Air Emissions Inventories for Ports

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1 June 2015

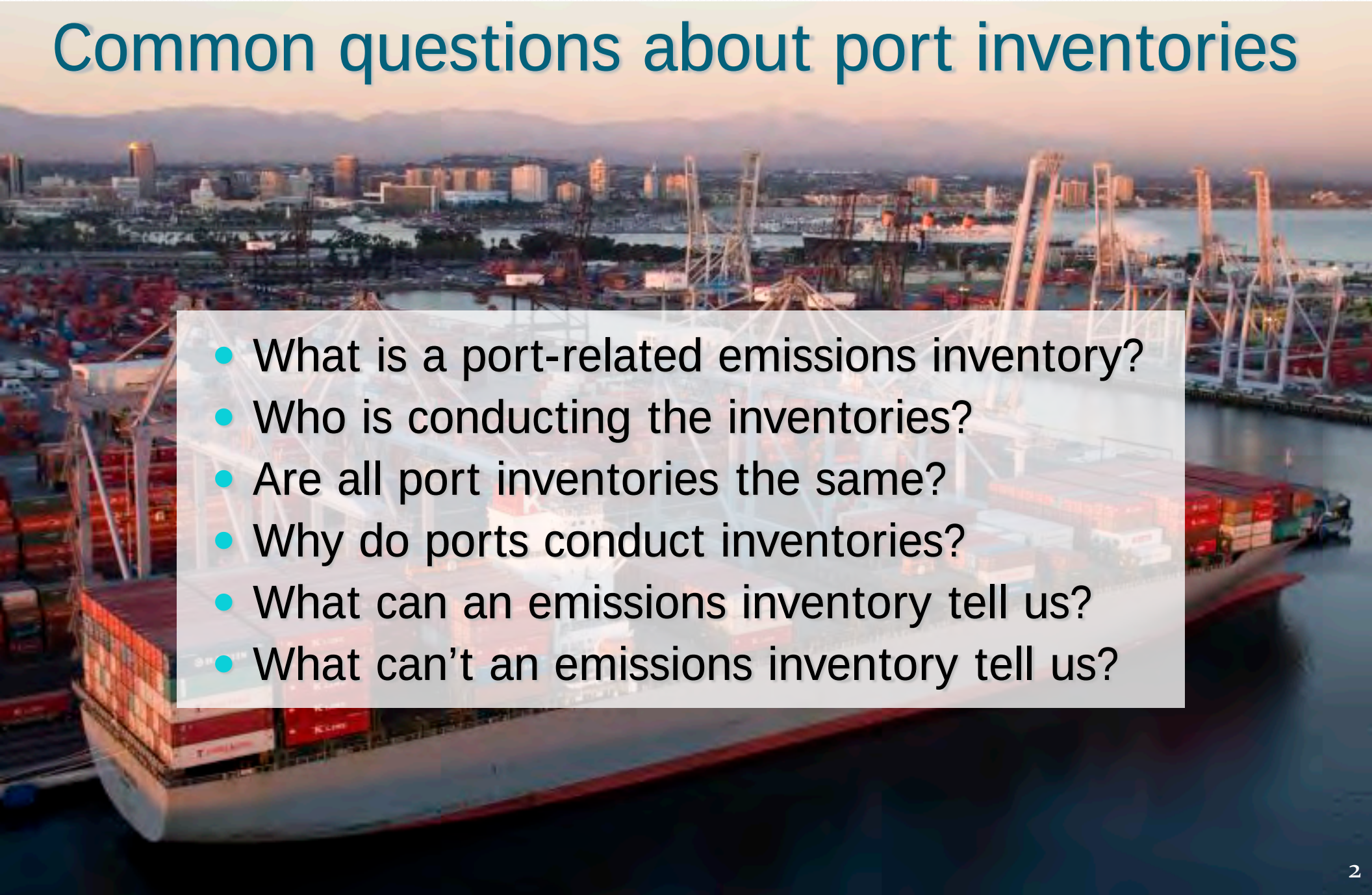
STARCREST CONSULTING GROUP, LLC
ENVIRONMENTAL MANAGEMENT
AIR QUALITY • CLIMATE • SUSTAINABILITY

Starcrest

- Founded 1997 – focus on port/maritime air quality issues
- Conducting activity-based port-related emissions inventories for over 17 years (North America, Asia, Europe)
- Lead consultant for the San Pedro Bay Ports Clean Air Action Plan (Port of Long Beach & Port of Los Angeles)
- Technical lead IAPH WPCI – carbon footprinting initiatives
- Recently completed the IMO 3rd GHG Study for international shipping with UCL, FMI, & others
- Recently completed the IMO *Emission Control & Energy Efficiency Measures for Ships in the Port Area*
- Serving on US EPA's Mobile Source Technical Review Subcommittee – port-related emissions

- Develop dynamic models for scenario analysis & to support technical-based policy decisions

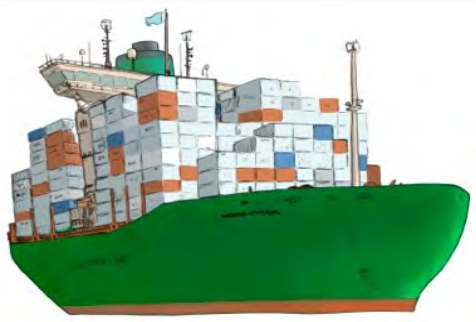
Common questions about port inventories



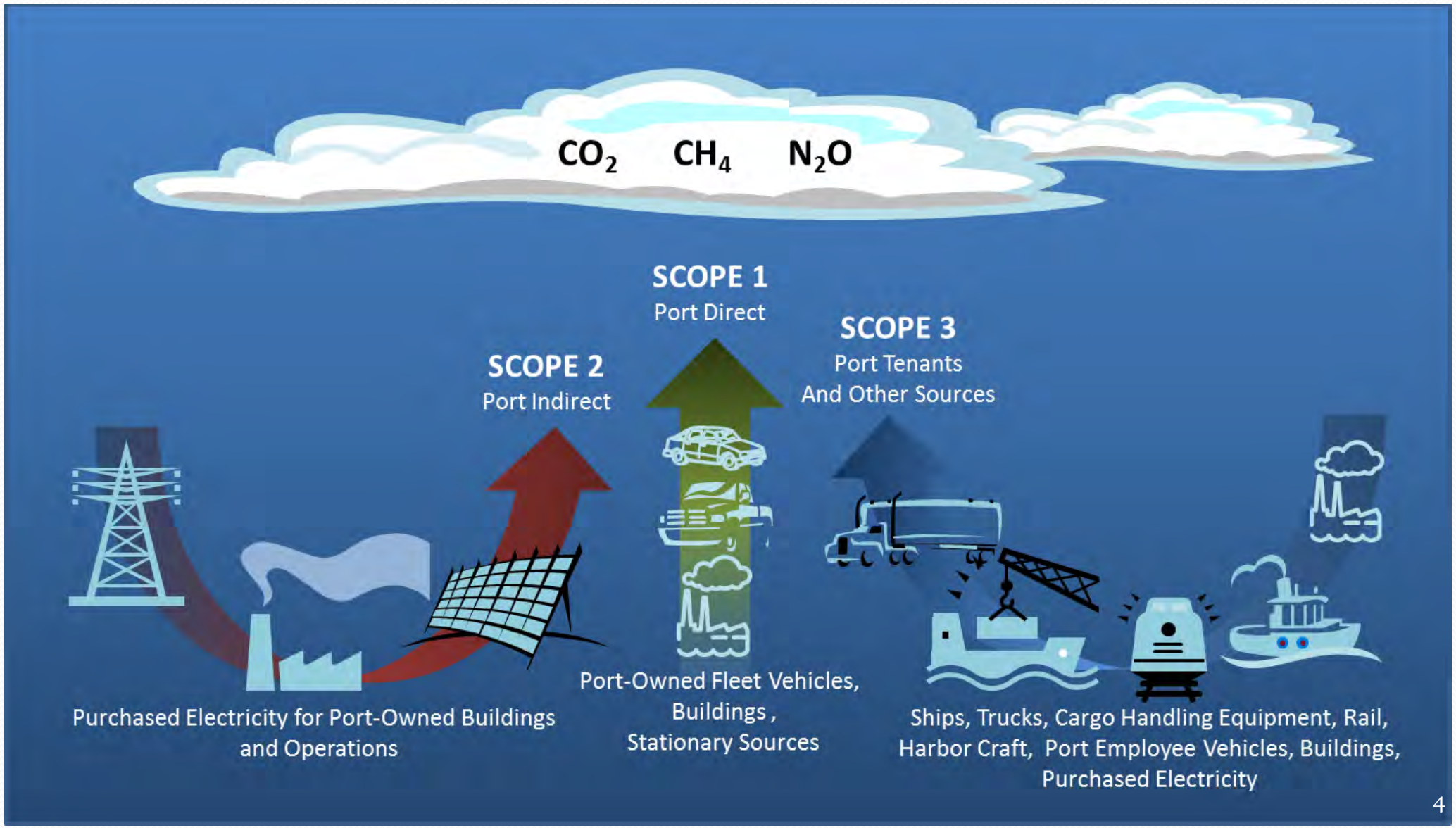
- What is a port-related emissions inventory?
- Who is conducting the inventories?
- Are all port inventories the same?
- Why do ports conduct inventories?
- What can an emissions inventory tell us?
- What can’t an emissions inventory tell us?

What is a port-related emissions inventory?

- Accounting of port-related activities & related emissions
- Within a specified geographical domain
- For a specified time period
- Activities are grouped by mode into source categories - pollutants




Activities are grouped ownership categories or scopes - GHGs



Who is conducting inventories?

- Regulatory agencies
- Ports addressing air emissions & GHGs
  - North America
  - Asia
  - Europe
  - Australia
- Industry

Ports conducting inventories in the US

Are all port inventories the same?

- Inventories are based on their drivers & intended use(s)
- They can differ by:
  - Type
  - Geographical domain
  - Temporal period
  - Pollutants covered
  - Methods & models
  - Level of detail
  - Level of QA/QC

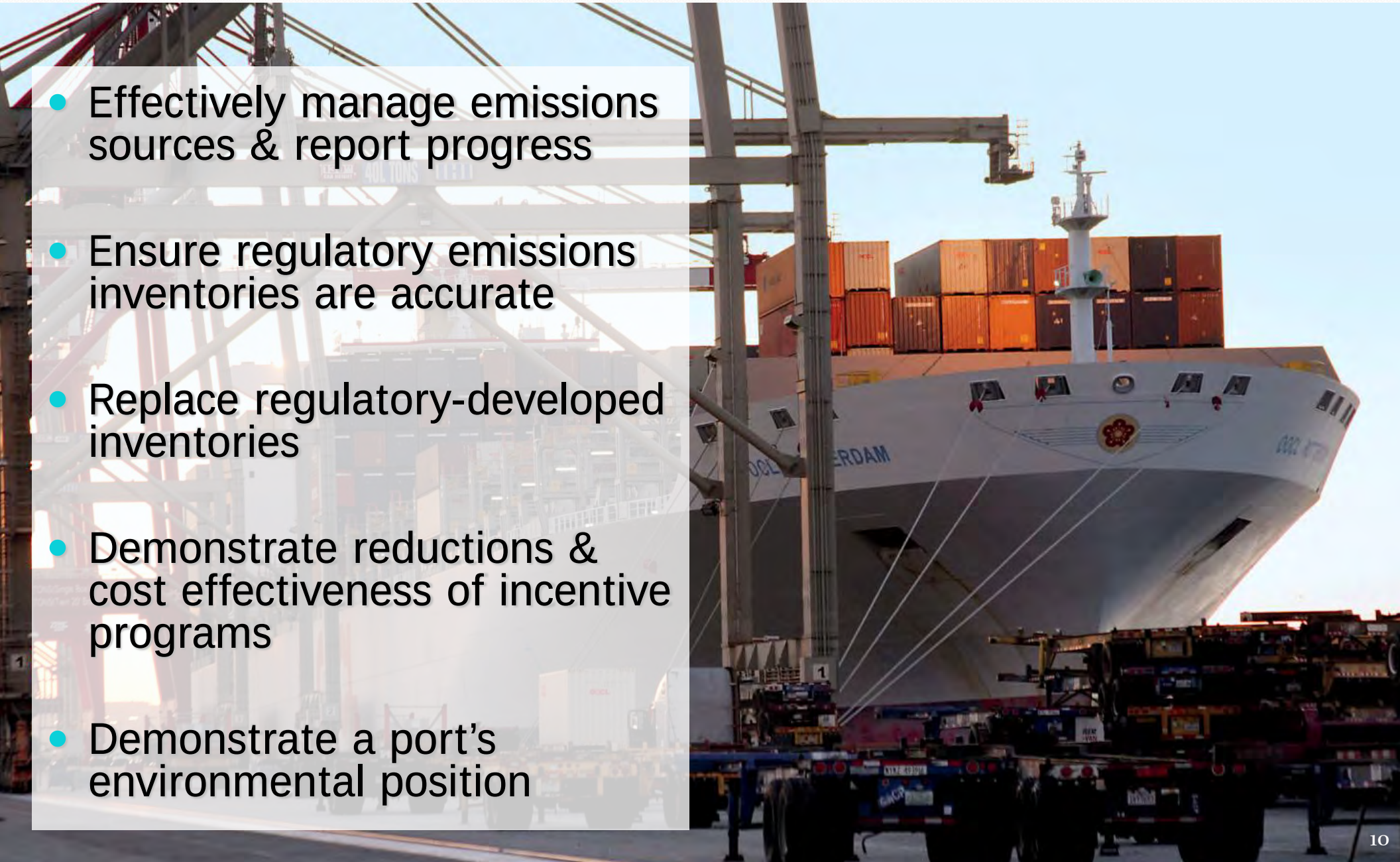
Types of inventories

- Activity-Based
  - Incorporates Locally Generated Activity Data
  - Incorporates Actual Equipment Counts & Parameters
  - Minimizes Assumptions
  - Most Accurate
- Surrogate-Based
  - Incorporates Other Published Port Data
  - Scales Emissions from Surrogate Port
  - Maximizes Assumptions
  - Least Accurate
- Hybrid
  - Incorporates Local & Surrogate Data
  - Limits Some Assumptions
  - More Accurate than Surrogate

Example of level of detail

- Ocean-going vessels
  - By cargo type (container, bulk, roro, etc.)
  - By system (propulsion, auxiliary, & boilers)
  - By propulsion system (direct drive, diesel-eletric, etc.)
  - By engine type (2-stroke, 4-stroke, gas-Otto, gas-Diesel, etc.)
  - By fuel type (HFO, MDO/MGO) & sulfur content
  - By engine tier (IMO Tier)
  - By operational mode (open water, transition, maneuvering, at-berth, at-anchorage)
  - For bulk liquid – at-berth discharging or loading
  - By engine load – using Automated Identification System (AIS)
  - By control technology (scrubber, SCR, EGR, low sulfur fuel, etc.)

Why do ports conduct inventories?



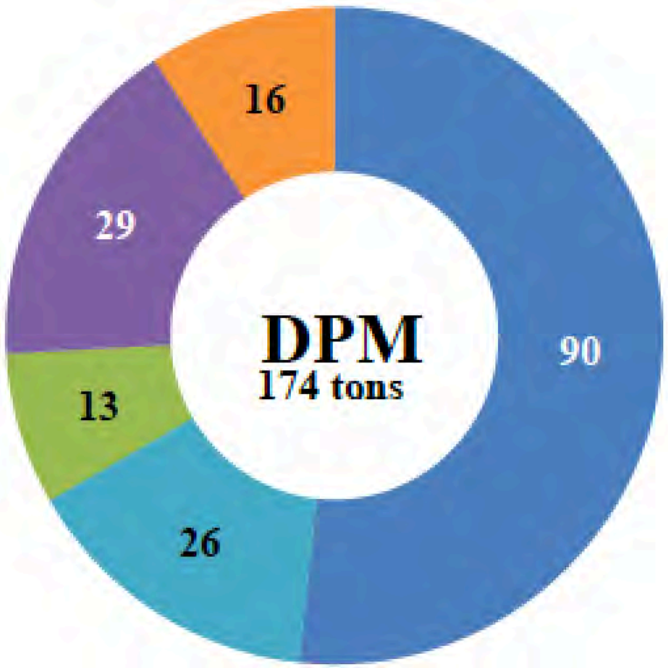
- Effectively manage emissions sources & report progress
- Ensure regulatory emissions inventories are accurate
- Replace regulatory-developed inventories
- Demonstrate reductions & cost effectiveness of incentive programs
- Demonstrate a port's environmental position

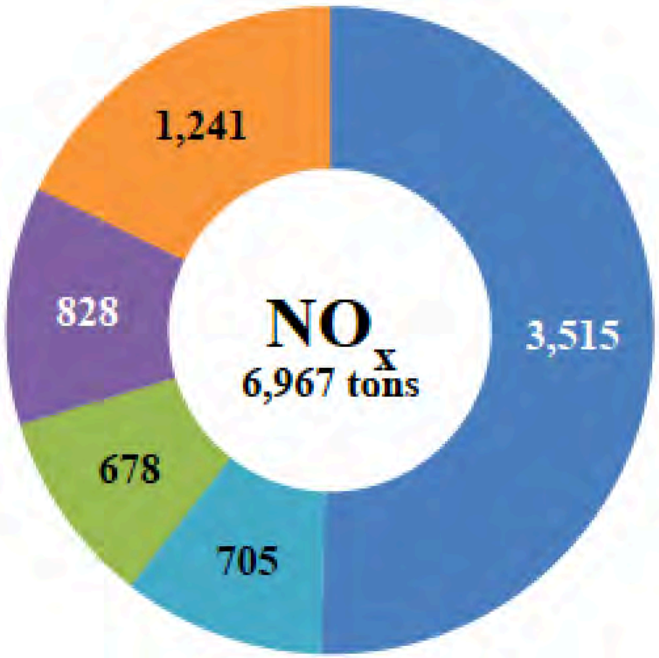
What can an emissions inventory tell us?

Various Examples

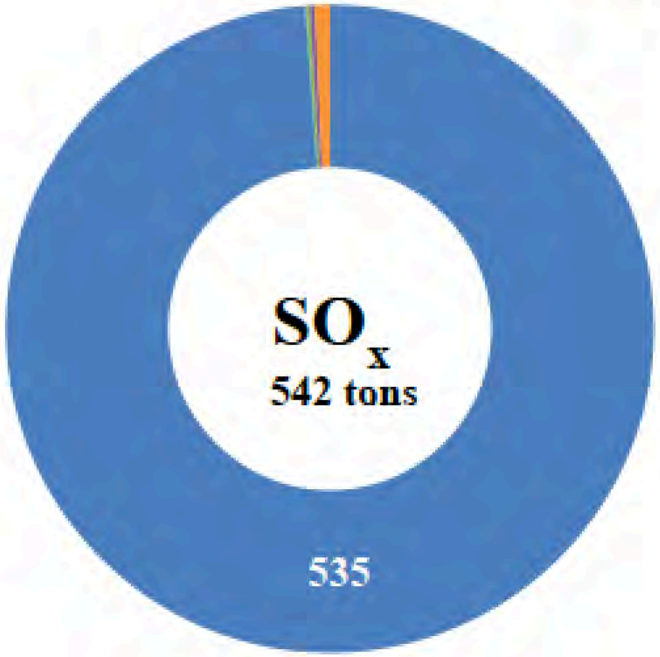
Emissions by pollutant

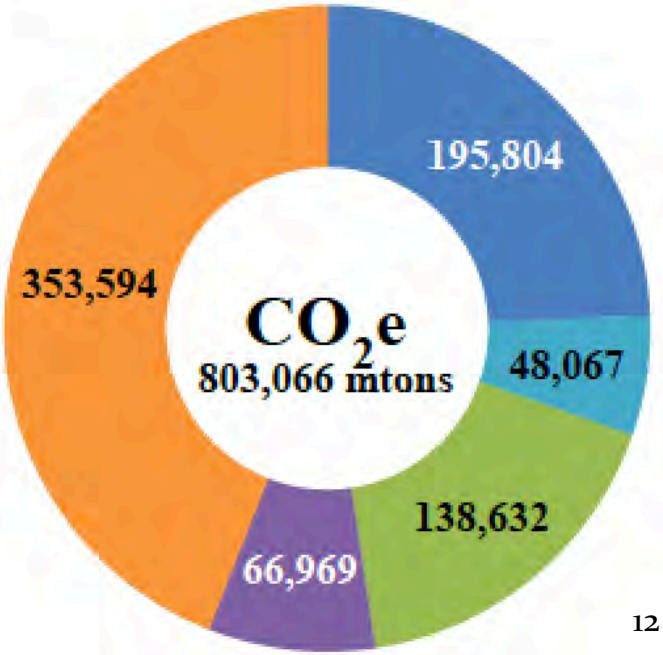
by source category



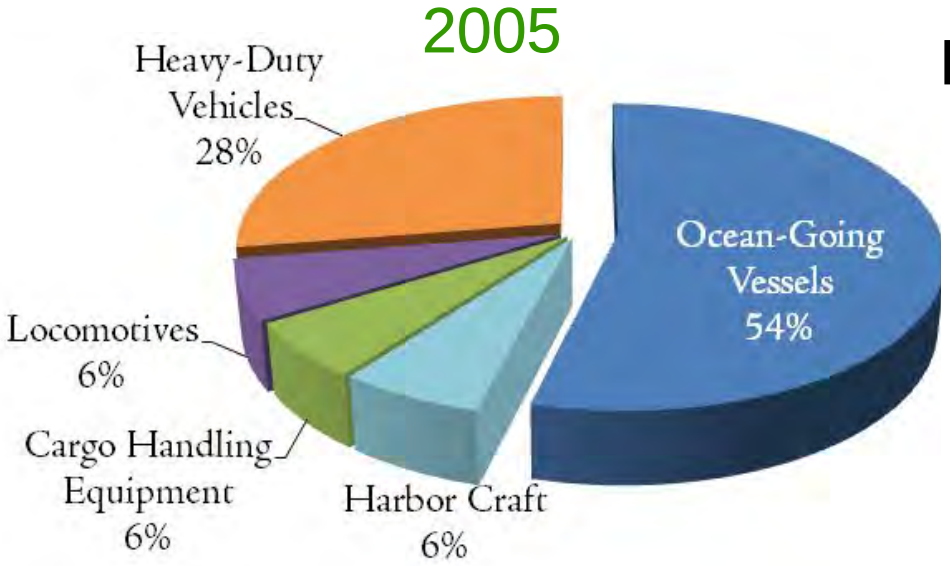


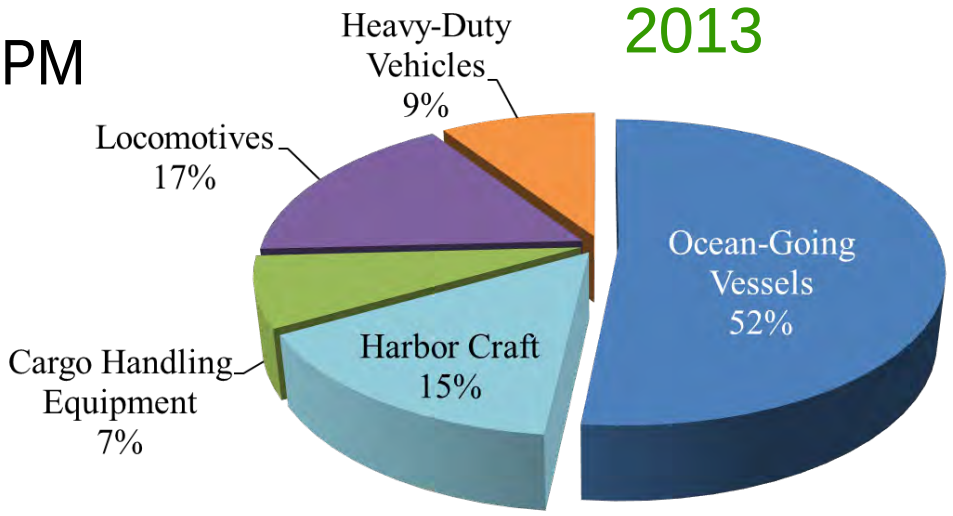
- Ocean-Going Vessels
- Harbor Craft
- Cargo Handling Equipment
- Locomotives
- Heavy-Duty Vehicles



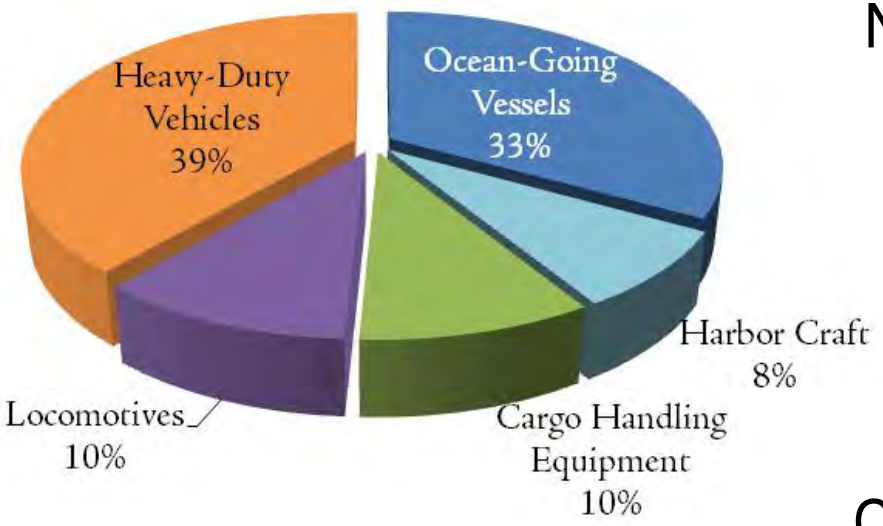


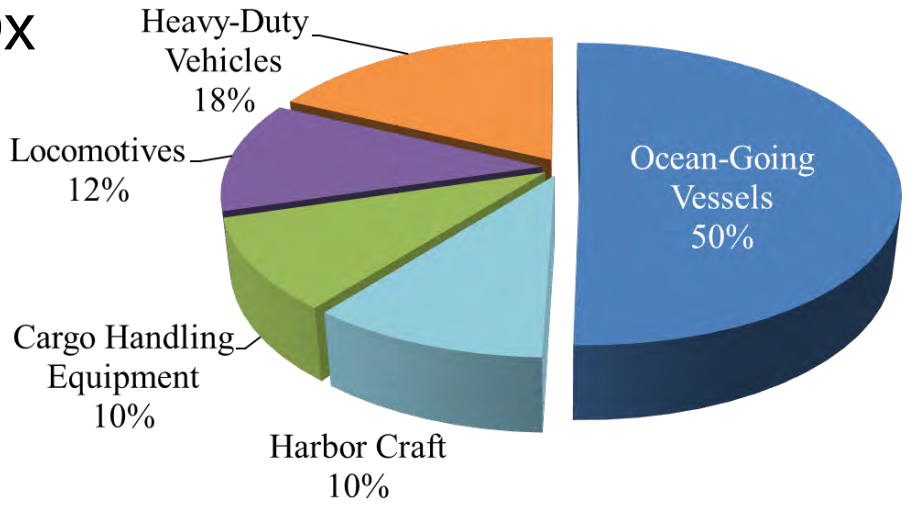
DPM



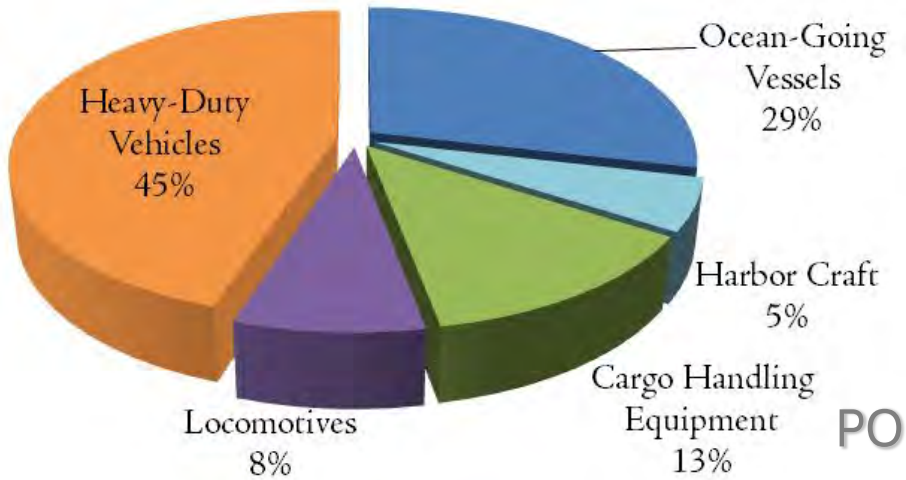


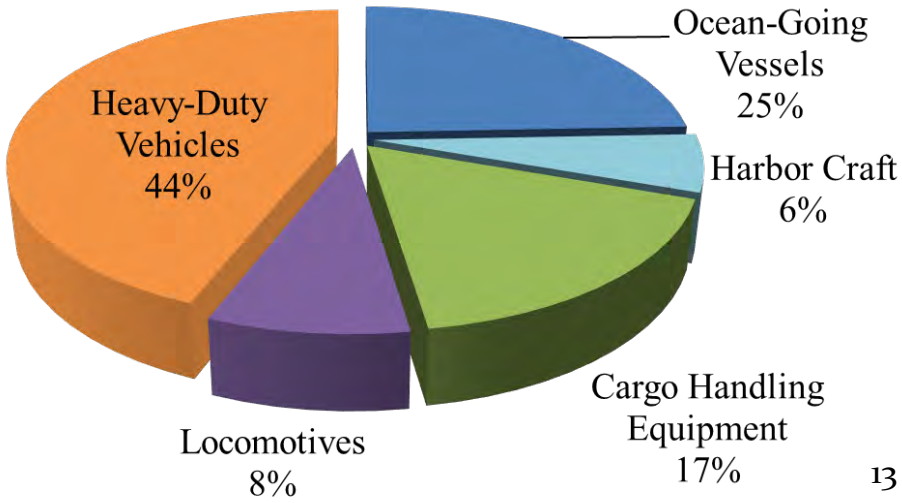
NOx





CO_2e





POLA 2013

2005 - 2013 AIR QUALITY REPORT CARD

THE PORT OF LOS ANGELES

PRIMARY POLLUTANTS DEFINED

DPM = Diesel Particulate Matter
NOx = Oxides of Nitrogen
SOx = 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 Green House Gas contributor)

OVERALL EMISSIONS REDUCTIONS CY 2005-2013

Pollutant	CY 2005-2013 %	tons
DPM	80%	712
$PM_{2.5}$	79%	651
PM_{10}	80%	779
NOx	57%	9,311
SOx	90%	4,645

EMISSIONS PER 10,000 TEU HANDLED

Pollutant	CY 2005-2013 %	tons
DPM	81%	0.96
$PM_{2.5}$	79%	0.88
PM_{10}	81%	1.05
NOx	59%	12.90
SOx	90%	6.24

OCEAN-GOING VESSEL EMISSIONS REDUCTIONS

Pollutant	CY 2005-2013 %	tons
DPM	81%	386
$PM_{2.5}$	78%	353
PM_{10}	81%	456
NOx	34%	1,811
SOx	89%	4,496

HEAVY-DUTY VEHICLE/CLEAN TRUCK EMISSIONS REDUCTIONS

Pollutant	CY 2005-2013 %	tons
DPM	93%	229
$PM_{2.5}$	93%	209
PM_{10}	93%	227
NOx	80%	5,113
SOx	91%	38

HARBOR CRAFT EMISSIONS REDUCTIONS

Pollutant	CY 2005-2013 %	tons
DPM	52%	29
$PM_{2.5}$	52%	27
PM_{10}	52%	29
NOx	47%	615
SOx	91%	6

RAIL EMISSIONS REDUCTIONS

Pollutant	CY 2005-2013 %	tons
DPM	49%	28
$PM_{2.5}$	49%	26
PM_{10}	49%	28
NOx	52%	884
SOx	99%	97

CARGO-HANDLING EQUIPMENT EMISSIONS REDUCTIONS

Pollutant	CY 2005-2013 %	tons
DPM	76%	40
$PM_{2.5}$	73%	36
PM_{10}	73%	39
NOx	57%	888
SOx	84%	8

CO_2 EQUIVALENT REDUCTIONS BY SOURCE TYPE

Source Type	CY 2005-2013 %	metric tons
Ocean-Going Vessels	35%	103,603
Harbor Craft	16%	9,132
Cargo Handling Equipment*	-3%	-3,680
Rail	19%	15,403
Heavy-Duty Vehicles	25%	116,459
TOTAL		**240,917**

** All percentages reflect a reduction in emissions except cargo handling equipment.*

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, NOx, and SOx 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 CARB's Goods Movement Emission Reduction Plan.

Clean Air Action Plan (CAAP) Goals *(% reduction compared to 2005)*	2014	2023
DPM	72%	77%
NOx	22%	59%
SOx	93%	93%

Health Risk Reduction Standard 2020 85%
(% reduction in residential cancer risk compared to 2005)

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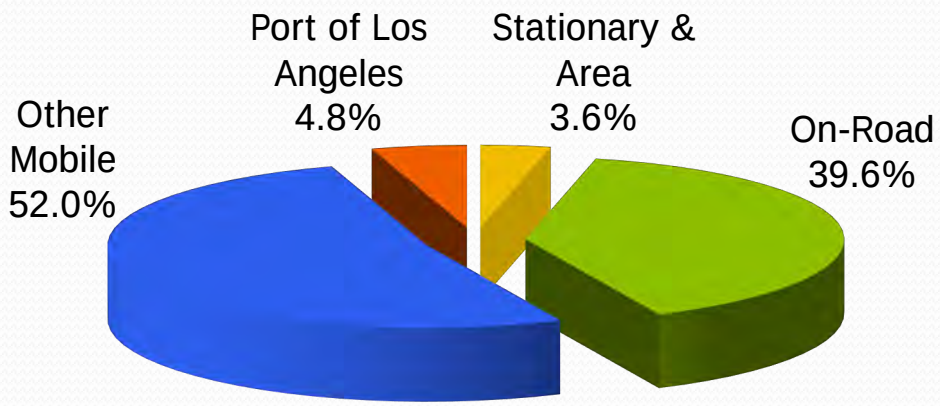
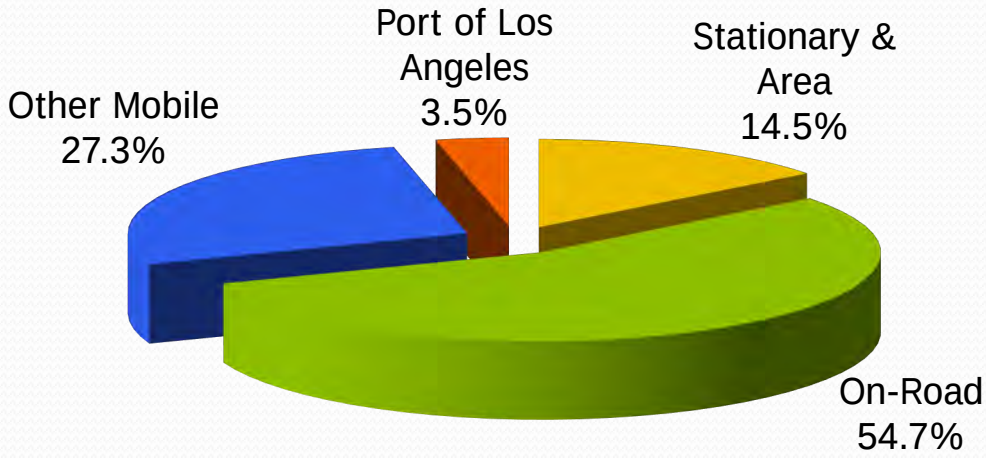
Regional contributions

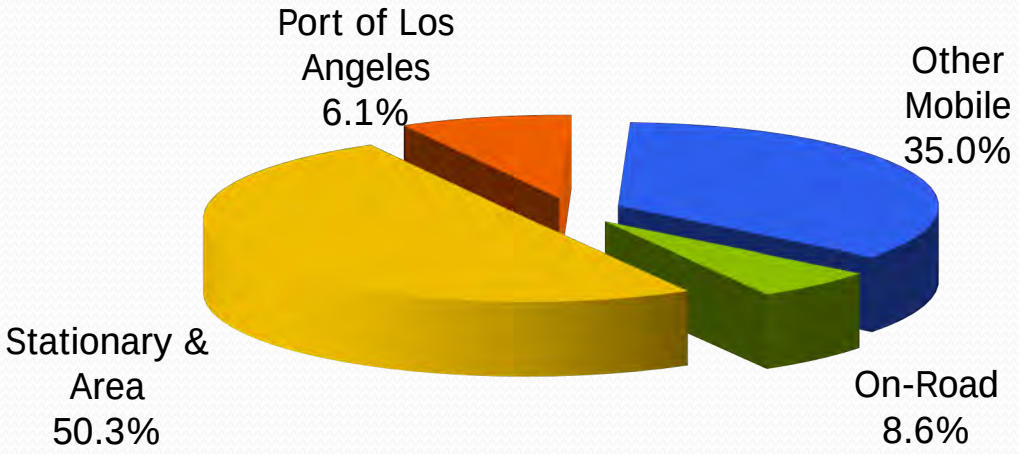
DPM



NOx



SOx



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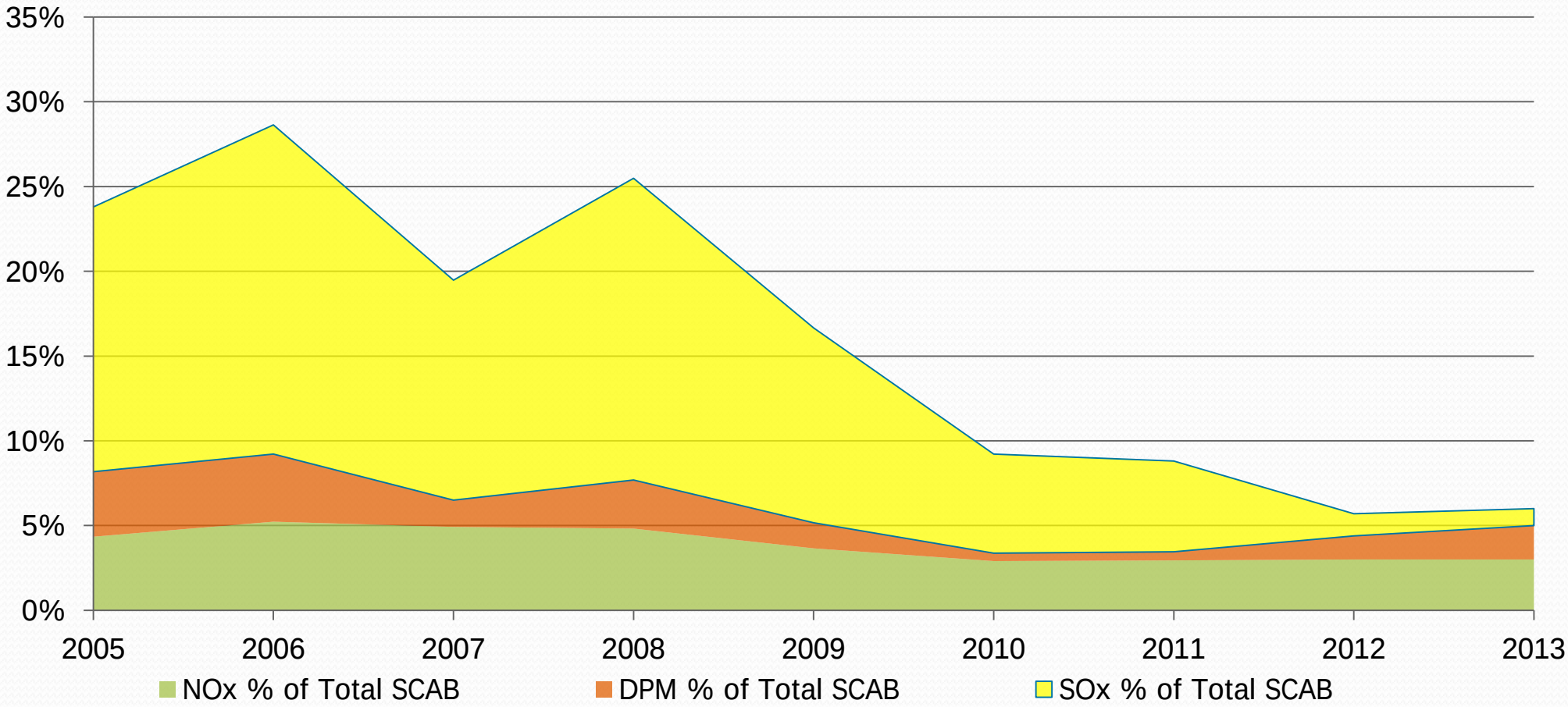
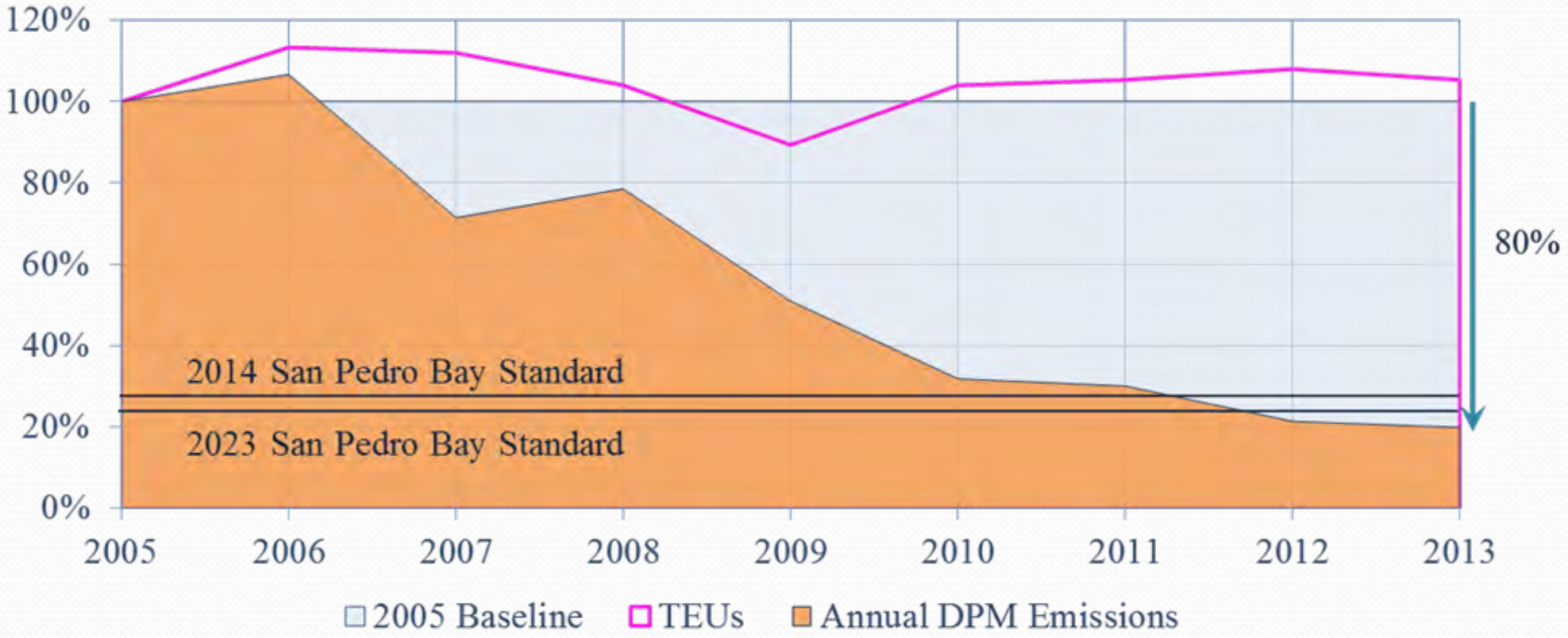
Regional contributions changes



Port-wide emissions compared to a baseline year

DPM



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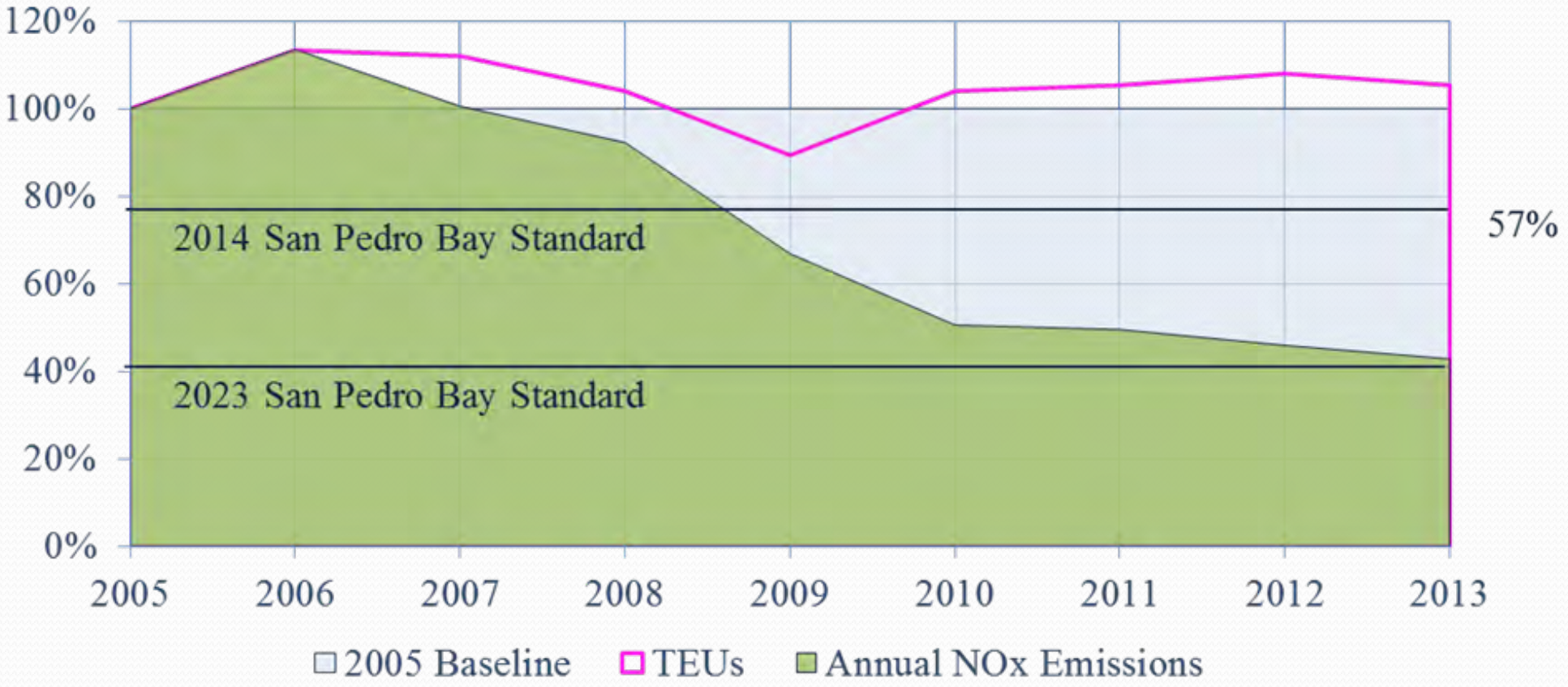
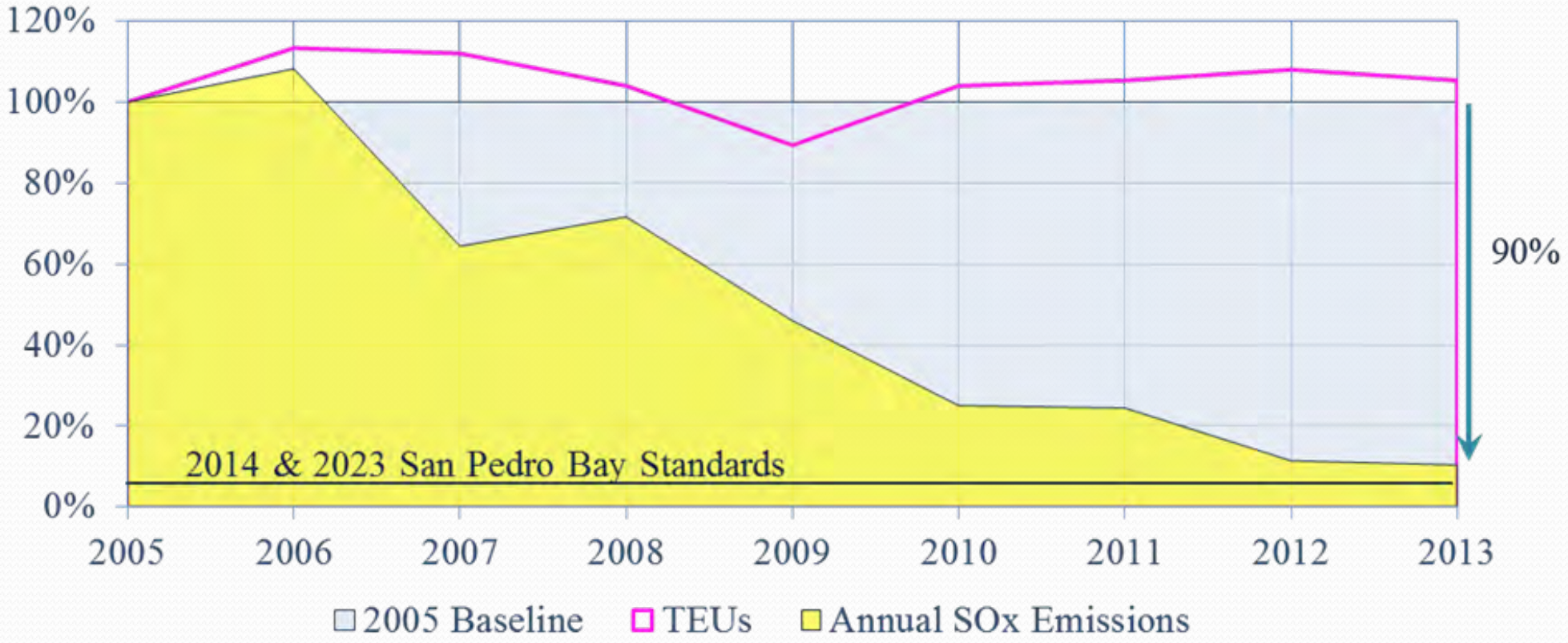
Port-wide emissions compared to a baseline year

NOx



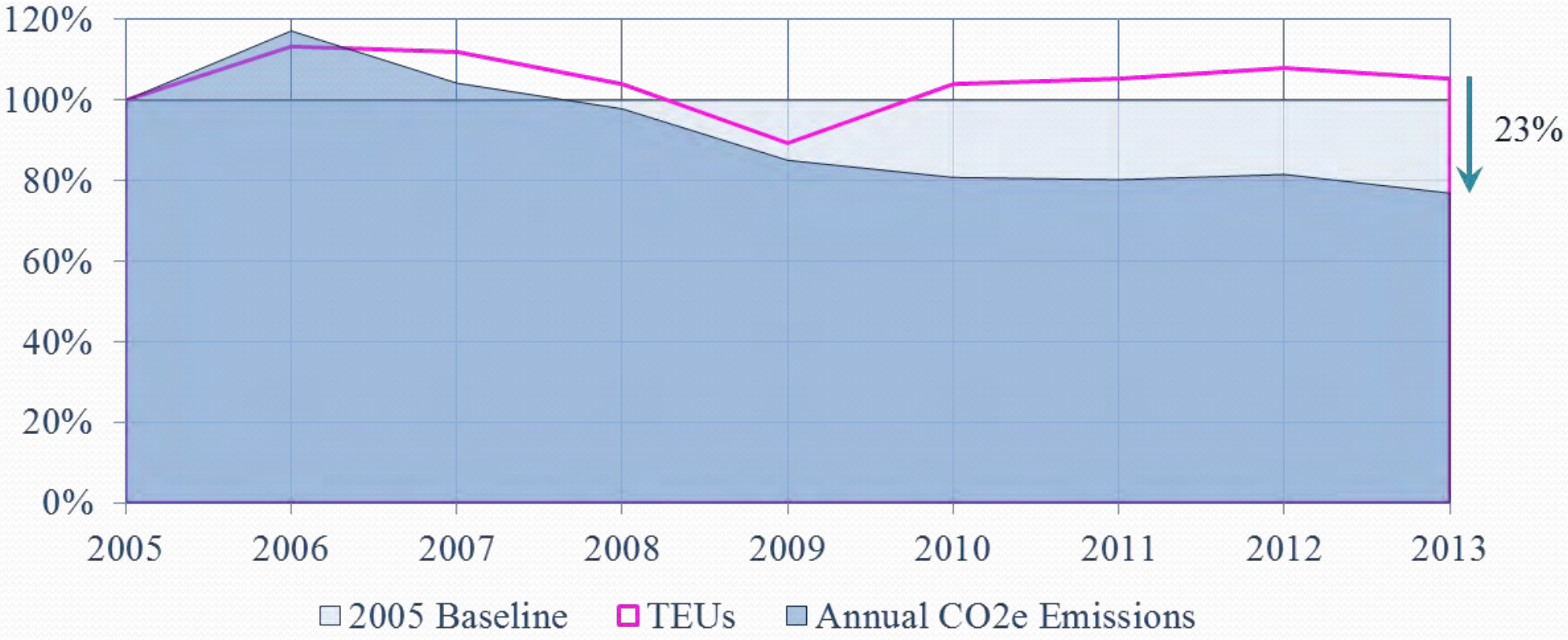
Port-wide emissions compared to a baseline year

SOx

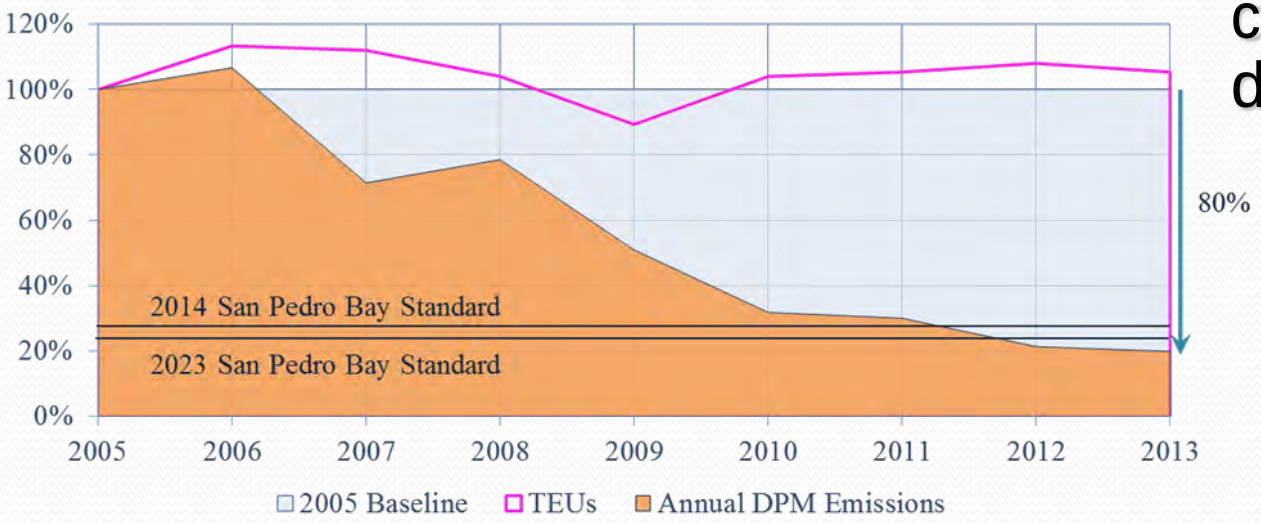


Port-wide emissions compared to a baseline year

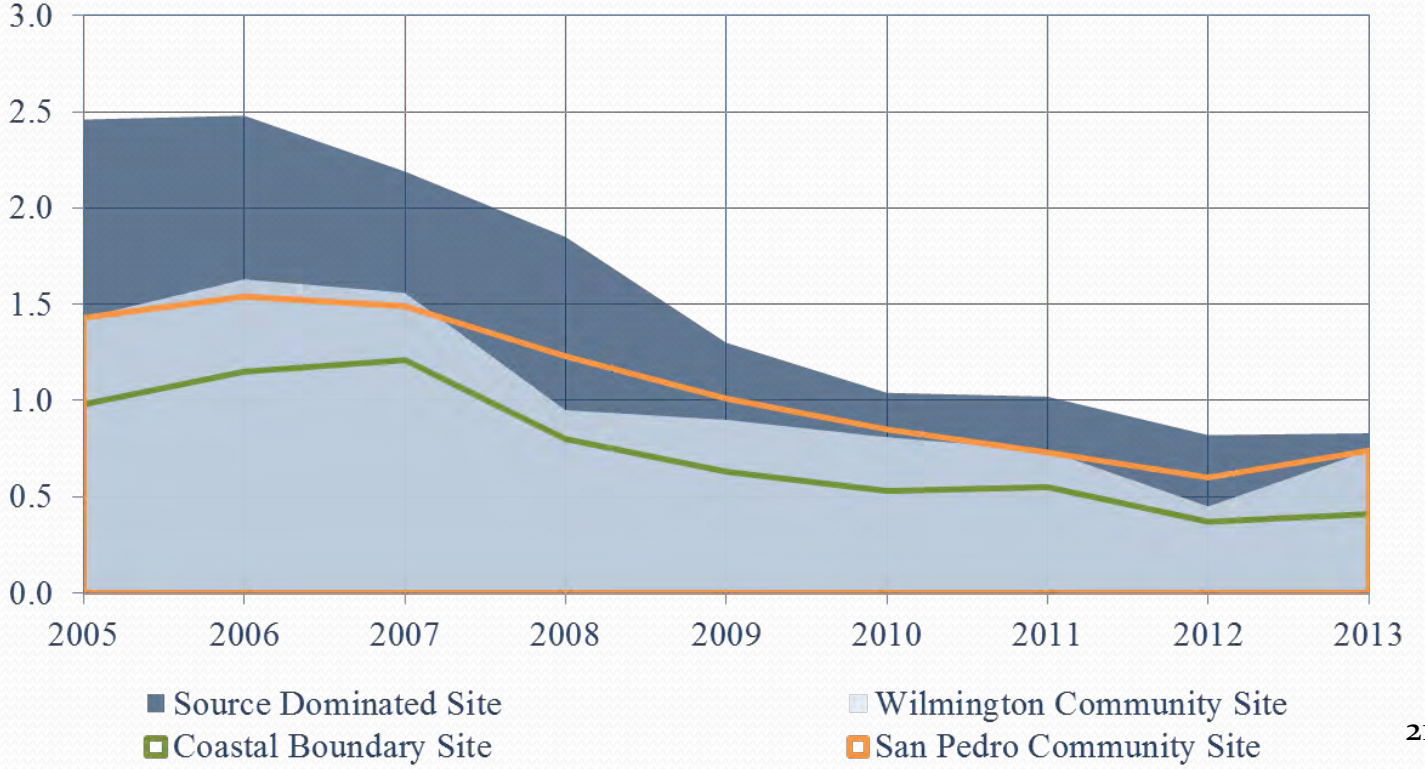
CO_2e



DPM



Port-wide emissions compared to air monitoring data



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Efficiency changes compared to baseline year

2005

Port-wide DPM efficiencies have continued to improve since 2005 with an 81% reduction from 1.18 to 0.22 tons per 10,000 TEUs.

Port-wide NOx efficiencies have continued to improve since 2005 with a 59% reduction from 21.75 to 8.85 tons per 10,000 TEUs.

Port-wide SOx efficiencies have continued to improve since 2005 with a 90% reduction from 6.93 to 0.69 tons per 10,000 TEUs.

Port-wide CO2e efficiencies have continued to improve since 2005 with a 27% reduction from 1,395 to 1,020 tons per 10,000 TEUs.

2013

DPM

2005 476 tons

2013 90 tons

2005 245 tons

2013 16 tons

POLA 2013

Source category emissions compared to baseline (2005 v 2013)

2005 57 tons

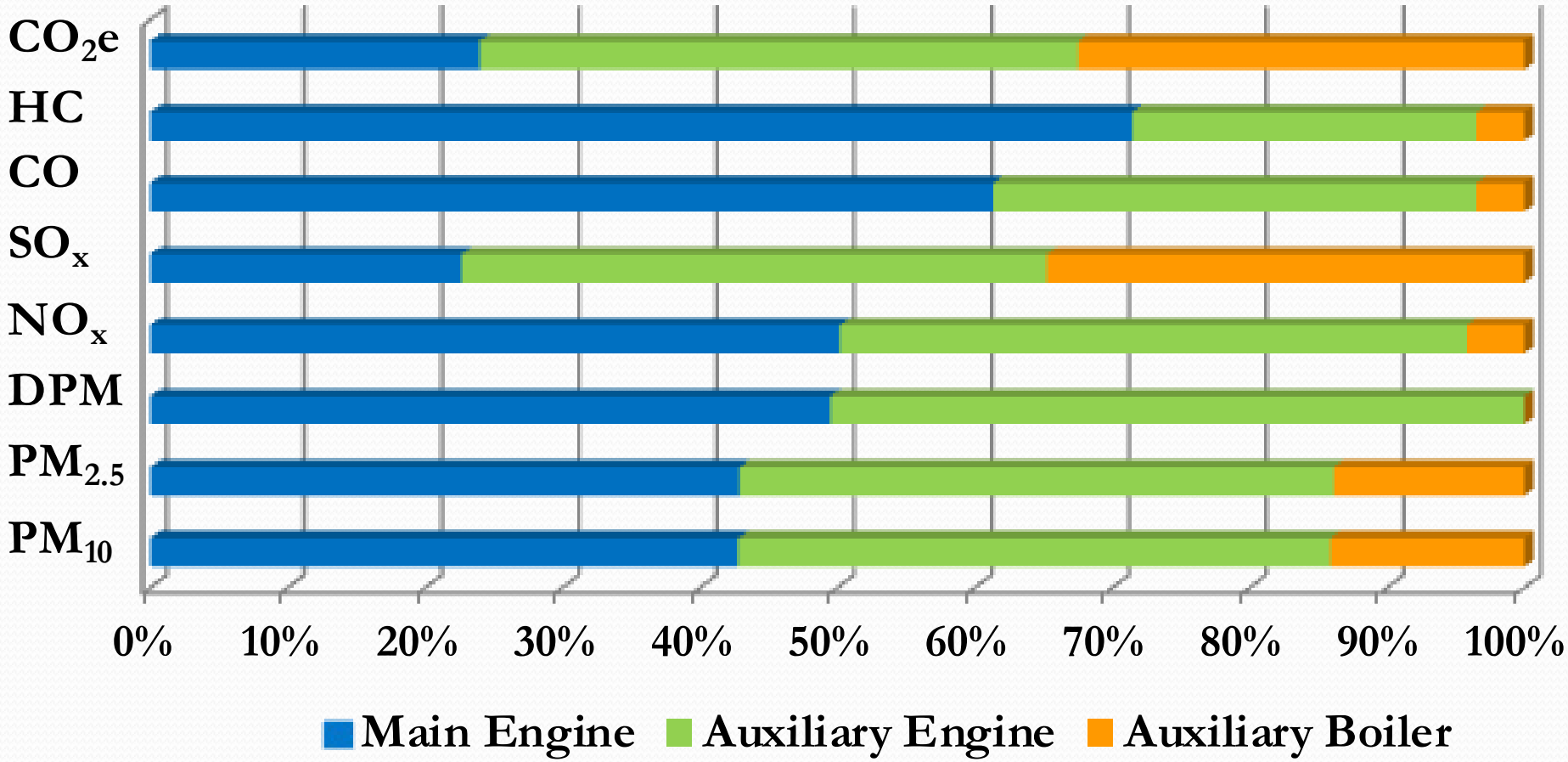
2013 29 tons

2005 53 tons

2013 13 tons

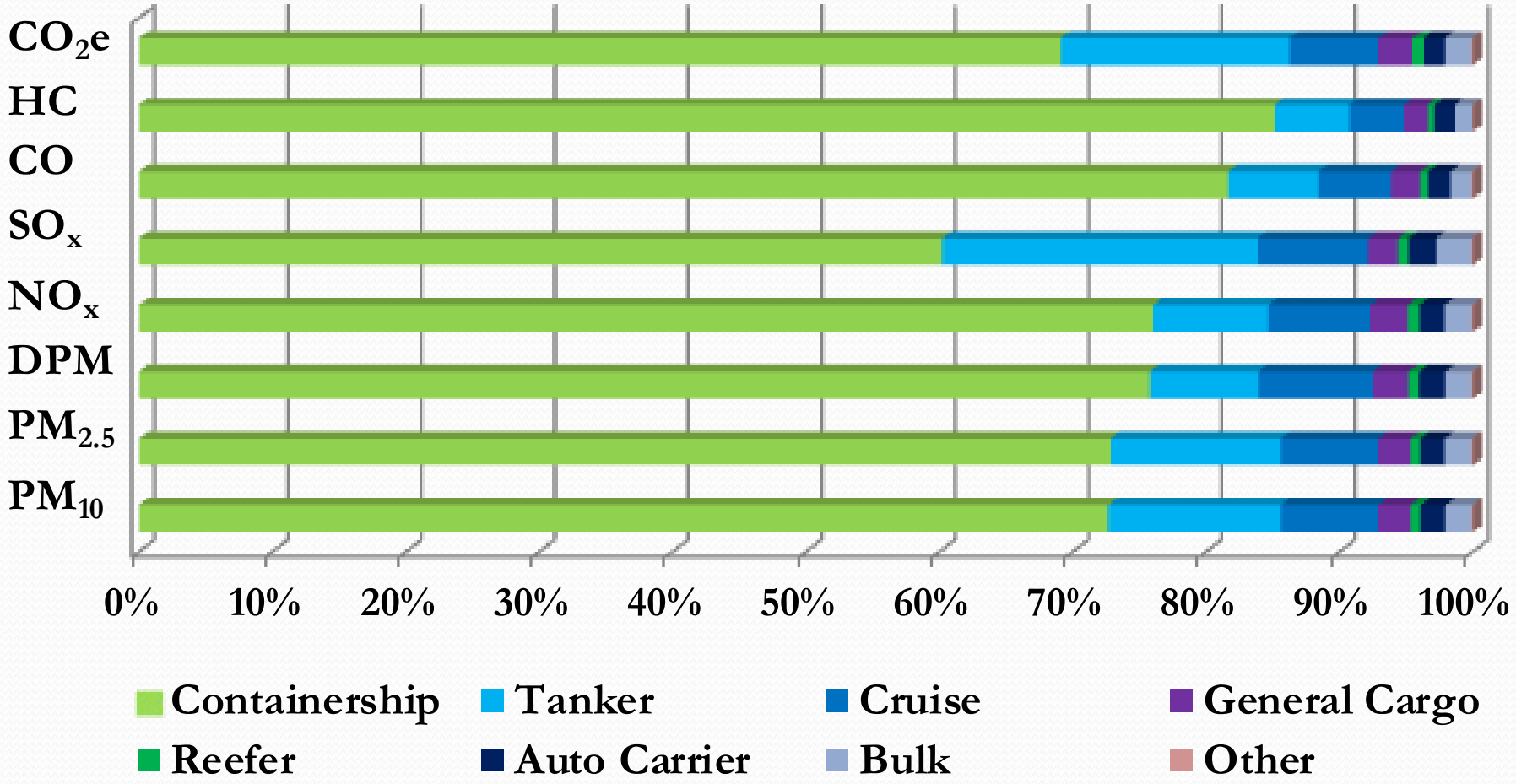
Emission contributions within source category

Ocean-going vessels



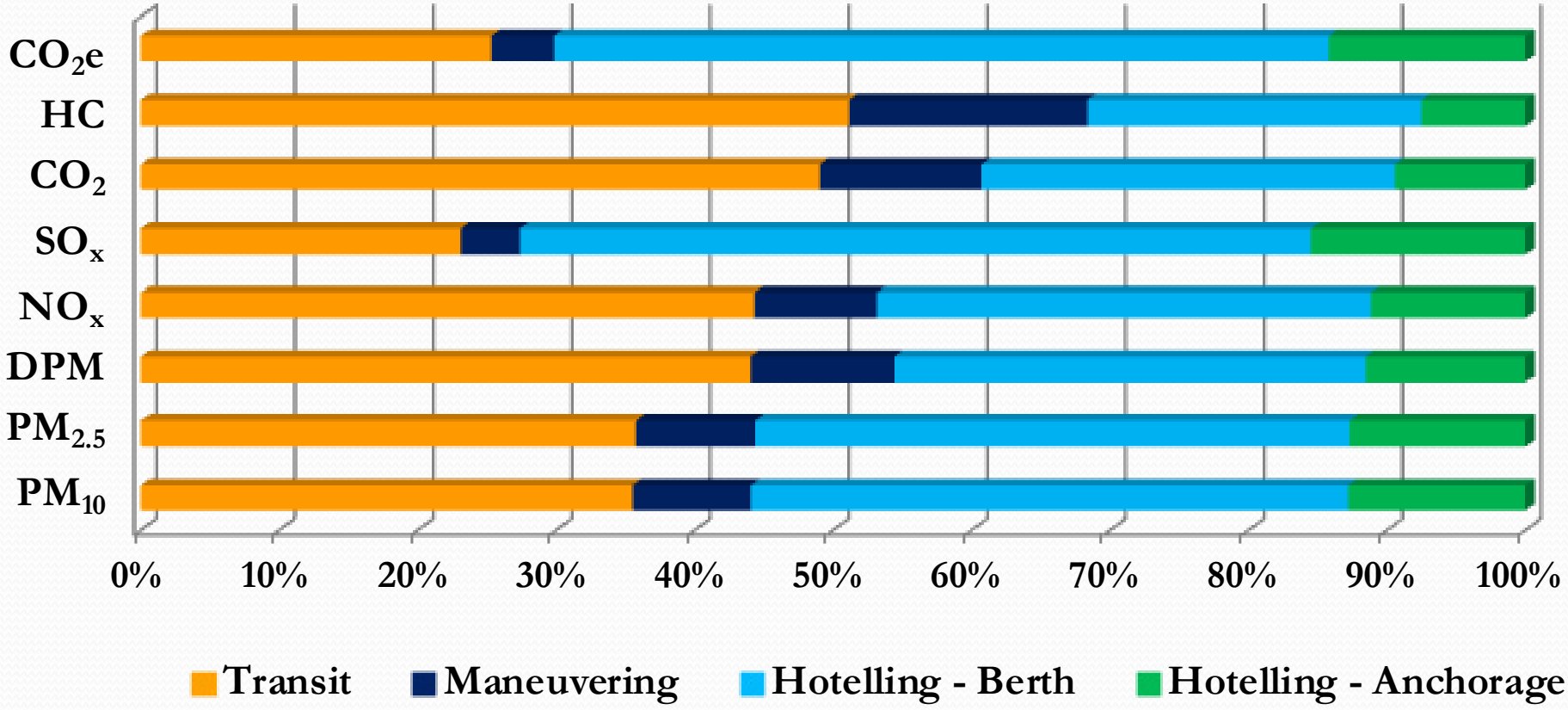
Emission contributions within source category

Ocean-going vessels



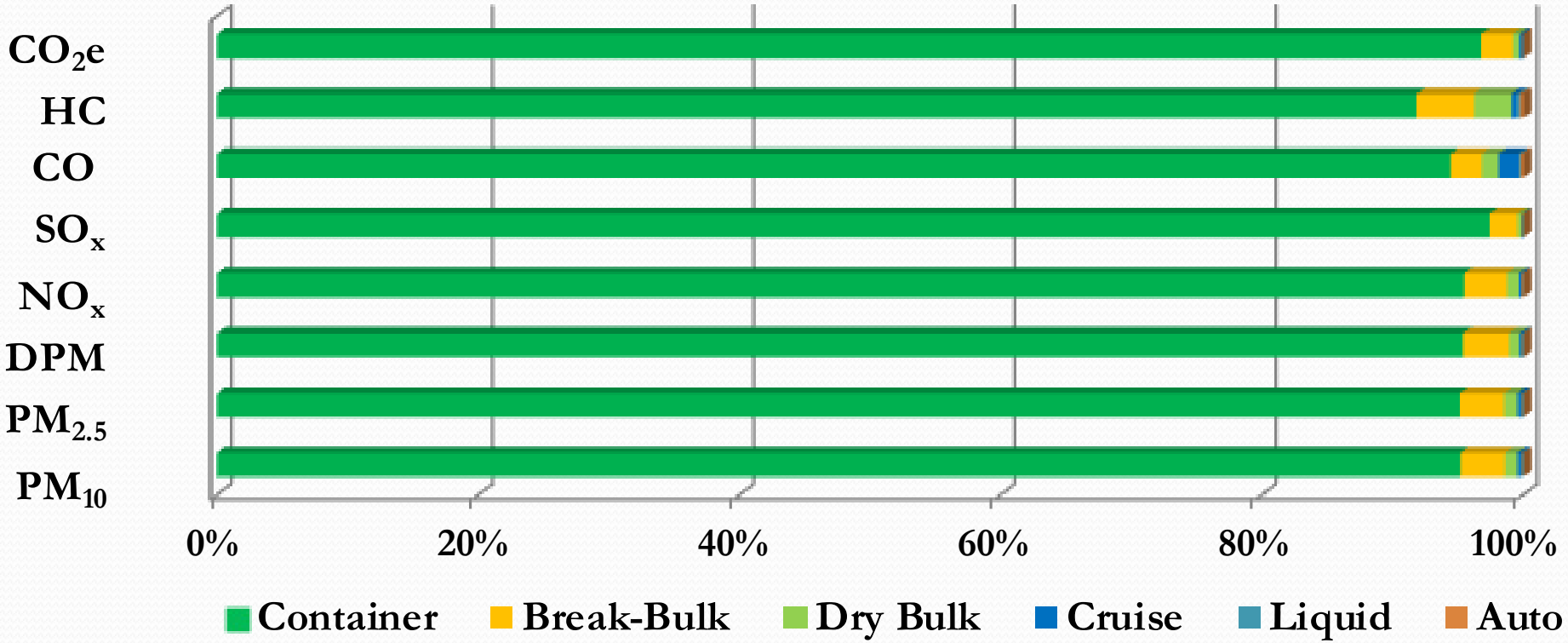
Emission contributions within source category

Ocean-going vessels



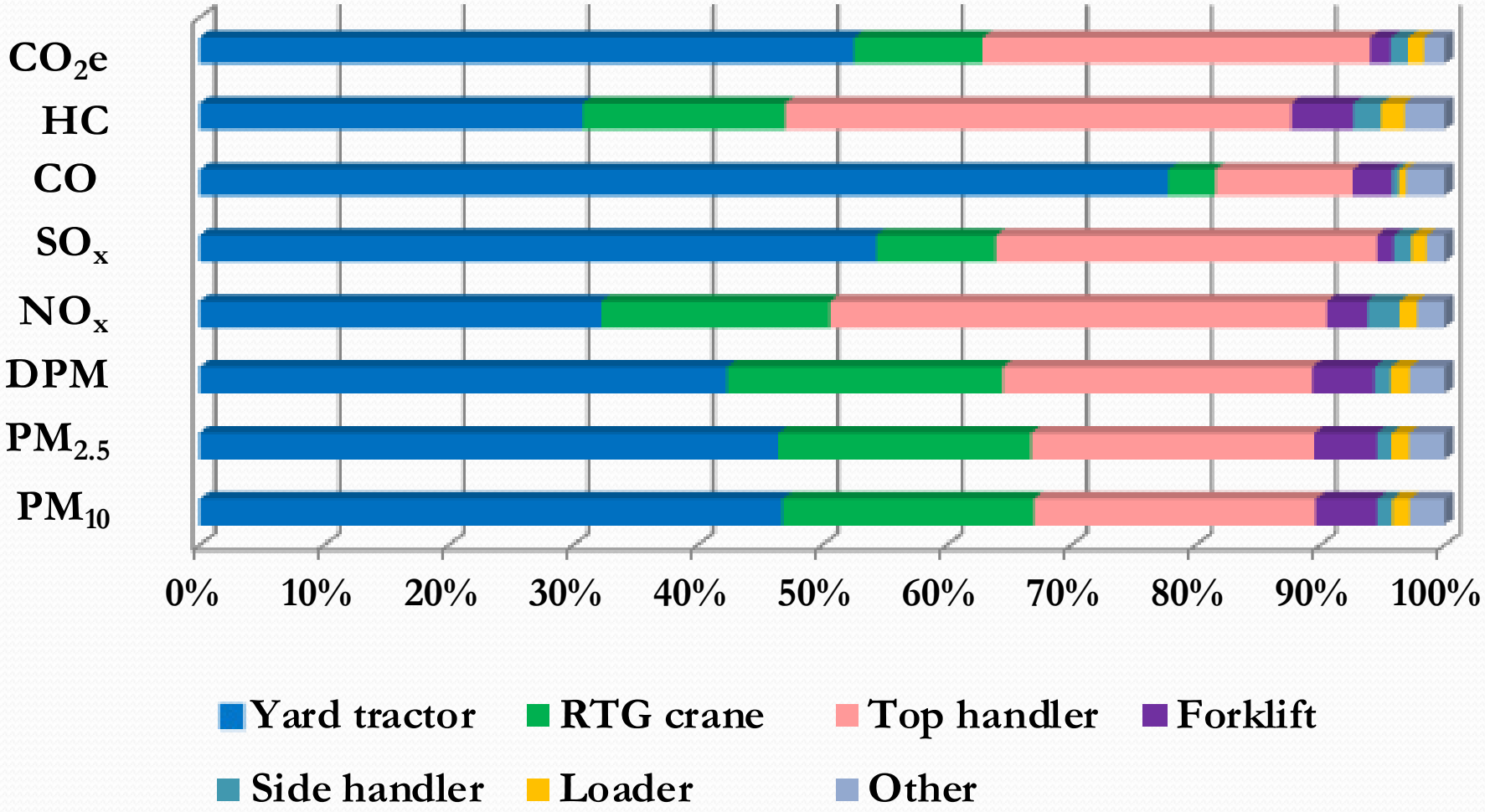
Emission contributions within source category

Cargo handling equipment



Emission contributions within source category

Cargo handling equipment



Efficiency changes

POLA 2013

Year	All Arrivals	Containership Arrivals	TEUs	Average TEUs/Call
2013	2,033	1,463	7,867,863	5,378
2012	1,968	1,370	8,077,714	5,896
2011	2,072	1,376	7,940,511	5,771
2010	2,035	1,355	7,831,902	5,780
2009	2,010	1,355	6,748,995	4,981
2008	2,241	1,459	7,849,985	5,380
2007	2,528	1,577	8,355,038	5,298
2006	2,707	1,632	8,469,853	5,190
2005	2,516	1,479	7,484,625	5,061
Previous Year (2013-2012)	**3%**	**7%**	**-3%**	**-9%**
CAAP Progress (2013-2005)	**-19%**	**-1%**	**5%**	**6%**

POLB 2013

Year	Container Throughput (TEU)	Cargo Throughput (metric tons)	All Arrivals	Containership Arrivals	Average TEU per call
2005	6,709,818	78,560,726	2,690	1,332	5,037
2013	6,730,574	77,929,480	1,921	911	7,388
Change (%)	**0.3%**	**-1%**	**-29%**	**-32%**	**47%**

What can't an emissions inventory tell us?

- Can't tell you health effects
- They are typically present estimates of the past
  - Not real time
  - Not actuals
- They might not align with air monitors

Notes on standardization

- Methods are generally standard
- Currently many port-related emissions inventories are “bespoke”
- Carbon footprinting guidance by IAPH
- Industry & others

Danke!
Questions?

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AIR QUALITY • CLIMATE • SUSTAINABILITY

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