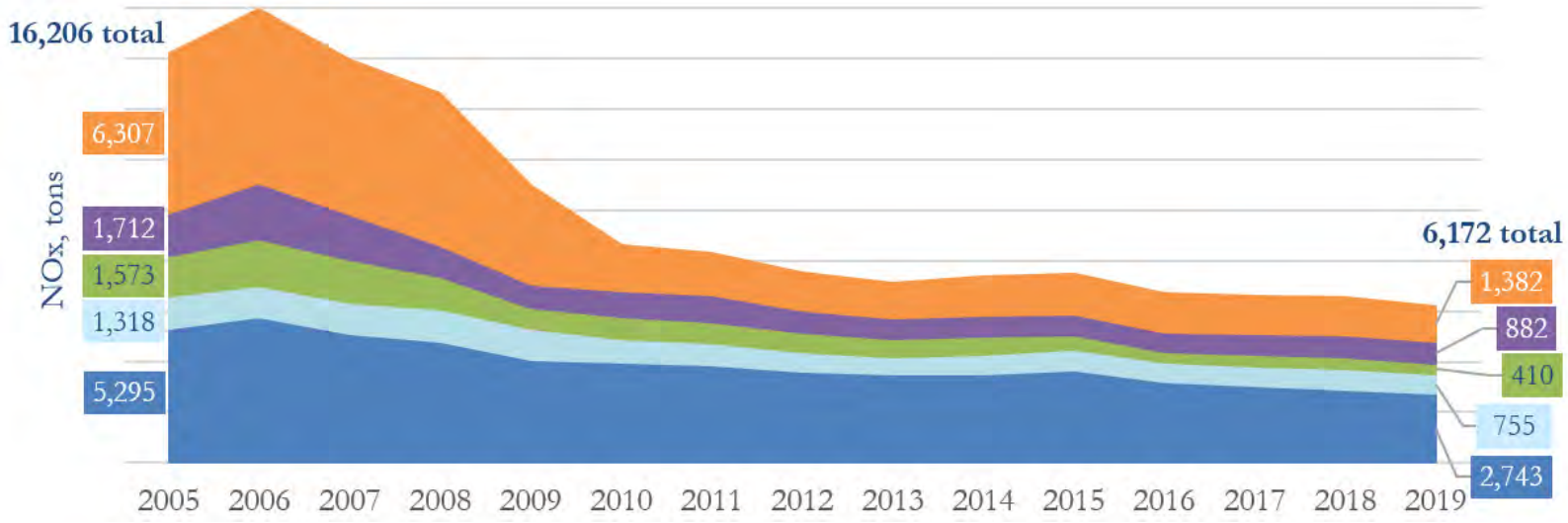
The POLA emissions inventory and CAAP focus on the reduction of DPM, NOx, and SOx as well as GHGs, reported in carbon dioxide equivalents (CO_2e). One of the primary focuses of the CAAP has been the continued reduction in the emissions from each source category in the face of growing cargo throughput. The following figures illustrate the changes in port-related emissions contribution by source category between 2005 and 2019.

DPM Emissions Contributions by Source Category



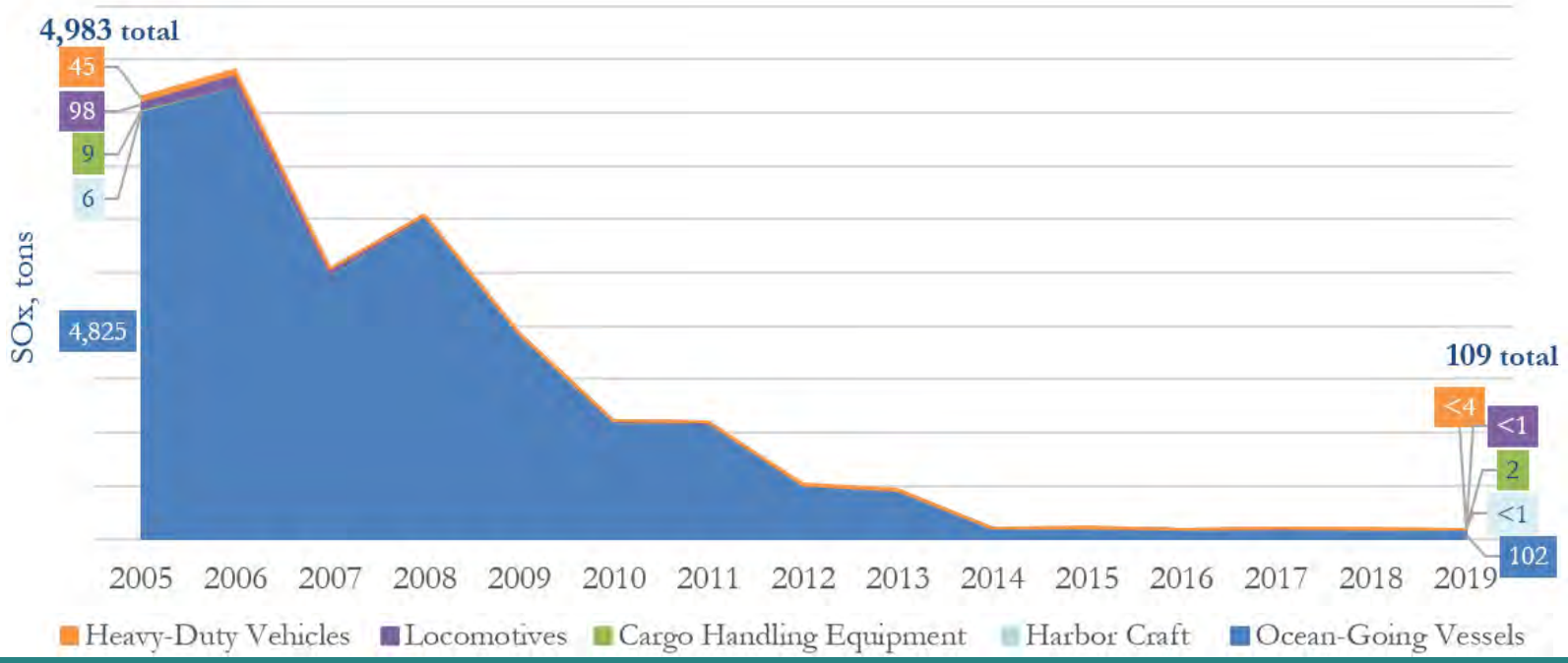
In 2005, DPM emissions were dominated by ships and trucks making up 714 tons or 81%, with cargo handling equipment, locomotives, and harbor craft making up 165 tons or 19%. In 2019, together rail and harbor craft emitted ***more*** DPM than ships. CHE and truck DPM contributions are ***nearly eliminated***. 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. While NOx has been reduced from 2005 at 16,206 tons to 2019 at 6,172 tons or 62%, the recent CAAP update highlights new strategies to target further reductions in NOx. Reductions from existing regulations are continuing to have strong positive impacts, such as the recent and significant reductions seen in CHE where NOx emissions have been cut by 40% between 2014 and 2019.

NOx Emissions Contributions by Source Category



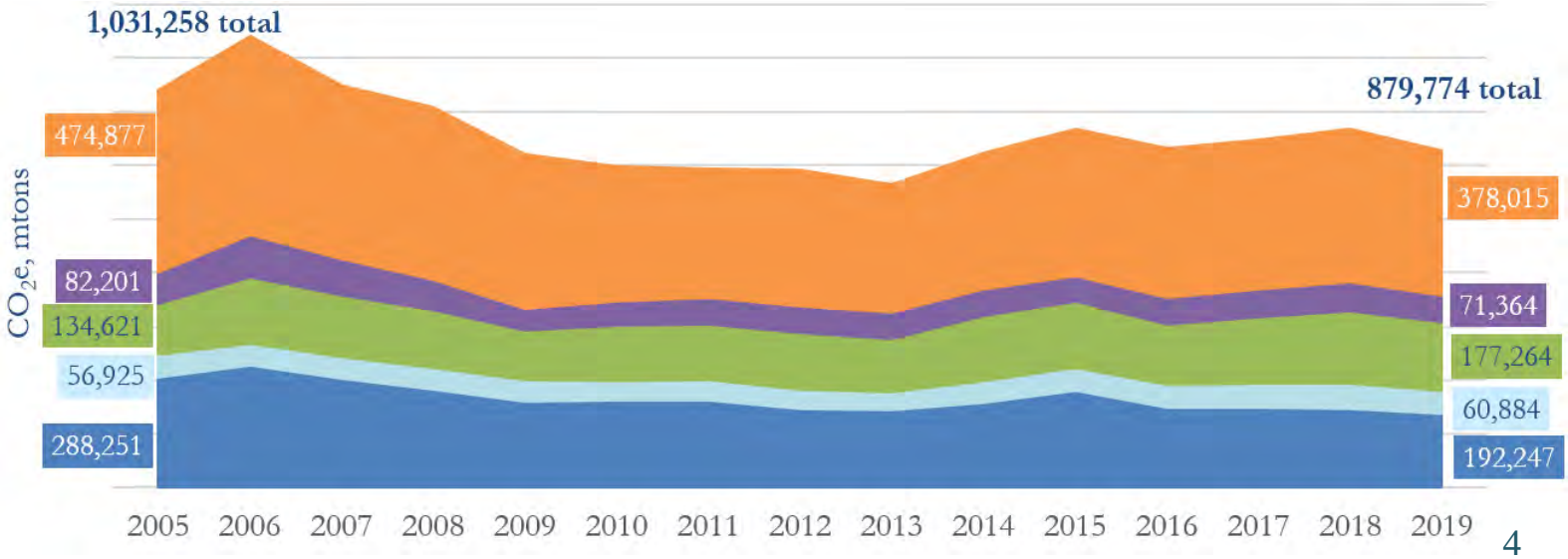
Total emissions for DPM, NOx, and SOx and emissions by source category are presented in the figures in tons. GHGs are reported in metric tons (mtons). Additional pollutants are included in the more detailed technical reports located at: *https://www.portoflosangeles.org/environment/air-quality/air-emissions-inventory*.

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%. GHG emissions decreased 6% from 2018 levels due to reduced activity at the anchorages and increased use of shore power. Trucks continue to be the dominant source of GHG emissions with ships and cargo handling equipment coming in second and third. Highlighted reductions in CO_2e, since 2005, include 33% for ships, 19% for trucks, and 13% for locomotives. Cargo handling equipment and harbor craft GHG emissions have increased over that time at 32% and 7%, respectively.

CO_2e Emissions Contributions by Source Category



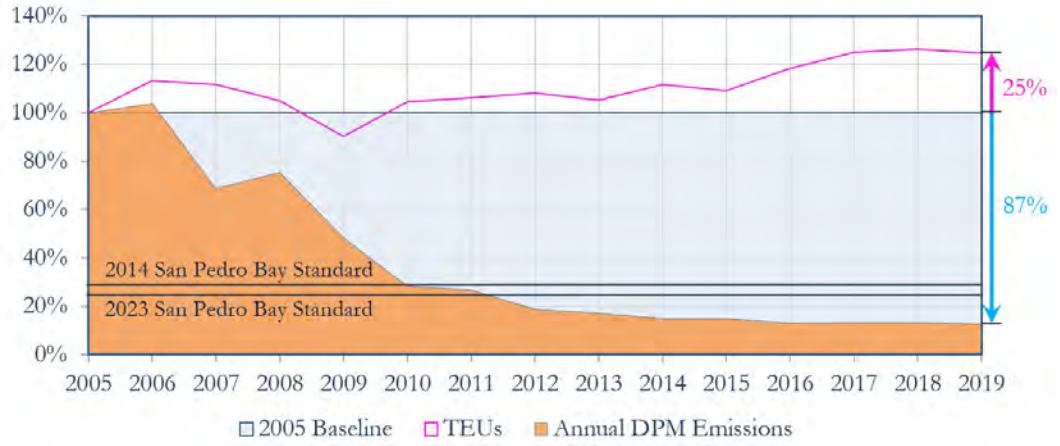
2005 & 2019 Regional Emission Contributions

Illustrated below are the 2005 and 2019 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 79%, NOx reduced by 64%, and SOx reduced by 73%. When considering POLA-related contributions to the basin, DPM emissions have reduced by 57%, NOx emissions have slightly decreased, and SOx emissions have reduced by 92%, since 2005. POLA-related contribution to basin-wide $PM_{2.5}$ and PM_{10} emissions are 0.5% and 0.2%, respectively.

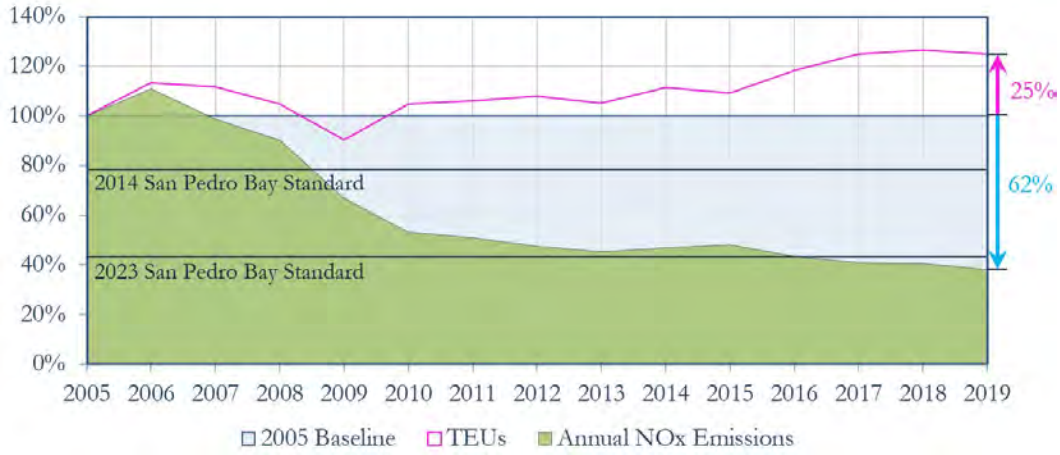
2005-2019 CAAP Progress

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).



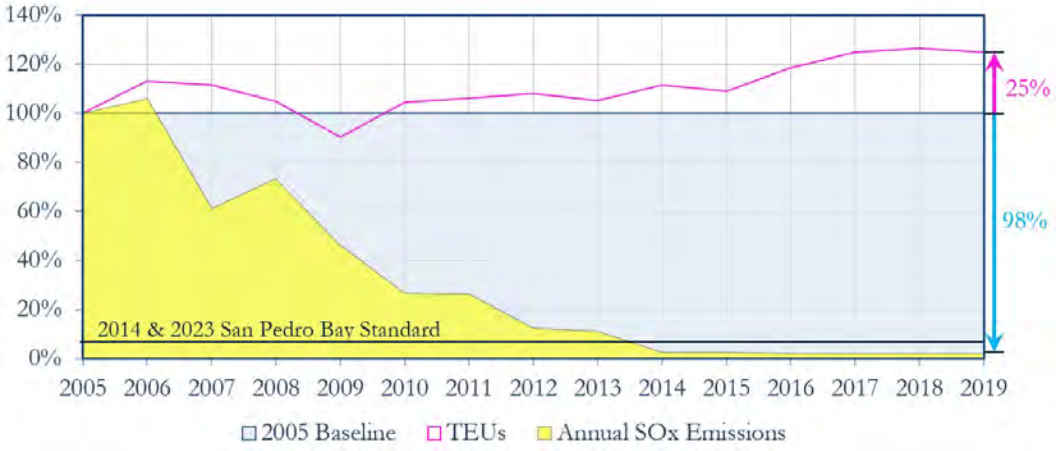
Port DPM Emissions

In 2019, emissions have reduced 87% while cargo increased 25%, compared to 2005 levels.



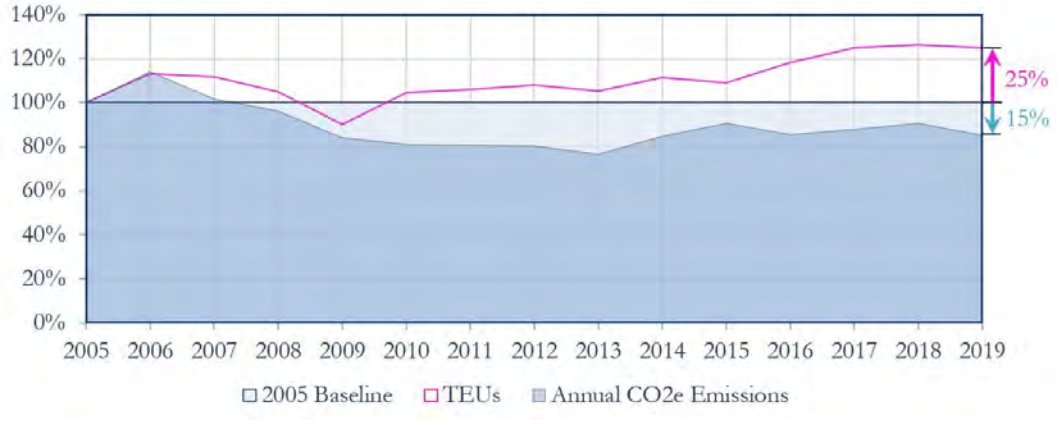
Port NOx Emissions

In 2019, emissions have reduced 62% while cargo increased 25%, compared to 2005 levels.



Port SOx Emissions

In 2019, emissions have reduced 98% while cargo increased 25%, compared to 2005 levels.



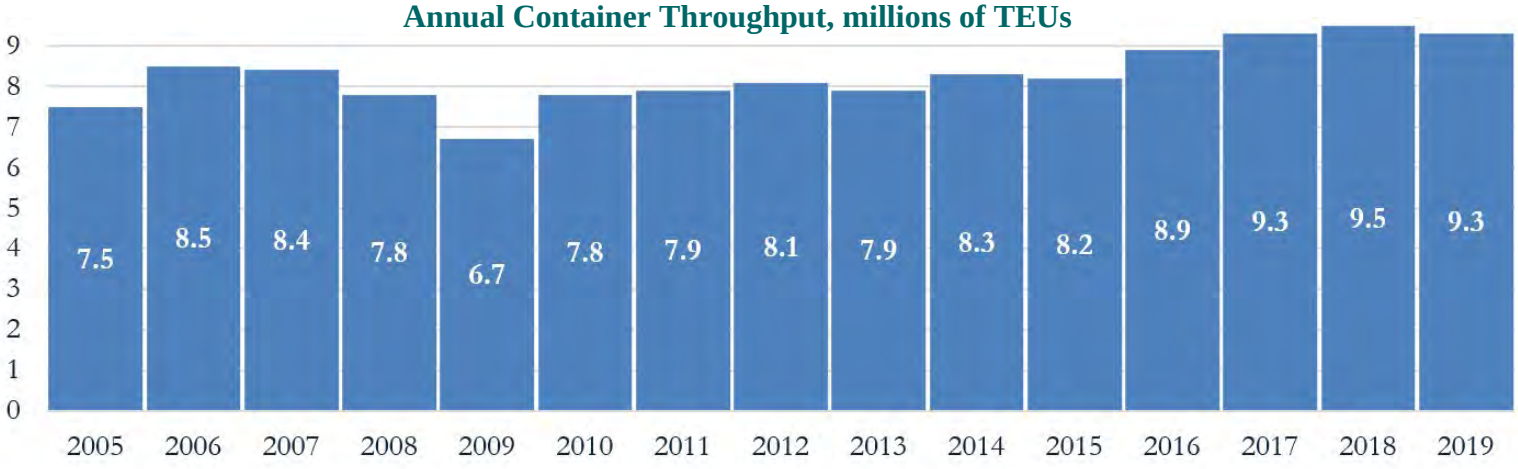
Port CO_2e Emissions

In 2019, emissions have reduced by 15% while cargo increased 25% compared to 2005 levels.

2005-2019 Cargo Growth

Cargo growth from 2005 to 2019 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 2019 in millions of TEUs. Note that in 1990, POLA moved 2.1 million TEUs, which is the baseline year for CAAP GHG goals.

Annual Container Throughput, millions of TEUs



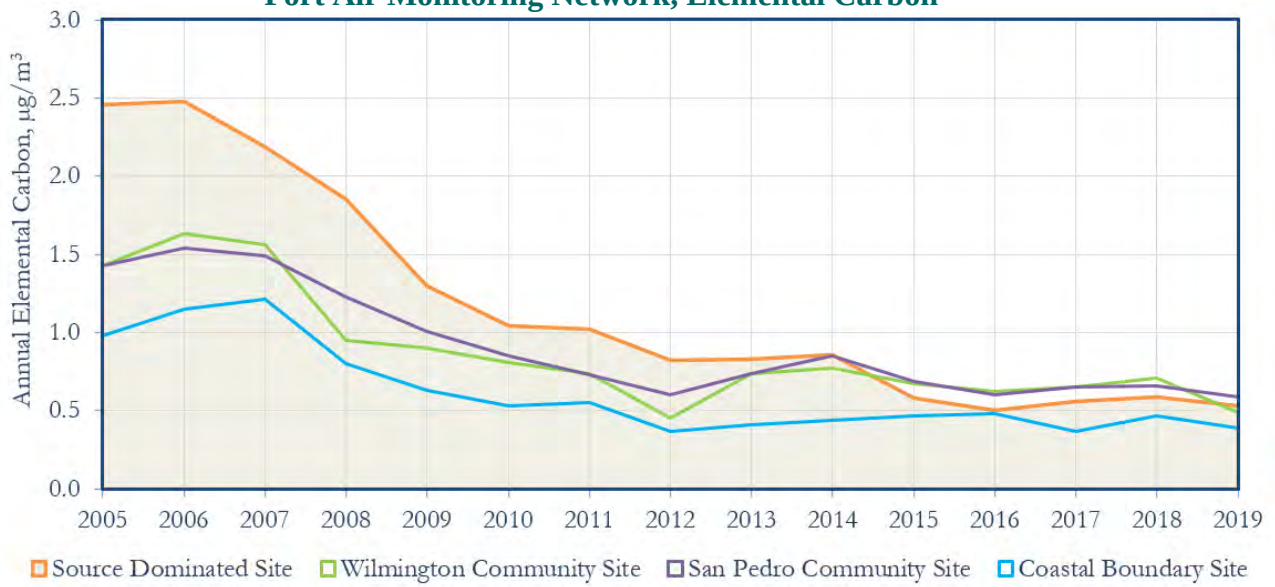
2005-2019 Air Monitoring

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 59-79%, which trends similarly with the DPM emissions inventory trends over the same period.

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. Starting in 2013, events held in the vicinity of the Coastal Boundary site and limited cruise vessel berthing's are most likely responsible for the slight increase in elemental carbon caught by that sampler. For more information, visit:

monitoring.cleanairactionplan.org

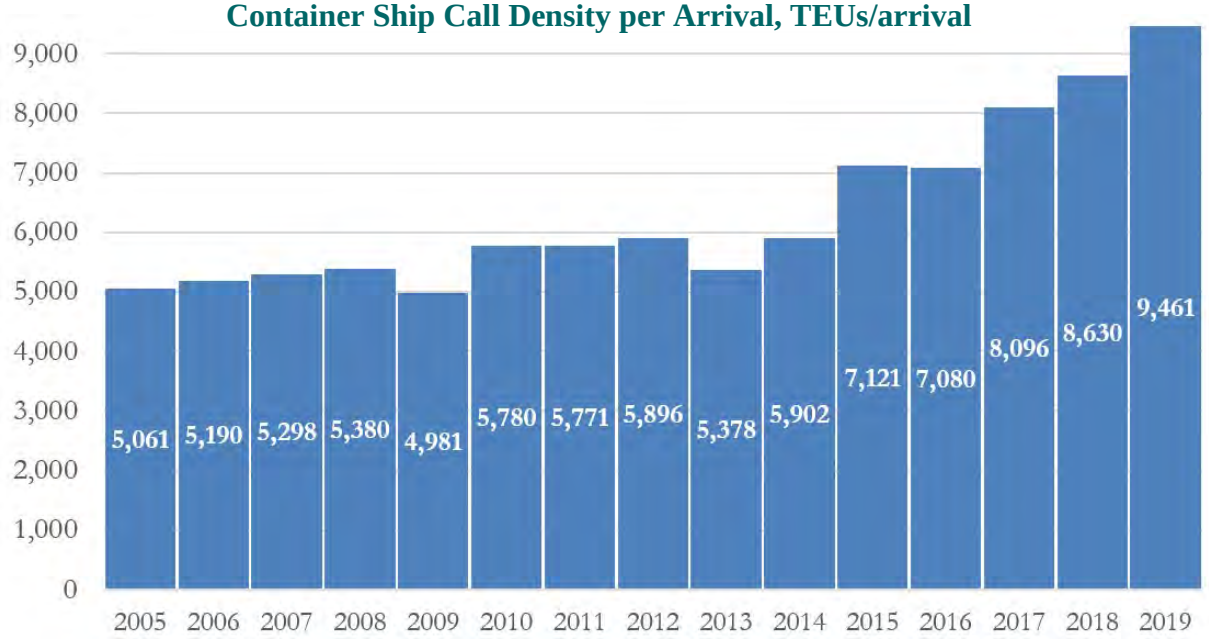
Port Air Monitoring Network, Elemental Carbon



2005-2019 Port-Related Efficiency Trends

Port-related efficiency improvements significantly contribute to port-related emissions trends. 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 87% (nearly doubling) more cargo per arrival in 2019, compared to 2005. Non-container ship arrivals increased 9% from 2018, however are still 32% below 2005 arrival levels.

Container Ship Call Density per Arrival, TEUs/arrival



Container ship call density, measured in TEUs per container ship arrival, has significantly increased since 2013. This represents a significant change in the container ship fleet calling POLA as fewer, larger ships are able to call. The investments in larger ships by the shipping lines, investments in port infrastructure improvements by the Port, and investments by the terminals in newer more efficient terminal operations over the past two decades, enabled the transition in overall fleet size and the efficiency improvements that have led to lower emissions. There were 33% fewer container ship calls in 2019 moving 25% more TEUs, compared to 2005. If these improvements had not been accomplished, there would have been an additional 1,500+ container ship calls in 2019 and emissions would have been significantly higher. POLA has spent ~$300 million since 2007 to become the cleanest port in the world.

Container & Non-Container Ship Arrivals

San Pedro Bay Ports Technology Advancement Program

Although significant emissions reductions have been achieved under the San Pedro Bay Ports Clean Air Action Plan (CAAP), the Port of Los Angeles and Port of Long Beach (San Pedro Bay Ports) continue to place great emphasis on green development, including a particular focus on zero emissions technologies. Fostering the development of zero emissions technologies is a key component of the Ports' plans to achieve their voluntary air quality goals that will also help to greatly reduce regional greenhouse gas emissions.

The San Pedro Bay Ports have taken a proactive role in providing funds for various proposed emission-reduction projects through the Technology Advancement Program (TAP), established by the CAAP in 2006. The Ports' TAP, the oldest continuous running and highest funded port-led program, functions to accelerate the verification or commercial availability of clean technologies in the port market through evaluation and demonstration with the goal of reducing emissions. To encourage the deployment and commercialization of zero emissions technology, the Ports have partnered with various stakeholders including agencies, original equipment manufacturers, and equipment owners/operators on zero emissions demonstration projects.

Since 2007, through TAP projects, grant-funded demonstrations, and cost-sharing partnerships with other agencies to the levels below:

- $49+ million of Port investment
- $359+ million partner investment
- $408+ million total investment

Adoption of the 2017 CAAP Update represented a huge leap forward for the Ports. The plan sets ambitious goals to transform the truck fleet to zero emissions by 2035 and the terminal equipment to zero emissions by 2030, as well as interim targets for near-zero emissions deployment if no feasible zero-emissions technologies exist. The ports are an excellent testing ground for zero emissions equipment. Equipment used at the ports work long hours under harsh conditions. Zero emissions equipment that can be successfully demonstrated under port conditions are likely to have greater success in other industries.

Since its inception, the TAP has completed ***28 projects,*** of which

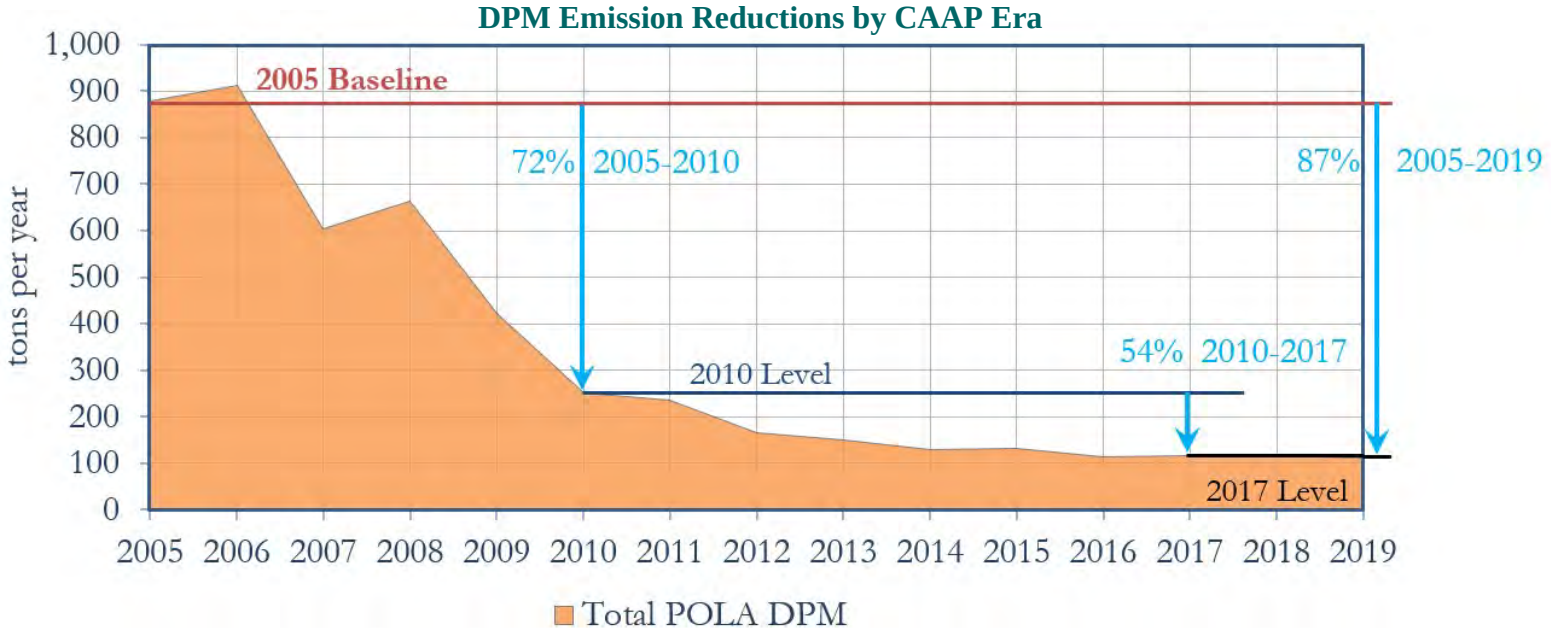
5 OGV projects	1 HC project	11 CHE projects
1 rail project	10 truck projects	

Currently, the ***Port of Los Angeles is leading or participating in 16 regional projects*** with multiple partners to demonstrate near-zero and zero emissions engines and associated fueling or charging infrastructure. The ***projects at Port of Los Angeles include testing*** 12 zero emissions Class 8 trucks: two battery-electric and 10 hydrogen fuel cell models; and 49 near-zero and zero emissions pieces of cargo handling equipment: 22 electric yard tractors, five zero emissions forklifts, two electric top handlers, and 20 renewable natural gas yard tractors.

https://cleanairactionplan.org/technology-advancement-program/

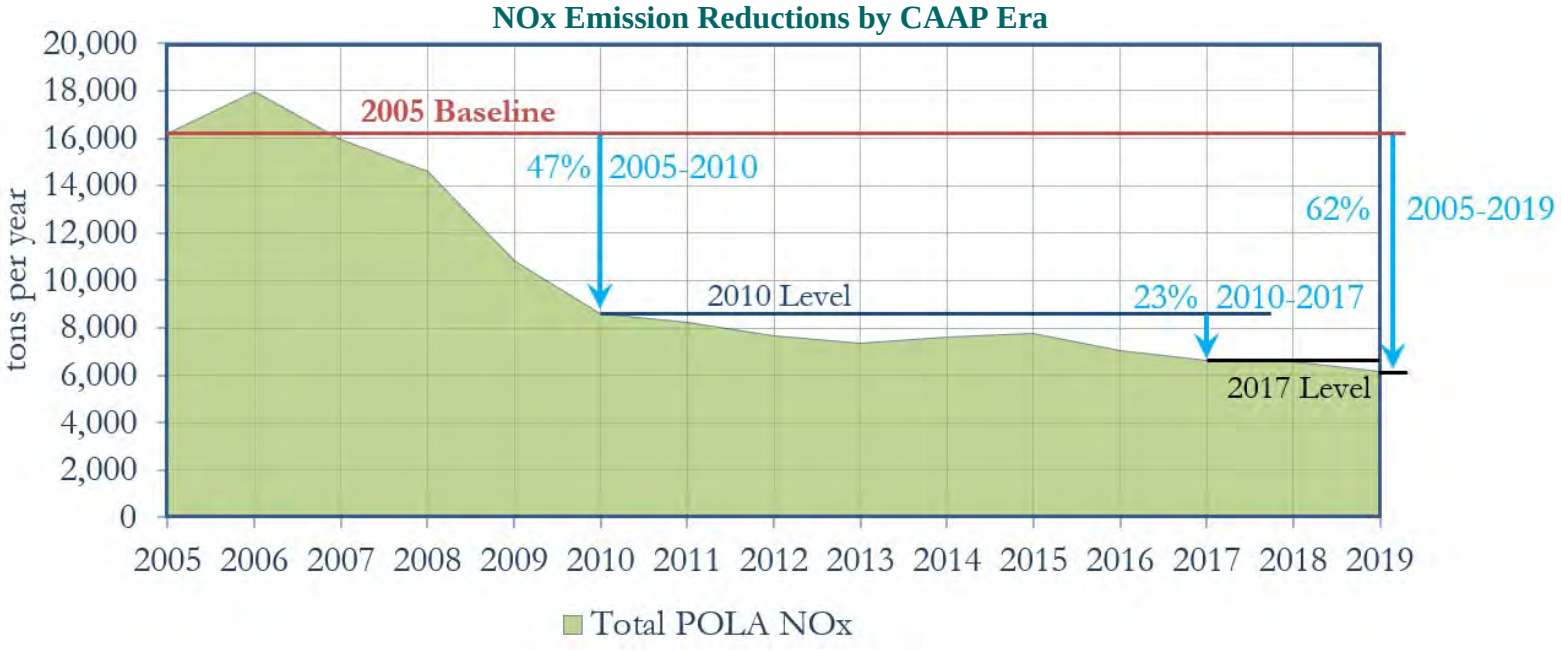
Reductions by CAAP Era

Emission reductions associated since CAAP (2005-2010), 2010 Update (2010-2017), and 2017 Update.



It is a natural evolution that reducing emissions becomes more challenging and costly overtime. Early stages are typically associated with significant emission reductions because fleets are at their direst and the most cost-effective solutions can be applied. As fleets clean up, reductions become more challenging, complex, and costly. Making things more complex, DPM is relatively easy to reduce compared to NOx due to the options available.

Looking at emission reductions over the history of the CAAP and its updates, we can see that from 2005-2010, DPM was reduced 72% and NOx was reduced by 47%. From 2010 to 2017, DPM was reduced a further 54% and NOx was reduced a further 23%. These are still significant reduction levels which came at a much higher cost than the reductions achieved.

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Looking Ahead

The COVID-19 pandemic is a once in a century tragic event that has completely disrupted everything in the world, including trade, and it sets 2020 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 when the first disruptions appeared.

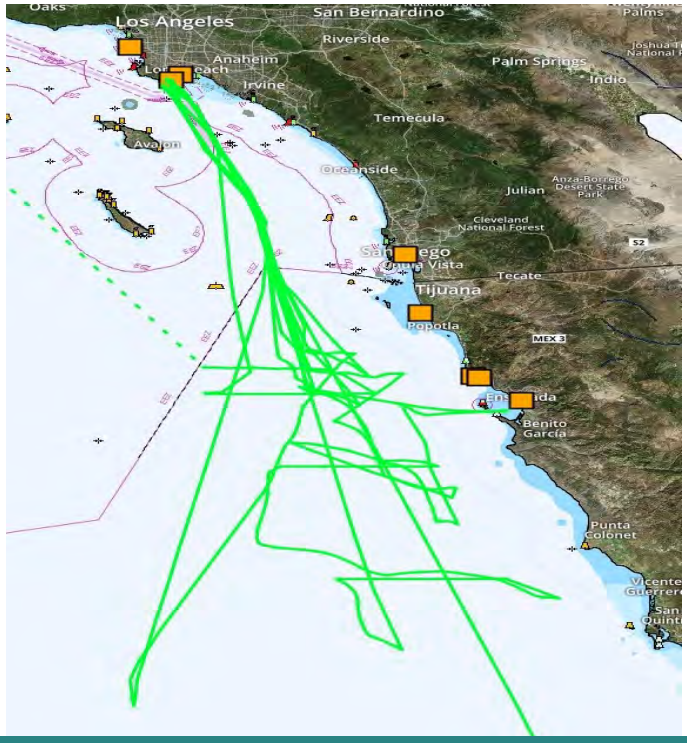
The pandemic's impacts on international shipping were acute. In the first six months of 2020, ship calls were down by over 142 arrivals or 16% compared to 2019 and cruise ship activity spiked in April and then dropped off. POLA tanker activity is significantly down compared to 2019, while transient tanker activity calling the anchorages (not calling either POLA or POLB) spiked in April and continues at high levels.

One of the most pressing impacts was on the global cruise industry, where cruise ship companies and crews were suddenly faced with having to find a port to discharge passengers as countries, including the United States, started to prohibit ships berthing at their ports.

It is important to note that cruise ships typically never call the anchorages, but rather go to either POLA or POLB. In April, an unprecedented level of activity hit both POLA and the anchorages in the San Pedro Bay – this has never happened during the emission inventory era.

Company and crews scrambled to find locations to discharge passengers, get supplies for the ship and the crews, and hold position while their companies determined the extent of the impacts, and ultimately where to park their ships to wait the pandemic out.

Several of the cruise ships that called San Pedro Bay in April were neither home ported nor planned to even visit the area. Some stayed in the anchorages, while others would call POLA to resupply then move south to Mexican waters and sit until needing resupply and then either call POLA or go to a Mexican port.



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.

Another unique event happened in 2020; the Governor of California issued two Executive Orders (EO) due to extreme heat events that allowed ships to not plug into the grid, which was struggling to meet demand. The two EOs declared that vessels initially berthed between 17-24 August and 4-11 September were no longer required to use shore power until 24 August and 11 September, respectively. The results were that 4 container ships in August cancelled their Alternative Maritime Power (AMP) and another 7 container ships cancelled in September, for a total of 11 cancellations.

The Port of Los Angeles is America's premier port and has a strong commitment to developing innovatively strategic and sustainable operations that benefit Southern California's economy and quality of life. North America's leading seaport by container volume and cargo value, the Port of Los Angeles facilitated $276 billion in trade during 2019. San Pedro Bay port complex operations and commerce facilitate one in nine jobs in the five-county Southern California region.

For more information & the detailed technical report

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