PORT OF LOS ANGELES
EMISSIONS INVENTORY HIGHLIGHTS - 2014

THE PORT
OF LOS ANGELES

Technical Report
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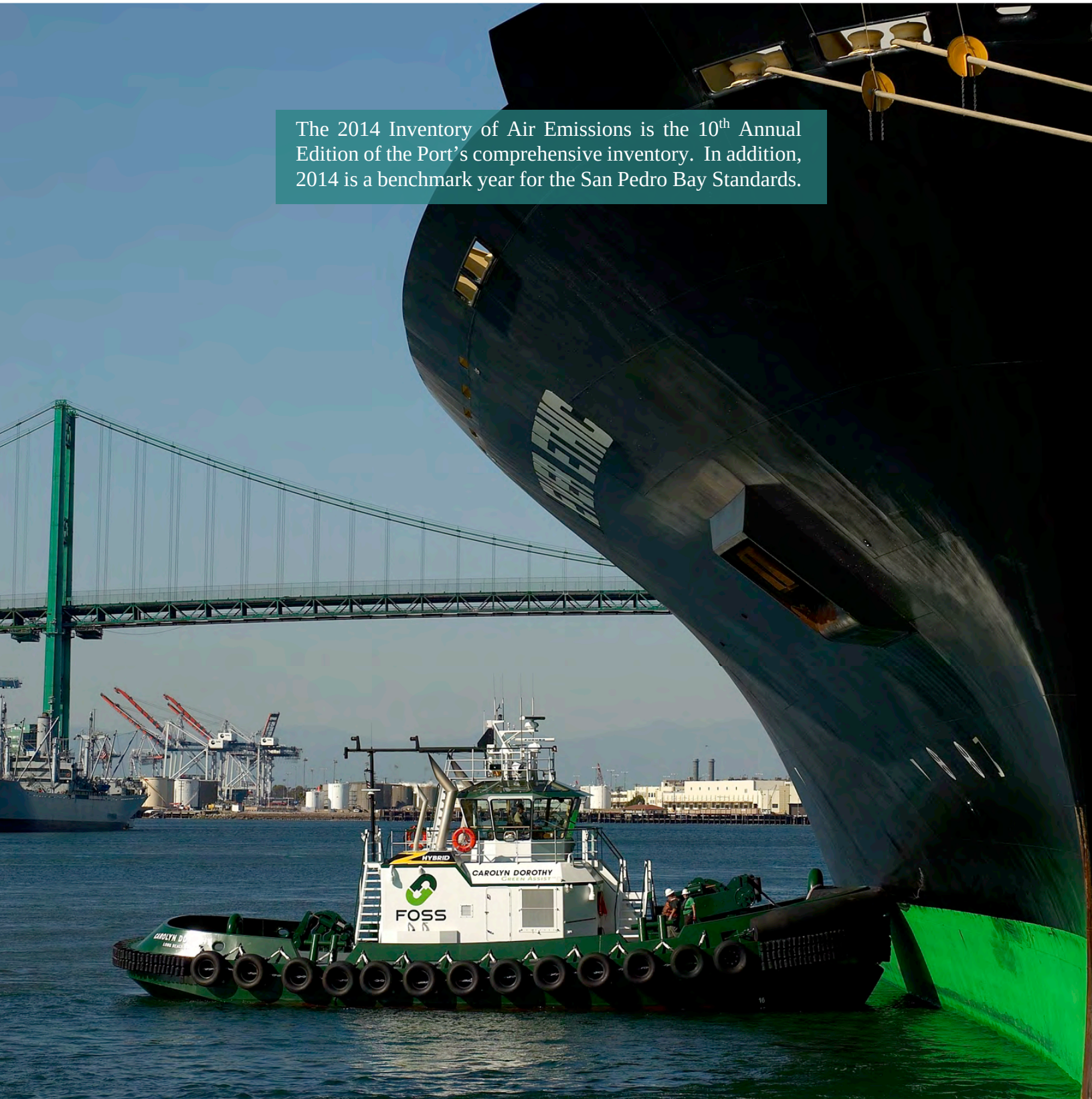
FOREWORD

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 2014 inventory findings, trends in emissions and cargo since 2005, CAAP measure progress, and upcoming highlights for 2015 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*)



The 2014 Inventory of Air Emissions is the 10th Annual Edition of the Port's comprehensive inventory. In addition, 2014 is a benchmark year for the San Pedro Bay Standards.

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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 POLA; Illustrations by Rodolfo Montalvo

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, POLB, and the South Coast Air Quality Management District 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 and the United States Environmental Protection Agency Region 9 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, both POLA and the Port of Long Beach (POLB) developed mass emissions and health-risk reduction standards in coordination with the United States Environmental Protection Agency (EPA) Region 9, the California Air Resources Board (CARB), and the South Coast Air Quality Management District (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 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 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, and 93% SOx
By 2023, reduce emissions by 77% DPM, 59% NOx, and 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.

2014 San Pedro Bay Standards

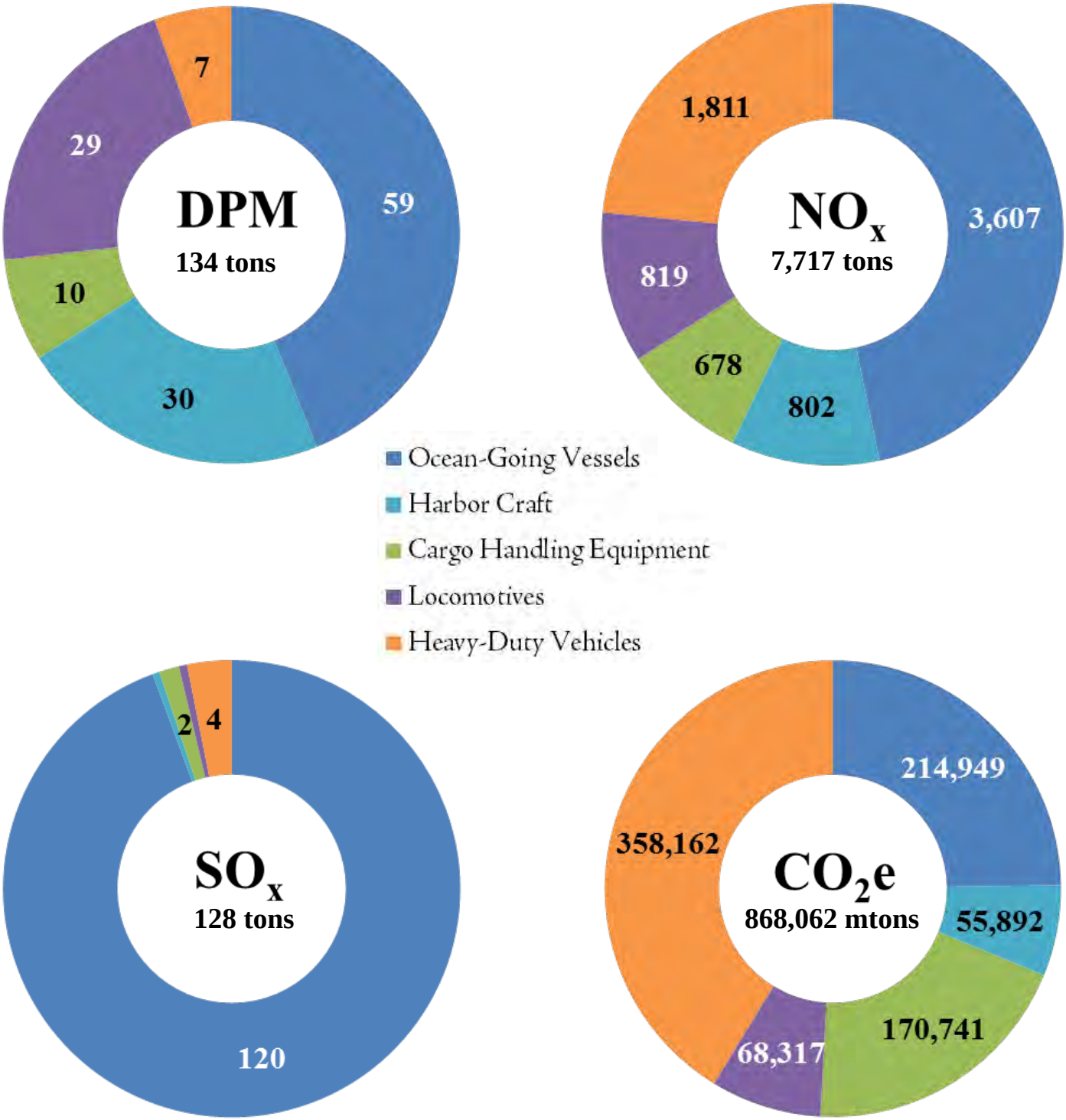
The 2014 annual emissions inventory demonstrated that the Port not only met but exceeded the San Pedro Bay Standards for 2014, which in return significantly reduced the impacts on the local communities around the Port. The work is not done. There are the 2023 standards to be achieved and the greater challenge of growing the Port green such that the Port emissions remain below the standards into the future.

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*)

2014 EMISSIONS INVENTORY SUMMARY

The POLA emissions inventory and CAAP focus on emissions of DPM, NOx, and SOx as well as greenhouse gases. In addition, other pollutants are included in the more detailed technical reports (*portoflosangeles.org /environment/studies_reports.asp*). In 2014, the ocean-going vessel source category continues to be the significant driver of DPM, NOx, and SOx emissions. Greenhouse gases, expressed in carbon dioxide equivalents (CO_2e), were dominated by heavy-duty vehicles followed by ocean going vessels and cargo handling equipment. Total emissions for DPM, NOx, and SOx and emissions by source category, are presented in the following figures in tons. CO_2e is presented in metric tons (mtons).

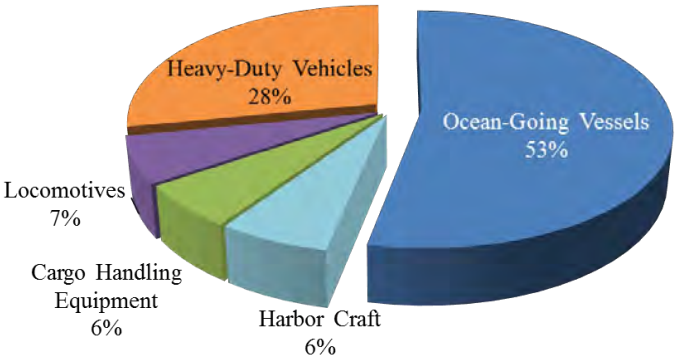


2005-2014 SOURCE CATEGORY CONTRIBUTION CHANGES

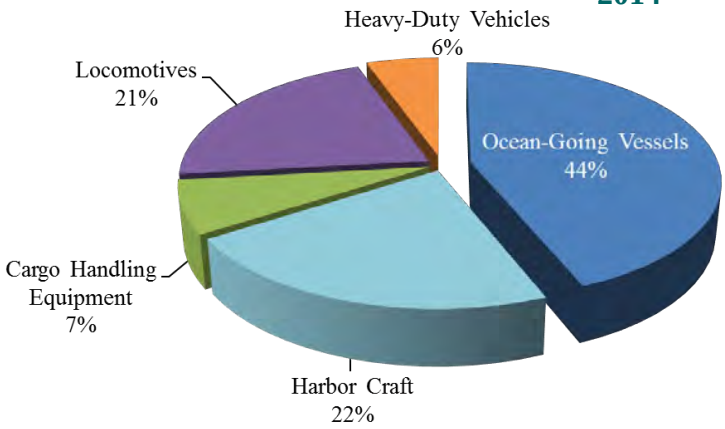
The contribution of each source category to total port-related emissions has changed since 2005 due to the implementation of the CAAP measures, various regulatory requirements that have come into effect for all source categories, and industry efforts to reduce emissions. The following figures illustrate the changes in port-related emissions contribution by source category between 2005 and 2014. Ocean-going vessels make up over 94% of SO_x emissions.

DPM Emissions Contributions by Source Category

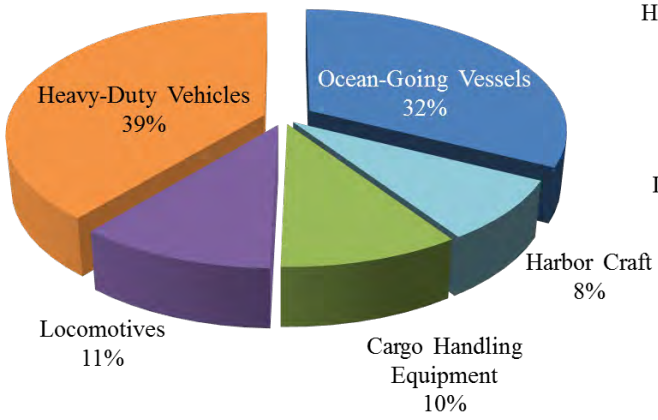
2005

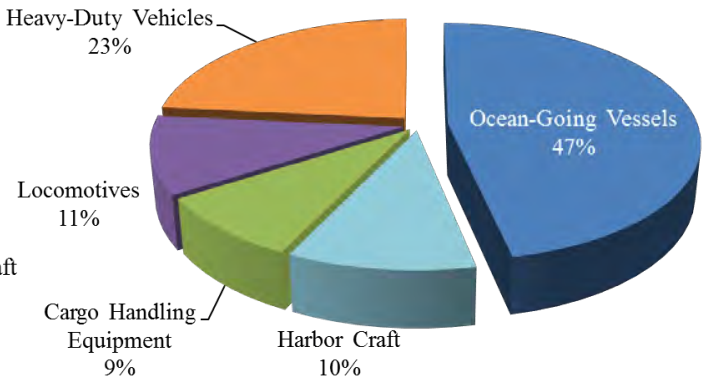


2014

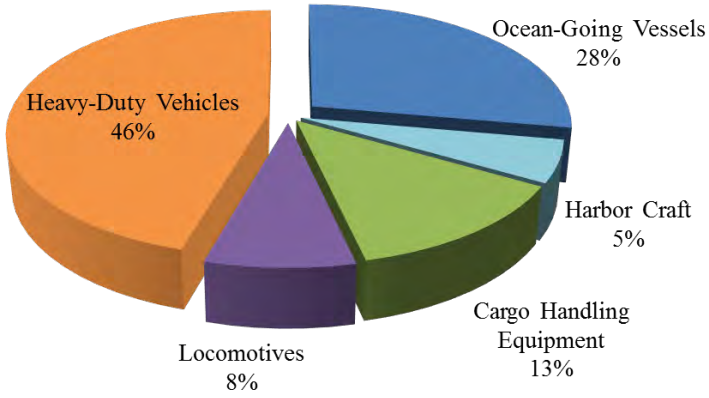


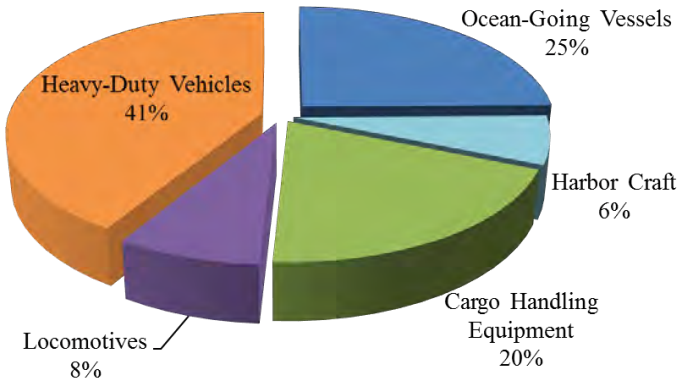
NOx Emissions Contributions by Source Category





CO_2e Emissions Contributions by Source Category

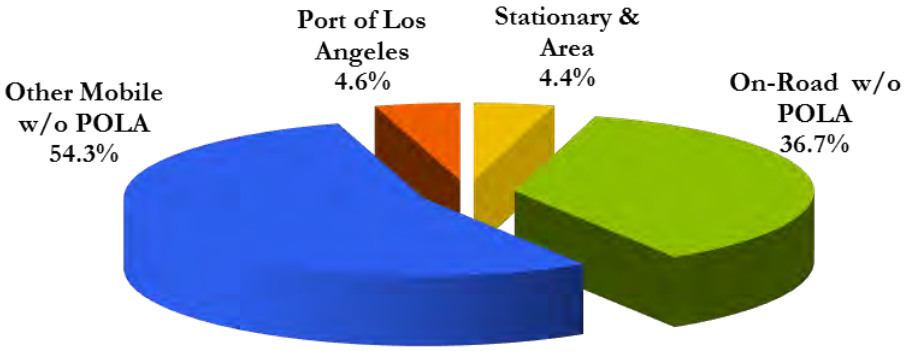




2014 REGIONAL EMISSIONS CONTRIBUTION

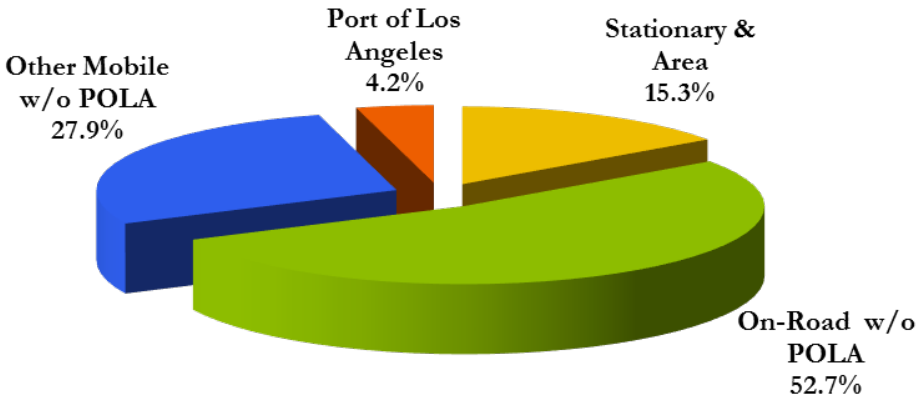
Illustrated below are the 2014 percent pollutant contributions of port-related emissions relative to the total South Coast Air Basin emissions.

DPM



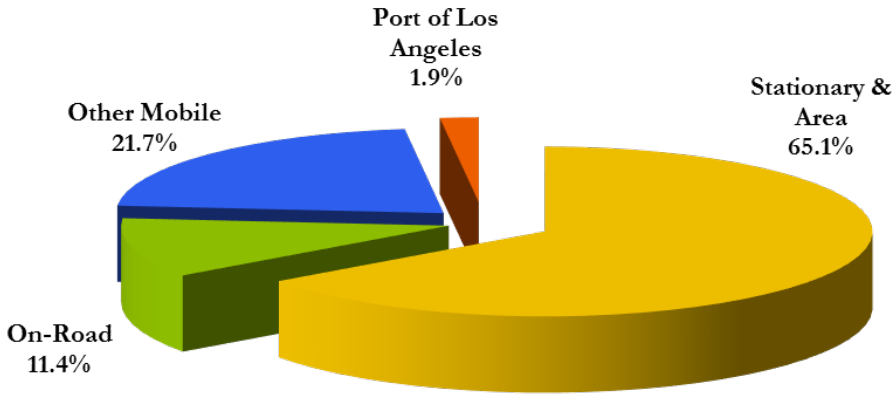
In 2005, port-related emissions contributed 8% of the total basin-wide DPM emissions and less than 5% contribution in 2014 while handling 11% more container cargo than in 2005.

NOx



In 2005, port-related emissions contributed 4% of the total basin-wide NOx emissions and 4.2% contribution in 2014 while handling 11% more container cargo than in 2005.

SOx



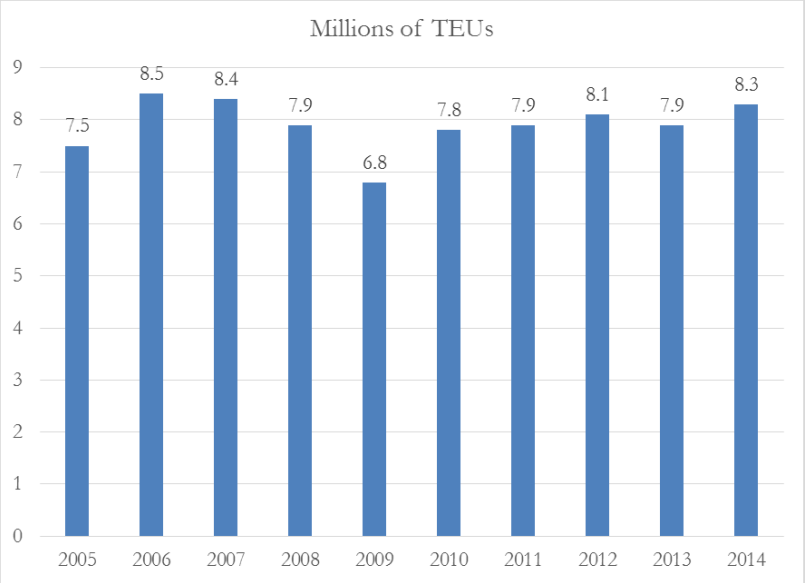
In 2005, port-related emissions were 24% of the total basin-wide SOx emissions and 1.9% contribution in 2014. This represents a 92% reduction in the basin-wide SOx contribution since 2005 while handling 11% more container cargo.

2005-2014 ACTIVITY & CARGO GROWTH

Activity and cargo growth from 2005 to 2014 provide an overall context for the changes in emissions over time. The following figure presents the changes in cargo-related activity from 2005 to 2014 in millions of containers (measured in twenty foot equivalent units or TEUs) annually. As can be seen in the trends figure, cargo peaked in 2006 and then dropped off significantly in the 2008-2009 period. From 2010 to 2014 TEUs have recovered above 2005 levels.

Over the same period of time, vessel call distributions changed showing a shifting of the deployed fleet over time. Events relating to the financial crisis that began in late 2007 have resulted in significant changes to the fleets calling POLA, as shipping lines adjust their fleets in response to the changes in cargo volumes and box rates. Container ship call data shows definite size-related trends as the fleet transitions; generally the changes have had a positive effect on ship-related emissions.

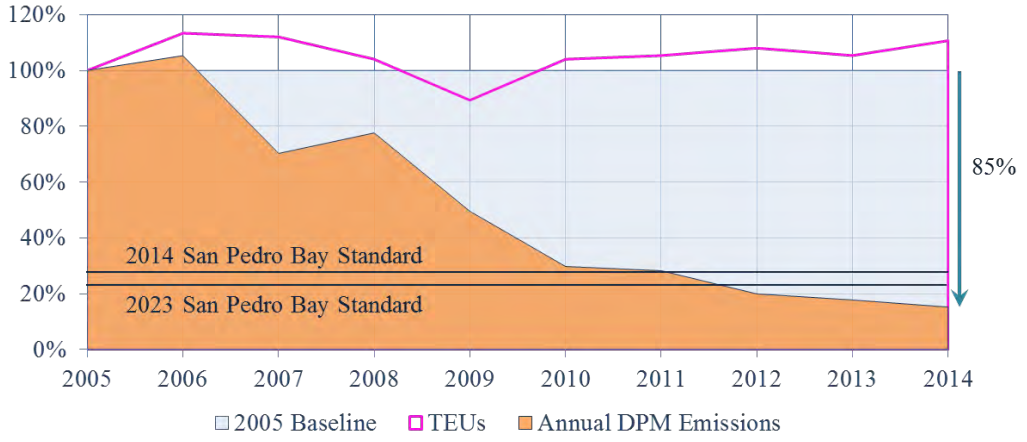
Containerized Cargo Volume



In addition to container growth, activity increased for cruise ships and tankers in 2014.

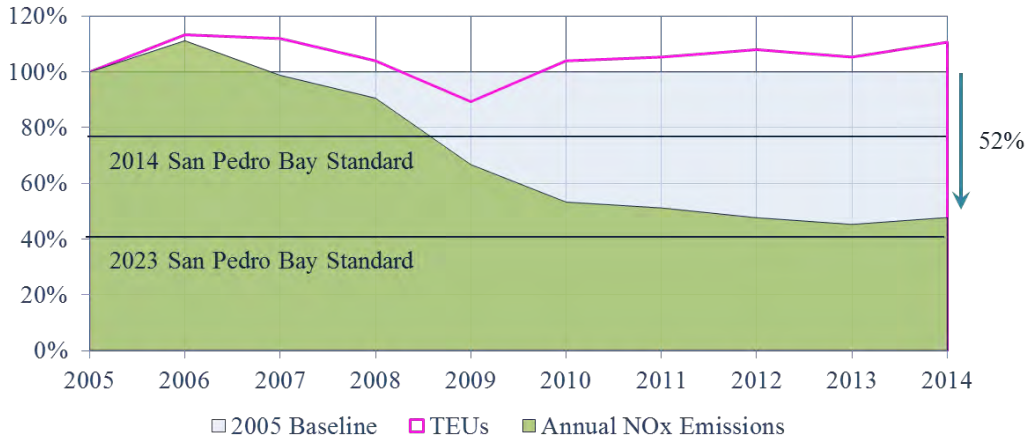
2005-2014 PORT-RELATED EMISSIONS TRENDS

Cargo activities and emissions have diverged paths since 2006 with emissions reductions far exceeding changes in cargo volumes due to the implementation of the CAAP and various CARB/EPA regulations. The figures below show the port-related trends for DPM, NOx, SOx, and CO_2e.



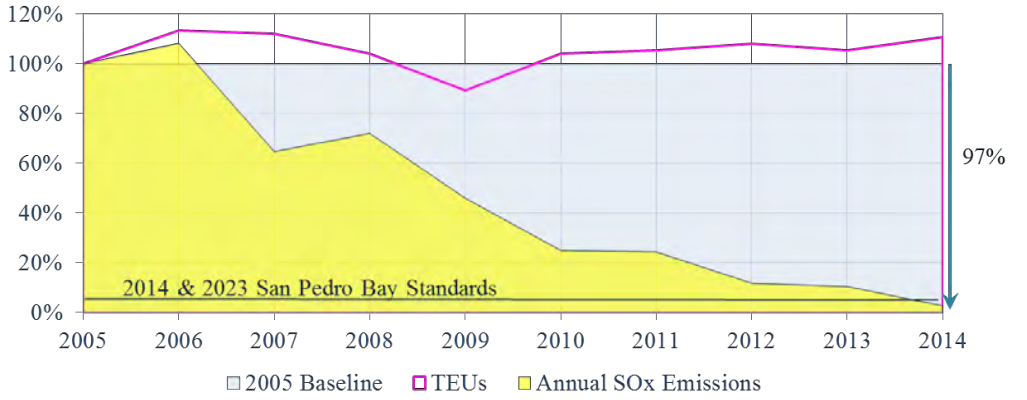
Port DPM Emissions

Port-related DPM emissions have decreased 85% since 2005. These reductions were led by vessel speed reduction, cleaner vessel fuels, AMP, and the Clean Truck Program, which all contributed to significant reductions in DPM emissions through 2014.



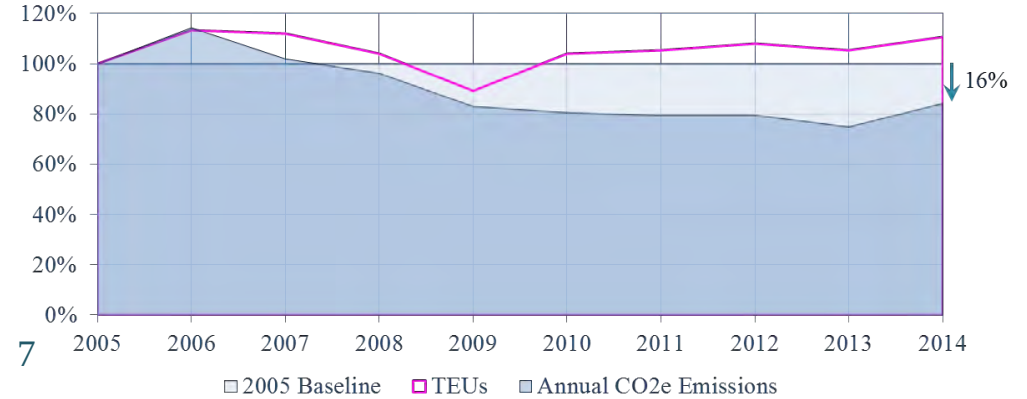
Port NOx Emissions

Port-related NOx emissions have decreased 52% since 2005. The slight increase from 2013 is due to additional cruise and tanker activity, temporary congestion at the port, and increases in on-road truck deterioration.



Port SOx Emissions

Port-related SOx emissions have decreased 97% since 2005. These reductions were led by the CARB vessel fuel switching regulation, Environmental Ship Index, use of ultra low sulfur diesel by on-road and off-road vehicles, vessel speed reduction, and AMP.



Port CO_2e Emissions

Since 2005, greenhouse gas emissions have been reduced by 16% as a result of "co-benefits" from the implementation of CAAP measures. The slight increase from 2013 is due to additional cruise and tanker activity, temporary congestion at the port, and increases in on-road truck deterioration.

2005-2014 PORT-RELATED EFFICIENCY TRENDS

Port-related efficiency improvements track well with total port-related emissions trends. The following illustrates the efficiency improvements on per 10,000 twenty-foot equivalent units (TEUs) basis. This is an important metric to normalize emissions reductions and accurately present real progress in light of fluctuating cargo volume.

Port-wide DPM efficiencies have continued to improve since 2005 with an 86% reduction from 1.18 to 0.16 tons per 10,000 TEUs.

Port-wide NOx efficiencies have continued to improve since 2005 with a 57% reduction from 21.59 to 9.25 tons per 10,000 TEUs.

Port-wide SOx efficiencies have continued to improve since 2005 with a 98% reduction from 6.61 to 0.15 tons per 10,000 TEUs.

Port-wide CO_2e efficiencies have continued to improve since 2005 with a 24% reduction from 1,375 to 1,041 tons per 10,000 TEUs.


MARINER OF THE SEAS
NASSAU

SOURCE CATEGORY HIGHLIGHTS

Ocean-going vessels

Emissions comparisons 2005-2014.

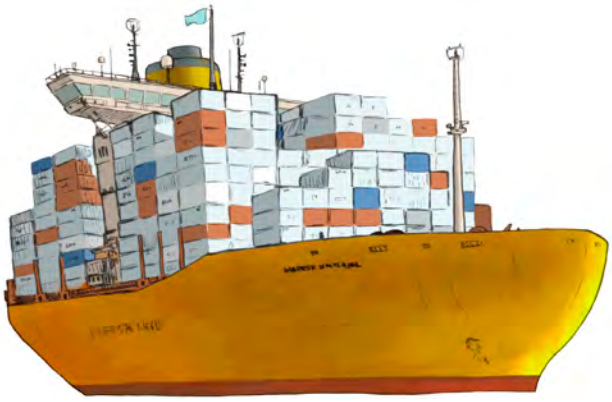
DPM Emission by Year

2005 471 tons

2014 59 tons

In 2014, container ship anchorage NOx emissions increased by 1,351% or 165.8 tons compared to 2013 due to the temporary congestion experienced at the port. NOx emissions were further increased due to 23% increase in cruise ship calls and 18% increase in tanker calls compared to 2013 activity. These increases were nearly fully offset by increased use of shore power at berth.

SOx Emission by Year



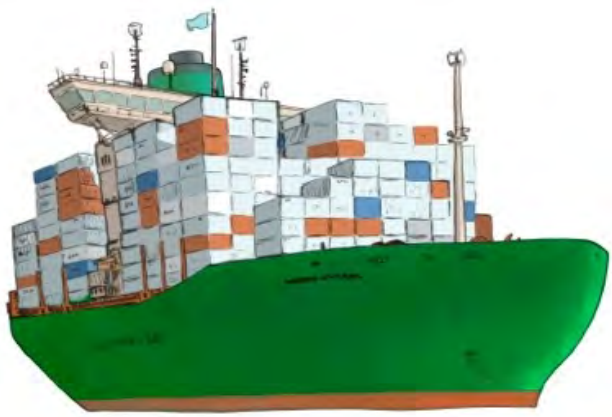
2005 4,789 tons

2014 120 tons

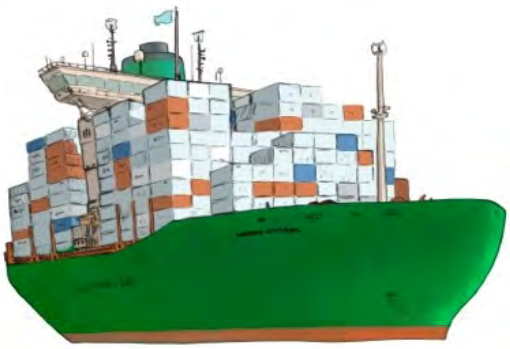
Ship-related emissions continue to show reductions in 2014 due to successful implementation of CAAP measures, Environmental Ship Index incentives, CARB fuel-based regulations, and AMP. Highlights include:

- Continued high compliance rates with the voluntary vessel speed reduction (VSR) program
  - 95% compliance 20 nautical miles (nm)
  - 84% compliance 20-40 nm
- Increasing use of AMP while at berth

NOx Emission by Year



2005 5,248 tons



2014 3,607 tons

Utilizing AMP for one container or cruise ship call reduces ~1 ton of NOx generated onboard the ship. City of Los Angeles' Department of Water & Power generates the same energy at 96% less NOx emissions. The resulting NOx reduction per call is the equivalent of taking 295 cars off the road for a year.

Since the start of 2014, CARB's shore-power regulation requires container, reefer, and cruise lines that have more than 25 fleet calls to utilize AMP for 50% of their calls. The regulation increases to 70% in 2017 and 80% in 2020. Further reductions from AMP will increase in upcoming emissions inventories.

Zero Emission Technology Demonstration!

TransPower, Inc. located in Poway, CA is one of various companies developing electric drayage trucks and electric yard tractors for use in the San Pedro Bay Ports of Los Angeles and Long Beach (Ports). Their Zero-Emission Cargo Transport (ZECT) Demonstration is funded by the Ports, California Energy Commission, U.S. Department of Energy, South Coast Air Quality Management District, and TransPower to produce 7 electric class 8 trucks. The project is currently underway and 4 of the 7 trucks have been fully integrated and deployed in drayage operations. TransPower has also developed 2 electric yard tractors for port operations, funded through a California Air Resources Board AB 118 grant. These tractors have been deployed at terminals in the Port of Los Angeles for demonstration. To date the demonstrations are promising, though so far none of the vehicles has undergone long term testing in the maritime goods movement environment to determine if the technology can perform successfully in those applications. Longer-term evaluations of these technologies are still needed to establish the technical viability, operational reliability. The Port is committed to expanded development and testing of zero emission technologies.

SOURCE CATEGORY HIGHLIGHTS

Trucks

DPM Emissions Comparison

2005 248 tons

2014 7 tons

NOx Emissions Comparison

2005 6,307 tons

2014 1,811 tons

SOx Emissions Comparison

2005 45 tons

2014 4 tons

The development and implementation of the Clean Truck Program (CTP) continues to be a true success story of the CAAP. The first program of its kind for port-related trucks, it continues to accelerate the benefits from EPA cleaner engine standards by banning older model year trucks from access to port facilities. The illustrations on the left compare DPM, NOx, and SOx emissions in 2005 to 2014. The CARB ULSD rule came into effect in June 2006 which dramatically reduced truck-related SOx emissions.

As part of the CTP implementation, the following three incremental truck model year bans at port facilities have been implemented:

- Ban #1 - October 1, 2008: All pre-1989 trucks were banned
- Ban #2 - January 1, 2010: All 1989-1993 trucks were banned in addition to 1994-2003 trucks that had not been retrofitted
- Ban #3 - January 1, 2012: All trucks not meeting 2007 EPA clean truck standards were banned.

The CTP has been so successful that ports along the West, Gulf, and East coasts are implementing similar versions of the program. Overseas ports are also looking at the CTP as a measure they can employ to reduce port-related emissions.

In 2014, the third full year of the CTP, emissions are increasing modestly as trucks accrue mileage, which is a part of normal engine operations. This phenomenon occurs in the CTP due to the lower turnover rate of the newer 2007 through pre-2010 trucks in the program.

In 2005, over 99% of the trucks servicing POLA terminals were older than 2004 and 50% of those were older than 1994. In 2014, approximately 64% were 2007-2009 and 36% were 2010 or newer trucks.

SOURCE CATEGORY HIGHLIGHTS

Rail Locomotives

There are two types of railroad services associated with port-related cargo movements: switching and line haul. Switching services are related to the building and organizing of unit trains, railcar pickup and delivery to the various terminals, and related yard work. Class 1 line haul services are related to the interstate movement of trains for nationwide cargo distribution. The illustrations below show how DPM, NOx, and SOx emissions have changed since 2005 for all port-related locomotive emissions.

The Pacific Harbor Line, Inc. (PHL) is the primary company providing switching services at POLA. PHL currently operates 23 locomotives in and around the port areas. In 2005, the PHL switching fleet consisted of locomotives built from the 1950s to the 1970s, which is typical for the industry. Over the past several years, with assistance from POLA, POLB, AQMD, and CARB - PHL has replaced all of their aging locomotives with a modern fleet of advanced low-emissions locomotives using Tier 3 or better engines; the full benefits from this latest advancement have been seen since 2012.

As of 2014, SOx emissions have been virtually eliminated from locomotives.

DPM Emissions Comparison

2005 57 tons

2014 29 tons

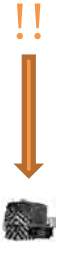
NOx Emissions Comparison

2005 1,712 tons

2014 819 tons

SOx Emissions Comparison

2005 98 tons



2014 1 ton

Since 2005, SOx emissions from locomotives has been nearly eliminated (reduced by 99%) through federal and state rules requiring ultra low sulfur or ULSD fuels, which are capped at less than 10 parts per million sulfur.

SOURCE CATEGORY HIGHLIGHTS

Cargo Handling Equipment

Efforts to reduce emissions associated with cargo handling equipment (CHE) were among the earliest emissions reduction control measures implemented at POLA, including several that predate the CAAP. DPM and NOx emissions have been reduced through a combination of regulations, emissions reduction projects/grants, installation of emissions control devices, and the use of on-road engines in CHE. SOx emissions have been significantly reduced through the CARB ULSD mandate in 2006. The illustrations present the relative change in CHE emissions from 2005 versus 2014.

Cargo handling equipment emissions were significantly reduced since 2005. The combination of terminal efficiency improvements, cleaner engine standards, grant project funding, and efforts by terminal operators to reduce fuel consumption and emissions are the reasons for the reductions in annual emissions.

- DPM has been reduced 81% since 2005
- NOx has been reduced 57% since 2005
- SOx has been reduced 81% since 2005

In 2014, less than 6% of all CHE engines were Tier 1 or older. That means that over 94% were Tier 2 or cleaner. The remaining 94% of the CHE fleet had the following engine types: 10% Tier 2, 11% Tier 3, 10% Tier 4i, 1.5% Tier 4, and nearly 59% were powered by cleaner on-road engines. For the remaining engines the tier level could not be identified as they were assumed to be the equipment type average.

Harbor Craft

Most of the emissions reductions associated with harbor craft have been achieved through grant funding by POLA through AQMIP and AQMD/CARB programs for replacing older vessel engines with newer, cleaner engines. These efforts continue to reduce DPM and NOx annual emissions. SOx was reduced in 2006 by CARB's ULSD fuel rule which significantly reduced the harbor craft contribution to total port-related sulfur emissions.

CHE Emissions 2005-2014

Harbor craft emissions have decreased significantly since 2005. A combination of engine repowers, CARB regulations, and innovative solutions from vessel owners/operators are responsible for the reductions in annual emissions.

- DPM has been reduced 47% since 2005
- NOx has been reduced 39% since 2005
- SOx has been reduced 90% since 2005

In 2005, 48% of the harbor craft fleet engines were Tier 1 or older, 2% were Tier 2, and no Tier 3 engines. In 2014, only 23% were Tier 1 or older, 35% Tier 2, and 15% Tier 3. For the remaining engines for both years the tier level could be identified, however the unknowns reduced from 49% to 27% since 2005.

AIR MONITORING HIGHLIGHTS

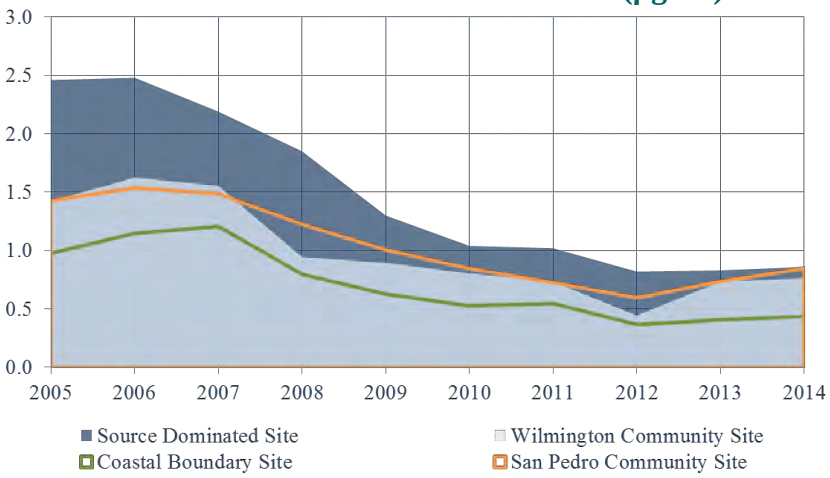
Air Quality Monitoring Trends

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 concentrations have been reduced by 41-65%, which trends similarly with the DPM emissions inventory numbers over the same period.

Air monitoring provides for another "real world" metric in addition to the inventories to measure the Port's progress in reducing its mass emissions and health-risk related impacts.

POLA has four monitoring stations that started to collect elemental carbon data in 2005. These stations consist of the coastal boundary station (typically representing background levels), the Wilmington and San Pedro community sites, and a source dominated site on Terminal Island – in the middle of port-related operations. *(caap.airsis.com/Default.aspx)*

2005-2014 Annual Average Elemental Carbon Concentrations (µg/m^3)



LOOKING AHEAD

2015 & Beyond

With eyes on the future, looking for innovative methods to sustaining emissions reductions while accommodating growth, POLA continues to look for emissions reduction and efficiency opportunities. Through the Technology Advancement Program or TAP, POLA is evaluating tomorrow's technologies today (*cleanairactionplan.org/programs/tap/default.asp*).

Throughout 2014 the Port continued to develop strategies for Zero Emissions equipment culminating in the draft Zero Emissions White Paper presented to the Board of Harbor Commissions in July 2015. The white paper details the Port's testing of zero emissions technology to date, and its proposed near-term plan for encouraging zero emission technology use in maritime goods movement, particularly as it relates to drayage trucks and yard tractors. By 2020, the Port plans to facilitate testing and development of up to 200 zero emission vehicles. (*portoflosangeles.org/pdf/Zero_Emmissions_White_Paper_DRAFT.pdf*).

In 2015, increase use of shore power is anticipated at part of the CARB shore power regulations for applicable container and cruise ships.

ESI is an international indexing system for clean ships and was developed under the International Association of Ports & Harbors, World Ports Climate Initiative. POLA was the first Pacific Rim and Western Hemisphere port to join the index. (*esi.wpci.nl/Public/Home*)

Emissions reductions will be continued through the ongoing implementation of the Environmental Ship Index (ESI) incentive program to reward and recognize the top performing cleanest vessels.

POLA is a founding member of the World Port Climate Initiative (WPCI) of the International Association of Ports and Harbors (IAPH). Approximately 60 of the world's key ports, acknowledging their unique capacity as key hubs in global supply chains, have come together in a commitment to reduce their greenhouse gas emissions while continuing their role as transportation and economic centers. POLA hosted the formation of the WPCI in November 2008 and has been the lead port for the IAPH Tool Box and Carbon Footprinting working groups. In 2013, POLA implemented the WPCI ESI as it looks to continue to reduce emissions from ships. At the end of 2014, there were over 2,800 participating ships in the ESI database. (*wpci.iaphworldports.org/index.html)*

Further advancement in clean technologies and deployment of cleaner equipment is anticipated in 2014. There will be an increasing number of 2010 or newer trucks into the fleet serving POLA, an increase in the use of alternative fuels, and further development and deployment of electric trucks and cargo handling equipment.

It is anticipated that the impacts from the unusual period of temporary congestion will intensify the container ship emissions at anchorage for the 2015 emissions inventory.

As stated earlier, the Port of Los Angeles, in collaboration with the Port of Long Beach, is in the process of updating the CAAP. It is anticipated that the update will result in the identification of new strategies that will assist in the continued reductions of port-related emissions.

The Port of Los Angeles is America's premier port and has a strong commitment to developing innovative strategic and sustainable operations that benefit Southern California's economy and quality of life. As North America's leading seaport in terms by container volume and cargo value, the Port of Los Angeles facilitated $290 billion in trade during 2014. Port operations and commerce facilitate more than 148,000 jobs (about one in 12) in the City of Los Angeles and 531,000 jobs (or one in 16) in the five-county Southern California region. The San Pedro Bay Ports support more than 1 million California jobs and 3.1 million nationwide.

For more information & the detailed technical report.
(portoflosangeles.org/environment/studies_reports.asp)