SECTION 8 COMPARISON OF 2009 AND 2005 FINDINGS AND EMISSION ESTIMATES

The emissions for 2009 and 2005 calendar year activity are compared in this section. Each subsection compares findings for that source category and presents the emissions comparisons. For each specific source category, if there was a methodological change in 2009, then the 2005 emissions were recalculated using 2005 activity with the new 2009 methodology to provide a valid basis for comparison. If there was no change in methodology, then the emissions included in the previous 2008 EI report were used for the comparison.

Table 8.1 and Figure 8.1 illustrate the differences in vessel calls and container cargo throughputs as well as the average TEUs per containership call between 2005 and 2009. In 2009, there was a 24% decrease in total TEU throughput, and 15% decrease in overall calls and containership calls compared to 2005. The average TEUs handled per containership call also decreased 11% in 2009 possibly due to containerships either running less full, calling at more west-coast berths per service, or discharging more cargo at other ports.

Table 8.1: TEUs and Vessel Call Comparison, %

Year	All Inbound Call	Containership Calls	TEUs	Average TEUs/Call
2005	2,690	1,332	6,709,818	5,037
2009	2,287	1,132	5,067,597	4,477
Change (%)	**-15%**	**-15%**	**-24%**	**-11%**

Figure 8.1: TEUs and Vessel Call Comparison, %

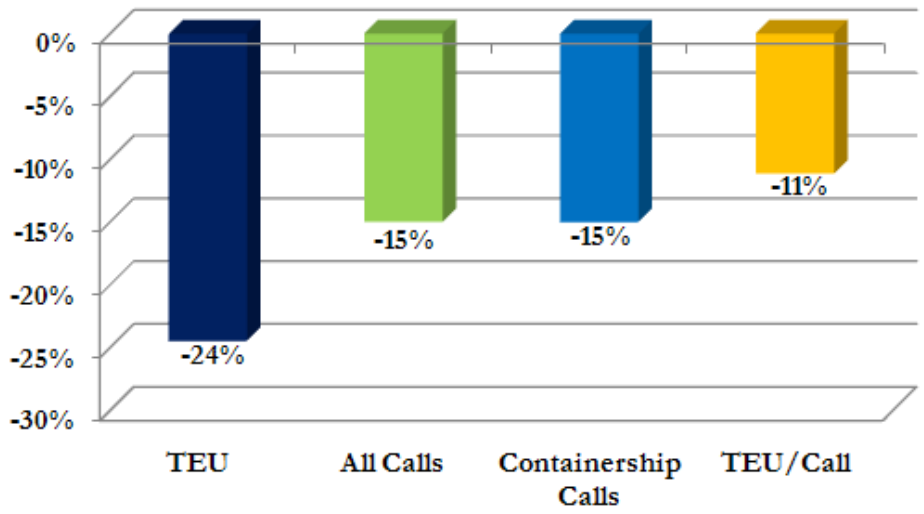


Table 8.2 and Figure 8.2 present the total net change in emissions for all source categories in 2009 as compared to 2005. Port-related emissions decreased for all pollutants by 35% to 52% in 2009 when compared to 2005 due to reduced throughput levels, implementation of emission reduction strategies, and improvement in the terminals' operational efficiency.

Table 8.2: 2009-2005 Port-wide Emissions Comparison, tpy and %

EI Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC
2005	1,085	915	977	15,588	6,740	3,215	779
2009	543	453	471	10,129	3,661	1,819	483
Change (tpy)	**-542**	**-462**	**-507**	**-5,459**	**-3,079**	**-1,396**	**-295**
Change (%)	**-50%**	**-51%**	**-52%**	**-35%**	**-46%**	**-43%**	**-38%**

Figure 8.2 compares the 2005-2009 percent change in emissions to percent change in throughput, including containerized cargo in TEU and total tonnage in metric tons (MT).

Figure 8.2: 2009-2005 Port-wide Emissions Comparison, %

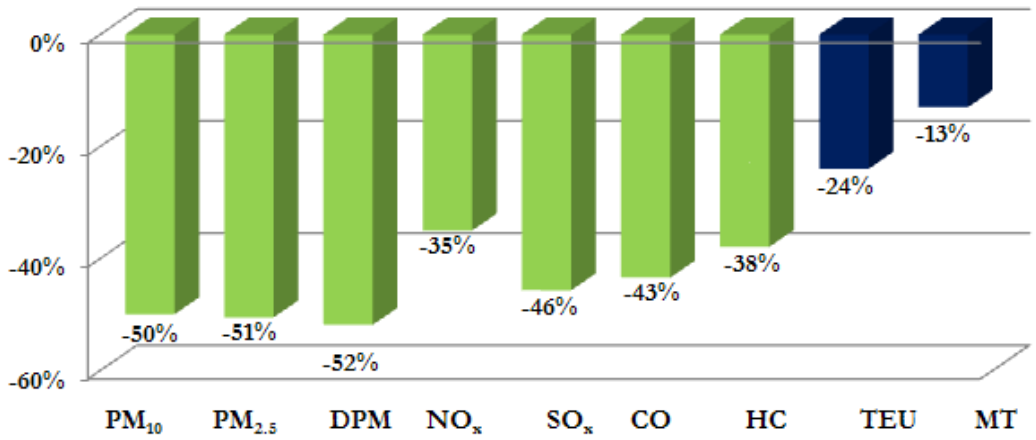


Table 8.3 presents the greenhouse gas emissions comparison between 2009 and 2005.

Table 8.3: 2009-2005 Port-wide GHG Emissions Comparison, metric tons and %

EI Year	CO_2 Equivalent	CO_2	N_2O	CH_4
2005	994,298	968,523	81	32
2009	778,039	769,415	27	17
Change (tpy)	**-216,259**	**-199,108**	**-54**	**-14**
Change (%)	**-22%**	**-21%**	**-67%**	**-46%**

Table 8.4 and Figure 8.3 show the tons of emissions per 10,000 TEU in 2005 and 2009. The tons of emissions per 10,000 TEU decreased in 2009 which was an improvement from 2005.

Table 8.4: 2009-2005 Port-wide Tons of Emissions per 10,000 TEU and %

EI Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC	CO_2 Equivalent
2005	1.6	1.4	1.5	23.2	10.0	4.8	1.2	1,630.0
2009	1.1	0.9	0.9	20.0	7.2	3.6	1.0	1,688.8
Change (%)	**-34%**	**-34%**	**-36%**	**-14%**	**-28%**	**-25%**	**-18%**	**4%**

Figure 8.3: 2009-2005 Port-wide Tons of Emissions per 10,000 TEU Comparison%

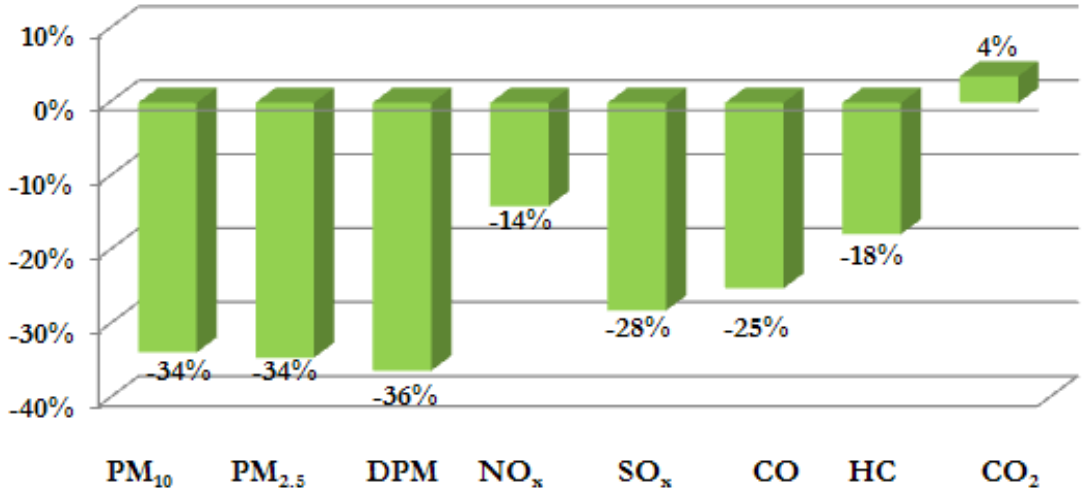


Table 8.5 compares emissions change by source category from 2005 to 2009. Emissions from OGV, CHE, rail locomotives and trucks decreased for all pollutants when comparing 2005 and 2009 emissions. OGV emissions decreased due to lower TEU throughput and the implementation of CARB's Marine Fuel Regulation (which became effective in July 2009) and the Port's VSR and Fuel Incentive Programs. Harbor craft emissions decreased for NO_x and SO_x emissions, while PM emissions did not change and CO and HC emissions increased. The small increase in CO and HC for harbor craft is directly related to change in activity level with lesser impact from introduction of cleaner engines that do not have lower CO and HC standards. The decrease in emissions for cargo handling equipment was due to lower activity in 2009 and the continued replacement, and retrofit of existing cargo handling equipment due to the implementation of CAAP's measure for CHE and CARB's CHE regulation. The decrease in rail emissions was primarily due to lower activity in 2009 and cleaner fleet of switcher and line-haul locomotives operating at the Port. Truck emissions decreased significantly in 2009 because of the reduced total TEU throughput, implementation of the Port's Clean Truck Program resulting in accelerated introduction of newer trucks, lower overall idling times, and decreased total vehicle miles travelled.

It should be noted that the 2009 truck emissions were estimated based on call-weighted model year distribution which represented a change in methodology compared to previous inventories. For 2005, there was no significant difference between the population and call-weighted model year distributions. However, for comparison purposes, 2005 truck emissions which were originally estimated based on the population-weighted model year distribution, were re-estimated based on the call-weighted distribution.

Table 8.5: Port-wide Emissions Comparison by Source Category, tpy and %

	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC
2005							
Ocean-going vessels	699	559	591	6,381	6,610	574	246
Harbor craft	46	42	46	1,120	5	298	71
Cargo handling equipment	36	33	36	1,137	11	342	50
Rail locomotives	43	40	43	1,273	76	179	66
Heavy-duty vehicles	262	241	262	5,677	39	1,823	345
Total	**1,085**	**915**	**977**	**15,588**	**6,740**	**3,215**	**779**
2009							
Ocean-going vessels	388	310	316	5,149	3,651	512	223
Harbor craft	46	42	46	1,054	1	325	76
Cargo handling equipment	18	17	18	568	1	201	17
Rail locomotives	21	20	21	714	5	120	38
Heavy-duty vehicles	70	64	70	2,644	3	662	129
Total	**543**	**453**	**471**	**10,129**	**3,661**	**1,819**	**483**
% Change							
Ocean-going vessels	-45%	-45%	-47%	-19%	-45%	-11%	-9%
Harbor craft	0%	0%	0%	-6%	-88%	9%	7%
Cargo handling equipment	-50%	-49%	-50%	-50%	-91%	-41%	-65%
Rail locomotives	-50%	-51%	-50%	-44%	-93%	-33%	-42%
Heavy-duty vehicles	-73%	-73%	-73%	-53%	-92%	-64%	-63%
Total	**-50%**	**-51%**	**-52%**	**-35%**	**-46%**	**-43%**	**-38%**

Table 8.6 compares GHG emissions change by source category from 2005 to 2009. The CO_2 equivalent port-wide emissions decreased by 22% in 2009 compared to 2005. This is due in part to the 24% decrease in TEU throughput in 2009.

Table 8.6: Port-wide GHG Emissions Comparison by Source Category, metric tons per year and %

	CO_2 Equivalent	CO_2	N_2O	CH_4
2005				
Ocean-going vessels	369,188	362,506	21	5
Harbor craft	45,045	44,407	2	1
Cargo handling equipment	103,869	102,967	3	3
Rail locomotives	60,706	60,104	2	5
Heavy-duty vehicles	415,490	398,538	53	18
Total	**994,298**	**968,523**	**81**	**32**
2009				
Ocean-going vessels	340,476	334,375	19	4
Harbor craft	47,911	47,230	2	1
Cargo handling equipment	77,648	77,060	2	2
Rail locomotives	41,772	41,360	1	3
Heavy-duty vehicles	270,232	269,389	2	6
Total	**778,039**	**769,415**	**27**	**17**
% Change				
Ocean-going vessels	-8%	-8%	-9%	-10%
Harbor craft	6%	6%	7%	2%
Cargo handling equipment	-25%	-25%	-35%	-36%
Rail locomotives	-31%	-31%	-31%	-32%
Heavy-duty vehicles	-35%	-32%	-96%	-64%
Total	**-22%**	**-21%**	**-67%**	**-46%**

Note: In 2005, the emission factor for the HDV N_2O was estimated using an equation based on a correlation between N_2O and NO_x. Starting with the 2007 inventory, the EF was changed to reflect information released by CARB which correlates the N_2O EF with fuel consumption. This new correlation produces lower EFs and therefore, lower emission estimates than the previous method. However, this change has only a minor effect on the overall CO_2 equivalent emissions, as reflected in Table 8.6.

8.1 Ocean-Going Vessels

The methodology used to estimate 2009 ocean-going vessel emissions is the same as the methodology used in the 2008 Air Emissions Inventory.

Table 8.7 compares overall OGV engines activity (in terms of kW-hrs) in 2005 and 2009. The table shows a 6% increase in auxiliary engine activity, 12% increase in boiler activity (total kW-hrs) and a 42% decrease in main engine activity with an overall 7% decrease in total engine activity. The decrease in main engine activity is attributed to the slower speeds of vessels participating in the VSR program. As vessel speed is reduced, propulsion engine power is also reduced. The increase in auxiliary engine and boiler activity is also attributed to the vessels' lower speeds within the 40 nautical mile VSR zone. Due to the slower vessel speeds and lower loads on main engines during transit, the boilers and auxiliary engines are being used for longer periods of time.

Table 8.7: OGV Engine Activity Comparison, kW-hrs

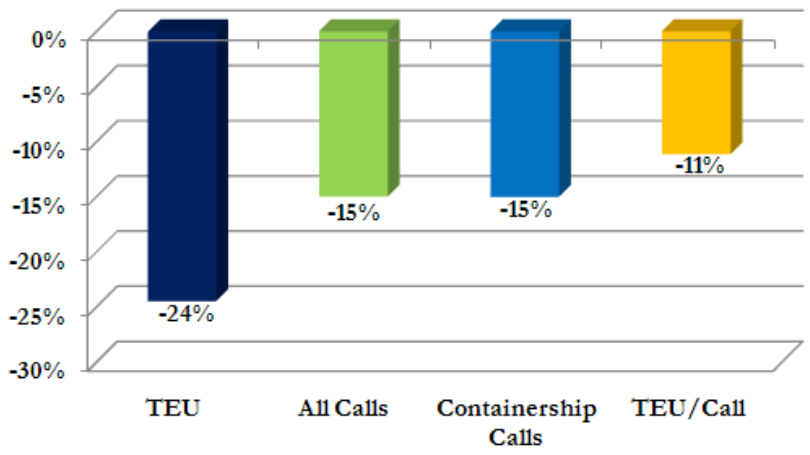
Year	Total All Engines Total kW-hr	Main Eng Total kW-hr	Aux Eng Total kW-hr	Boiler Total kW-hr
2005	489,460,155	143,586,047	229,359,348	116,514,760
2009	455,182,027	83,142,256	242,013,240	130,026,531
Change (%)	**-7%**	**-42%**	**6%**	**12%**

Table 8.8 compares the vessel calls and TEU throughput for 2005 and 2009. The number of total arrival calls and containership calls decreased in 2009 as compared to 2005.

Table 8.8: TEUs per Vessel Call Comparison

Year	All Inbound Call	Containership Calls	TEUs	Average TEUs/Call
2005	2,690	1,332	6,709,818	5,037
2009	2,287	1,132	5,067,597	4,477
Change (%)	**-15%**	**-15%**	**-24%**	**-11%**

Figure 8.4: OGV Emissions Comparison, %



The various emission reduction strategies for ocean-going vessels utilized in 2009 are listed in Table 8.9 and summarized below:

- The percent of calls with vessels that had fuel-efficient slide valves (2004 and newer vessels equipped with MAN B&W propulsion engines) was 38% in 2009 as compared to 14% in 2005.

- The percent of calls with IMO-compliant vessels (model year 2000 and newer) was 69% in 2009 as compared to 36% in 2005.

- The percent of vessel calls that switched to a cleaner fuel (0.5% S) for boilers, main and auxiliary engines at berth and within 24 nm was 100% from July 2009 to end of December 2009 when the CARB Fuel Regulation was in effect.

- The percent of vessel calls in 2009 that switched to a cleaner fuel (0.2% S) under the Port's Fuel Incentive Program (in place from January 2009 to end of June 2009) for main engines (during transit) and auxiliary engines (at-berth) was 5% of 2009 calls.

- In 2009, approximately 95% of the vessel calls complied with the VSR program (within 20 nm) as compared to 68% in 2005. In January 2009, the VSR program was extended up to 40 nm with a compliance rate of 72% for 2009.

- Approximately 3% of vessel calls used shore power in 2009.

Table 8.9: OGV Emission Reduction Strategies

Year	Slide Valve	IMO Compliant	Percent (%) of All Calls Fuel Switch Aux Eng	Fuel Switch Main Eng	VSR 20 nm	VSR 40 nm	Shore Power
2005	14%	36%	14%	0%	68%	0%	0%
2009	38%	69%	see note (a)	see note (a)	95%	72%	3%

Note (a): In 2009, the percentage of the main and auxiliary engines and auxiliary boilers switching to lower sulfur marine fuel varied throughout the year with the implementation of CARB's marine fuel regulation, the Port's voluntary Fuel Incentive Program, and voluntary actions by shipping companies. The percent of vessel calls in 2009 switching to cleaner fuels (0.2% S) under the Port's Fuel Incentive Program (in place for first six months of 2009) in auxiliary engines at berth and main engines within 20 nm (or 40 nm) from the Port was approximately 5% of vessel calls. A compliance rate of 100% was assumed for CARB's marine fuel regulation which became effective on July 1, 2009 requiring the use of lower sulfur fuel (0.5% sulfur) in main and auxiliary engines and auxiliary boilers.

Table 8.10 shows the emissions estimate comparisons for calendar year 2009 and 2005 for OGV in tons per year and as a percent change.

Table 8.10: OGV Emissions Comparison, tpy and %

Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC
2005	699	559	591	6,381	6,610	574	246
2009	388	310	316	5,149	3,651	512	223
Change (tpy)	**-311**	**-249**	**-275**	**-1,232**	**-2,959**	**-62**	**-23**
Change (%)	**-45%**	**-45%**	**-47%**	**-19%**	**-45%**	**-11%**	**-9%**

Table 8.11 shows the GHG emission estimate comparisons for calendar year 2009 and 2005 in metric tons.

Table 8.11: OGV GHG Emissions Comparison, metric tons and %

Year	CO_2 Equivalent	CO_2	N_2O	CH_4
2005	369,188	362,506	21	5
2009	340,476	334,375	19	4
Change (tpy)	**-28,712**	**-28,131**	**-2**	**-0.4**
Change (%)	**-8%**	**-8%**	**-9%**	**-10%**

From 2005 to 2009, emissions decreased 45% for particulate matter, 47% for DPM, 19% for NO_x, 45% for SO_x, 11% for CO, and 9% for HC. Figure 8.5 also highlights the 24% decrease in TEU throughput compared to emission changes from 2005 to 2009.

Figure 8.5: OGV Emissions Comparison, %

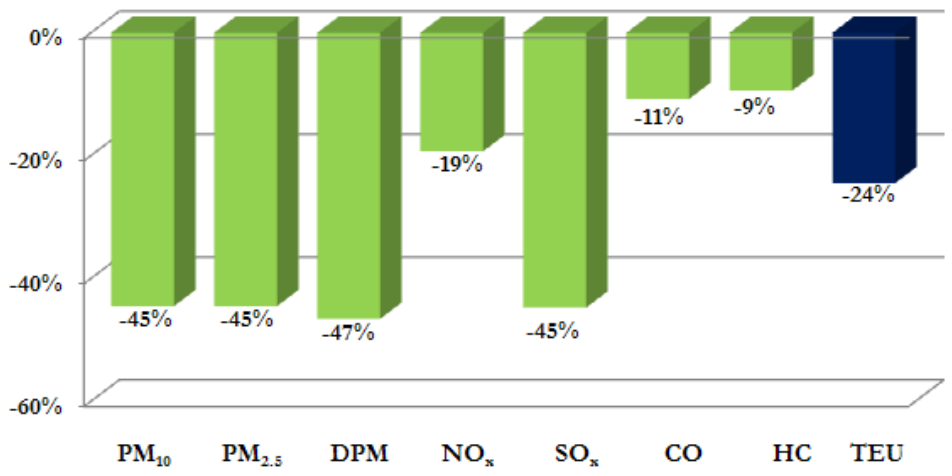
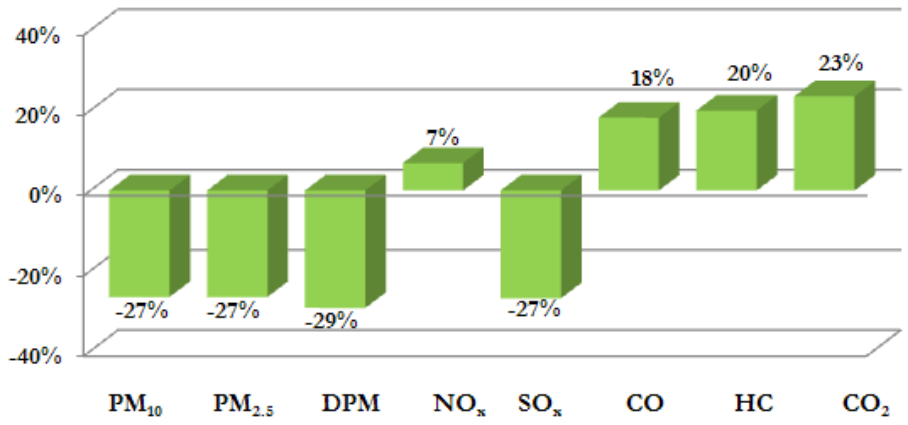


Table 8.12 and Figure 8.6 show the OGV tons of emissions per 10,000 TEU for 2005 and 2009. The tons of emissions per 10,000 TEU improved for PM and SO_x in 2009 compared to 2005.

Table 8.12: 2009-2005 OGV Tons of Emissions per 10,000 TEU and %

EI Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC	CO_2 Equivalent
2005	1.0	0.8	0.9	9.5	9.9	0.9	0.4	605.2
2009	0.8	0.6	0.6	10.2	7.2	1.0	0.4	747.3
Change (%)	**-27%**	**-27%**	**-29%**	**7%**	**-27%**	**18%**	**20%**	**23%**

Figure 8.6: 2009-2005 OGV Tons of Emissions per 10,000 TEU, %



8.2 Harbor Craft

As shown in Table 8.13, there was a 3% increase in the harbor craft population operating at the Port, 10% increase in total engine count and 8% increase in the overall activity (as measured by kilowatt hours) from 2005 to 2009. There was also a 68% increase in the total number of replaced engines in the harbor craft vessel fleet since 2005.

Table 8.13: Harbor Craft Engine Comparison

Year	Vessel Count	Engine Count	Total kW-hr	Repowered Engine Count	Total Hours
2005	92	301	67,965,048	79	285,586
2009	95	331	72,286,691	133	345,509
Change (%)	**3%**	**10%**	**8%**	**68%**	**21%**

Table 8.14, compares the propulsion and auxiliary average engine horsepower and hours of activity in 2009 compared to 2005. The main and auxiliary engines operating hours for crew boats, ocean tugs and workboats increased in 2009. The significant activity increase for crew boats and work boats is primarily due to the activity data provided in 2009 which may have included their entire operating domain including services to oil facilities beyond port-related activities. The propulsion engine hours decreased for excursion, government and tugboats.

Table 8.14: Engine Horsepower and Hours Comparison, % Change

Harbor Craft Type	Propulsion Engines HP	Propulsion Engines Hrs	Auxiliary Engines HP	Auxiliary Engines Hrs
Assist Tug	-6%	3%	15%	18%
Crew boat	22%	36%	76%	69%
Excursion	-16%	-17%	-6%	-24%
Ferry	3%	3%	0%	-2%
Government	13%	-73%	-64%	37%
Ocean Tug	-9%	161%	9%	161%
Tugboat	-28%	-14%	-35%	-27%
Work boat	30%	820%	276%	772%

Table 8.15 summarizes the percent distribution of engines based on EPA's engine standards for 2005 and 2009. As expected, the percentage of Tier 2 engines increased since 2005 due to the introduction of newer vessels with newer engines into the fleet and replacements of existing higher-emitting engines with cleaner engines. The reason for higher Tier 0 count in 2009 as compared to 2005 was because there were more engines with unknown model years in 2005, most of which were likely Tier 0.

Table 8.15: Harbor Craft Engine Standards Comparison by Tier

	2009	2005	% Change
Unknown	23	102	-77%
Tier 0	138	86	60%
Tier 1	89	94	-5%
Tier 2	81	19	326%
Total	**331**	**301**	**10%**

The methodology used to estimate 2009 harbor craft emissions was the same as the methodology used in the 2008 Inventory of Air Emissions. Thus, the 2005 harbor craft emissions used to compare to the 2009 emissions below are the same as those in the 2008 Inventory of Air Emissions. Table 8.16 shows the emissions estimate comparisons for harbor craft in tons per year and as a percent change.

Table 8.16: Harbor Craft Emissions Comparison, tpy

EI Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC
2005	46	42	46	1,120	5	298	71
2009	46	42	46	1,054	1	325	76
Change (tpy)	**0**	**0**	**0**	**-65**	**-4**	**27**	**5**
Change (%)	**0%**	**0%**	**0%**	**-6%**	**-88%**	**9%**	**7%**

In 2009, there was a significant reduction (88%) in SO_x emissions due to the exclusive use of 15 ppm ULSD in all harbor craft equipped with diesel engines. In 2005, none of the harbor craft diesel engines used ULSD. Despite the overall 8% increase in activity, there was no change in PM emissions and a 6% reduction in NO_x emissions. There was an increase in emissions of 9% for CO and 7% for hydrocarbons. The small increase in CO and HC is more directly related to change in activity (8%) with lesser impact from introduction of cleaner engines that do not have lower CO and HC standards.

Figure 8.7 shows the comparison of harbor craft emissions between 2005 and 2009.

Figure 8.7: Harbor Craft Emissions Comparison, %

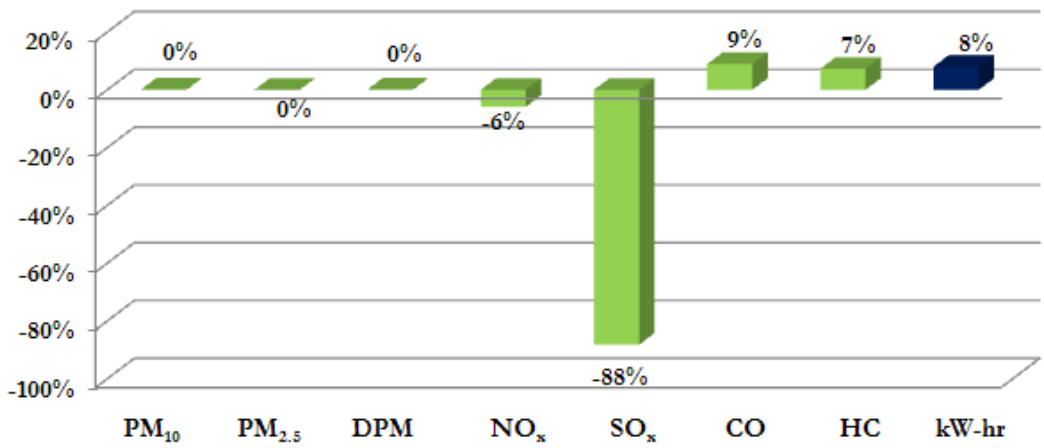


Table 8.17 shows the GHG emission estimate comparisons for calendar year 2009 and 2005 in metric tons.

Table 8.17: Harbor Craft GHG Emissions Comparison, metric tons and %

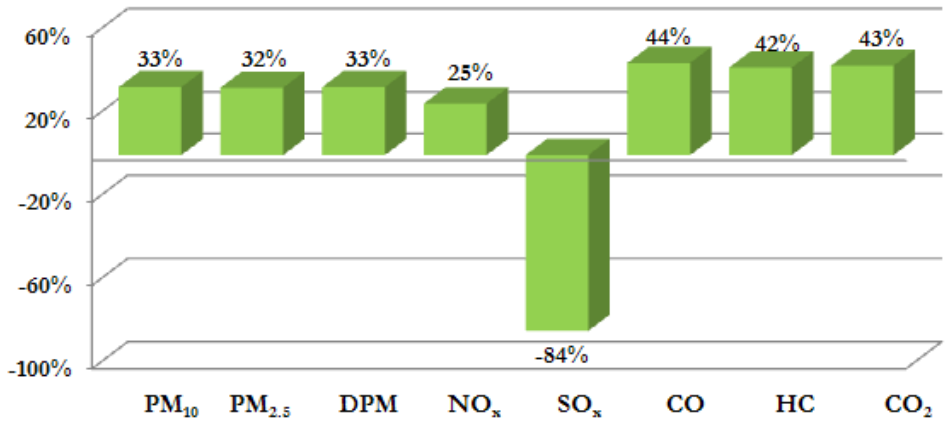
Year	CO_2 Equivalent	CO_2	N_2O	CH_4
2005	45,045	44,407	2	1
2009	47,911	47,230	2	1
Change (tpy)	**2,866**	**2,824**	**0**	**0**
Change (%)	**6%**	**6%**	**7%**	**2%**

Table 8.18 and Figure 8.8 show the harbor craft tons of emissions per 10,000 TEU for 2005 and 2009. The tons of emissions per 10,000 TEU increased for most pollutants in 2009 from 2005, with the exception of SO_x. The increased emissions per 10,000 TEU shows less overall emissions efficiency in 2009 for harbor craft.

Table 8.18: 2009-2005 Harbor Craft Tons of Emissions per 10,000 TEU and %

EI Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC	CO_2 Equivalent
2005	0.07	0.06	0.07	1.67	0.01	0.44	0.11	72.8
2009	0.09	0.08	0.09	2.08	0.00	0.64	0.15	104.0
Change (%)	**33%**	**32%**	**33%**	**25%**	**-84%**	**44%**	**42%**	**43%**

Figure 8.8: 2009-2005 Harbor Craft Tons of Emissions per 10,000 TEU, %



8.3 Cargo Handling Equipment

From 2005 to 2009, there was an 8% increase in the equipment count and a 36% decrease in activity, measured as total kilowatt-hours.

Table 8.19: CHE Count and Engine Activity Comparison

	Total Population	Total kW-hr
2005	1,259	158,375,789
2009	1,358	100,780,433
Change (%)	**8%**	**-36%**

Tables 8.20 and 8.21 compare the CHE emission reduction technologies and fuels used in 2009 and 2005. While there was a significant increase in the number of CHE equipped with cleaner on-road engines in 2009, the CHE equipped with DOCs continued to be replaced with newer equipment. Emulsified fuel was not used in 2009 due to supplier unavailability.

Table 8.20: CHE Emission Reduction Technologies Comparison

Equipment	2009 DOC	2005 DOC	2009 On-road Engine	2005 On-road Engine	2009 Propane Engine	2005 Propane Engine	2009 DPF	2005 DPF	2009 Vycon REGEN	2005 Vycon REGEN
Forklifts	16	40	0	0	128	122	1	0	0	0
RTG Cranes	11	11	0	0	0	0	1	0	3	0
Side Handlers	32	42	0	0	0	0	2	0	0	0
Top Handlers	79	92	0	0	0	0	8	0	0	0
Yard Tractors	348	514	292	53	6	0	0	0	0	0
Other	1	2	2	0	13	11	0	0	0	0
Total	**487**	**701**	**294**	**53**	**147**	**133**	**12**	**0**	**3**	**0**

Table 8.21: CHE Fuels Comparison

Equipment	2009 Emulsified Fuel	2005 Emulsified Fuel	2009 O_2 Diesel	2005 O_2 Diesel	2009 ULSD	2005 ULSD
Forklifts	0	3	4	4	116	0
RTG Cranes	0	16	0	12	89	0
Side Handlers	0	4	0	8	34	0
Top Handlers	0	10	0	10	154	0
Yard Tractors	0	151	83	81	713	0
Other	0	2	0	0	87	0
Total	**0**	**186**	**87**	**115**	**1,193**	**0**

The 2009 methodology to estimate cargo handling equipment emissions was the same as the methodology used in the 2008 Air Emissions Inventory. Thus, the 2005 cargo handling equipment emissions used to compare to the 2009 emissions below are the same as those in the 2008 Inventory of Air Emissions. Table 8.22 shows the emissions estimate comparisons for calendar year 2009 and 2005 for cargo handling equipment in tons per year and as a percent change.

Table 8.22: Cargo Handling Equipment Comparison of Emission Estimates, tpy

EI Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC
2005	36	33	36	1,137	11	342	50
2009	18	17	18	568	1	201	17
Change (tpy)	**-18**	**-16**	**-18**	**-569**	**-10**	**-141**	**-32**
Change (%)	**-50%**	**-49%**	**-50%**	**-50%**	**-92%**	**-41%**	**-65%**

The decrease in SO_x emissions is due to the use of 15 ppm ULSD in all cargo handling equipment with diesel engines in 2009. While the overall equipment activity decreased by 36% from 2005 levels (due to recent economic slowdown which continued in 2009), the range of emission reductions was from 41% to 92% for all pollutants. The rate of emission reductions was higher than the rate of activity decrease because of the continued implementation of the CAAP's measure for CHE and CARB's CHE regulation resulting in the introduction of newer and cleaner equipment in combination with the use of ULSD.

Figure 8.9: CHE Emissions Comparison, %

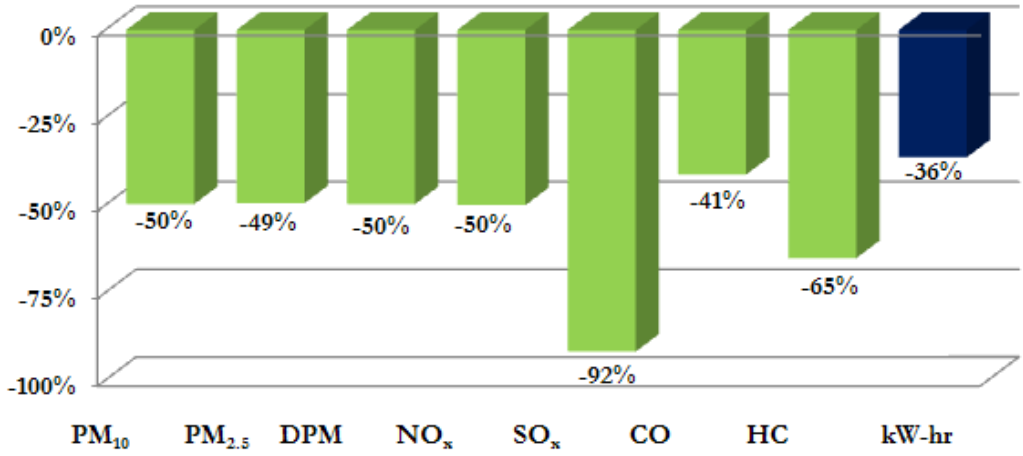


Table 8.23 shows the GHG emission estimate comparisons for calendar year 2009 and 2005 in metric tons.

Table 8.23: Cargo Handling Equipment Comparison of GHG Emission Estimates, metric tons and %

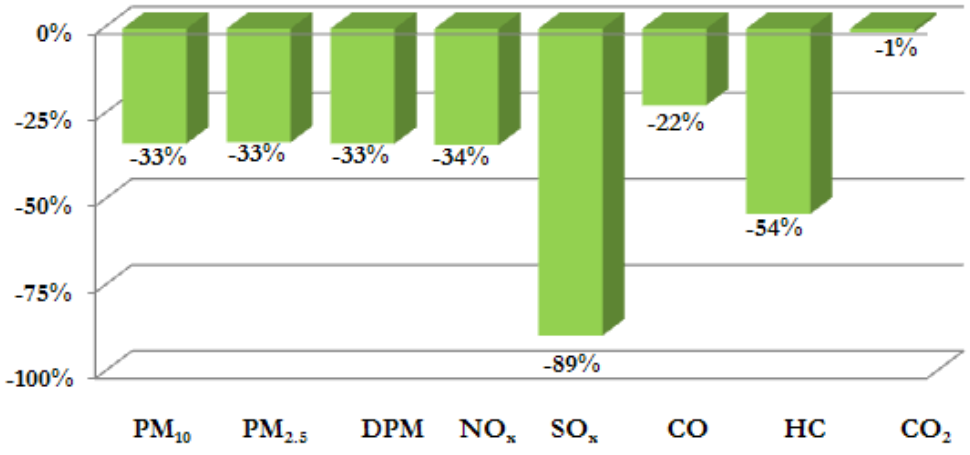
EI Year	CO_2 Equivalent	CO_2	N_2O	CH_4
2005	103,869	102,967	3	3
2009	77,648	77,060	2	2
Change (tpy)	**-26,221**	**-25,907**	**-1**	**-1**
Change (%)	**-25%**	**-25%**	**-35%**	**-36%**

Table 8.24 and Figure 8.10 show the CHE tons of emissions per 10,000 TEU for 2005 and 2009. The tons of emissions per 10,000 TEU decreased for all pollutants in 2009; an improvement from 2005.

Table 8.24: 2009-2005 CHE Tons of Emissions per 10,000 TEU and %

EI Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC	CO_2 Equivalent
2005	0.05	0.05	0.05	1.69	0.02	0.51	0.07	170.3
2009	0.04	0.03	0.04	1.12	0.00	0.40	0.03	168.5
Change (%)	**-33%**	**-33%**	**-33%**	**-34%**	**-89%**	**-22%**	**-54%**	**-1%**

Figure 8.10: 2009-2005 CHE Tons of Emissions per 10,000 TEU, %



The following tables and figures for CHE activities are included as additional comparisons between 2005 and 2009. Table 8.25 and Figure 8.11 show a comparison of CHE counts by equipment type. In total, there was an 8% increase in equipment count from 2005 to 2009. Forklifts and side handlers equipment counts went down from 2005 due to equipment retirement and terminal efficiency improvements.

Table 8.25: CHE Count Comparison

	Count		Percent Change
Equipment	**2009**	**2005**	**2009-2005**
Forklifts	252	295	-15%
RTG Cranes	89	85	5%
Side Handlers	34	43	-21%
Top Handlers	154	113	36%
Yard Tractors	713	641	11%
Sweepers	22	15	47%
Other	94	67	40%
Total	**1,358**	**1,259**	**8%**

Figure 8.11: CHE Count Comparison, % Change

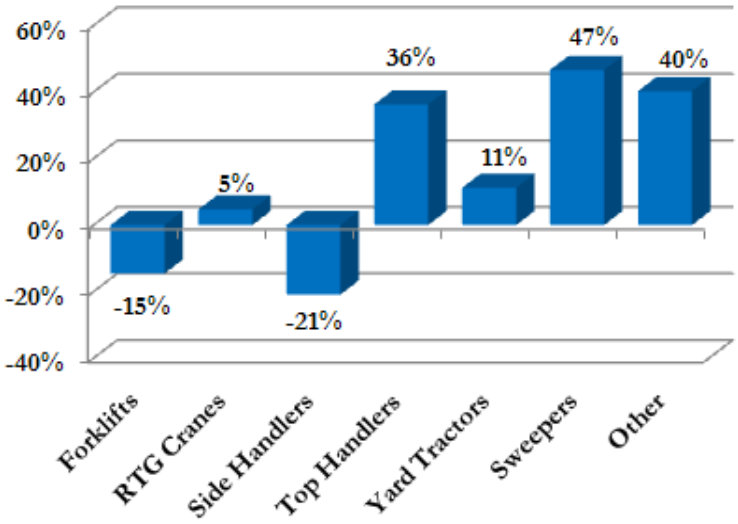


Table 8.26 and Figure 8.12 show the comparison of CHE activity by equipment type. In 2009, the average annual hours of activity were lower than in 2005 for all equipment. The decrease in hours is attributed to the slowdown in economy.

Table 8.26: CHE Activity Comparison

	Average Annual Hours		Percent Change
Equipment	**2009**	**2005**	**2009-2005**
Forklifts	426	710	-40%
RTG Cranes	970	1,964	-51%
Side Handlers	602	1,148	-48%
Top Handlers	1,450	1,999	-27%
Yard Tractors	1,301	2,186	-40%
Sweepers	397	502	-21%

Figure 8.12: CHE Activity Comparison, % Change

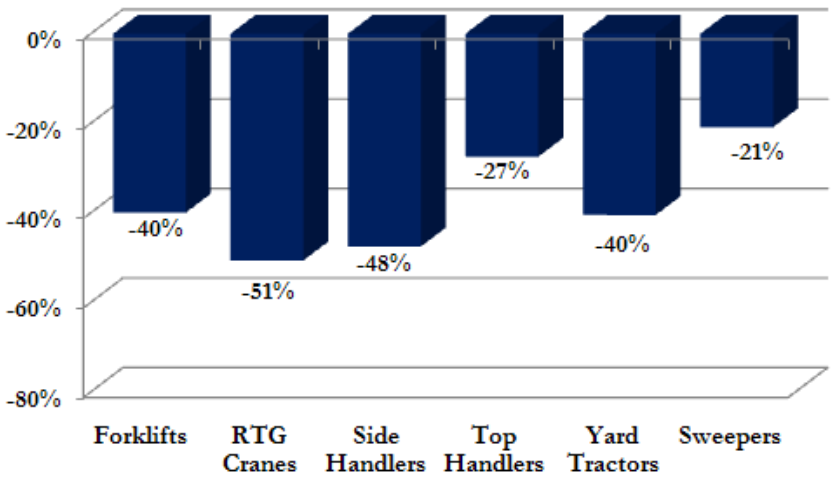
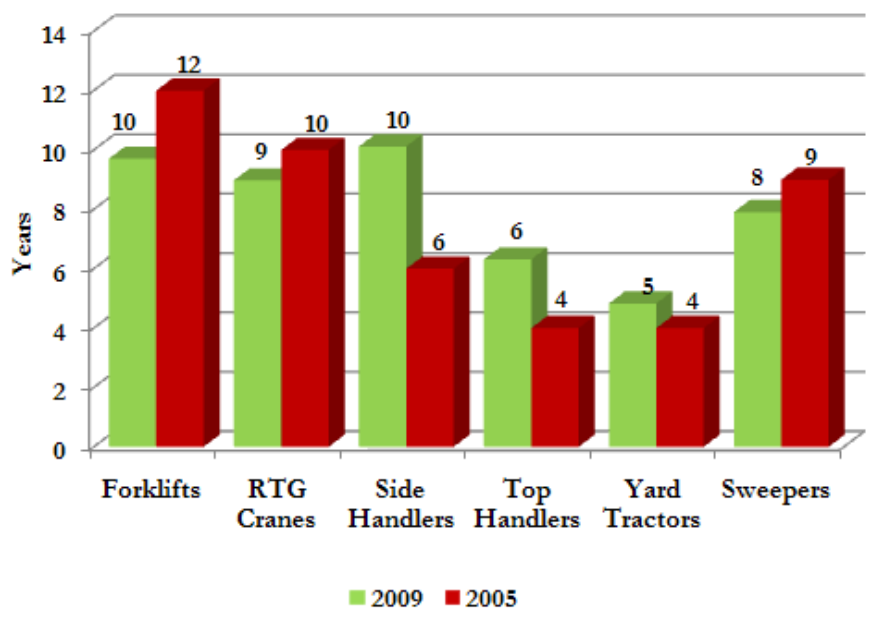


Table 8.27 and Figure 8.13 show a comparison of the average model year and average age for CHE by equipment type. The average age of forklifts, RTG cranes and sweepers are lower than they were in 2005. The average age of side handlers, top handlers and yard tractors are greater in 2009 than 2005 even though the average model year of the equipment is newer.

Table 8.27: CHE Average Model Year and Age Comparison, 2009 vs. 2005

	Model Year Avg		Average Age	
Equipment	**2009**	**2005**	**2009**	**2005**
Forklifts	1999	1993	10	12
RTG Cranes	2000	1995	9	10
Side Handlers	1999	1999	10	6
Top Handlers	2003	2001	6	4
Yard Tractors	2004	2001	5	4
Sweepers	2001	1996	8	9

Figure 8.13: CHE Average Age Comparison, years



8.4 Rail Locomotives

Table 8.28 shows the various throughput comparisons for rail locomotives for 2005 and 2009. From 2005 to 2009, there was an 11% increase in total on-dock rail throughput.

Table 8.28: TEU Throughput Comparison

	2005	2009	% Change
Total Port Throughput	6,709,818	5,067,597	-24%
Total On-Dock Rail*	1,094,765	1,211,137	11%
% On-Dock	16%	24%	

* Based on average of 1.8 TEUs per container

The methodology used to estimate 2009 rail locomotive emissions was the same as that used in the 2008 Air Emissions Inventory except for the use of updated EPA's emission factors for switcher locomotives (based on EPA's new brake specific fuel consumption factor for switcher locomotives); therefore, the 2005 emissions was re-estimated based on the 2009 methodology for comparison. Table 8.29 and 8.30 show the emissions estimate comparisons for calendar year 2009 and 2005 for locomotive engines in tons per year and as a percent change.

Table 8.29: Rail Emissions Comparison, tpy and %

EI Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC
2005	43	40	43	1,273	76	179	66
2009	21	20	21	714	5	120	38
Change (tpy)	**-21**	**-20**	**-21**	**-559**	**-71**	**-59**	**-28**
Change (%)	**-50%**	**-51%**	**-50%**	**-44%**	**-93%**	**-33%**	**-42%**

Table 8.30: Rail GHG Emissions Comparison, metric tons and %

EI Year	CO_2 Equivalen	CO_2	N_2O	CH_4
2005	60,706	60,104	2	5
2009	41,772	41,360	1	3
Change (tpy)	**-18,934**	**-18,744**	**-1**	**-2**
Change (%)	**-31%**	**-31%**	**-31%**	**-32%**

There was an overall decrease in emissions from rail locomotives in the range of 33% to 93% from 2005 to 2009. The decrease in rail emissions in 2009 was primarily due to lower activity in 2009, rail efficiency improvements, and turn over to cleaner locomotives. Figure 8.14 summarizes the emissions changes from 2005 to 2009 for rail locomotives at the Port.

Figure 8.14: Rail Emissions Comparison, %

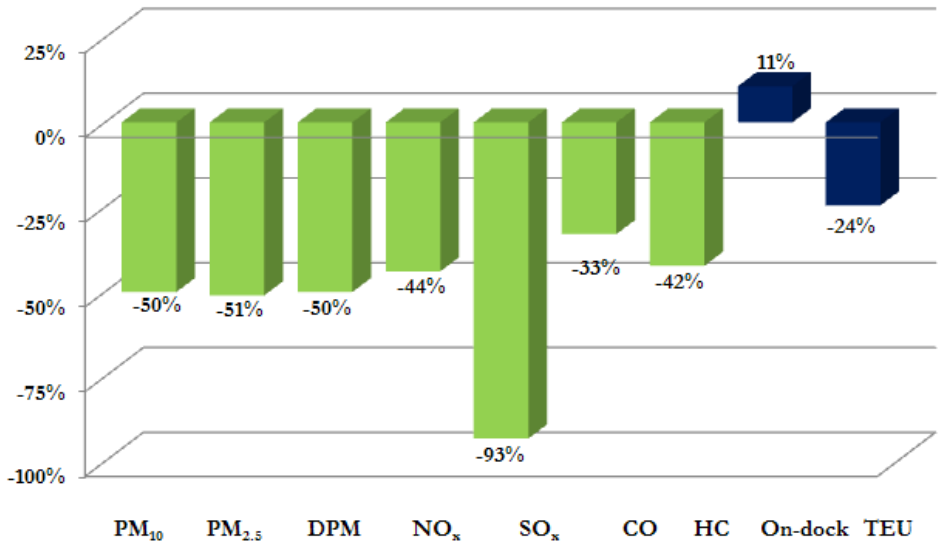
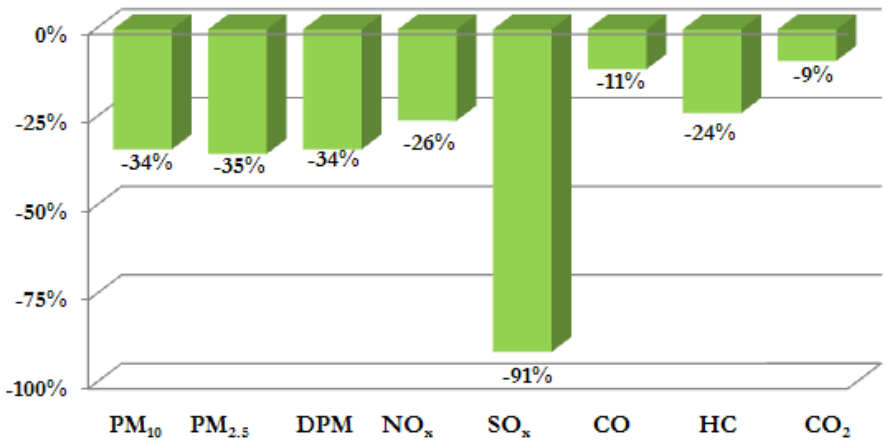


Table 8.31 and Figure 8.15 show the rail locomotive tons of emissions per 10,000 TEU for 2005 and 2009. With the exception of CO and CO_2, the tons of emissions per 10,000 TEU decreased in 2009; an improvement from 2005.

Table 8.31: 2009-2005 Rail Tons of Emissions per 10,000 TEU and %

EI Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC	CO_2 Equivalent
2005	0.06	0.06	0.06	1.90	0.11	0.27	0.10	99.5
2009	0.04	0.04	0.04	1.41	0.01	0.24	0.08	90.7
Change (%)	**-34%**	**-35%**	**-34%**	**-26%**	**-91%**	**-11%**	**-24%**	**-9%**

Figure 8.15: 2009-2005 Rail Tons of Emissions per 10,000 TEU, %



8.5 Heavy-Duty Vehicles

The methodology used in 2009 to estimate HDV emissions is the same methodology as used in the 2008 Air Emissions Inventory, with the exception of using call-weighted model year distribution instead of population weighted distribution. Please refer to section 6.5.7 for discussion of this improvement to methodology.

Emissions from the HDV source category have continued to improve due largely to the following factors affecting the number of truck visits, newer trucks, and average idling times.

- Reduced number of trucks in 2009 due to economic downturn.
- Younger fleet of trucks in 2009 due to the Port's CTP launched October 2008 which includes a progressive ban of older trucks between 2008 and 2012.
- The terminals continued to optimize their gate systems with OCR and the addition of RFID readers to identify and help check in trucks complying with the CTP ban provisions, which also helped reduce idling time.
- Assembly Bill 2650 (known as the Lowenthal Bill), introduced in 2004, required that each marine terminal in California operate in a manner that does not cause the engines on trucks to idle or queue for more than 30 minutes while waiting to enter the gate into the marine terminal.
- Since July 2005, all marine terminals at the ports of Long Beach and Los Angeles, offer off-peak shifts on nights and weekends. As part of the program, a Traffic Mitigation Fee is required for cargo movement through the ports during peak daytime hours.

The average on-terminal total idling time at container terminals has continued to improve. Table 8.32 shows the decrease in total port-wide idling time.

Table 8.32: HDV Total Idling Time Comparison, hours

EI Year	Total Idling Hours
2005	3,854,273
2009	1,394,861
Change (%)	**-64%**

Table 8.33 compares the vehicle miles traveled for heavy-duty trucks in 2005 and 2009.

Table 8.33: HDV Vehicle Miles Traveled Comparison, miles

Activity Location	2009 VMT	2005 VMT	Change %
On-Terminal	1,882,977	2,866,476	-34%
On-Road	146,337,769	213,716,895	-32%
	148,220,746	**216,583,371**	**-32%**

Table 8.34 summarizes the average age of the port-related fleet for 2005 and 2009. Compared to 2005, the average age of trucks visiting the Port has decreased from 11.2 to 10.9 years (population-weighted) and to 6.9 years (call-weighted) due to the Port's Clean Truck Program which was launched in October 2008 requiring the progressive ban of pre-2007 trucks between 2008 and 2012.

Table 8.34: Port-related Fleet Weighted Average Age

Year	Population-Weighted Average Age	Call-Weighted Average Age
2009	10.9	6.9
2005	11.2	11.2

Emissions decreased for trucks in 2009 when compared to 2005 due to the total TEU throughput decrease (-24%) at the Port due to the recent economic slowdown, lower idling time (-64%), and the decreased total vehicle miles travelled (-32%). The use of ULSD by on-road trucks and the improved fuel economy for the fleet had an impact on SO_x emissions as it is calculated per gallon of fuel consumed. These factors had a positive impact on the heavy-duty vehicle emissions which decreased by 73% for PM, 53% for NO_x, 92% for SO_x, 64% for CO, and 63% for HC in 2009 from 2005. Table 8.35 and Figure 8.16 summarize the emission changes.

Table 8.35: HDV Emissions Comparison, tpy and %

EI Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC
2005	262	241	262	5,677	39	1,823	345
2009	70	64	70	2,644	3	662	129
Change (tpy)	**-192**	**-177**	**-192**	**-3,033**	**-36**	**-1,161**	**-216**
Change (%)	**-73%**	**-73%**	**-73%**	**-53%**	**-92%**	**-64%**	**-63%**

Figure 8.16: HDV Emissions Comparison, %

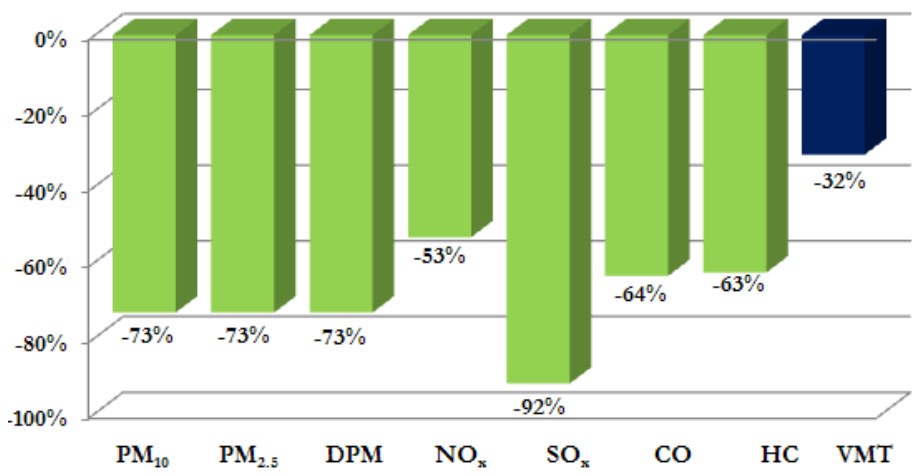


Table 8.36 shows the GHG emission estimate comparisons for calendar year 2009 and 2005 in metric tons.

Table 8.36: HDV GHG Emissions Comparison, metric tons and %

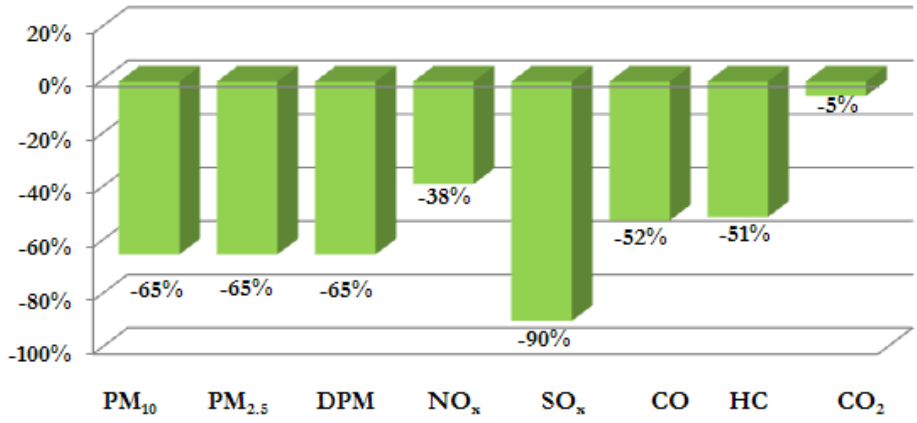
EI Year	CO_2 Equivalent	CO_2	N_2O	CH_4
2005	415,490	398,538	53	18
2009	270,232	269,389	2	6
Change (tpy)	**-145,258**	**-129,149**	**-51**	**-11**
Change (%)	**-35%**	**-32%**	**-96%**	**-64%**

Table 8.37 and Figure 8.17 show the HDV tons of emissions per 10,000 TEU for 2005 and 2009. The tons of emissions per 10,000 TEU decreased for all pollutants in 2009 from 2005 which represents an improvement.

Table 8.37: 2009-2005 HDV Tons of Emissions per 10,000 TEU and %

EI Year	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	HC	CO_2 Equivalent
2005	0.39	0.36	0.39	8.46	0.06	2.72	0.51	619.2
2009	0.14	0.13	0.14	5.22	0.01	1.31	0.25	586.3
Change (%)	**-65%**	**-65%**	**-65%**	**-38%**	**-90%**	**-52%**	**-51%**	**-5%**

Figure 8.17: 2009-2005 HDV Tons of Emissions per 10,000 TEU, %



8.6 CAAP Progress

One of the main purposes of the Port's annual emissions inventories is to provide a progress update on achieving the Clean Air Action Plan's San Pedro Bay Standards. These draft standards consist of the following reductions goals:

- Draft Mass Emissions Reduction Standards:
  - By 2014, reduce emissions by 72% for DPM, 22% for NO_x, and 93% for SO_x from 2005 levels
  - By 2023, reduce emissions by 77% for DPM, 59% for NO_x, and 92% for SO_x from 2005 levels

Note: At the time of publication of this document, the standards bulleted above are draft standards that have been released for public review but not formally adopted by the Board of Harbor Commissioners. It is anticipated that the standards will be presented to the Board in 2010 as part of the CAAP Update process currently underway.

The reduction of port-related emissions in 2009 compared to 2005 can be attributed to a number of causes, including emissions reduction programs implemented by the Port, such as the Clean Trucks Program, Green Flag Vessel Speed Reduction Program, Vessel Low Sulfur Fuel Incentive Program, and shore power for vessels at berth. In addition, emissions reductions can also be attributed to the recent downturn in global economic conditions that in turn resulted in reduced cargo throughput volumes through the Port in 2009.

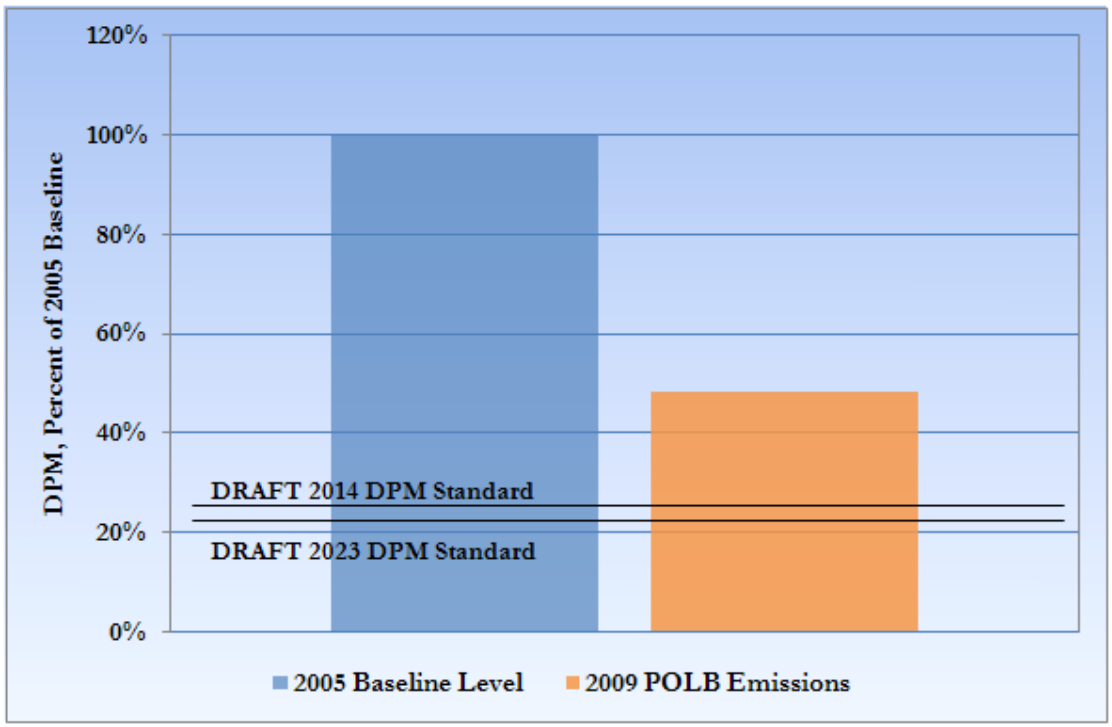
Economic forecasts indicate that cargo volumes through the Port of Long Beach will increase in upcoming years. While emissions reductions are expected to increase in the future toward the CAAP goals, the rapid rate of emissions reductions in recent years may not continue as cargo volumes increase. However, continued implementation of the CAAP and regulatory programs will continue to provide emissions benefits from port-related sources, and offset impacts from the projected growth in trade.

The draft mass emissions reduction standards are represented as a percentage reduction of emissions from 2005 levels. Tables 8.38 to 8.40 and Figures 8.18 through 8.20 present the standardized estimates of emissions by source category for calendar years 2005 and 2009 using 2009 methodology. Additionally, the figures provide the 2014 and 2023 draft mass emissions reduction standards against the 2005/2009 comparison.

Table 8.38: DPM Emissions by Calendar Year and Source Category, tpy

Category	2005	2009
OGV	591	316
HC	46	46
CHE	36	18
Rail	43	21
HDV	262	70
Total	**977**	**471**
% Cumulative Reduction		**51.8%**

Figure 8.18: DPM Reductions - Progress to Date

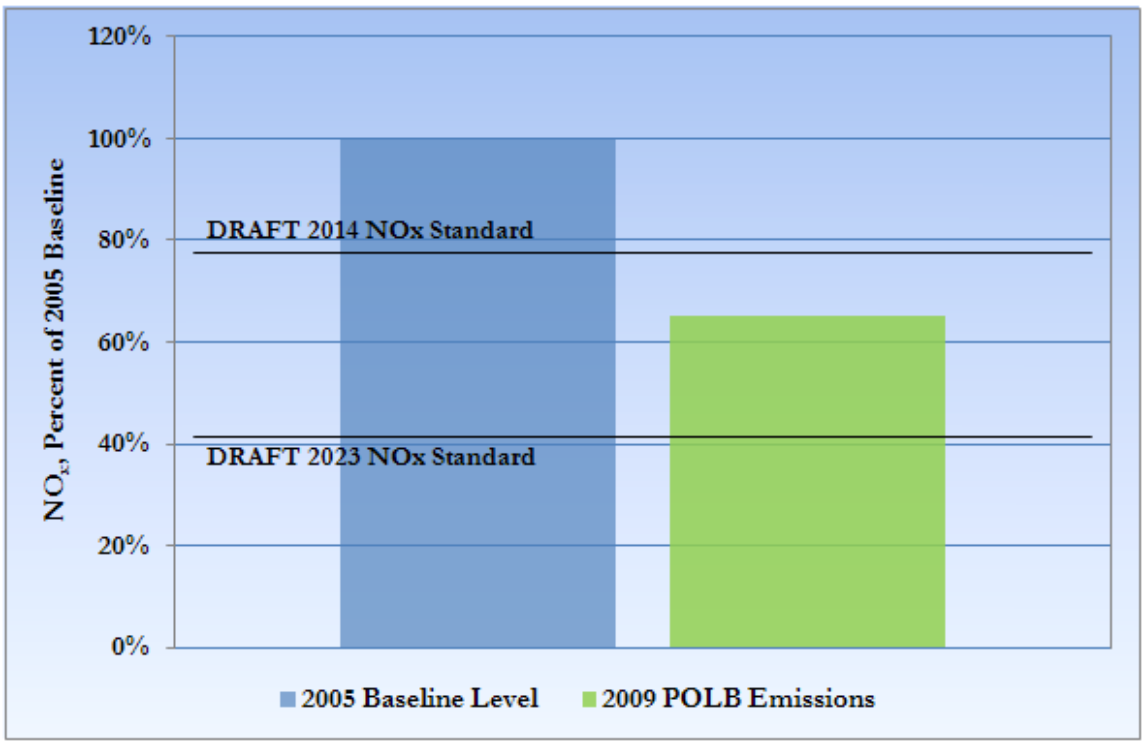


As presented above, by 2009 the Port is over half way towards meeting the draft DPM mass emission reduction standards. With implementation of the CAAP measures (vessel speed reduction, shore power), the Port's Clean Truck Program and CARB's OGV marine fuel regulation (effective for the full year in 2010), it is anticipated that the DPM reduction trend will continue in 2010 and subsequent years.

Table 8.39: NO_x Emissions by Calendar Year and Source Category, tpy

Category	2005	2009
OGV	6,381	5,149
HC	1,120	1,054
CHE	1,137	568
Rail	1,273	714
HDV	5,677	2,644
Total	**15,588**	**10,129**
% Cumulative Reduction		**35.0%**

Figure 8.19: NO_x Reductions - Progress to Date

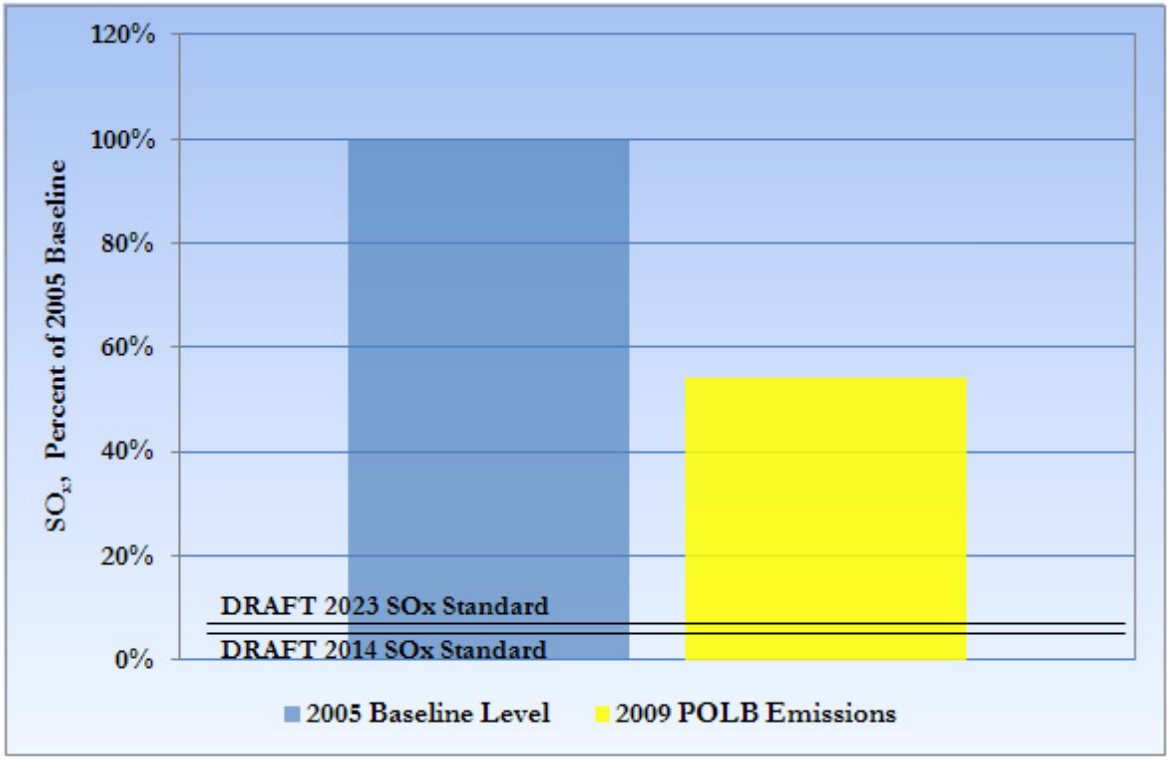


As presented above, the Port is exceeding the 2014 draft NO_x mass emission reduction standard in 2009 and is half way towards meeting the 2023 standard. The Port's Clean Truck Program and CAAP measures including the expanded Vessel Speed Reduction Program, shore power, and slide valves in OGVs are the primary strategies for reducing NO_x emissions. Implementation of these strategies and CARB's OGV at-berth regulation will significantly help in meeting these standards despite potential increases in throughput.

Table 8.40: SO_x Emissions by Calendar Year and Source Category, tpy

Category	2005	2009
OGV	6,610	3,651
HC	5	1
CHE	11	1
Rail	76	5
HDV	39	3
Total	**6,740**	**3,661**
% Cumulative Reduction		**45.7%**

Figure 8.20: SO_x Reductions - Progress to Date



As presented above, by 2009, the Port is half way towards meeting the SO_x draft mass emission reduction standards. Implementation of CAAP measures and CARB's OGV fuel regulation will result in even higher rates of SO_x reductions in the coming years.