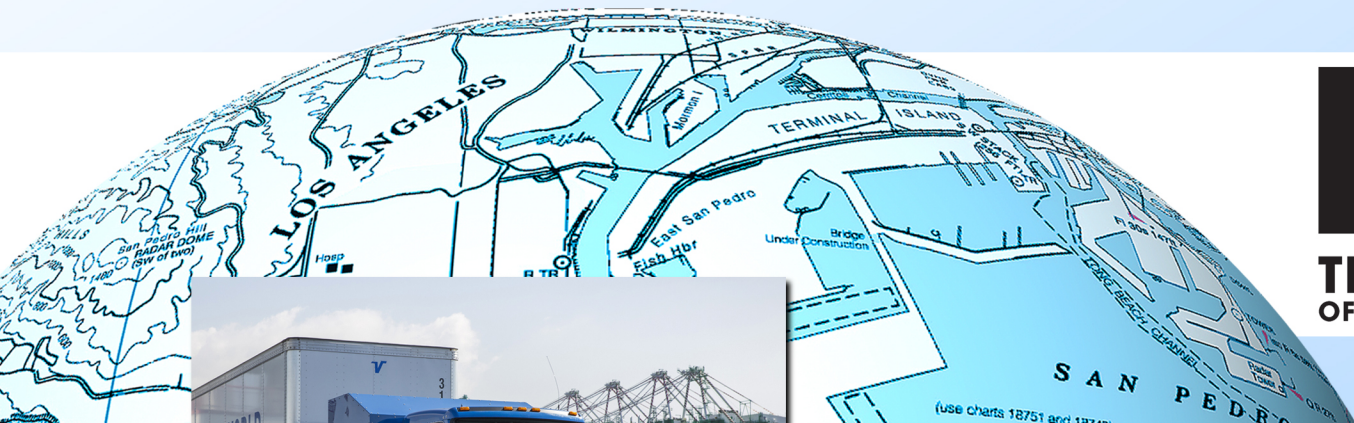


PORT OF LOS ANGELES EMISSIONS INVENTORY HIGHLIGHTS - 2016



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 2016 inventory findings, trends in emissions and cargo since 2005, CAAP

measure progress, and upcoming highlights for 2017 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.



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), and sulfur oxides (SOx).

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 Update, and the current update which is under development.

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 standards 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 standards are compared to 2005 baseline levels.



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 standards 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.

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

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

In addition, the CAAP sets out various measures for ocean-going vessels (OGV), harbor craft, 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

The CAAP continues to undergo its second update process that started in 2016. For this update stakeholder involvement has been significantly increased. In addition to DPM, NOx, and SOx, this update will incorporate greenhouse gases more prominently. For more information and to get involved, visit: www.cleanairactionplan.org/2017-clean-air-action-plan-update/

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 portoflosangeles.org/environment/studies_reports.asp

2016 AIR QUALITY REPORT CARD

COMPARED TO 2005



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 Standard for DPM, NO_x, and SO_x have target years of 2014 and 2023 to support state ambient air quality goals.
- Health Risk Reduction Standard has a target year of 2020 to align with California Air Resources Board's Goods Movement Emission Reduction Plan.



Clean Air Action Plan (CAAP) Goals (% reduction compared to 2005)	2014	2023
DPM	72%	77%
NO _x	22%	59%
SO _x	93%	93%
Health Risk Reduction Standard	2020	85%
<i>(% reduction in residential cancer risk compared to 2005)</i>		

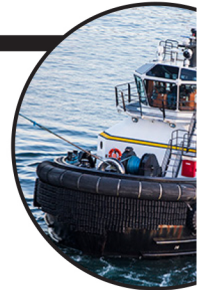


HEAVY-DUTY VEHICLE/CLEAN TRUCK EMISSIONS REDUCTIONS

Pollutant	CY 2005-2016	
	%	tons
DPM	97%	241
PM _{2.5}	97%	230
PM ₁₀	97%	240
NO _x	71%	4,450
SO _x	90%	41

HARBOR CRAFT EMISSIONS REDUCTIONS

Pollutant	CY 2005-2016	
	%	tons
DPM	52%	29
PM _{2.5}	52%	26
PM ₁₀	52%	29
NO _x	43%	568
SO _x	89%	6



OVERALL EMISSIONS REDUCTIONS CY 2005-2016

Pollutant	CY 2005-2016	
	%	tons
DPM	87%	765
PM _{2.5}	85%	699
PM ₁₀	86%	818
NO _x	57%	9,183
SO _x	98%	4,869



RAIL EMISSIONS REDUCTIONS

Pollutant	CY 2005-2016	
	%	tons
DPM	50%	28
PM _{2.5}	49%	26
PM ₁₀	50%	28
NO _x	54%	932
SO _x	99%	97

EMISSIONS PER 10,000 TEU HANDLED REDUCTIONS

Pollutant	CY 2005-2016	
	%	tons
DPM	89%	1.05
PM _{2.5}	88%	0.96
PM ₁₀	88%	1.12
NO _x	63%	13.72
SO _x	98%	6.53



CARGO HANDLING EQUIPMENT EMISSIONS REDUCTION

Pollutant	CY 2005-2016	
	%	tons
DPM	91%	48
PM _{2.5}	88%	43
PM ₁₀	88%	47
NO _x	72%	1,139
SO _x	82%	8



OCEAN-GOING VESSEL EMISSIONS REDUCTIONS

Pollutant	CY 2005-2016	
	%	tons
DPM	90%	419
PM _{2.5}	87%	373
PM ₁₀	89%	474
NO _x	40%	2,095
SO _x	98%	4,718



CO2 EQUIVALENT EMISSIONS BY SOURCE TYPE

Source Type	CY 2005-2016	
	%	tons
Ocean-Going Vessels	28%	80,559
Harbor Craft	-2%	-1,423
Cargo Handling Equipment	-19%	-25,038
Rail	18%	14,814
Heavy-Duty Vehicles	17%	80,849
TOTAL	15%	149,761

PRIMARY POLLUTANTS DEFINED:
DPM = Diesel Particulate Matter
NO_x = Oxides of Nitrogen

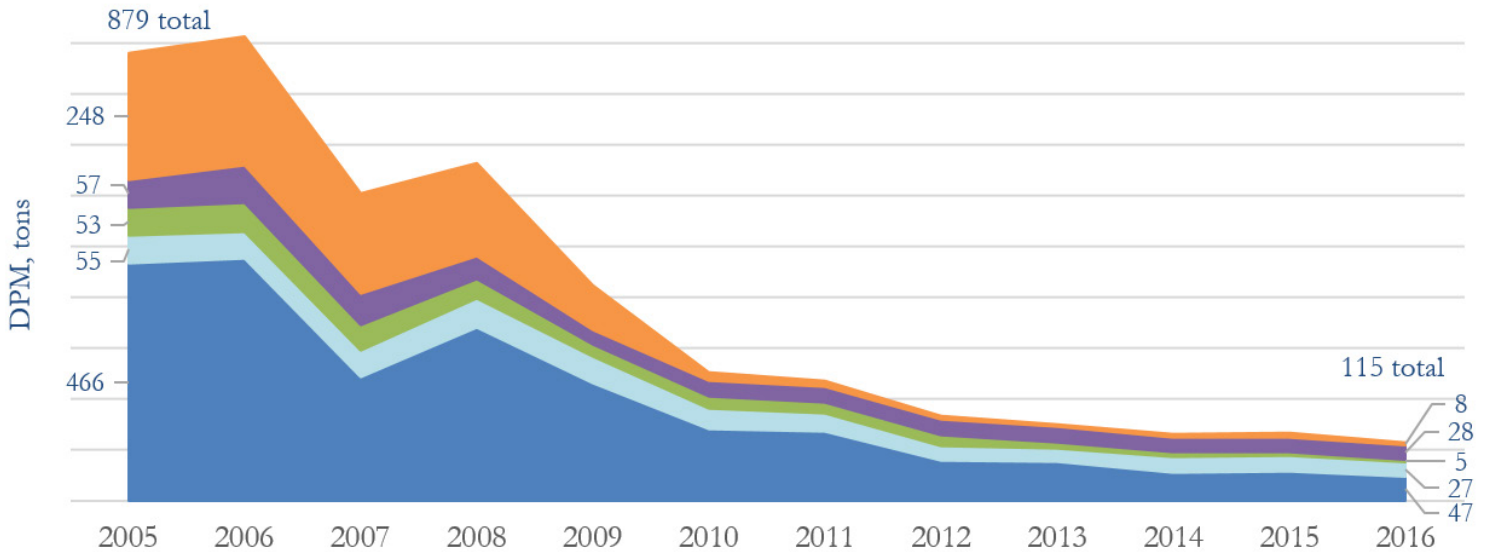
SO_x = Oxides of Sulfur
PM_{2.5} = Particulate Matter less than 2.5 microns in diameter
PM₁₀ = Particulate Matter less than 10 microns in diameter

CO₂ = Carbon Dioxide
(A Green House Gas contributor)

2005-2016 EMISSIONS INVENTORY TRENDS

The POLA emissions inventory and CAAP focus on the reduction of DPM, NOx, and SOx as well as greenhouse gas emissions. One the primary focuses of the CAAP has been the continued reduction in the emissions from ships, trucks, and CHE due to each source category's relative contribution to across pollutant and greenhouse gas emissions. The following figures illustrate the changes in port-related emissions contribution by source category between 2005 and 2016.

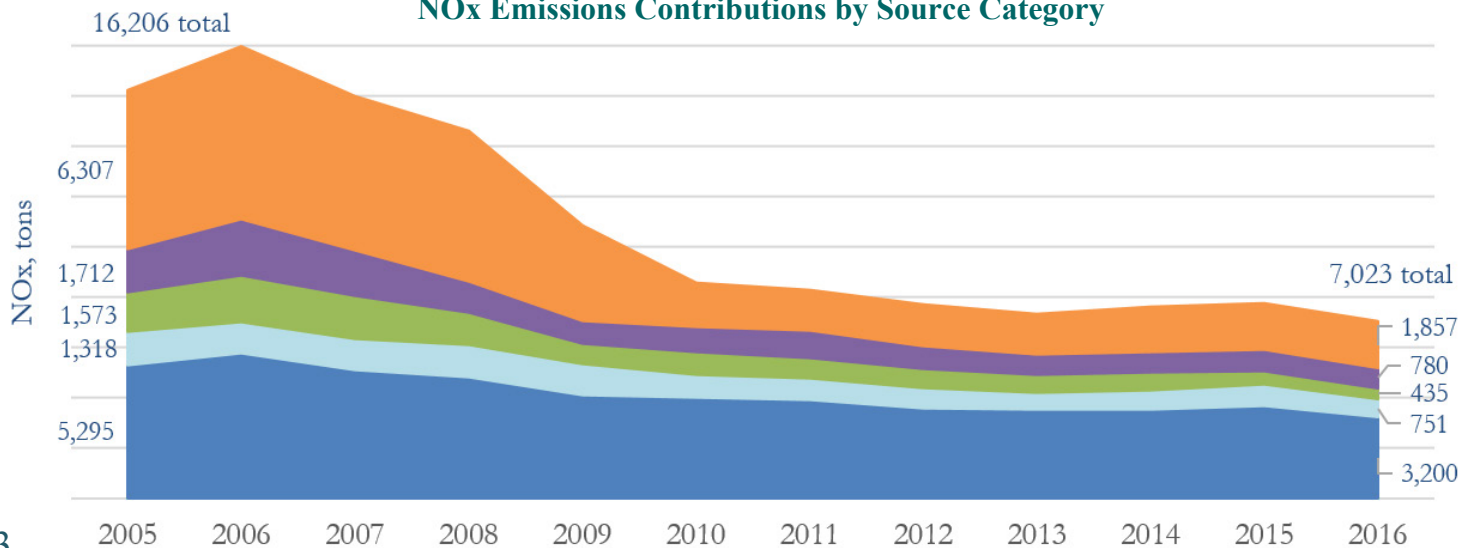
DPM Emissions Contributions by Source Category



■ Heavy-Duty Vehicles
 ■ Locomotives
 ■ Cargo Handling Equipment
 ■ Harbor Craft
 ■ Ocean-Going Vessels

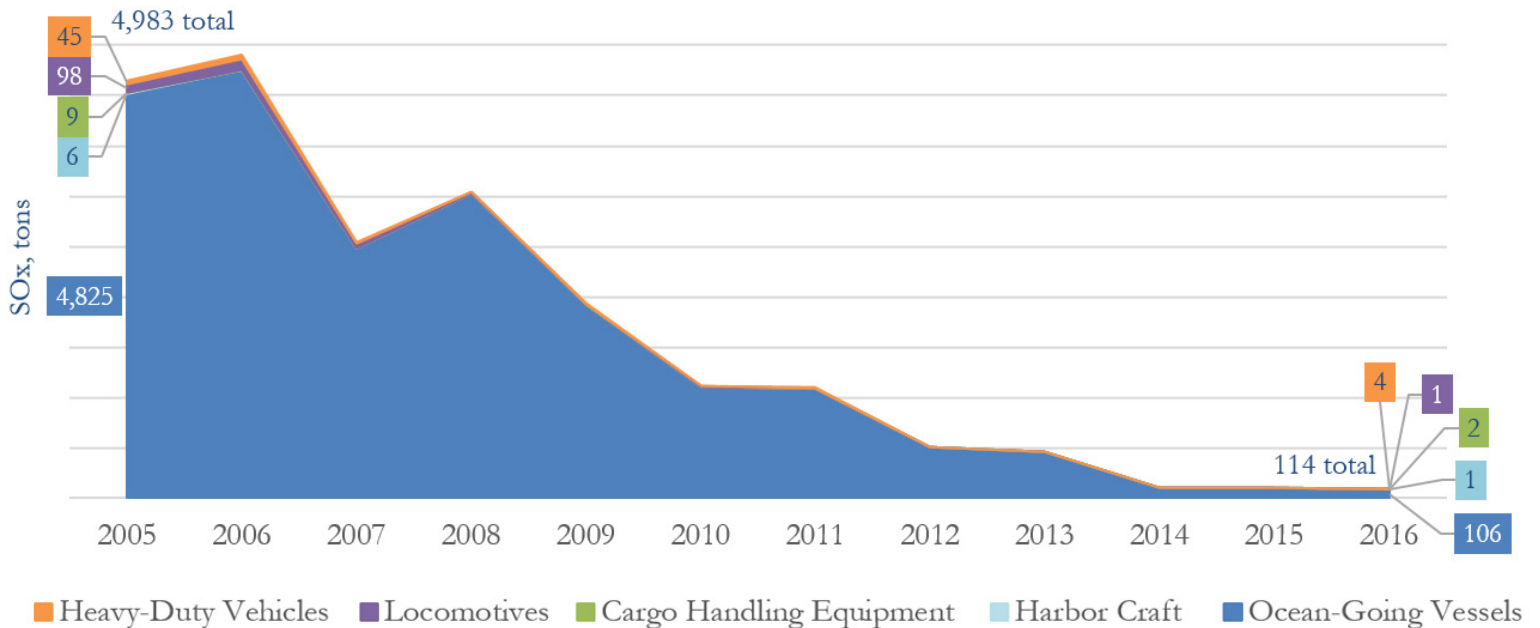
In 2005, DPM emissions were dominated by ships and trucks making up 714 tons or 81%, with cargo handling equipment, locomotives, and harbor craft making up 165 tons or 19%. In 2016, rail and harbor craft emit *more* DPM than ships!! CHE and truck DPM contributions are *nearly eliminated*. These reductions 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 to 2016 at 7,023 tons or 57%, the new 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 36% between 2014 and 2016!

NOx Emissions Contributions by Source Category



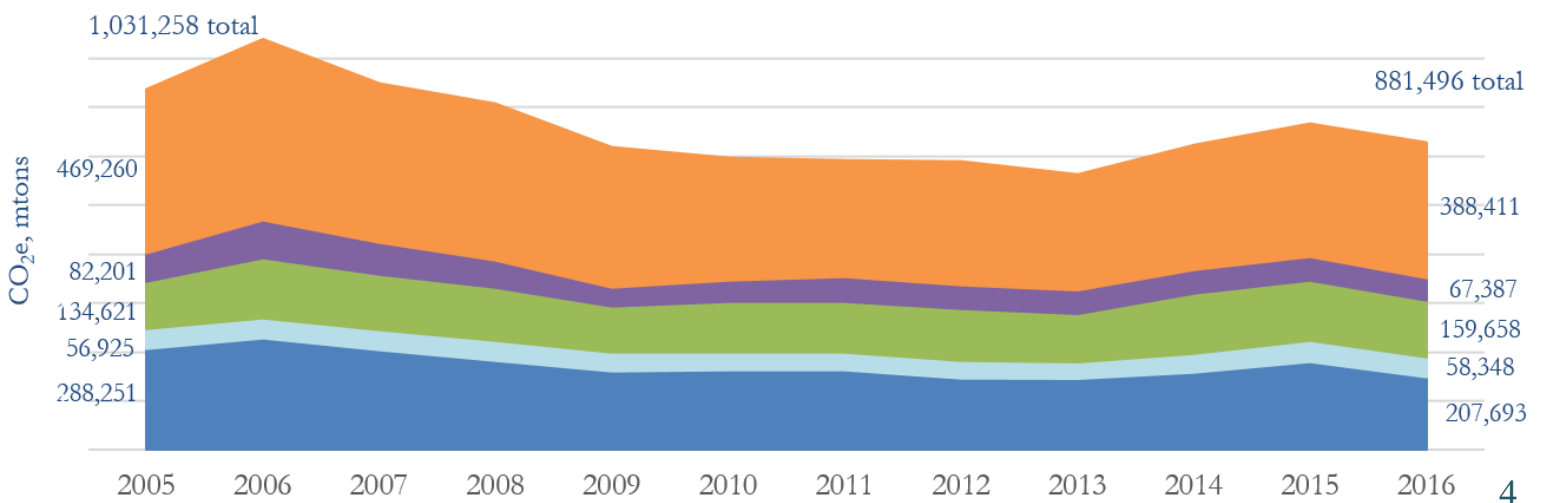
Total emissions for DPM, NOx, and SOx and emissions by source category, are presented in the figures in tons. Greenhouse gases (GHGs), represented by carbon dioxide equivalents or CO₂e are presented in metric tons (mtons). Additional pollutants are included in the more detailed technical reports located at: portoflosangeles.org/environment/studies_reports.asp.

SOx Emissions Contributions by Source Category



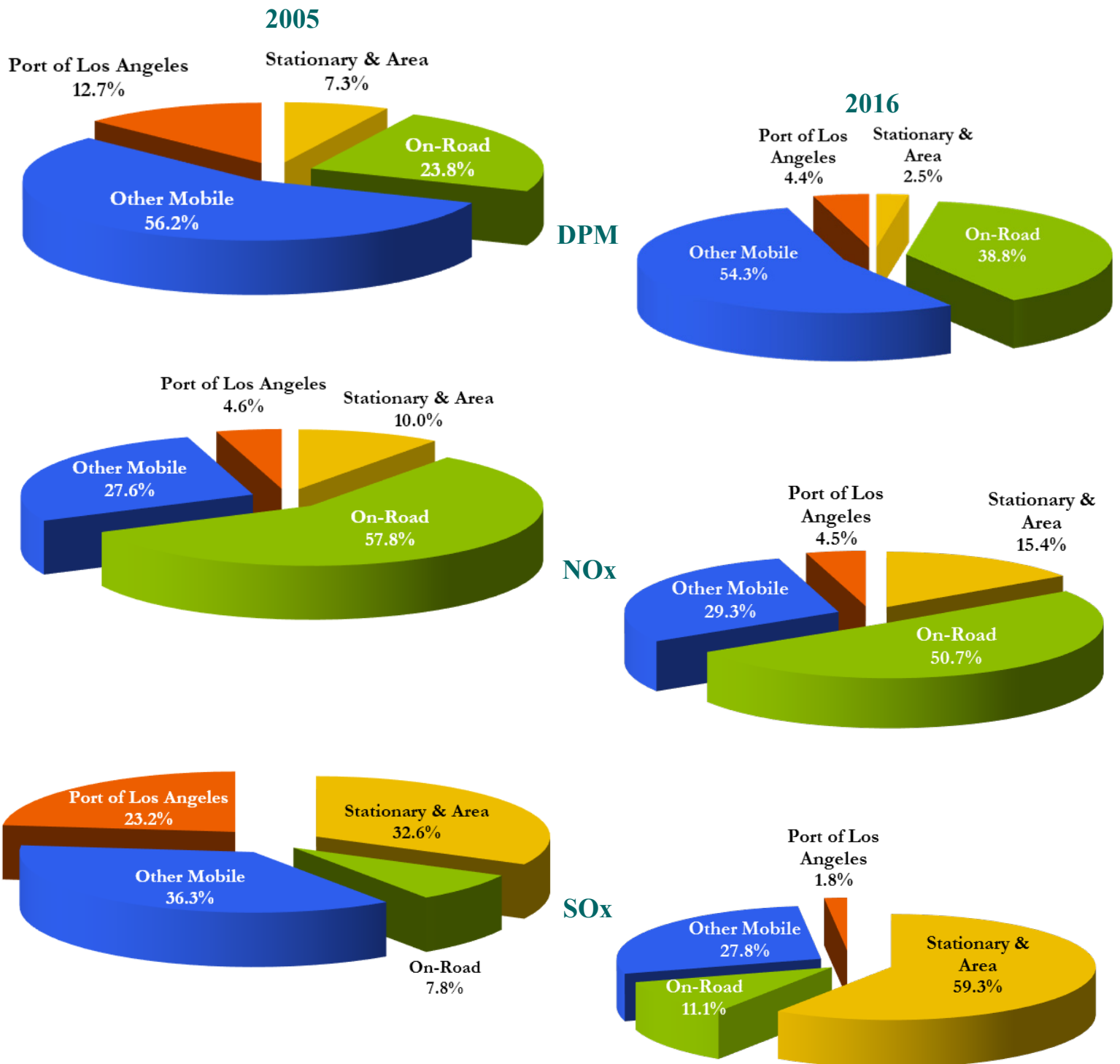
The efforts to reduce SOx have had dramatic success since 2005! Ships have always dominated SOx emissions due to their fuel's high sulfur content. CARB and EPA fuel regulations and CAAP programs like ESI incentives, VSR, and operational efficiencies have reduced port-related SOx emissions by 98%! The ESI incentives and operational efficiencies will continue to further reduce sulfur emissions from ships in the future. GHG emissions decreased 6% from 2015 levels due to reduced activity at the anchorages and increased use of shore power. Trucks continue to dominant GHG emissions with ships and cargo handling equipment coming in second and third. Highlighted reductions in CO₂e, since 2005, include 28% for ships, 18% for locomotives, and 17% for trucks. Cargo handling equipment and harbor GHG emissions have increased over that time at 19% and 3%, respectively.

CO₂e Emissions Contributions by Source Category



2005 & 2016 REGIONAL EMISSIONS CONTRIBUTION

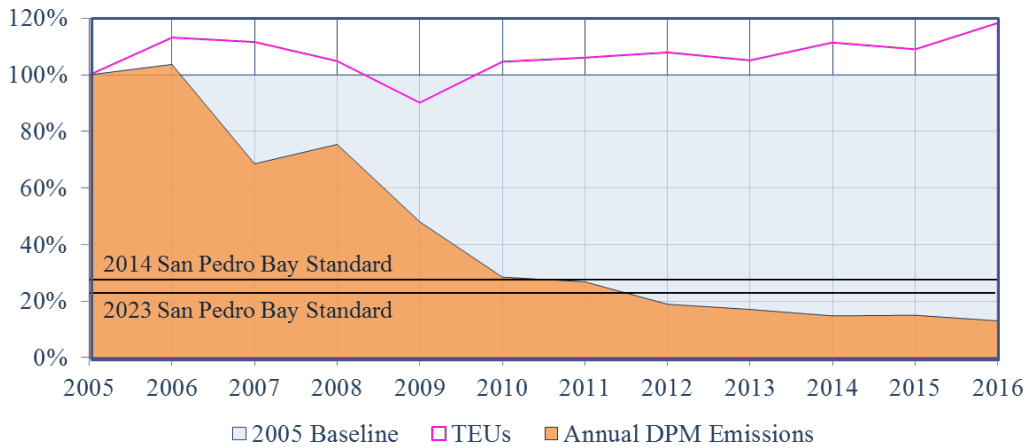
Illustrated below are the 2005 and 2016 percent pollutant contributions of port-related emissions relative to the total South Coast Air Basin emissions.



Basin emissions have continued to be reduced from 2005 levels. The port-related emissions contributions to total Basin DPM and SOx have significantly decreased. The port-related NOx contributions have slightly decreased, while other mobile, stationary, and area sources have increased their contributions. Since 2005, Port-related Basin DPM contributions have reduced by 65%, NOx contributions have continued to keep pace with the other source categories, and SOx contributions have reduced by 92%!

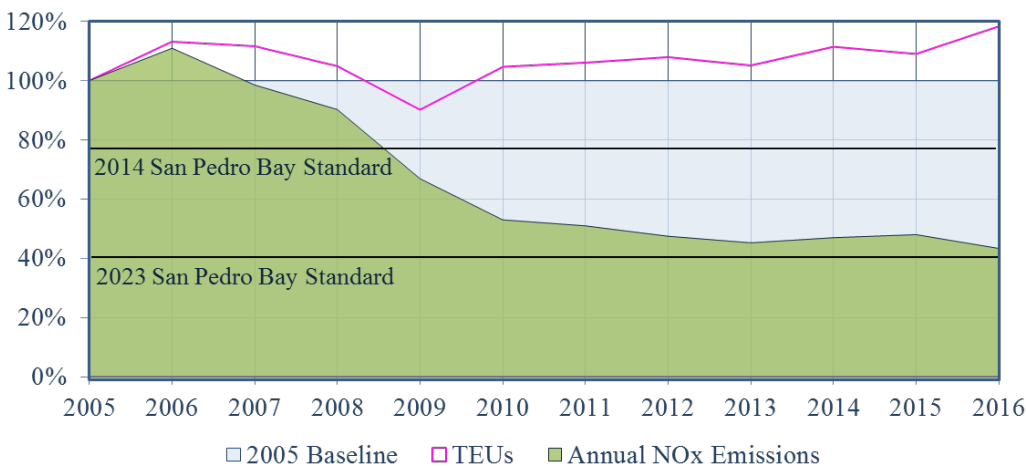
2005-2016 PORT-RELATED EMISSIONS TRENDS

The figures below show the port-related trends for DPM, NOx, SOx, and CO₂e, as well as cargo throughput measured in twenty foot equivalent units or teus.



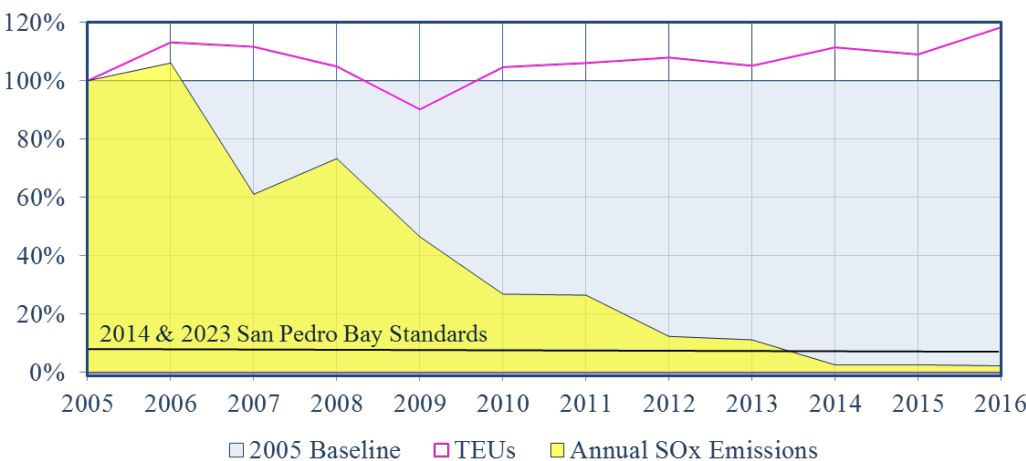
Port DPM Emissions

In 2016, DPM emissions are 87% below 2005 levels.



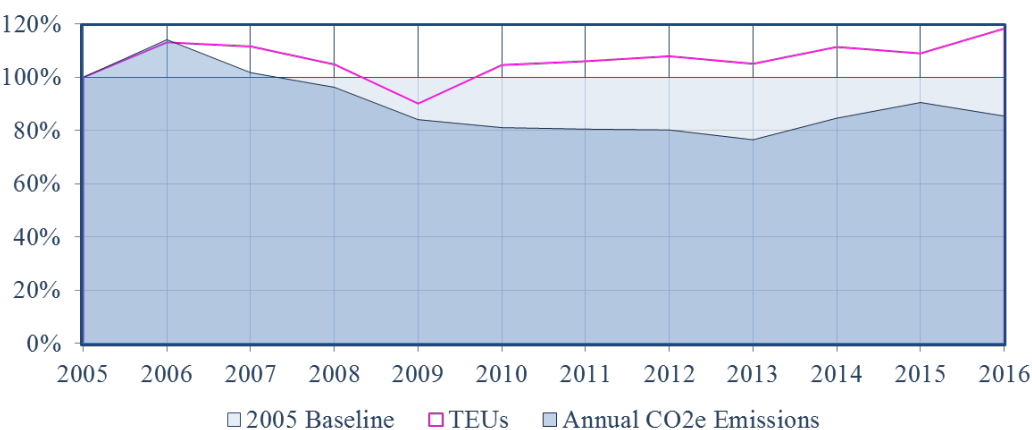
Port NOx Emissions

In 2016, NOx emissions are 57% below 2005 levels.



Port SOx Emissions

In 2016, SOx emissions are 98% below 2005 levels.



Port CO₂e Emissions

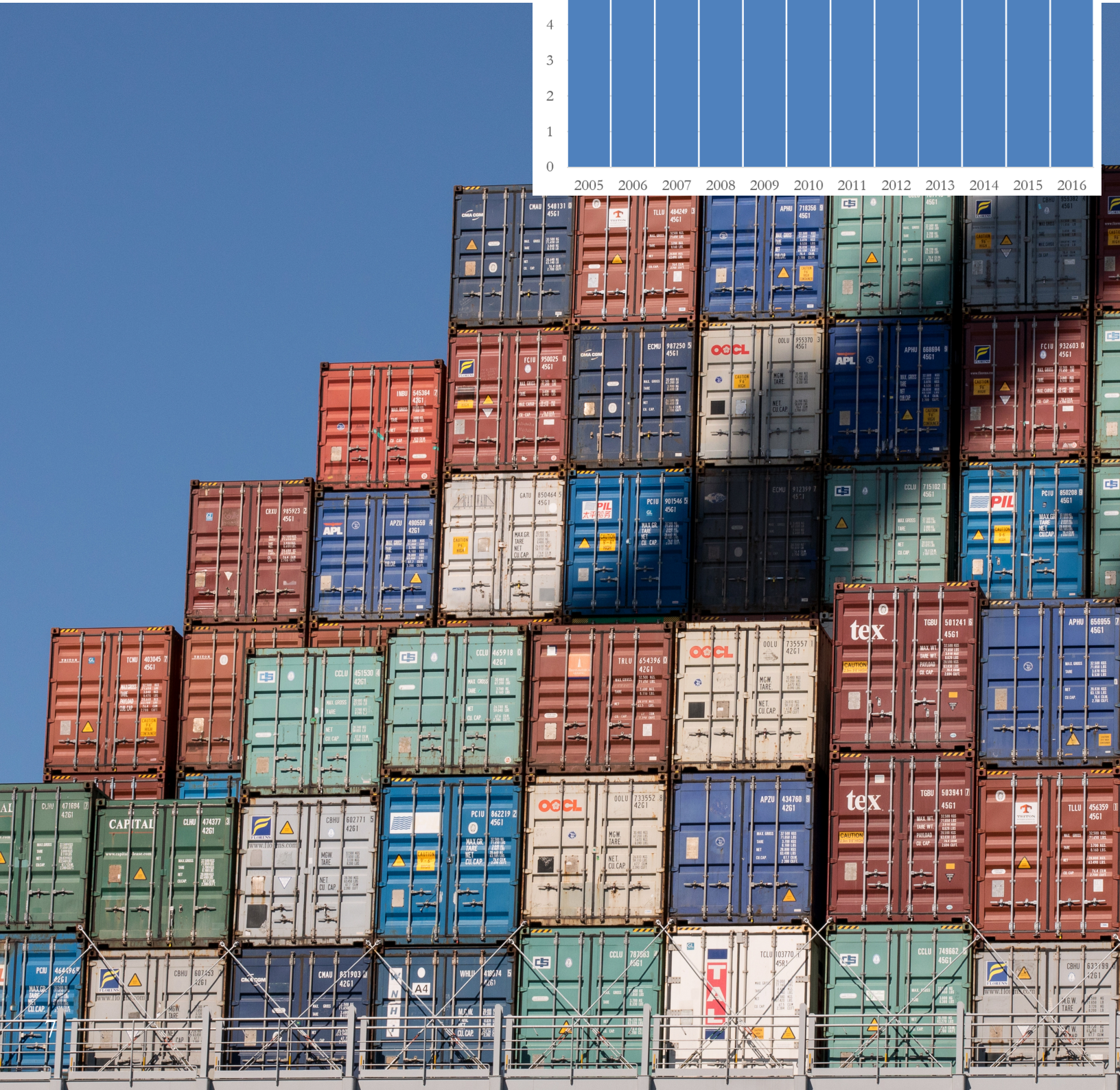
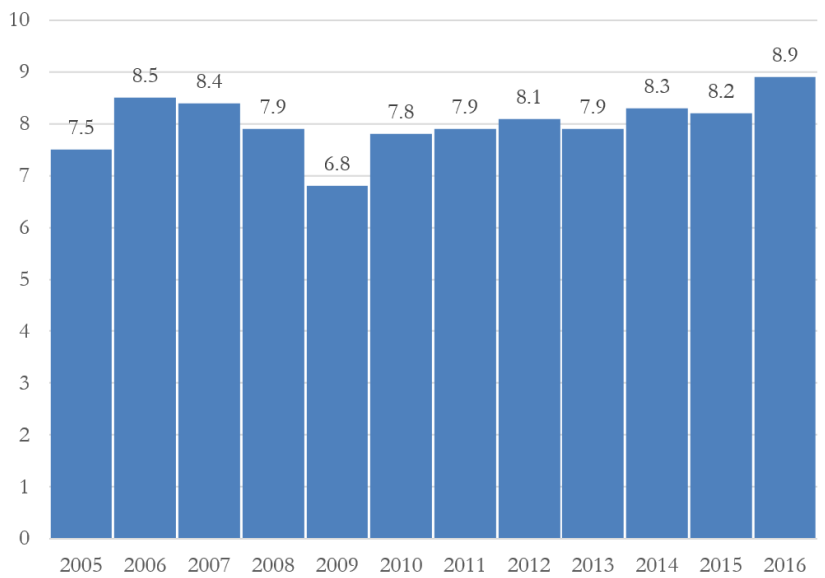
In 2016, CO₂e emissions are 15% below 2005 levels.

2005-2016 CARGO GROWTH

Cargo growth from 2005 to 2016 provides an overall activity context for the changes in emissions over time. The following figure presents the changes in cargo-related activity from 2005 to 2016 in millions of containers, measured in teus annually. As shown in the figure, container cargo volumes are at their highest point in 2016 and it is the first year to beat the previous peak of 2006.

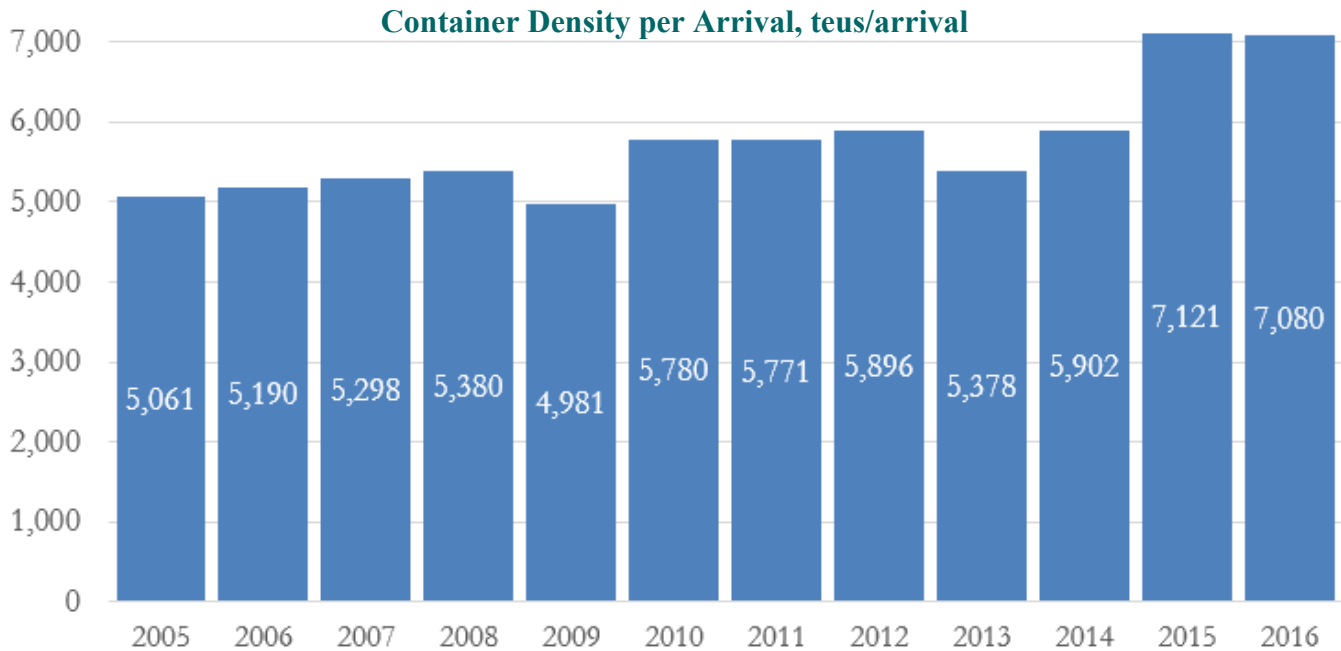
Containerized Cargo Volume

Millions of teus

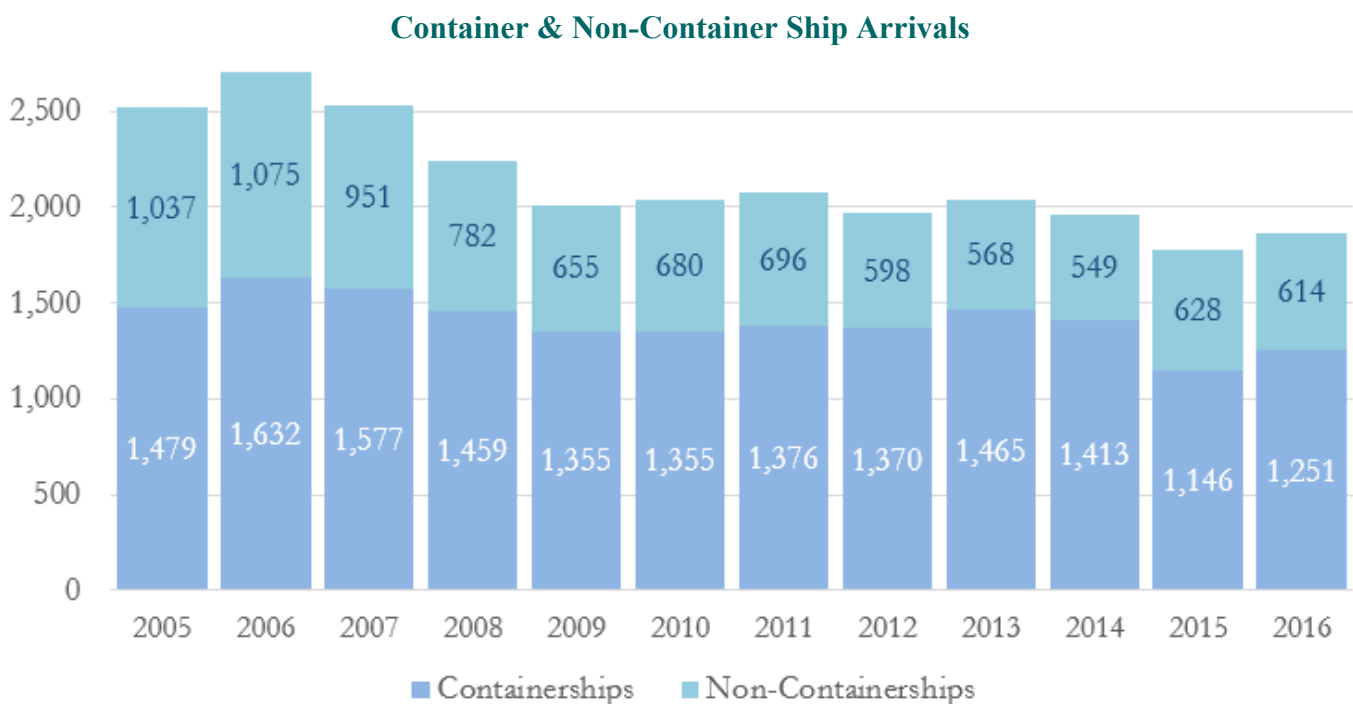


2005-2016 PORT-RELATED EFFICIENCY TRENDS

Port-related efficiency improvements track well with total port-related emissions trends. The following figures illustrate the efficiency improvements observed related to container density per arrival basis and the 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 ships to bring 18% more cargo in 2016 compared to 2005.



Container density, measured in teus per containership arrival, which significantly increased in 2015, continued that trend in 2016. These are the first two years in the port's history that container volumes have exceeded 5,000 teu per arrival mark. Both container ship arrivals and container cargo volumes increased 9% between 2015 and 2016, however it is uncertain if this is a trend or due to changes within the various container shipping alliances and their associated ship deployment schedules. Noncontainer ship arrivals slightly decreased from 2015 to 2016. Compared to 2006, the previous peak year for cargo, total ship arrivals have **decreased by 842 ship arrivals!**



Ports & Maersk Line Team Up on Efficiency

Shipping company Maersk Line and the Ports of Los Angeles and Long Beach are partnering to measure the environmental benefits of a \$125 million upgrade for 12 Maersk container ships. This project is part of the Ports' CAAP Technology Advancement Program (TAP) and will involve the installation of high-tech equipment to track vessel emissions and energy efficiency over the next three years, enabling more transparency and ultimately reducing the environmental impact of vessels calling at the San Pedro Bay port complex. The Ports are contributing a combined \$1 million to real-time tracking systems that represents a maritime industry first, to better pinpoint vessel energy consumption while ships are operating at various modes at both sea and at berth.

The project will continuously record how much energy and fuel each engine uses in conjunction with speed, engine power, weather and other operational variables through use of mass flow meters and an interface to the Integrated Control System on-board to capture key performance data. Information will be uploaded to Maersk Line servers via satellite, and each ship will be able to communicate in real-time with Maersk Line's Global Vessel Performance Centre to increase operational efficiency.

“This is the equivalent of strapping a Fitbit onto a large container ship,”** said Dr. Lee Kindberg, Director of Environment and Sustainability for Maersk Line, a global ocean transportation company and a division of the Maersk Group. **“We’ll be tracking vessel performance and emissions 24/7. This advances our ability to reduce greenhouse gases and other pollutants on a global scale.”

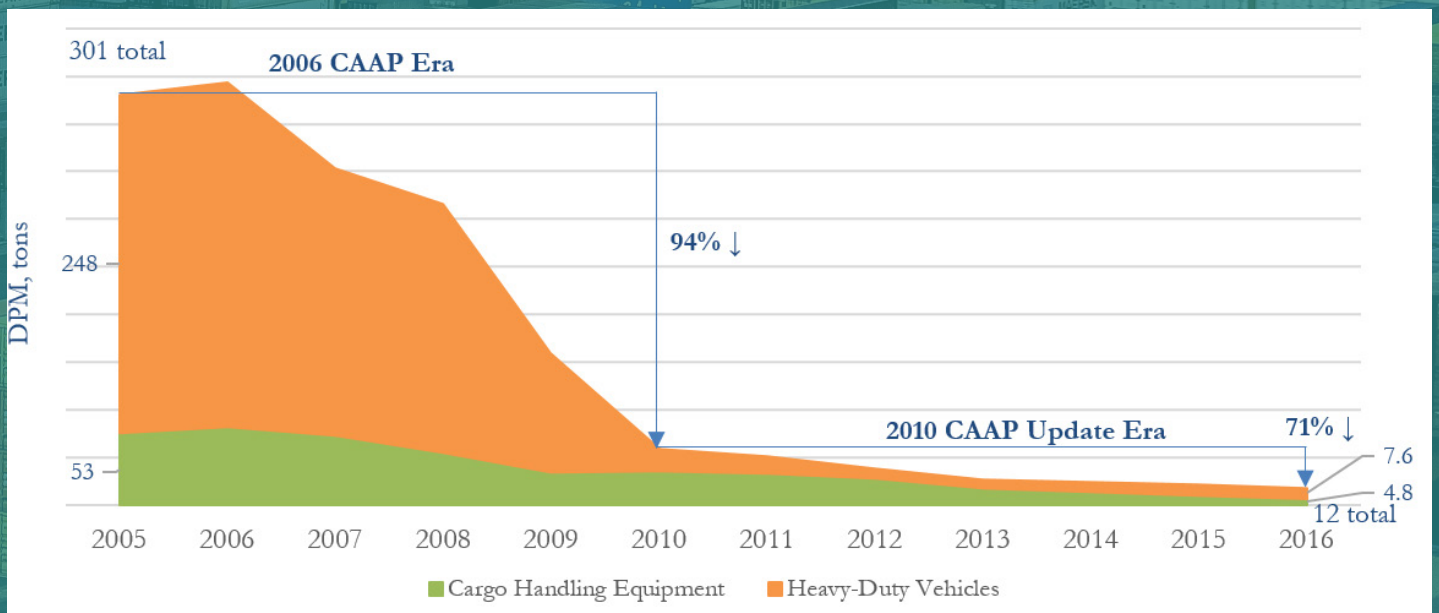
For more information on TAP projects, visit: www.cleanairactionplan.org/technology-advancement-program/





Truck & Cargo Handling Equipment DPM Emissions Trends

Looking at truck and CHE emission reductions due to the CAAP Clean Truck Program and CARB regulations, there are two distinct reduction time periods, original CAAP (2005-2010) and the 2010 CAAP Update (2010-2016). The combined DPM reductions for trucks and CHE during the original CAAP time period is 94%! For the 2010 CAAP Update time period an additional 71% reduction has occurred! Over the entire time period, DPM emissions in 2016 are **only 4%** of what they were in 2005 while moving 18% more cargo!



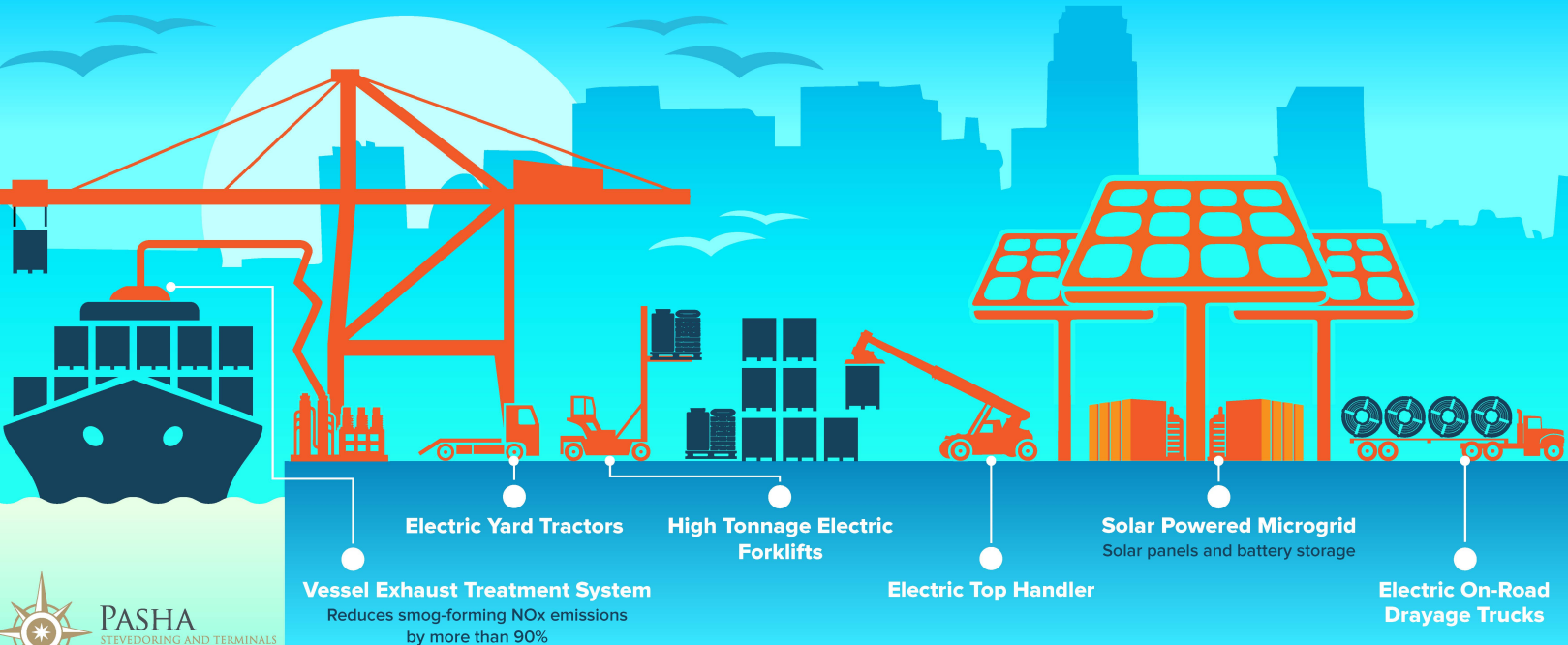
Public-Private Partnerships for Cleaner Future

As an example of the continued efforts by POLA to work towards a cleaner future, the Pasha Green Omni Terminal Project was commenced in 2016. This innovative project combines zero and near-zero emission technologies in an effort to improve the efficiency and emissions profile of the non-automated terminal. The lessons learned from this project will be applicable to other terminals, rail facilities, warehouses, and other facilities in the greater logistic chain.

For more information visit:

https://www.portoflosangeles.org/newsroom/2016_releases/news_052616_green_omni.asp

Pasha Green Omni Terminal



For more information visit
www.portoflosangeles.org

Zero and near-zero emission technologies to improve air quality in our community

3,200

Tons Per Year

Greenhouse Gases
REDUCED

56,000

Pounds Per Year

Diesel Particulate Matter,
Nitrogen Oxides & Other
Harmful Emissions
ELIMINATED

14,100

Cars Off The Road
Per Day

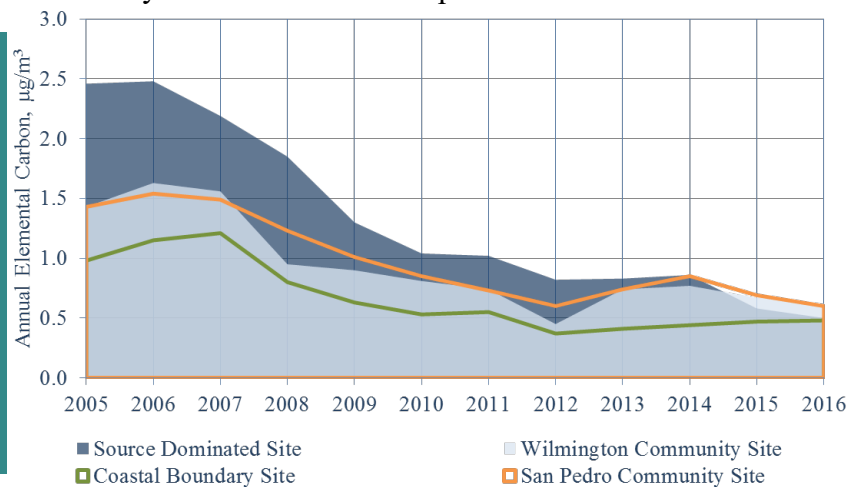
Equivalent South Coast
Air Basin
**CLEAN AIR
GAINS**

AIR MONITORING HIGHLIGHTS

Air Quality Monitoring Trends

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 51-80%, 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 sites, and a source dominated site 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: caap.airsis.com/Default.aspx



LOOKING AHEAD

2017 & Beyond

In mid-July 2017, the Ports of Los Angeles and Long Beach released the draft 2017 CAAP Update. The document outlines a new set of aggressive near-term and long-term strategies for the nation's busiest harbor complex to further reduce harmful air pollution from all port-related sources, assist the state in meeting aggressive greenhouse gas reduction goals, and ultimately achieve zero emissions for trucks and terminal equipment.

The draft 2017 CAAP Update incorporates feedback from nearly two years of extensive dialogue with industry, environmental groups, regulatory agencies and neighboring communities. The ports conducted multiple small-group meetings and a large public workshop prior to releasing a Discussion Document in November 2016 detailing their goals, priorities and strategies for public review and comment.

Since the release of the Discussion Document, the ports have held more than 50

stakeholder meetings and two community workshops, leading up to the July release.

Updated strategies in the CAAP incorporate local, regional, state and federal standards and regulations, as well as anticipate clean air regulations under development by the California Air Resources Board. The CAAP also aligns with the vision and targets of state and local leadership, as identified in the California Sustainable Freight Action Plan adopted in 2016 and the aggressive joint zero emissions initiatives announced in early June by Los Angeles Mayor Eric Garcetti and Long Beach Mayor Robert Garcia.

The 2017 CAAP will set new goals, aligned with city and state goals, for greenhouse gas reductions and continues to maintain the DPM, NO_x, SO_x, and health risk goals from the 2010 CAAP Update.

For more information, visit: www.cleanairactionplan.org/2017-clean-air-action-plan-update/



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 \$272 billion in trade during 2016. 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
portoflosangeles.org/environment/studies_reports.asp