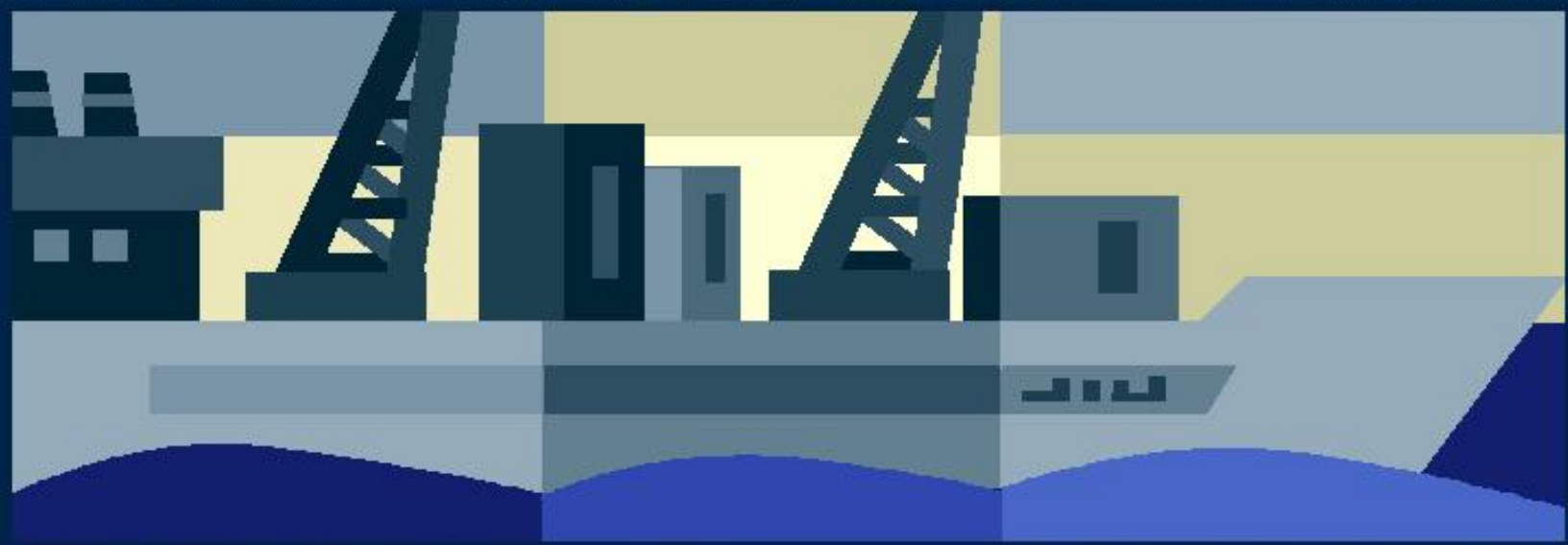


OCEAN-GOING VESSEL DWELLING EMISSIONS FOR YEAR 2000



December 2005



**Prepared for:
The Port Authority of New York and New Jersey**

Prepared by:



Under Contract to Hatch Mott MacDonald

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ACRONYMS AND ABBREVIATIONS

CMV	commercial marine vessel
CMVEI	commercial marine vessel emissions inventory
CO	carbon monoxide
EI	emissions inventory
EPA	Environmental Protection Agency
NJ	New Jersey
NO _x	nitrogen oxides
NY	New York
NYNJLINA	New York New Jersey Long Island Nonattainment Area
OGV	ocean-going vessel
PANYNJ	Port Authority of New York & New Jersey
PM _{2.5}	particulate matter, 2.5 microns or less in diameter
PM ₁₀	particulate matter, 10 microns or less in diameter
SO ₂	sulfur dioxide
VOC	volatile organic compound

EXECUTIVE SUMMARY

In 2003, Starcrest Consulting Group, LLC (Starcrest) finalized an emissions inventory (EI) for the Port Authority of New York and New Jersey (PANYNJ), which quantified calendar year 2000 emissions from commercial marine vessels (CMV)¹ operating throughout the New York/New Jersey Long Island Non-Attainment Area (NYNYLINA). The report that follows identifies those emissions from the 2000 EI that constitute dwelling emissions from ocean-going vessels (OGV) calling at the PANYNJ's marine terminals, which the PANYNJ leases to private operators.

The Commercial Marine Vessel Emissions Inventory (CMVEI) includes ocean-going vessels, tug- and tow-boats, ferries, and other vessels. OGV are a subset of CMV, and are typically the only subcategory of CMV having dwelling emissions. During dwelling, auxiliary diesel engines are used to provide electrical power for the vessel, in contrast to emissions from transiting and maneuvering, which use the vessel's main propulsion engines.

Dwelling emissions associated with OGVs docking at the marine terminals that the PANYNJ leases to private operators contribute 760 tons of NO_x emissions annually to the NYNJLI Non-Attainment Area. This accounts for 0.16% of the NYNJLINA NO_x emissions. For SO₂, the contribution is 911 tons, which accounts for 0.35% of the NYNJLINA SO₂ emissions. For other criteria pollutants, the contribution is 0.01% or less (see Table 1 of the report).

The emissions from OGV dwelling represent a small percentage of the overall emissions for the counties where PANYNJ leased terminals are operated (see Table 5 of the report). For example, OGV dwelling emissions of NO_x range from 0.06% in Hudson County, New Jersey to 0.72% in Richmond County, New York. The overall county emissions on which these percentages are based are extracted from the Environmental Protection Agency (EPA) National Emission Inventory.²

¹ Starcrest Consulting Group, LLC, *The New York, New Jersey, Long Island Nonattainment Area Commercial Marine Vessel Emissions Inventory*, April 2003.

²EPA, National Emission Inventory Data, 2000. See: <http://www.epa.gov/ttn/chief/net/neidata.html>; and ftp://ftp.epa.gov/pub/EmisInventory/nei_criteria_summaries/2000criteria-summaryfiles/.

INTRODUCTION

In 2003, Starcrest Consulting Group, LLC (Starcrest) finalized an emissions inventory (EI) for the Port Authority of New York and New Jersey (PANYNJ), which quantified calendar year 2000 emissions from commercial marine vessels (CMV)³ operating throughout the New York/New Jersey Long Island Non-Attainment Area (NYNYLINA). The report that follows identifies those emissions from the 2000 EI that constitute dwelling emissions from ocean-going vessels (OGV) calling at the PANYNJ's marine terminals, which the PANYNJ leases to private operators.

POLLUTANTS

The pollutants covered by the Commercial Marine Vessel Emissions Inventory (CMVEI) include:

- nitrogen oxides (NO_x)
- volatile organic compounds (VOCs)
- carbon monoxide (CO)
- sulfur dioxide (SO₂)
- particulate matter (PM) (2.5 and 10 micron).

GEOGRAPHICAL EXTENT

Dwelling emissions for ocean-going vessels visiting PANYNJ terminals were extracted from the 2000 CMVEI. The PANYNJ owns and leases the following facilities, as shown in Figure 1:

- Red Hook Container Terminal (Kings County, New York)
- Brooklyn Marine Terminal (Kings County, New York)
- Howland Hook Marine Terminal (Richmond County, New York)
- Auto-Marine Terminal (Hudson County, New Jersey)
- Port Newark (Essex County, New Jersey)
- Elizabeth Marine Terminal (Union County, New Jersey)

SOURCE CATEGORY

The CMVEI earlier cited includes ocean-going vessels, tug- and tow-boats, ferries, and other vessels. OGV are a subset of CMV, and are typically the only subcategory of CMV having dwelling emissions. During dwelling, auxiliary diesel engines are used to provide electrical power for the vessel, in contrast to emissions from transiting and maneuvering, which use the vessel's main propulsion engines.

³ Starcrest Consulting Group, LLC, *The New York, New Jersey, Long Island Nonattainment Area Commercial Marine Vessel Emissions Inventory*, April 2003.

Figure 1: PANYNJ Terminals Leased to Private Operators⁴



⁴ Source: Port Authority of New York & New Jersey web site, link at <http://www.panynj.gov/>, see Seaport, Port Facilities.

RESULTS

The first subtable of Table 1 combines statewide New York and New Jersey emissions, which were extracted from the Environmental Protection Agency (EPA) National Emission Inventory.⁵ In addition, as extracted from the 2000 CMVEI cited earlier, this subtable also compares total state emissions to the NYNJLINA; total CMV emissions to the NYNJLINA; total OGV dwelling emissions to the NYNJLINA; and total OGV dwelling emissions for vessels calling at terminals leased by the PANYNJ to private operators. The last line of each subtable presents OGV dwelling emissions for vessels calling at terminals leased by the PANYNJ to private operators as a percentage of the NYNJLINA emissions. The second and third subtables present each state separately.

Table 1 shows OGV dwelling emissions at terminals leased by the PANYNJ to private operators as compared to total emissions in the NYNJLINA. This table can be summarized as follows:

- For NO_x, OGV dwelling emissions at terminals leased by the PANYNJ to private operators represent 0.16% of the nonattainment area emissions.
- For VOC, OGV dwelling emissions at terminals leased by the PANYNJ to private operators represent 0.004% of the nonattainment area emissions.
- For CO, OGV dwelling emissions at terminals leased by the PANYNJ to private operators represent 0.003% of the nonattainment area emissions.
- For PM₁₀ and PM_{2.5}, OGV dwelling emissions at terminals leased by the PANYNJ to private operators represent 0.01% of the nonattainment area emissions.
- For SO₂, OGV dwelling emissions at terminals leased by the PANYNJ to private operators represent 0.35% of the nonattainment area emissions.

Table 2 breaks OGV dwelling emissions at terminals leased by the PANYNJ to private operators down further by vessel type, and Figure 2 illustrates this breakdown for the pollutant NO_x. For NO_x, OGV dwelling emissions at terminals leased by the PANYNJ to private operators is only 0.16% of the NYNJLINA total. This 0.16% is broken down by vessel type as follows: container ships account for 73% of the dwelling emissions, followed by bulk at 12%, and the other vessel types make up the remaining 15%.

⁵EPA, National Emission Inventory Data, 2000. See: <http://www.epa.gov/ttn/chief/net/neidata.html>; and ftp://ftp.epa.gov/pub/EmissionInventory/nei_criteria_summaries/2000criteriafiles/.

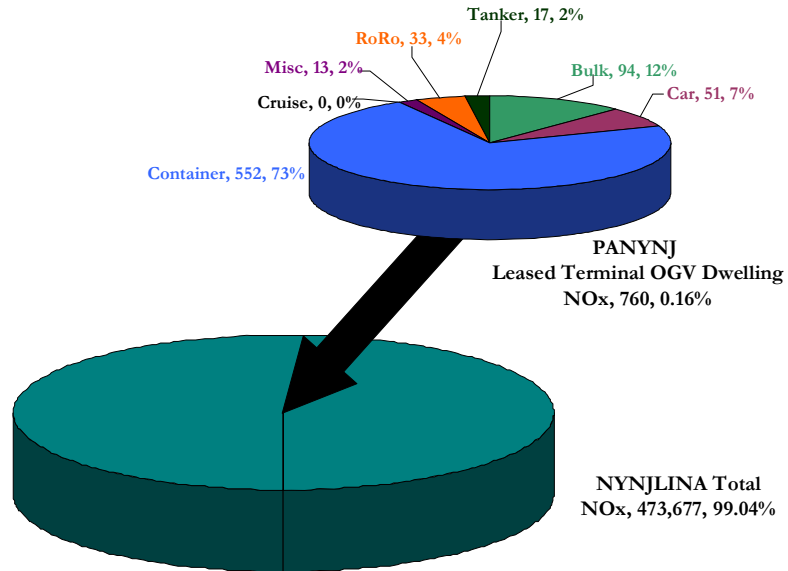
Table 1: Comparison of Regional and Vessel Dwelling Emissions, tons per year

New York and New Jersey						
Geographical Extent/Source	NO_x	VOC	CO	PM₁₀	PM_{2.5}	SO₂
New York and New Jersey	1,086,959	1,174,315	7,444,713	1,241,436	427,474	674,616
NYNJLINA	473,677	531,178	3,265,051	392,916	144,915	263,236
CMV	12,107	450	1,885	501	461	6,712
OGV Dwelling	1,862	48	279	56	51	2,234
OGV Dwelling at PANYNJ						
Leaseholds	760	20	114	23	21	911
<i>percent NYNJLINA emissions</i>	0.16%	0.004%	0.003%	0.01%	0.01%	0.35%
New Jersey						
Geographical Extent/Source	NO_x	VOC	CO	PM₁₀	PM_{2.5}	SO₂
New Jersey	346,302	388,755	2,466,005	309,955	112,511	130,748
New Jersey Portion of NYNJLINA	189,136	212,382	1,324,459	175,597	62,732	125,768
CMV	5,527	208	852	232	213	3,322
OGV Dwelling at PANYNJ						
Leaseholds	654	17	98	20	18	785
<i>percent NYNJLINA emissions</i>	0.35%	0.01%	0.01%	0.01%	0.03%	0.62%
New York						
Geographical Extent/Source	NO_x	VOC	CO	PM₁₀	PM_{2.5}	SO₂
New York	740,657	785,561	4,978,708	931,481	314,963	543,868
New York Portion of NYNJLINA	284,541	318,796	1,940,592	217,319	82,183	137,468
CMV	6,576	242	1,032	269	239	3,389
NY OGV Anchorage Dwelling	506	13	76	15	14	608
OGV Dwelling at PANYNJ						
Leaseholds	106	3	16	3	3	127
<i>percent NYNJLINA emissions</i>	0.04%	0.001%	0.001%	0.001%	0.004%	0.09%

Table 2: OGV Dwelling Emissions at Terminals Leased by the PANYNJ, by Vessel Type, tons per year

OGV Type	NO_x	VOC	CO	PM₁₀	PM_{2.5}	SO₂
Bulk	94	2	14	3	3	112
Car	51	1	8	2	1	62
Container	552	14	83	17	15	662
Cruise	0	0	0	0	0	0
Misc	13	0	2	0	0	15
RoRo	33	1	5	1	1	40
Tanker	17	0	3	1	0	20
	760	20	114	23	21	911

Figure 2: OGV NO_x Dwelling Emissions at Terminals leased by the PANYNJ, by Vessel Type, tons per year and percent



OGV dwelling emissions from terminals leased by the PANYNJ to private operators, by county, are presented in Tables 3 and 4, for New Jersey and New York, respectively.

Table 3: OGV Dwelling Emissions at Terminals Leased by the PANYNJ in New Jersey, by County, tons per year

Bergen County

Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	32,119	42,097	288,912	29,401	9,756	8,128
County CMV	204	9	26	8	7	61
OGV Dwelling at PANYNJ Leaseholds	0	0	0	0	0	0
<i>percent county emissions</i>	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Essex County

Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	44,781	43,632	271,412	37,921	15,020	67,702
County CMV	222	7	34	8	7	230
OGV Dwelling at PANYNJ Leaseholds	159	4	24	5	4	191
<i>percent county emissions</i>	0.36%	0.01%	0.01%	0.01%	0.03%	0.28%

Hudson County

Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	30,801	24,998	154,245	23,155	8,126	30,992
County CMV	2,106	70	344	82	75	1,103
OGV Dwelling at PANYNJ Leaseholds	18	0	3	1	0	22
<i>percent county emissions</i>	0.06%	0.00%	0.00%	0.00%	0.01%	0.07%

Middlesex County

Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	29,716	38,056	234,806	31,798	11,082	5,856
County CMV	402	17	56	16	15	203
OGV Dwelling at PANYNJ Leaseholds	0	0	0	0	0	0
<i>percent county emissions</i>	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Monmouth County

Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	22,675	30,442	213,674	29,847	10,459	3,771
County CMV	618	28	118	44	41	504
OGV Dwelling at PANYNJ Leaseholds	0	0	0	0	0	0
<i>percent county emissions</i>	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Union County

Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	29,043	33,158	161,409	23,475	8,289	9,320
County CMV	1,976	77	274	74	68	1,222
OGV Dwelling at PANYNJ Leaseholds	477	12	71	14	13	572
<i>percent county emissions</i>	1.64%	0.04%	0.04%	0.06%	0.16%	6.14%

Table 4: OGV Dwelling Emissions at Terminals Leased by the PANYNJ in New York, by County, tons per year

Bronx County						
Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	37,152	43,109	284,065	33,004	11,017	8,796
County CMV	173	8	22	7	6	54
OGV Dwelling at PANYNJ						
Leaseholds	0	0	0	0	0	0
<i>percent county emissions</i>	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Kings County						
Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	44,290	50,209	315,851	28,658	9,334	13,640
County CMV	1,219	42	201	55	50	949
OGV Dwelling at PANYNJ						
Leaseholds	44	1	7	1	1	52
<i>percent county emissions</i>	0.10%	0.00%	0.00%	0.00%	0.01%	0.38%

Nassau County						
Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	31,498	50,334	285,612	28,638	15,747	11,832
County CMV	67	2	13	2	2	12
OGV Dwelling at PANYNJ						
Leaseholds	0	0	0	0	0	0
<i>percent county emissions</i>	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

New York County						
Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	46,341	50,906	305,983	15,742	6,594	28,355
County CMV	1,311	39	211	41	37	487
OGV Dwelling at PANYNJ						
Leaseholds	0	0	0	0	0	0
<i>percent county emissions</i>	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Orange County						
Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	24,652	17,661	139,851	32,743	10,983	32,022
County CMV	76	3	10	3	3	22
OGV Dwelling at PANYNJ						
Leaseholds	0	0	0	0	0	0
<i>percent county emissions</i>	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Queens County						
Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	59,339	49,537	301,197	29,018	11,563	19,087
County CMV	1,627	70	230	69	64	614
OGV Dwelling at PANYNJ						
Leaseholds	0	0	0	0	0	0
<i>percent county emissions</i>	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 4: OGV Dwelling Emissions at Terminals Leased by the PANYNJ in New York by County, tons per year, continued

Richmond County						
Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	8,634	15,561	63,546	15,626	4,554	1,047
County CMV	1,713	61	295	78	64	1,138
OGV Dwelling at PANYNJ						
Leaseholds	62	2	9	2	2	74
<i>percent county emissions</i>	0.72%	0.01%	0.01%	0.01%	0.04%	7.11%

Rockland County						
Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	12,243	9,533	57,014	8,175	3,781	13,446
County CMV	27	1	3	1	1	8
OGV Dwelling at PANYNJ						
Leaseholds	0	0	0	0	0	0
<i>percent county emissions</i>	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Westchester County						
Geographical Extent/Source	NOx	VOC	CO	PM₁₀	PM_{2.5}	SO₂
County	20,392	31,944	187,474	25,715	8,611	9,242
County CMV	364	16	46	14	13	106
OGV Dwelling at PANYNJ						
Leaseholds	0	0	0	0	0	0
<i>percent county emissions</i>	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Table 5 summarizes emissions by contaminant for counties with OGV dwelling emissions from terminals leased by the PANYNJ to private operators, and shows that:

- For NO_x, OGV dwelling emissions at terminals leased by the PANYNJ to private operators range from 0.06% to 1.64% compared to total NO_x emissions within each county
- For VOC and CO, OGV dwelling emissions at terminals leased by the PANYNJ to private operators range from 0.002% to 0.04% compared to total VOC and CO emissions within each county
- For PM₁₀ and PM_{2.5}, OGV dwelling emissions at terminals leased by the PANYNJ to private operators range from 0.002% to 0.16% compared to total PM₁₀ and PM_{2.5} emissions within each county
- For SO₂, OGV dwelling emissions at terminals leased by the PANYNJ to private operators range from 0.07% to 7.11% compared to total SO₂ emissions within each county

Figures 3 through 7 illustrate the small fraction of overall county emissions represented by emissions from vessels dwelling at terminals leased by the PANYNJ to private operators. The OGV dwelling emission percentages in these figures represent the dwelling emissions divided by the countywide emissions shown in Tables 3 and 4 above for the counties listed by name in Table 5. The remaining counties do not have any dwelling emissions from private operators on terminals leased from PANYNJ. As Table 5 shows, the OGV dwelling emissions contribute a very small percentage of overall countywide emissions.

Table 5: OGV Dwelling Emissions from Terminals Leased by the PANYNJ to Private Operators as a Percent of the Total County Emissions for All Sources

County, State	NO _x	VOC	CO	PM ₁₀	PM _{2.5}	SO ₂
Essex County, NJ	0.36%	0.01%	0.01%	0.01%	0.03%	0.28%
Hudson County, NJ	0.06%	0.002%	0.002%	0.002%	0.01%	0.07%
Union County, NJ	1.64%	0.04%	0.04%	0.06%	0.16%	6.14%
Kings County, NY	0.10%	0.002%	0.002%	0.005%	0.01%	0.38%
Richmond County, NY	0.72%	0.01%	0.01%	0.01%	0.04%	7.11%

Figure 3: Percentage of Total County Emissions Contributed by OGV Dwelling Emissions from Terminals Leased by the PANYNJ to Private Operators – Union County, NJ

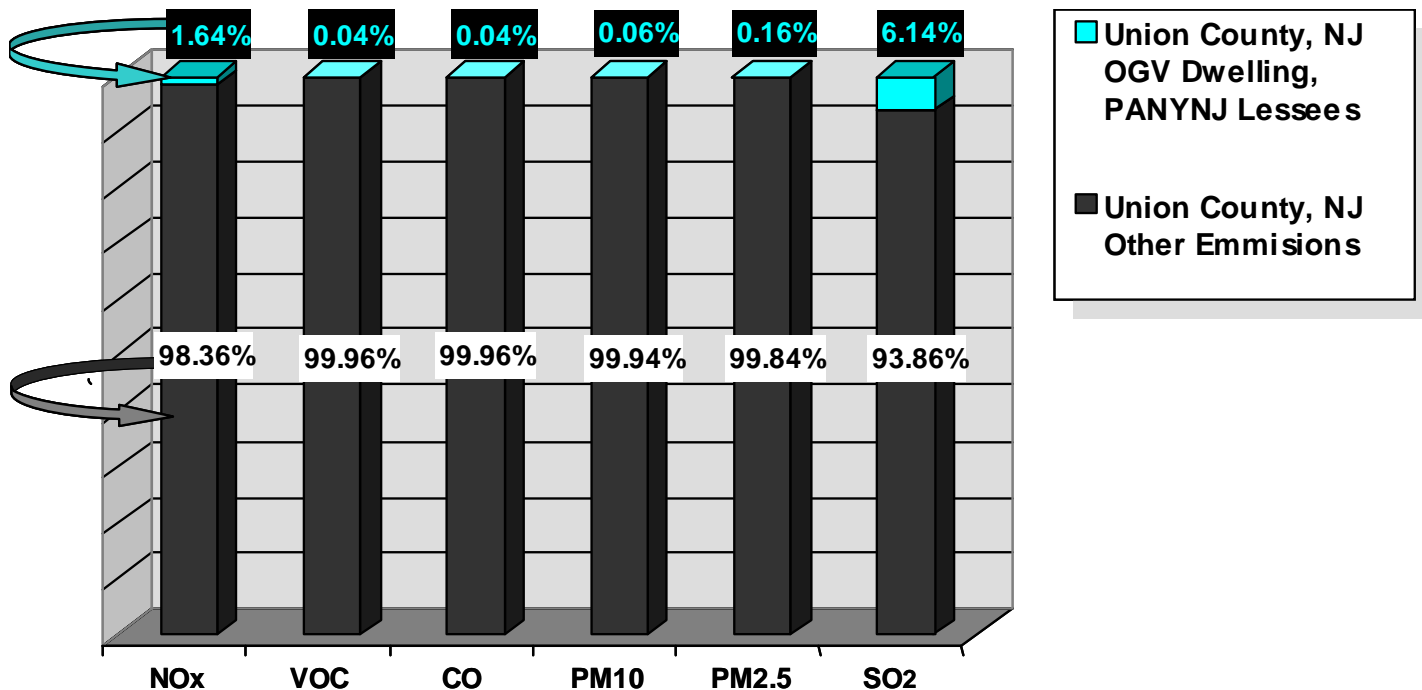


Figure 4: Percentage of Total County Emissions Contributed by OGV Dwelling Emissions from Terminals Leased by the PANYNJ to Private Operators – Essex County, NJ

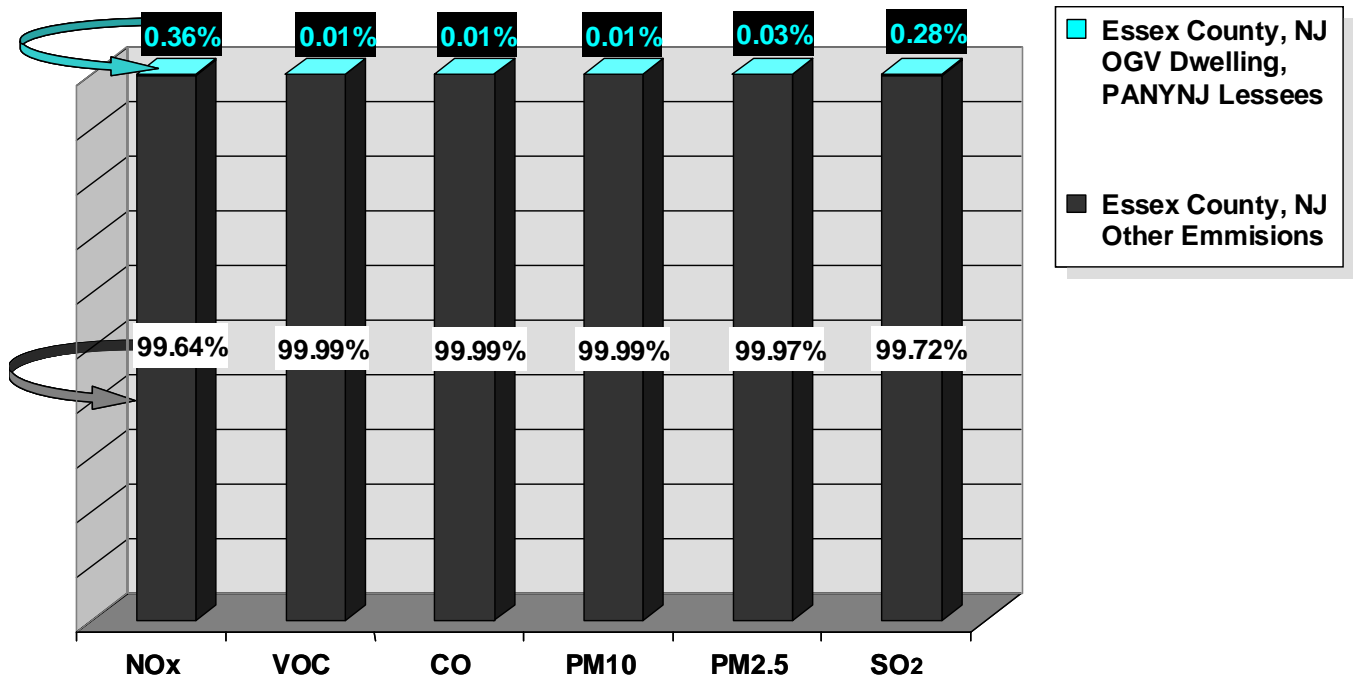


Figure 5: Percentage of Total County Emissions Contributed by OGV Dwelling Emissions from Terminals Leased by the PANYNJ to Private Operators – Richmond County, NY

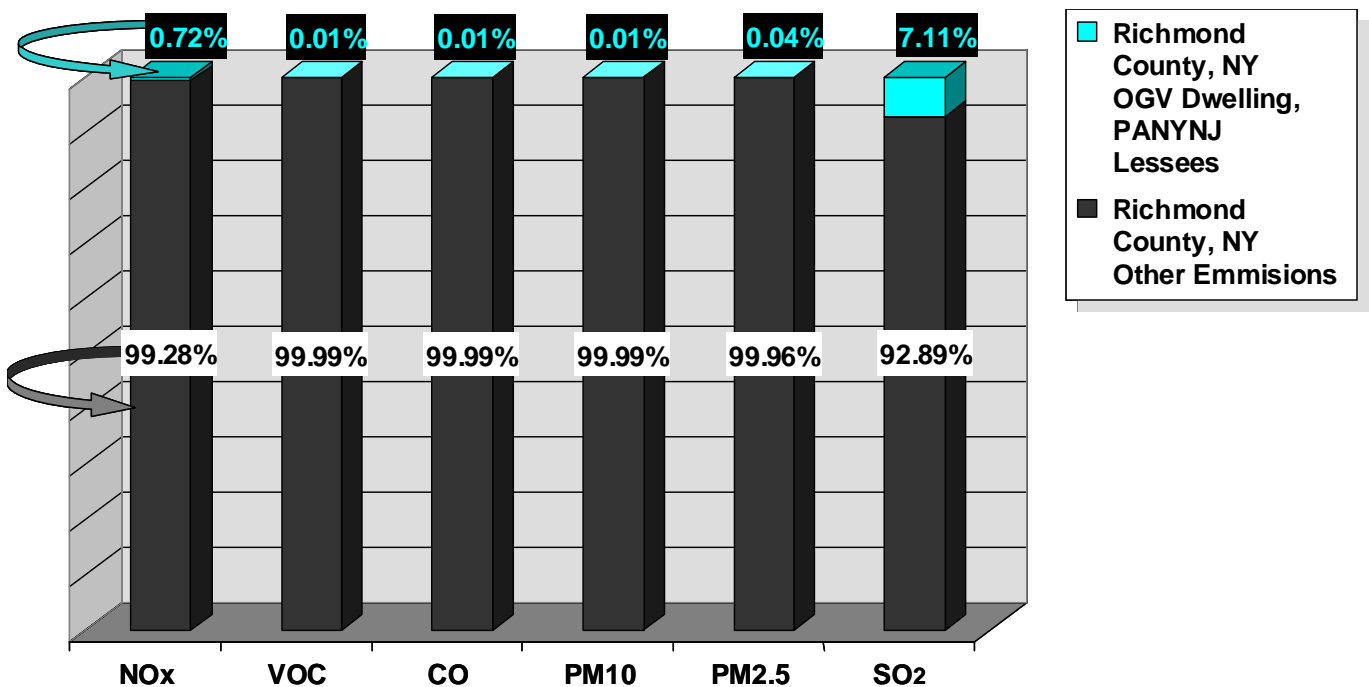


Figure 6: Percentage of Total County Emissions Contributed by OGV Dwelling Emissions from Terminals Leased by the PANYNJ to Private Operators – Kings County, NY

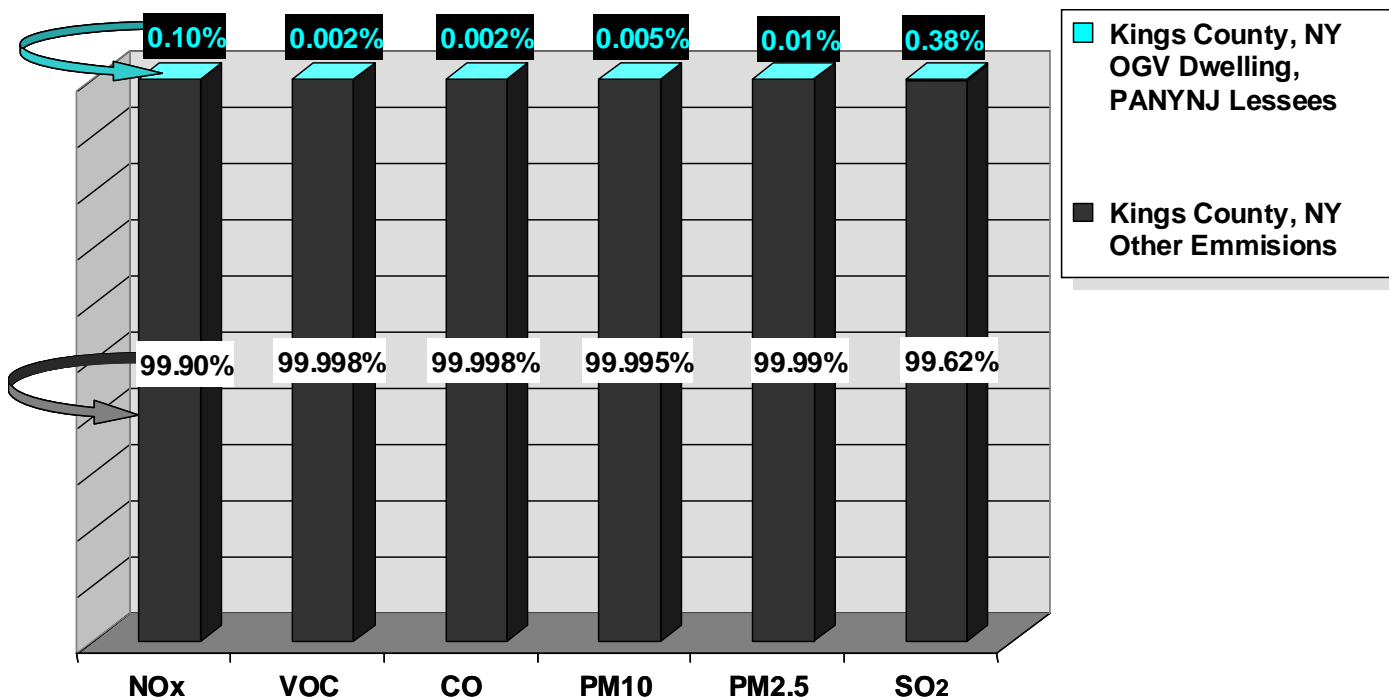


Figure 7: Percentage of Total County Emissions Contributed by OGV Dwelling Emissions from Terminals Leased by the PANYNJ to Private Operators – Hudson County, NJ

