THE PORT OF NEW YORK AND NEW JERSEY
HEAVY-DUTY DIESEL VEHICLE EMISSIONS INVENTORY

JULY 2007

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

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

CO	carbon monoxide
EF	Emission Factor
EI	Emissions Inventory
g/hr	grams per hour
g/mi	grams per mile
GVWR	gross vehicle weight rating
HDDV	heavy-duty diesel vehicle
hrs	hours
NAAQS	National Ambient Air Quality Standard
NOx	oxides of nitrogen
NYNJLINA	New York/New Jersey Long Island Non-Attainment Area
PANYNJ	Port Authority of New York and New Jersey
PONYNJ	Port of New York and New Jersey
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PM_{10}	particulate matter less than 10 microns in diameter
ppm	parts per million
SCC	Source Category Code
SO_2	sulfur dioxide
tpy	tons per year
U.S.	United States
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound

DATA CONFIDENTIALITY STATEMENT

Due to heightened port security and anti-competition concerns, results are aggregated, or are reported so as to make the identity of individual terminals/facilities indiscernible.

EXECUTIVE SUMMARY

Starcrest Consulting Group, LLC (Starcrest) developed an air emissions inventory to quantify emissions from heavy-duty diesel trucks that serve major marine terminal operations within the Port of New York and New Jersey (PONYNJ). The emissions inventory evaluates on-road heavy-duty diesel vehicles (HDDV) that transport freight into or out of the marine terminals' container terminals, warehouses and auto-handling facilities. The purpose of the HDDV emissions inventory is to continue the Port Authority of New York and New Jersey's (Port Authority) ongoing efforts to assess and evaluate the air quality conditions related to maritime activities within the geographical boundaries of the United States Environmental Protection Agency (U.S. EPA) designated New York/New Jersey/Long Island Non-Attainment Area (NYNJLINA) for ozone.

The major PONYNJ marine terminals are located in Kings and Richmond Counties, New York; and Essex, Hudson and Union Counties, New Jersey, as shown in Figure 1.1. Baseline emission estimates were developed for oxides of nitrogen (NOx), volatile organic compounds (VOC), carbon monoxide (CO), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), and sulfur dioxide (SO_2). Totals contained in this report include emissions from Heavy Duty Diesel Vehicles (HDDV) calling at marine terminals that the Port Authority leases to private terminal operators; and the privately owned/operated Global Marine Terminal, which is not a Port Authority facility and is located in Hudson County, NJ.

The U.S. EPA's vehicle emission modeling software MOBILE6.2 was used to estimate on-terminal and off-terminal HDDV emissions of NOx, VOC, CO, PM_{10}, $PM_{2.5}$ and SO_2. Activities included in the estimates are driving while on marine terminals and idling time. Emissions for off-terminal activity were estimated for container terminal HDDVs driving between the container terminals and origins and destinations in a 15-county region, including counties in New York and New Jersey within the NYNJLINA. The origin and destination data was obtained from a 2005 Port Authority origin/destination (O/D) study conducted by Vollmer.[1]

[1] Port Authority Marine Container Terminals Truck Origin-Destination survey, 2005, Prepared for The Port Authority of NY & NJ, November 2005, Revised 2/27/06, Prepared by Vollmer Associates

Total On-Terminal and Off-Terminal Emissions

Table ES1.1 combines statewide New York and New Jersey emissions, which were extracted from the U.S. EPA's National Emission Inventory.[2] In addition, this table compares total state emissions to the NYNJLINA and total marine terminal HDDV emissions to the NYNJLINA. The marine terminal emissions include (1) HDDV off-terminal emissions from one privately owned and operated container terminal (the Global Marine Terminal) and five container terminals leased by the Port Authority to private operators; and (2) on-terminal HDDV emissions from container, auto handling and warehouse facilities leased by the Port Authority to private operators and the privately owned and operated Global Marine Terminal.

The results of this study indicate that emissions from HDDVs serving the marine terminals within the PONYNJ, when compared to total emissions within the NYNJLINA, represent a small percentage of the total emissions (for NOx, less than 0.43%; and between 0.01% to 0.03% for VOC, CO, PM_{10}, $PM_{2.5}$ and SO_2) as shown below in Table ES1.1 and Figure ES1.1.

Table ES1.1: Comparison of Regional and Marine Terminal HDDV Emissions, tpy

New York and New Jersey Geographical Extent/ Source	VOC	CO	NOx	PM_{10}	$PM_{2.5}$	SO_2
New York and New Jersey	1,174,315.00	7,444,713.00	1,086,959.00	1,241,436.00	427,474.00	674,616.00
NYNJLINA	531,178.00	3,265,051.00	473,677.00	392,916.00	144,915.00	263,236.00
PONYNJ HDDV	81.27	639.78	2,059.07	42.40	41.13	36.51
percent NYNJLINA emissions	**0.02%**	**0.02%**	**0.43%**	**0.01%**	**0.03%**	**0.01%**

[2] EPA, 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/2000criterasummaryfiles/. Note: After extracting the New York and New Jersey emissions from the national emissions inventory data for 2000, the EPA added an update to the national inventory for 2002. While the comparisons in this report relate to the 2000 data, the differences between the two inventories would not be great enough to significantly change the nature or conclusions of the comparisons. It is possible that the earlier data is more representative of activity and emissions in the New York/New Jersey area than the 2002 data, given the effect on area commerce of the events that took place in September 2001. However, evaluating that possibility is beyond the scope of this report.

Figure ES1.1: Marine Terminal HDDV NOx Emissions Compared to NYNJLINA NOx Emissions

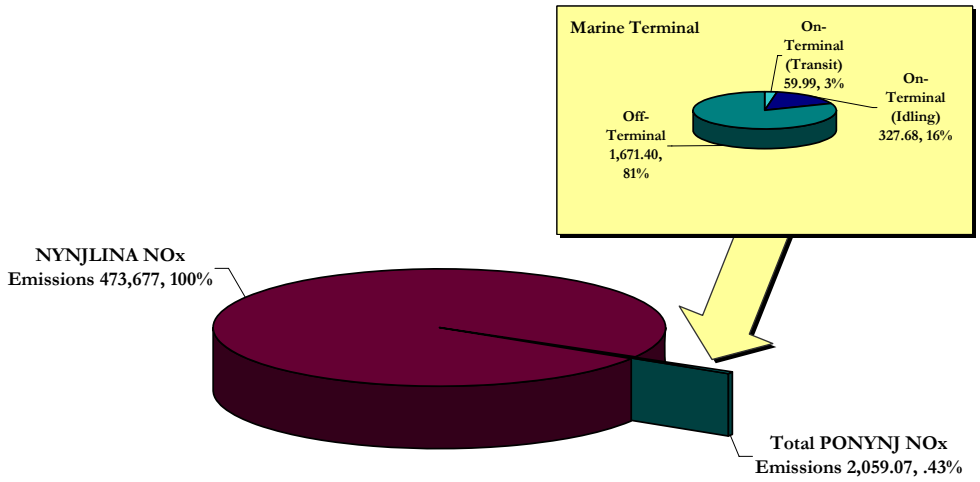


Figure ES1.1 illustrates that the entire marine terminal HDDV emissions contribution for oxides of nitrogen (NOx) represents 0.43% of overall NYNJLINA NOx emissions. This 0.43% of NOx emissions is further broken down to show the on-terminal emissions portions for auto-handling, warehouse and container operations, as well as HDDV off-terminal emissions from container operations. Off-terminal emissions represents 81% of the 0.43% of NOx emissions, while on-terminal idling and on-terminal transit emissions represents 16% and 3% respectively of the 0.43%.

On-Terminal

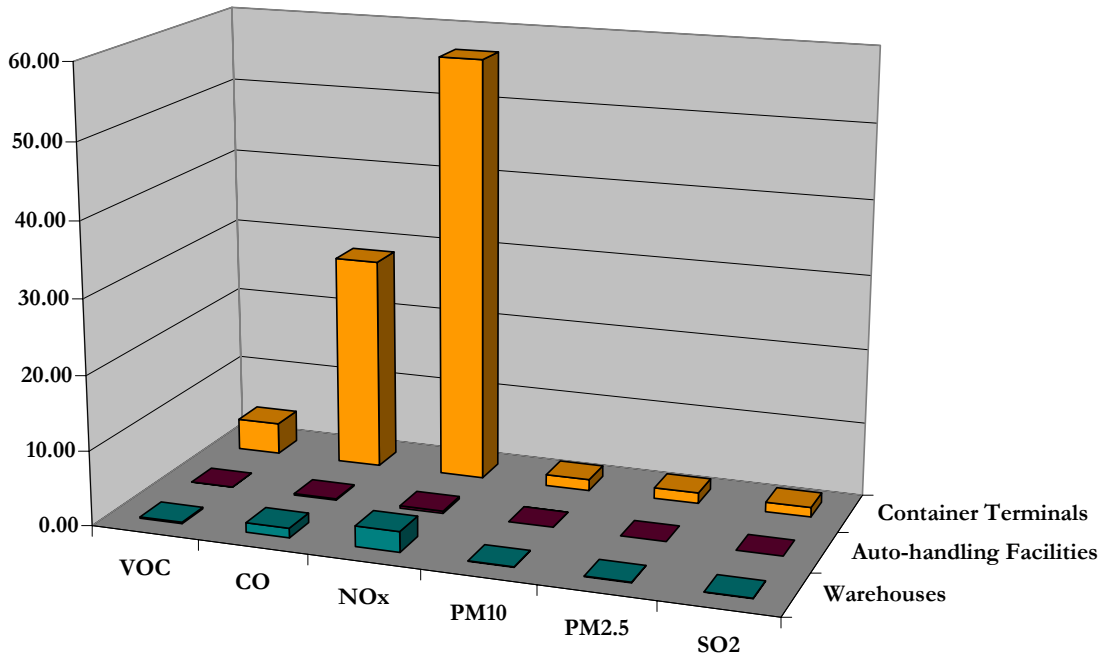
For the purposes of this report, PONYNJ on-terminal emissions are limited to Port Newark, the Elizabeth PA Marine Terminal, the Auto Marine Terminal and the Howland Hook Marine Terminal, which the Port Authority leases to private terminal operators; and the Global Marine Terminal, which is privately owned and operated. Overall, HDDVs visiting the PONYNJ container terminals emitted 95 percent of the total on-terminal emissions due to high activity levels (larger number of truck calls and their time spent on terminal). Warehouses' HDDV emissions amounted to 4 percent of the total on-terminal emissions with auto-handling facilities contributing 1 percent.[3] Emissions estimates for key pollutants in tons per year (tpy) are presented in Table ES1.2 and Figure ES1.1.

[3] Since some warehouses and auto-handling facilities did not participate in providing HDDV activity, some of this data was derived through extrapolation. For the sake of providing conservative figures, the model assumed engines idling throughout warehouse loading/unloading operations, contrary to typical observations

Table ES1.2: 2005 On-Terminal HDDV Transit Emissions Comparison by Maritime Operation and Pollutant, tpy

Maritime Operation	VOC	CO	NOx	PM_{10}	$PM_{2.5}$	SO_2
Warehouses	0.19	1.29	2.73	0.07	0.07	0.06
Auto-handling Facilities	0.03	0.17	0.33	0.01	0.01	0.01
Container Terminals	4.28	28.60	56.93	1.50	1.46	1.29
Total	**4.50**	**30.06**	**59.99**	**1.59**	**1.54**	**1.37**

Figure ES1.2: 2005 On-Terminal HDDV Transit Emissions Comparison, Total by Pollutant, tpy

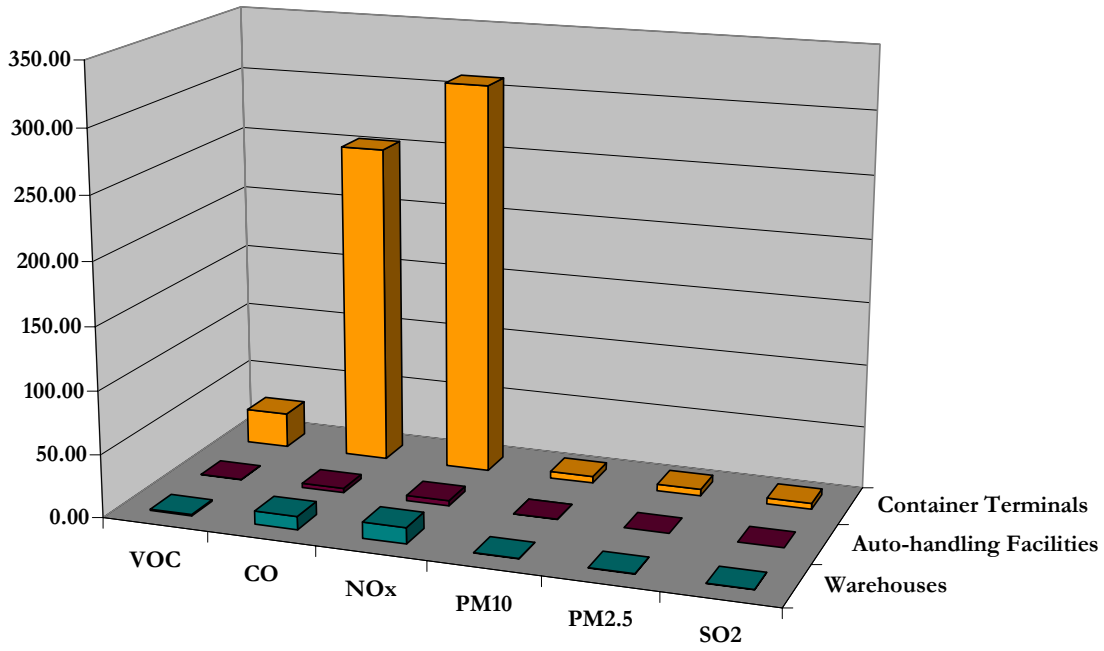


On-terminal HDDV idling emissions were significantly higher than on-terminal driving emissions. Container terminals contributed 95 percent of the total HDDV on-terminal idling emissions. Warehouses contributed 4 percent of HDDV on-terminal idling emissions and auto-handling facilities contributed 1 percent. HDDV idling emission estimates for key pollutants in tons per year are presented in Table ES1.3 and Figure ES1.3.

Table ES1.3: On-Terminal HDDV Idling Emissions, by Maritime Operation and Pollutant, tpy

Maritime Operation	VOC	CO	NOx	PM_{10}	$PM_{2.5}$	SO_2
Warehouses	1.15	10.46	12.78	0.22	0.22	0.19
Auto-handling Facilities	0.37	3.37	4.12	0.07	0.07	0.06
Container Terminals	27.92	254.22	310.78	5.43	5.26	4.67
Total	**29.44**	**268.04**	**327.68**	**5.72**	**5.55**	**4.93**

Figure ES1.3: On-Terminal HDDV Idling Emissions Comparison, Total by Pollutant, tpy



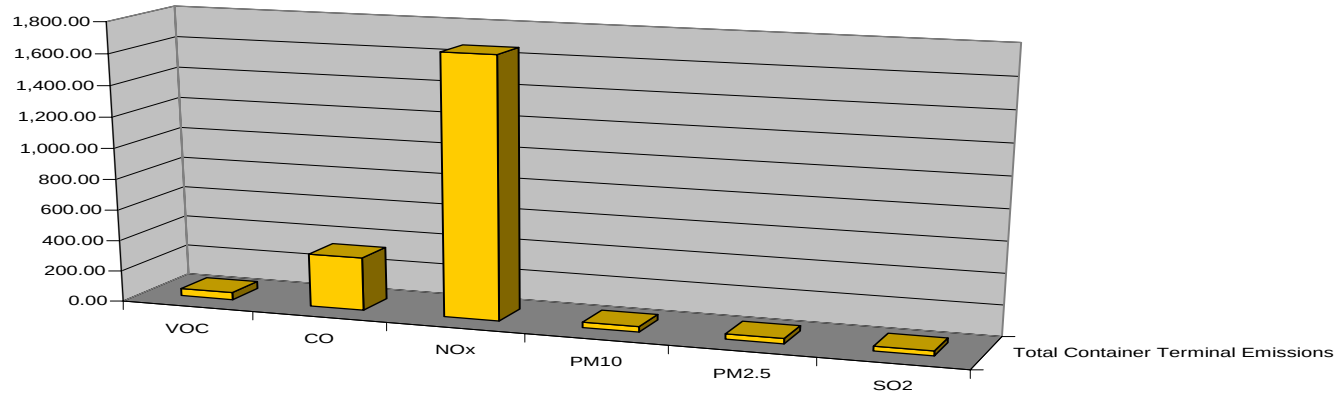
Off-Terminal

Strictly for the purposes of this HDDV Emissions Inventory, off-terminal emissions are only represented by container terminal emissions because the Port Authority has determined that landside moves into or out of the on-terminal warehouses and auto marine terminals are secondary traffic moves and are therefore not included in this report. Emission estimates in tons per year (tpy) for key pollutants are presented in Table ES1.4 and Figure ES 1.4.

Table ES1.4: Off-Terminal Container Terminal HDDV Emissions, by Pollutant tpy

Maritime Operation Container Terminal	VOC	CO	NOx	PM_{10}	$PM_{2.5}$	SO_2
Total	47.33	341.68	1,671.40	35.09	34.04	30.22

Figure ES1.4: Off-Terminal Container Terminal HDDV Emissions, by Pollutant tpy



INTRODUCTION

Movement of freight by Heavy-Duty Diesel Vehicles (HDDV) is one of the freight modes most commonly used by tenants of the Port Authority of New York and New Jersey (Port Authority). From all over the world, goods enter and leave the United States through the major marine terminals situated within the Port of New York and New Jersey (PONYNJ). The New York/New Jersey metropolitan area is one of the busiest freight handling and consumer centers in the country. With a predicted increase in freight movement over the next 25 years, there are concerns that there will be a decrease in regional transportation performance (e.g., more traffic congestion) and associated environmental issues such as an increase in diesel emissions. However, with careful planning and assessment, potential negative issues can be reduced and the New York/New Jersey metropolitan area can look forward to a boost in the economy, business and job opportunities, while promoting quality in transportation performance and the protection of the environment.[4]

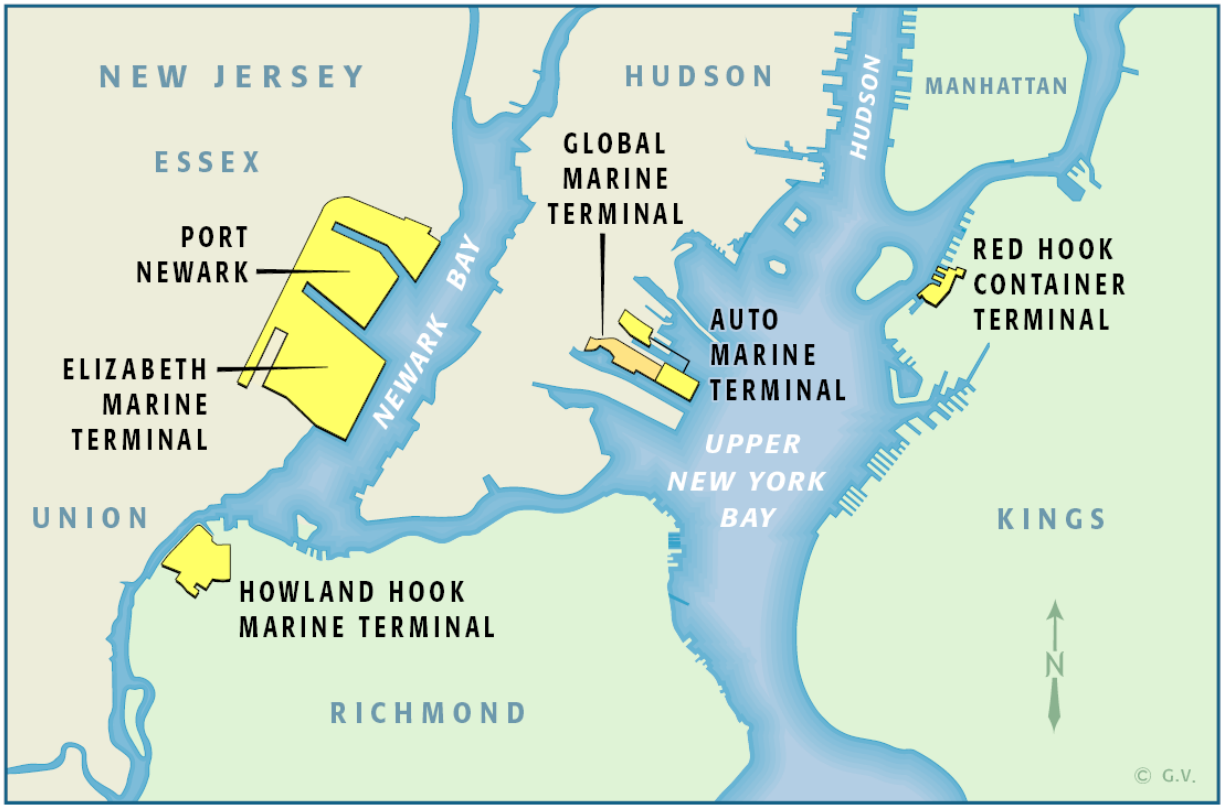
This report represents the Port Authority's ongoing effort to assess and evaluate air quality conditions related to maritime activities within the USEPA-designated New York/New Jersey/Long Island Non-Attainment Area (NYNJLINA) for ozone. By conducting an emissions inventory of HDDVs that visit PONYNJ's marine terminals, the Port Authority is seeking to: (1) quantify the contribution to overall emissions in the NYNJLINA attributable to HDDV maritime activity; and (2) help support a case to obtain funding through grants and other programs for enhancing air quality within the NYNJLINA.

Figure 1.1 shows the six major marine terminal complexes included in this study, which are located in either New Jersey or New York. The New Jersey facilities include three maritime complexes that the Port Authority leases to private operators: (1) Port Newark (includes container, auto marine and on-terminal warehousing); (2) the Elizabeth Port Authority Marine Terminal or EPAMT (includes container, auto marine and on-terminal warehousing); and (3) the Auto Marine Terminal. In addition, one privately owned and operated facility is included among the New Jersey facilities: the Global Marine Terminal, which is not associated with the Port Authority.[5] The remaining marine terminals, which the Port Authority leases to private operators, are located in New York and include: the Red Hook Container Terminal, and the New York Container Terminal at Howland Hook Marine Terminal.

[4] NJTPA Freight System Performance Assessment, 2005

[5] HDDV emissions associated with the privately owned and operated Global Marine Terminal are not reported separately from the remaining major marine terminals due to confidentiality issues.

Figure 1.1: Major Port of New York and New Jersey Freight Terminals



Heavy-duty diesel vehicle emissions were estimated by evaluating three principal forms of maritime operations: container terminal, auto-marine terminal, and on-terminal warehouse operations. Table 1.1 includes the names of the facilities for each maritime operation.

Table 1.1: Maritime Facilities by Type of Operation

Type of Operation	Maritime Facility
Container Terminals	1. Port Newark Container Terminal (PNCT) at Port Newark 2. Maher Terminal at EPAMT 3. APM Terminal at EPAMT 4. New York Container Terminal at Howland Hook 5. American Stevedoring Incorporated (ASI) at Red Hook Marine Terminal and Port Newark 6. Global Marine Terminal (non-Port Authority Facility, which is privately owned and operated), Jersey City, NJ
Auto Marine Terminals	1. Toyota Logistics at Port Newark 2. Foreign Auto Services (FAPS) at Port Newark 3. Wallenius Wilhelmsen Logistics (WWL) at EPAMT 4. Northeast Auto Terminal (NEAT) at the Auto Marine Terminal 5. BMW at the Auto Marine Terminal
On-Terminal Warehouses at Port Newark/EPAMT	1. Mid States Packaging & Distribution 2. Pittston Warehouse Corporation 3. AZ Container Freight 4. Linon Home Décor Products 5. Harbor Freight Transport 6. Port Newark Refrigerated Warehouse 7. Eastern Warehouse 8. Export Transport Co. 9. ASA Apple Inc. 10. Nationwide Transport and Warehouse 11. Glendale Warehouse and Distribution Corp. 12. Port Elizabeth Terminal and Warehouse 13. Van Brunt Port Jersey Warehouse Inc. 14. Port Warehouse & Distribution Corp. 15. Interglobal Morra 16. TRT International Ltd. 17. Tyler Distribution Centers Inc. 18. East Coast Warehouse & Distribution Corp.

This emissions inventory presents estimates of on and off-terminal HDDV emissions associated with PONYNJ major maritime operations. The PONYNJ emissions are compared to: (1) statewide emissions for New York and New Jersey; (2) total emissions within the 15-county New York/New Jersey/Long Island Non-Attainment Area (NYNJLINA); and (3) total county emissions for each of these individual 15 counties. Emissions are estimated for oxides of nitrogen (NOx), particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$), carbon monoxide (CO), volatile organic compounds (VOC) and sulfur dioxide (SO_2).

1.1 Operational Modes and Vehicle Types

1.1.1 Operational Modes

As mentioned in the Introduction, HDDVs are used extensively to move goods, particularly containerized cargo, to and from the marine terminals that serve as a bridge between land and sea transportation. HDDVs deliver goods to local, regional and national destinations. Over the course of the day, trucks are driven onto and through these container, warehouse and/or auto-handling facilities where they deliver and/or pick up goods. They are also driven on public roads within the boundaries of major, multi-terminal maritime hubs such as Port Newark/EPAMT, and on the public roads outside these hubs.

Areas of activity for which emissions have been estimated include on terminal (dropping off or picking up cargo) and off terminal.

- On-terminal operations include transiting the terminal to drop off and/or pick up cargo and idling while loading and unloading and departing the terminal.
- Off terminal operations consist of container terminal HDDVs origin/destination moves from/to the first point of rest within, or out to the limits of, the NYNJLINA region.

1.1.2 Vehicle Types

Heavy-Duty Diesel Vehicles can be distinguished in three ways: light heavy-duty, medium heavy-duty, and heavy heavy-duty. These categories are based on gross vehicle weight rating (GVWR) of the truck, including its trailer if so equipped.[6]

- Light HDV: 10,000 to 14,000 pounds
- Medium HDV: 14,000 to 33,000 pounds
- Heavy HDV: over 33,000 pounds

[6] Port of Los Angeles Baseline Air Emissions Inventory, Starcrest Consulting Group, LLC., (2001)

This report deals exclusively with diesel-fueled HDDVs. The most common configuration of HDDV is the articulated tractor-trailer (truck and semi-trailer) having five axles, including the trailer axles. The most common type of trailer in this study area is the container trailer, built to accommodate standard sized cargo containers. Another common configuration is the bobtail, which is a tractor traveling without an attached trailer. Other types include auto-carriers and flatbeds. These vehicles are all classified as heavy HDDVs regardless of their actual weight. Their classification is based on GVWR, which is a rating of the vehicle's total carrying capacity. Therefore, the emissions estimates do not distinguish among different configurations. In this study, more than 88 percent of the HDDVs were 80,000 pounds GVWR.

Figure 1.2 shows an example of a container truck transporting a container in a terminal. Figure 1.3 shows an example of a bobtail. The images of the trucks are not actual HDDVs used at the PONYNJ and are displayed for illustrative purposes only.

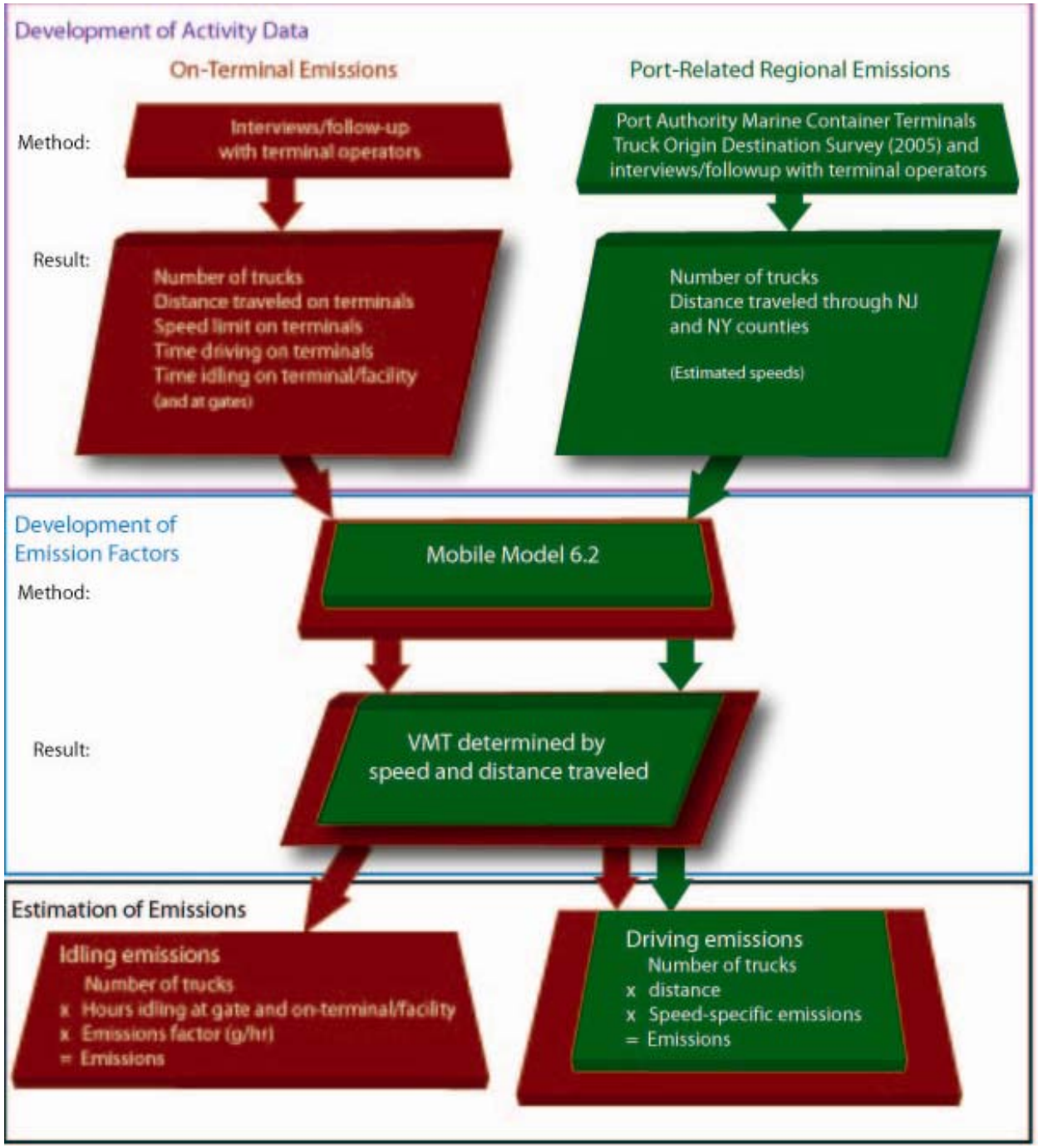
Figure 1.2: Truck with Container

Figure 1.3: Bobtail Truck

1.2 Methodology

In this section, the methodology used to collect data and the process in which emission estimates were developed is thoroughly discussed. Figure 1.4 illustrates this process in a flow diagram for on-terminal and off-terminal activity.

Figure 1.4: HDDV Emission Estimating Process



1.2.1 Data Acquisition

Data for the HDDV emission estimates came from two basic sources: terminal/facility operator interviews for container, warehouse and auto-handling facilities and the Port Authority Marine Container Terminals Truck Origin-Destination Survey 2005.[7] These information sources are discussed below.

On-Terminal

On November 28, 2006, the Port Authority and Starcrest organized a meeting with terminal/facility operators that operate maritime business out of container terminals, warehouse and auto-handling facilities, which are located within Port Newark/EPAMT (these facilities contain various auto, warehouse and container terminals), the Auto Marine Terminal, the Howland Hook Marine Terminal and the Red Hook Container Terminal. During the meeting, the participants learned about the project and its goals along with reviewing a survey that covered on-terminal and off-terminal HDDV activity. Following the meeting, the participants filled out the surveys and returned them directly to Starcrest. To encourage accurate and complete reporting, all information was promised to be kept confidential. For tenants who were unable to participate in the face to face meeting, a phone call was made along with sending out an email with the survey attached. In addition to receiving surveys through email, Starcrest conducted interviews over the phone.

The survey covered specific information on HDDV activity on and off-terminal. Questions included annual gate count, distance traveled on and off the terminal, speed traveled, idling time at the facility, origin-destination, and HDDV characteristics. Appendix A includes the HDDV survey that was used.

Table 1.2 illustrates the range and average of reported characteristics of on-terminal HDDV activities at maritime operating facilities.

Table 1.2: Summary of Reported On-Terminal Maritime Operating Characteristics

Maritime Operation	Annual Trips	Vehicle Miles Traveled	Speed (mph)	Idling Hours
Warehouses	291,818	172,130	14.74	206,800
Auto-Handling Facilities	123,449	19,867	14.00	66,600
Container Terminals	2,518,613	3,481,390	15.00	5,028,426
Total	**2,933,880**	**3,673,387**	**14.58**	**5,301,826**

[7] Port Authority Marine Container Terminals Truck Origin-Destination Survey, 2005 prepared by Vollmer

Note that, while the auto-handling facilities reported an average on-terminal idling time of 0.5 hours per truck, anecdotal information indicates that longer idling times may be more common. Further study in this area is warranted. The average speeds and distances shown in the table above were used to develop an operational profile to help estimate on-terminal vehicle miles traveled (VMT) and idling times, especially when the data for a particular terminal/facility was missing or thought to be unreliable or anomalous.

Off-Terminal

In order to have better knowledge on the origins and destinations of container truck movement, the commodities carried, and the route selected, for port planning and marketing purposes, the Port Authority retained a consultant to conduct an origin-destination study (the Vollmer Study). In total, six container terminals were surveyed; four in Port Newark and Elizabeth Port Authority Marine Terminal (one of which has joint operations at the Red Hook Container Terminal, NY), one in Jersey City, and one in Staten Island, New York (Howland Hook). There were three days in which surveys were taken, two during December 2004 in New York and one day in May 2005 in New Jersey. Over the three days, information was sought on typical truck movements, major commodities (import and export), and the origins and destinations of the trucks with their current loads.

The origin-destination study was very helpful in providing valuable information to the HDDV emissions inventory. From the study, several factors help determine off-terminal emissions for container terminals. Information used consists of: daily trip counts in and out of the marine terminals; number of vehicle axles; counties traveled to and from and the amount of time spent on-terminal. Based on this information, VMT were estimated for regional and local HDDV activity. This later was used with appropriate emission factors to determine off-terminal emissions.[8]

[8] Strictly for the purposes of this HDDV emissions inventory, landside moves into or out of the on-terminal warehouse and auto marine terminals has been defined as secondary and are therefore not included.

1.2.2 Emission Estimates

The general form of the equation for estimating vehicle emissions is:

$$E = EF * A$$

Where:

E = Emissions
EF = Emission Factor
A = Activity

There are two types of activity: engine running with vehicle moving at a given speed, and engine idling with vehicle at rest. Running emission factors are expressed in terms of grams per mile (g/mi) while idling emission factors are expressed in terms of grams per hour (g/hr). Therefore, the activity measure used for estimating running emissions is miles (known specifically as vehicle miles of travel, VMT) and the activity measure used for estimating idling emissions is hours. The emission factor (g/mi or g/hr) is multiplied by the activity measure (VMT or hours) to estimate grams of emissions, which are then converted to pounds or tons as appropriate. The time period covered by the emission estimate corresponds to the time period of the activity measure. For example, an annual VMT figure (miles per year) multiplied by a gram per mile emission factor results in a gram per year emission estimate.

The emission factors are developed using a software package called MOBILE6.2, which is the latest version of an emission factor model developed by the U.S. EPA. MOBILE6.2 estimates speed-specific emission factors for the pollutants included in this study, in grams per mile and grams per hour, for a series of vehicle type classifications representing all types of on-road vehicles. The model includes EPA's information and assumptions regarding age distribution, annual mileage, and other operating parameters of the vehicle classes.

1.3 On and Off Terminal Emission Estimates

On-terminal emissions have been estimated for each HDDV maritime operation, whereas off-terminal emissions include estimates only for container terminal trucks. The MOBILE6.2 emission estimates include the effects of standard assumed amounts of idling that are encountered in travel on public roads.

1.3.1 On-Terminal

For warehouse and auto-handling facilities, annual activity was used for on-terminal analysis. Since container terminal HDDV daily trip counts were taken from the Port Authority's origin-destination survey, daily counts were converted to trips per year. For each maritime operation (warehouse, auto-handling facility, and container terminal), emissions were calculated as tons per year, with idling and transit activities estimated separately. Table 1.3 summarizes the two modes of operation by terminal/facility type.

Table 1.3: 2005 On-Terminal HDDV VMT and Idling Hours by Maritime Operation

Maritime Operation	VMT	Idling Hours
Warehouses	172,130	206,800
Auto-Handling Facilities	19,867	66,600
Container Terminals	3,481,390	5,028,426
Totals	**3,673,387**	**5,301,826**

Emissions were calculated by multiplying the activity value by the relevant emission factor. For on-terminal travel NOx emissions for example, the total mileage, 3,673,387 VMT, was multiplied by the 15 mph NOx emission, 14.386 g/mi:

$$\frac{3{,}673{,}387 \text{ miles/yr} \times 14.386 \text{g/mi}}{453.6 \text{ g/lb} \times 2{,}000 \text{ lb/ton}} = 58.3 \text{ tons/yr}$$

For the purpose of demonstrating how emissions are calculated for transit activity, the emissions factor for 15 mph was used for this particular equation. However, as Table 1.4 suggests, the total NOx emissions for transit activity is a little higher due to a variation of different speed limits and therefore different emission factors were used.

Similarly, for idling emissions, total idling hours per year, 5,301,826, was multiplied by NOx emission factor for idling, 56.070g/hour:

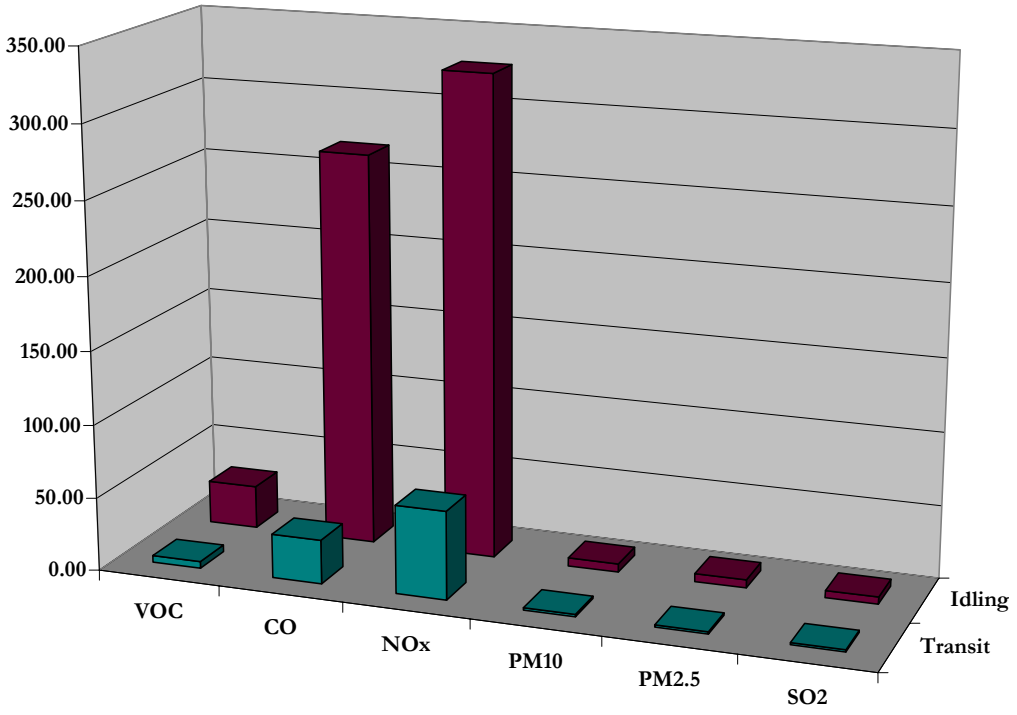
$$\frac{5{,}301{,}826 \text{ hours/yr} \times 56.070 \text{g/hour}}{453.6 \text{g/lb} \times 2{,}000 \text{ lb/ton}} = 327.7 \text{ tons/yr}$$

Results for all maritime operations are presented in Table 1.4 and Figure 1.5 in terms of short tons per year.

Table 1.4: Summary of On-Terminal HDDV Emissions (tpy)

	VOC	CO	NOx	PM10	PM2.5	SO2
Transit	4.50	30.06	59.99	1.59	1.54	1.37
Idling	29.44	268.04	327.68	5.72	5.55	4.93
Totals	**33.94**	**298.10**	**387.67**	**7.31**	**7.09**	**6.29**

Figure 1.5: On-Terminal HDDV Emissions Breakdown by Pollutant



1.3.2 Off-Terminal

Unlike the on-terminal HDDV emissions, off-terminal emissions are estimated for container terminals only since, for the purposes of this HDDV Emissions Inventory, the Port Authority has determined that warehouse and auto-carrier landside, off-terminal HDDV activities are secondary freight moves. From the Vollmer origin-destination study, Starcrest has determined vehicle miles traveled (VMT) within the boundaries of the 15-county NYNJLINA for HDDVs servicing the container terminals.

A calculation spreadsheet was developed to determine off-terminal emissions. The distance of the road segment was multiplied by the number of trucks traveling over that segment by the emission factors appropriate to the average speed for that segment. Then, emissions were calculated for that segment of road over the time period.

For example, if 100 trucks passed over 1 mile road segment at an average speed of 30 mph, the calculation for NOx would be:

$$\frac{100 \text{ trucks} \times 1 \text{ mile} \times 16.679 \text{ g/mile}}{453.6 \text{ g/lb} \times 2{,}000 \text{ lb/ton}} = 0.0018 \text{ tons}$$

Where, 16.679 g/mile is the NOx emission factor for 30 mph.

Table 1.5 presents off-terminal emission estimates for container terminal related activity in all 15 New York and New Jersey counties.

Table 1.5: New York and New Jersey Off-Terminal HDDV Transit Emissions, tpy

Total NYNJ Reginal Emissions Container Terminal	VOC	CO	NOx	PM_{10}	$PM_{2.5}$	SO_2
Total Emissions	**47.33**	**341.68**	**1,671.40**	**35.09**	**34.04**	**30.22**

1.4 Total HDDV On and Off Terminal-Related Emissions

Tables 1.6 through 1.17 and figures 1.6 through 1.17 present and compare, by pollutant HDDV on-terminal emissions from auto, warehouse and container HDDV operations; and off terminal container HDDV operations with total county-wide emissions for New Jersey and New York counties, respectively. *Note that the terminal related emissions are so much lower than the county-wide emissions as a whole that the figures are shown in a logarithmic scale. This means that each horizontal division (increasing number of tons) is ten times greater than the next lower division. With a standard linear scale, the columns representing the terminal related emissions would barely be visible.*

Table 1.6: Total On and Off-Terminal Related HDDV VOC Emissions in New Jersey by County, tpy

New Jersey VOC Emissions

County	County-Wide Emissions	Terminal-Related Emissions	Percent of Total
Bergen	42,097	3.2	0.008%
Essex	43,632	14.5	0.033%
Hudson	24,998	6.7	0.027%
Middlesex	38,056	10.5	0.028%
Monmouth	30,442	0.7	0.002%
Union	33,158	5.3	0.016%

Figure 1.6: Total On and Off-Terminal Related HDDV VOC Emissions in New Jersey by County, tpy

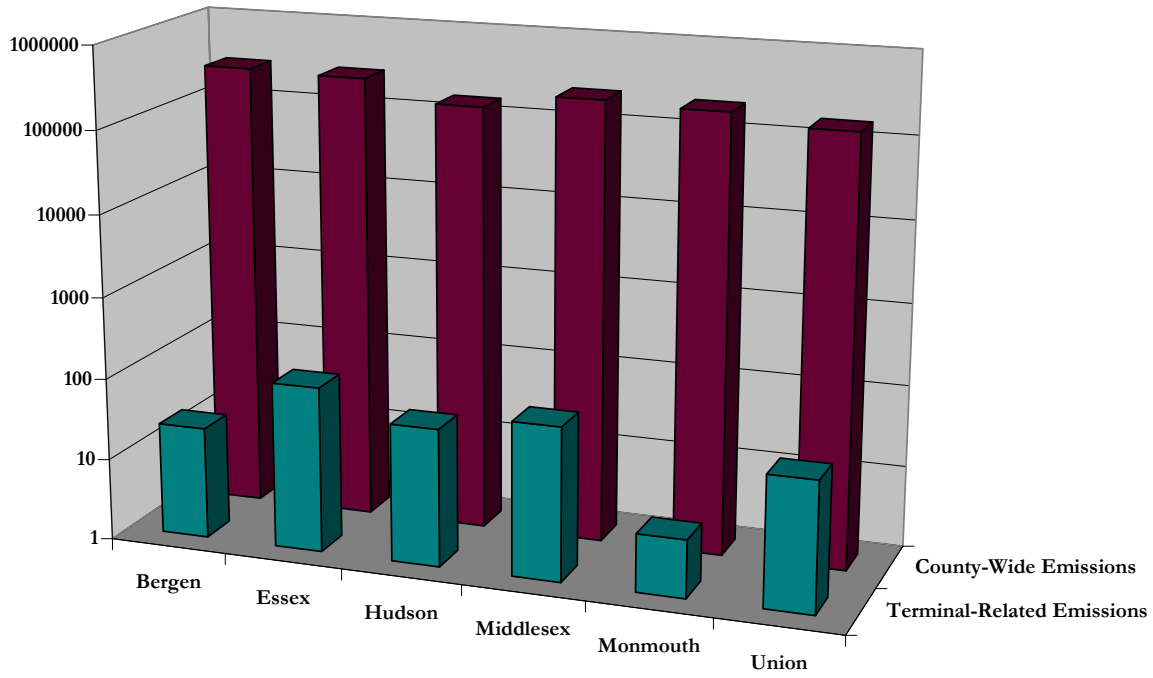


Table 1.7: Total On and Off-Terminal Related HDDV CO Emissions in New Jersey by County, tpy

New Jersey CO Emissions

County	County-Wide Emissions	Terminal-Related Emissions	Percent of Total
Bergen	288,912	23.1	0.008%
Essex	271,412	106.6	0.039%
Hudson	154,245	48.4	0.031%
Middlesex	234,806	75.7	0.032%
Monmouth	213,674	5.1	0.002%
Union	161,409	39.1	0.024%

Figure 1.7: Total On and Off-Terminal Related HDDV CO Emissions in New Jersey by County, tpy

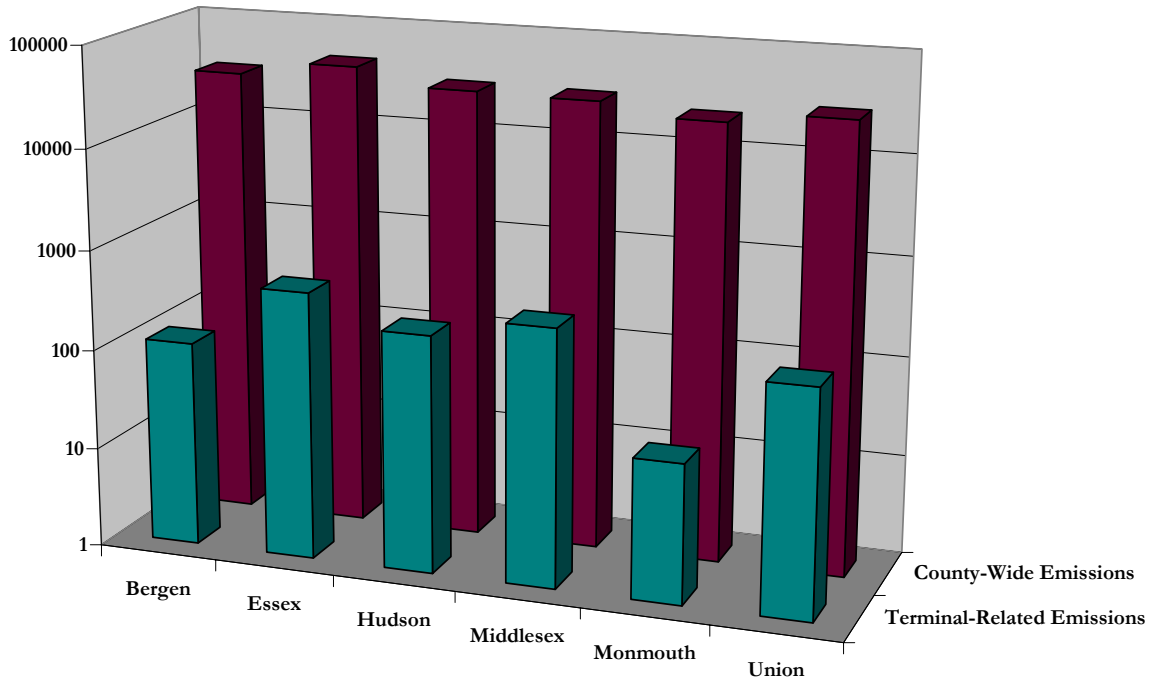


Table 1.8: Total On and Off-Terminal Related HDDV NOx Emissions in New Jersey by County, tpy

New Jersery NOx Emissions

County	County-Wide Emissions	Terminal-Related Emissions	Percent of Total
Bergen	32,119	113.1	0.352%
Essex	44,781	477.3	1.066%
Hudson	30,801	236.9	0.769%
Middlesex	29,716	370.4	1.246%
Monmouth	22,675	24.7	0.109%
Union	29,043	180.9	0.623%

Figure 1.8: Total On and Off-Terminal Related HDDV NOx Emissions in New Jersey by County, tpy

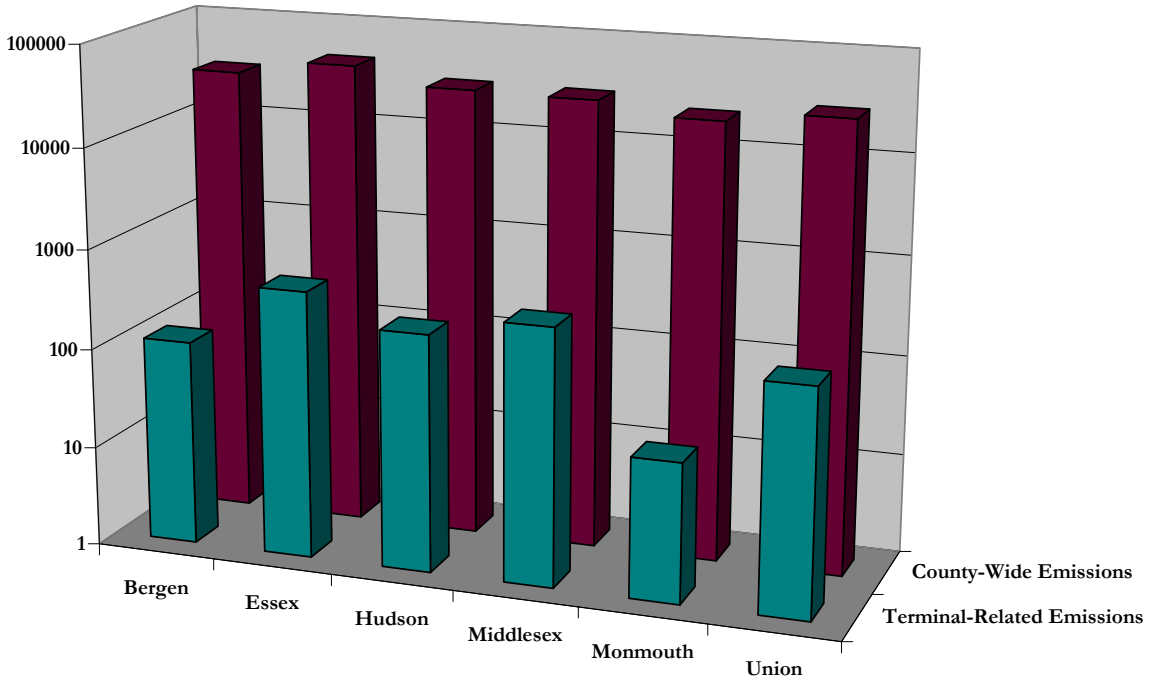


Table 1.9: Total On and Off-Terminal Related HDDV PM_{10} Emissions in New Jersey by County, tpy

New Jersey PM_{10} Emissions

County	County-Wide Emissions	Terminal-Related Emissions	Percent of Total
Bergen	29,401	2.4	0.008%
Essex	37,921	10.0	0.026%
Hudson	23,155	5.0	0.022%
Middlesex	31,798	7.8	0.025%
Monmouth	29,847	0.5	0.002%
Union	23,475	3.8	0.016%

Figure 1.9: Total On and Off-Terminal Related HDDV PM_{10} Emissions in New Jersey by County, tpy

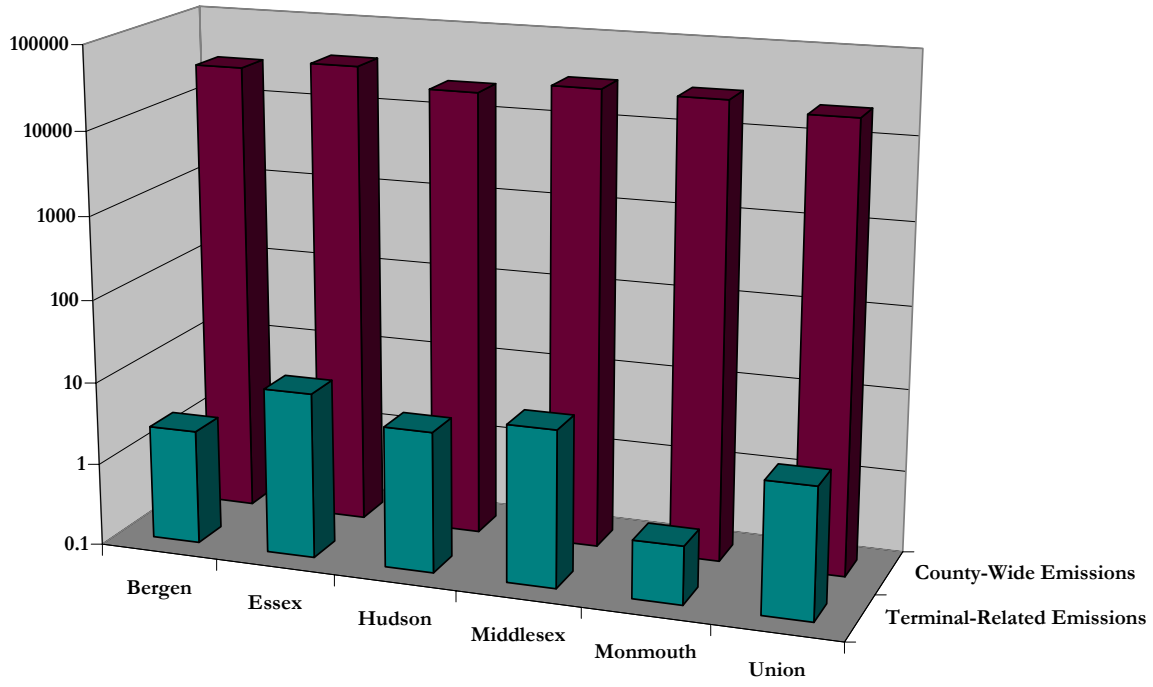


Table 1.10: Total On and Off-Terminal Related HDDV $PM_{2.5}$ Emissions in New Jerseyby County, tpy

New Jersey $PM_{2.5}$ Emissions

County	County-Wide Emissions	Terminal-Related Emissions	Percent of Total
Bergen	9,756	2.3	0.024%
Essex	15,020	15.7	0.104%
Hudson	8,126	4.8	0.059%
Middlesex	11,082	7.5	0.068%
Monmouth	10,459	0.5	0.005%
Union	8,289	3.7	0.044%

Figure 1.10: Total On and Off-Terminal Related HDDV $PM_{2.5}$ Emissions in New Jersey by County, tpy

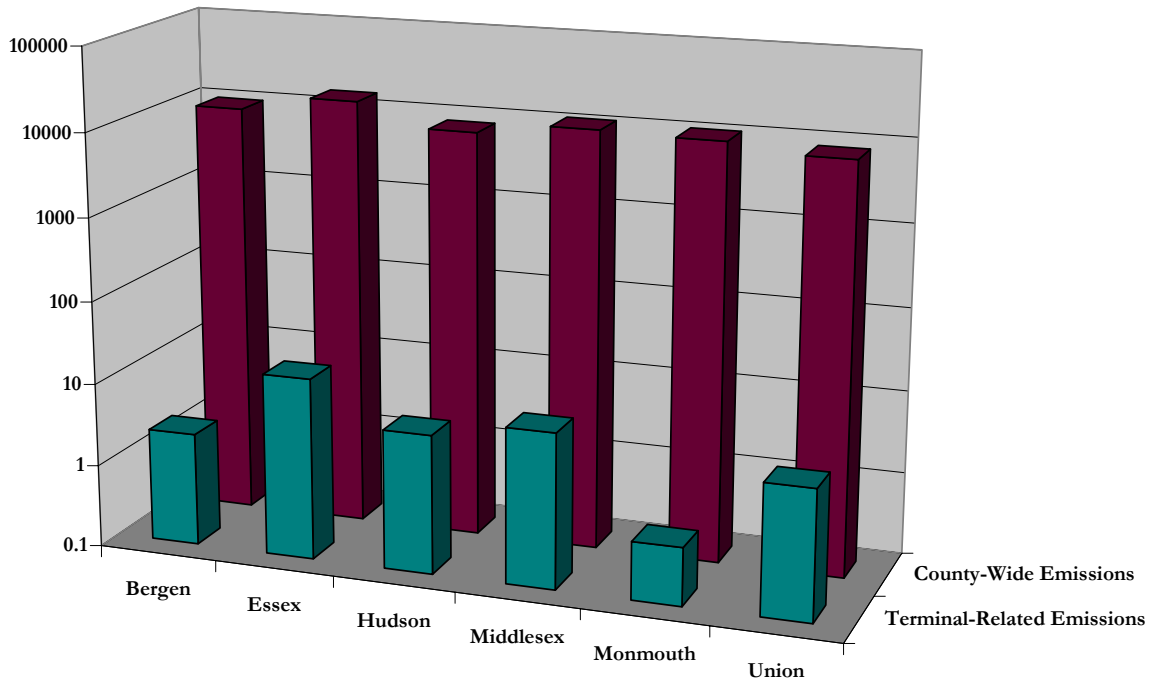


Table 1.11: Total On and Off-Terminal Related HDDV SO_2 Emissions in New Jersey by County, tpy

New Jersey SO_2 Emissions

County	County-Wide Emissions	Terminal-Related Emissions	Percent of Total
Bergen	8,128	2.1	0.026%
Essex	67,702	8.6	0.013%
Hudson	30,992	4.3	0.014%
Middlesex	5,856	6.7	0.114%
Monmouth	3,771	0.5	0.013%
Union	9,320	3.3	0.035%

Figure 1.11: Total On and Off-Terminal Related HDDV SO_2 Emissions in New Jersey by County, tpy

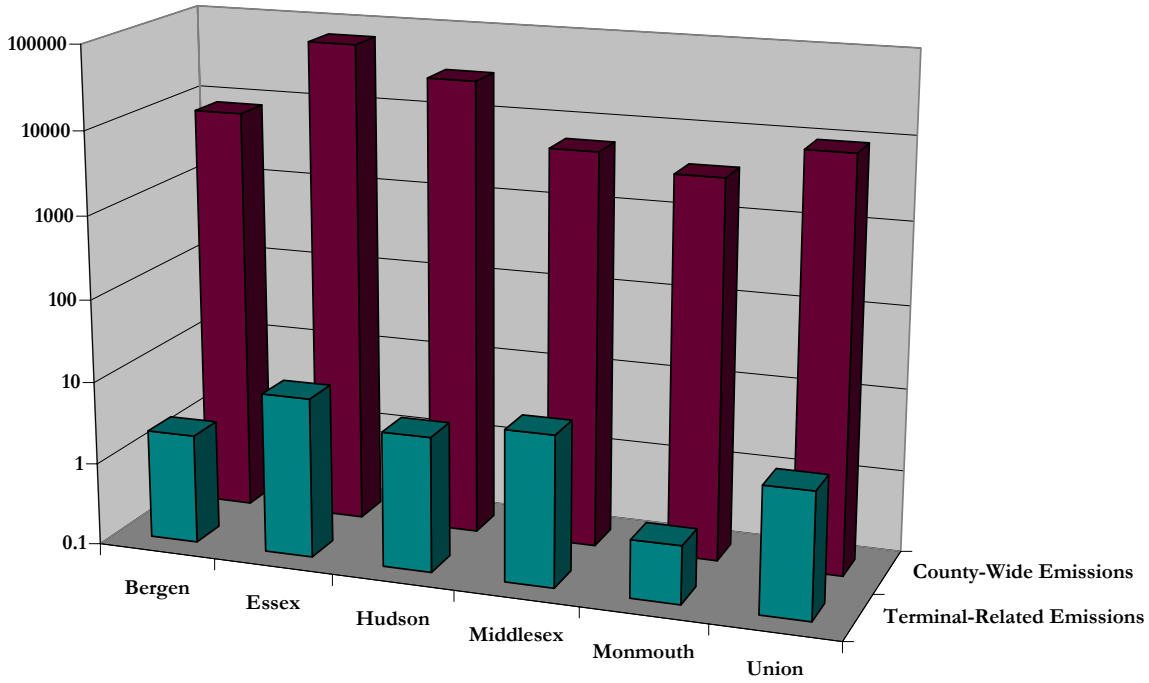


Table 1.12: Total On and Off-Terminal Related HDDV VOC Emissions in New York by County, tpy

New York VOC Emissions

County	County-Wide Emissions	Terminal-Related Emissions	Percent of Total
Bronx	43,109	1	0.002%
Kings	50,209	2.2	0.004%
Nassau	50,334	1.7	0.003%
New York	50,906	0.4	0.001%
Orange	17,661	0.9	0.005%
Queens	49,537	0.8	0.002%
Richmond	15,561	0.2	0.001%
Rockland	9,533	0.1	0.001%
Westchester	31,944	0.9	0.003%

Figure 1.12: Total On and Off-Terminal Related HDDV VOC Emissions in New York by County, tpy

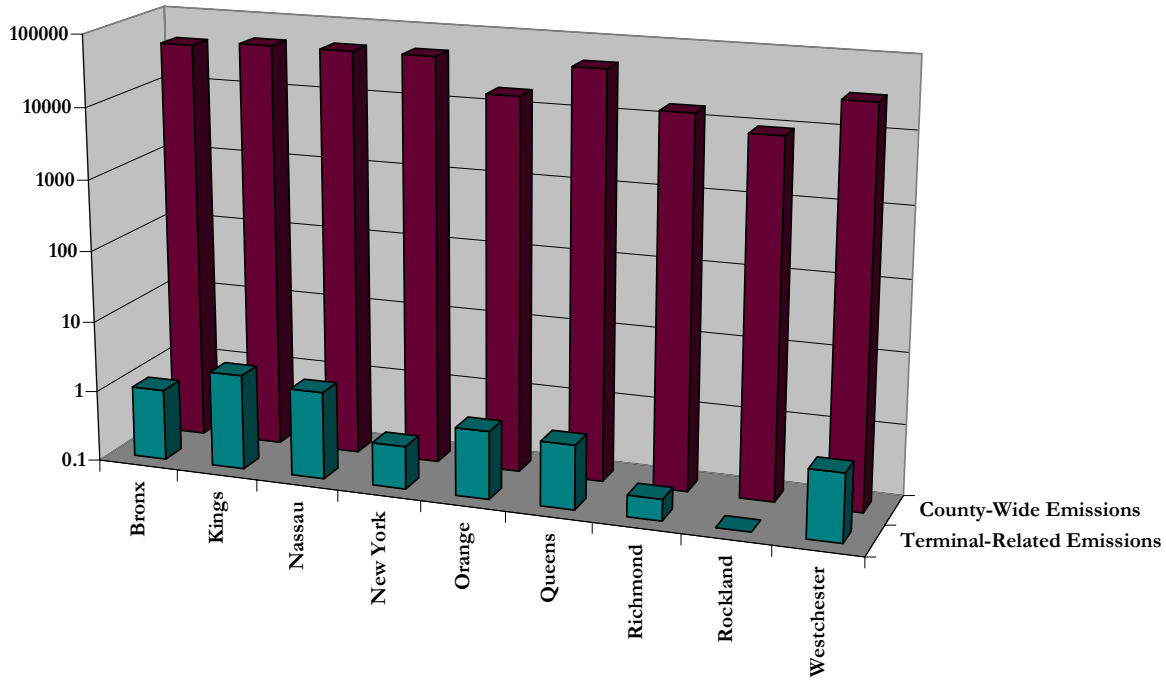


Table 1.13: Total On and Off-Terminal Related HDDV CO Emissions in New York by County, tpy

New York CO Emissions

County	County-Wide Emissions	Terminal-Related Emissions	Percent of Total
Bronx	284,065	7.1	0.002%
Kings	315,851	16	0.005%
Nassau	285,612	11.5	0.004%
New York	305,983	2.8	0.001%
Orange	139,851	6.7	0.005%
Queens	301,197	6	0.002%
Richmond	63,546	1.4	0.002%
Rockland	57,014	0.9	0.002%
Westchester	187,474	6.5	0.003%

Figure 1.13: Total On and Off-Terminal Related HDDV CO Emissions in New York by County, tpy

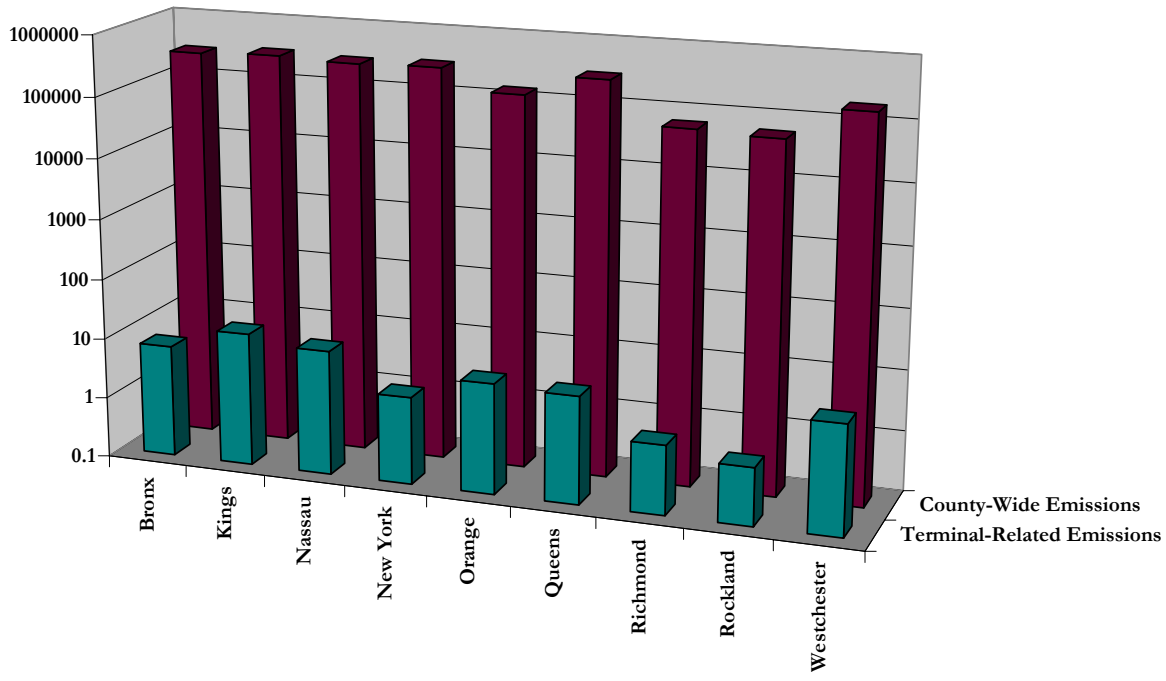


Table 1.14: Total On and Off-Terminal Related HDDV NOx Emissions in New York by County, tpy

New York NOx Emissions

County	County-Wide Emissions	Terminal-Related Emissions	Percent of Total
Bronx	37,152	34.6	0.093%
Kings	44,290	78.2	0.177%
Nassau	31,498	56.4	0.179%
New York	46,341	13.8	0.030%
Orange	24,652	32.7	0.133%
Queens	59,339	29.5	0.050%
Richmond	8,634	6.9	0.080%
Rockland	12,243	4.4	0.036%
Westchester	20,392	31.6	0.155%

Figure 1.14: Total On and Off-Terminal Related HDDV NOx Emissions in New York by County, tpy

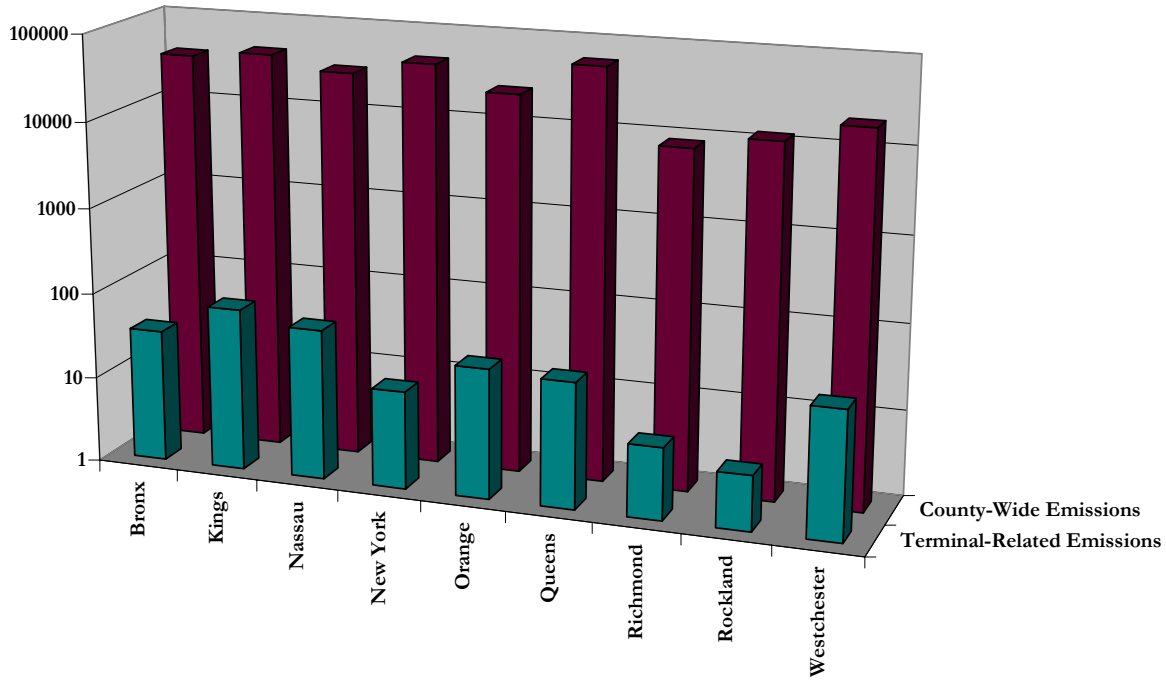


Table 1.15: Total On and Off-Terminal Related HDDV PM_{10} Emissions in New York by County, tpy

New York PM_{10} Emissions

County	County-Wide Emissions	Terminal-Related Emissions	Percent of Total
Bronx	33,004	0.7	0.002%
Kings	28,658	1.6	0.006%
Nassau	28,638	1.2	0.004%
New York	15,742	0.3	0.002%
Orange	32,743	0.7	0.002%
Queens	29,018	0.6	0.002%
Richmond	15,626	0.1	0.001%
Rockland	8,175	0.1	0.001%
Westchester	25,715	0.7	0.003%

Figure 1.15: Total On and Off-Terminal Related HDDV PM_{10} Emissions in New York by County, tpy

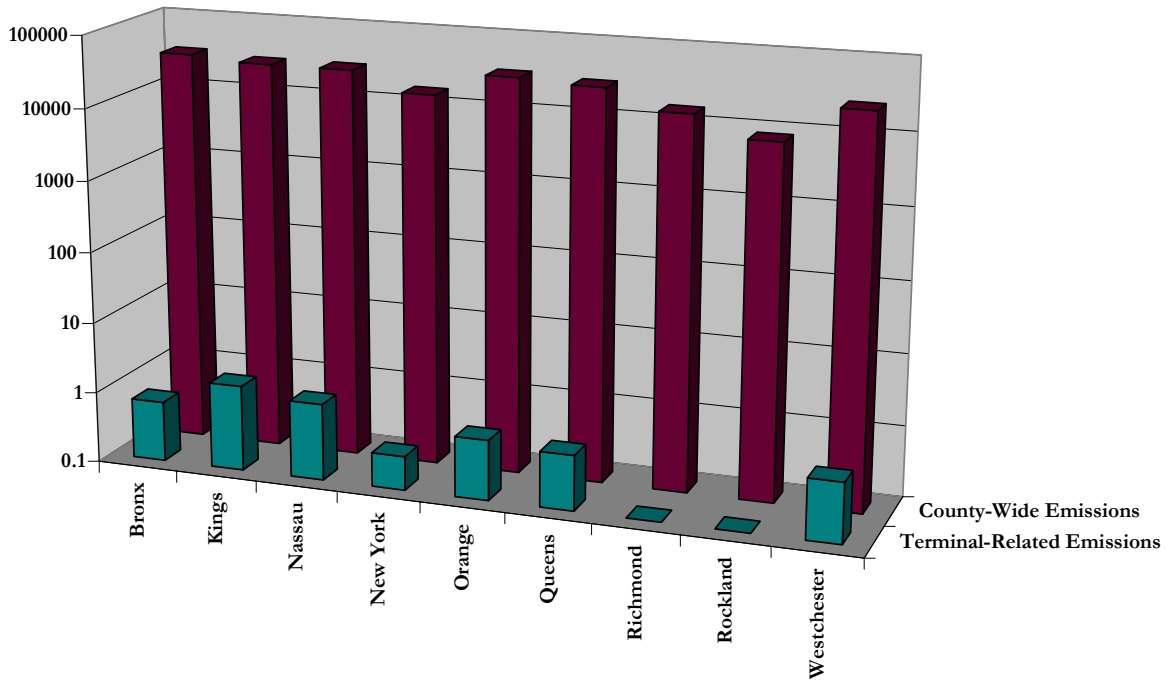


Table 1.16: Total On and Off-Terminal Related HDDV $PM_{2.5}$ Emissions in New York by County, tpy

New York $PM_{2.5}$ Emissions

County	County-Wide Emissions	Terminal-Related Emissions	Percent of Total
Bronx	11,017	0.7	0.006%
Kings	9,334	1.6	0.017%
Nassau	15,747	1.2	0.008%
New York	6,594	0.3	0.005%
Orange	10,983	0.7	0.006%
Queens	11,563	0.6	0.005%
Richmond	4,554	0.1	0.002%
Rockland	3,781	0.1	0.003%
Westchester	8,611	0.6	0.007%

Figure 1.16: Total On and Off-Terminal Related HDDV $PM_{2.5}$ Emissions in New York by County, tpy

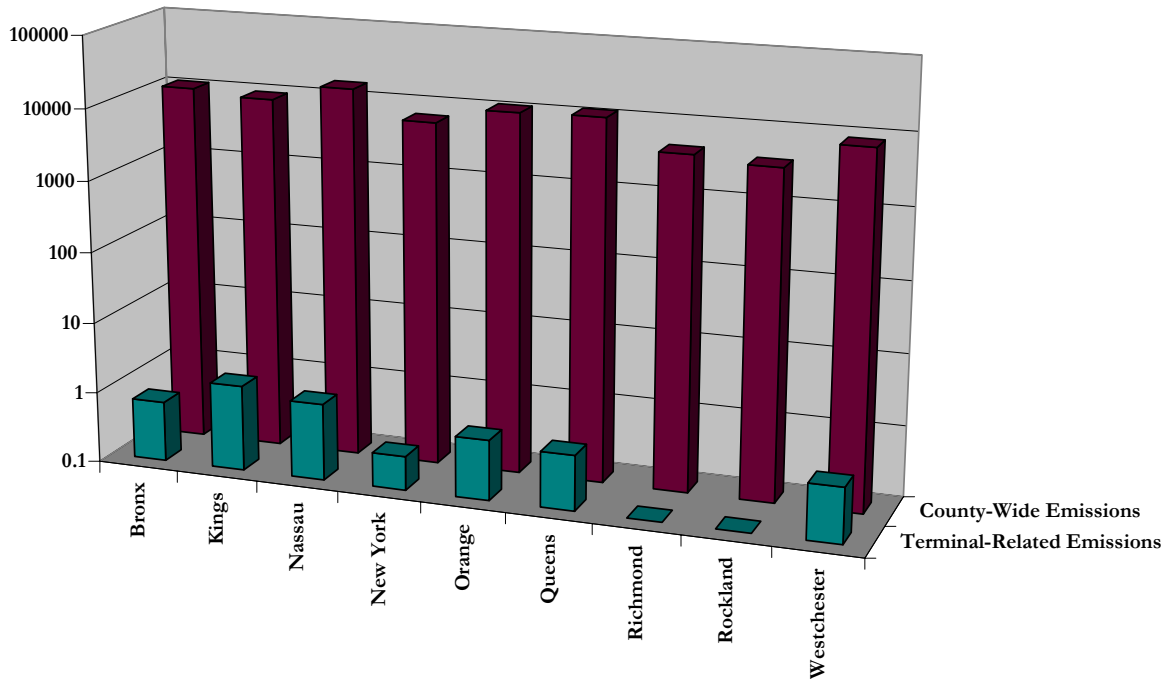
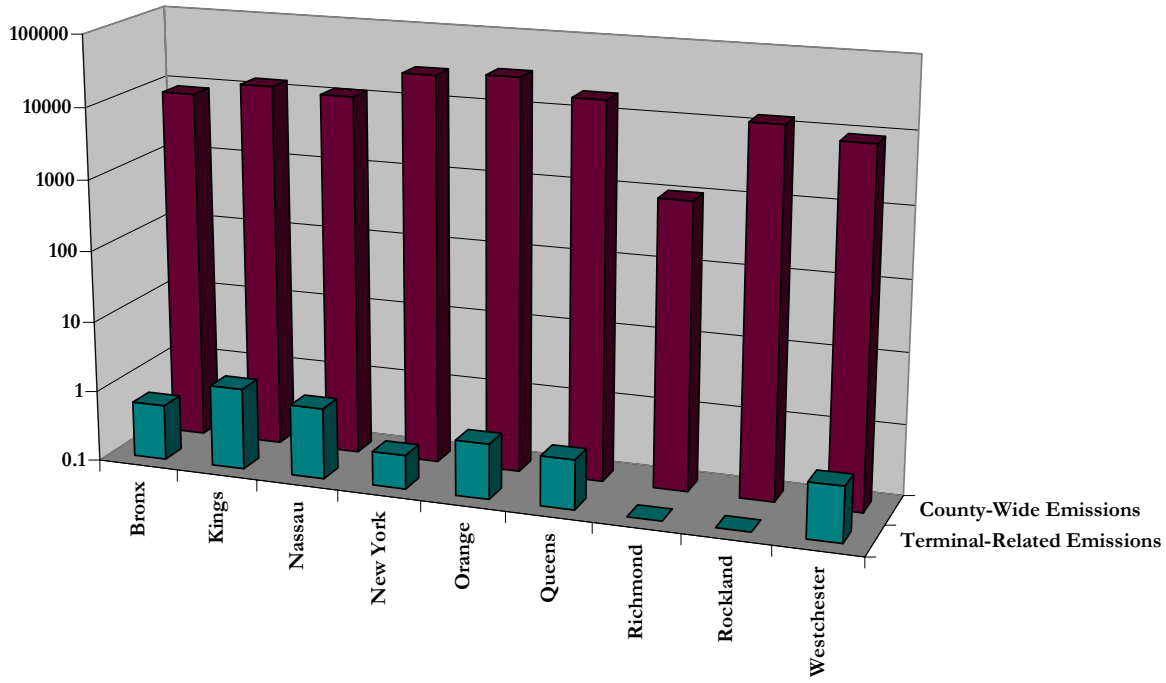


Table 1.17: Total On and Off-Terminal Related HDDV SO_2 Emissions in New York by County, tpy

New York SO_2 Emissions

County	County-Wide Emissions	Terminal-Related Emissions	Percent of Total
Bronx	8,796	0.6	0.007%
Kings	13,640	1.4	0.010%
Nassau	11,832	1	0.008%
New York	28,355	0.3	0.001%
Orange	32,022	0.6	0.002%
Queens	19,087	0.5	0.003%
Richmond	1,047	0.1	0.010%
Rockland	13,446	0.1	0.001%
Westchester	9,242	0.6	0.006%

Figure 1.17: Total On and Off-Terminal Related HDDV SO_2 Emissions in New York by County, tpy



1.5 On-Terminal vs. Off-Terminal Analysis

The totals of on-terminal (container, auto and warehouse) and off-terminal (container only) regional emission estimates are presented in Table 1.18.

Table 1.18: On-Terminal and Off-Terminal Marine Terminal Emission Estimates, tpy

Marine Terminal	VOC	CO	NOx	PM10	PM2.5	SO2
On-Terminal (Transit)	4.50	30.06	59.99	1.59	1.54	1.37
On-Terminal (Idling)	29.44	268.04	327.68	5.72	5.55	4.93
Off-Termianl	47.33	341.68	1,671.40	35.09	34.04	30.22
Total	**81.27**	**639.78**	**2,059.07**	**42.40**	**41.13**	**36.51**

Figures 1.18-1.23 illustrate the percentages on-terminal HDDV emissions vs. off-terminal HDDV emissions for each pollutant from the total marine terminal related HDDV emissions compared to the overall NYNJLINA emissions.

Figure 1.18: Comparison of On-Terminal and Off-Terminal Marine Terminal HDDV VOC Emission Estimates to NYNJLINA VOC Emissions

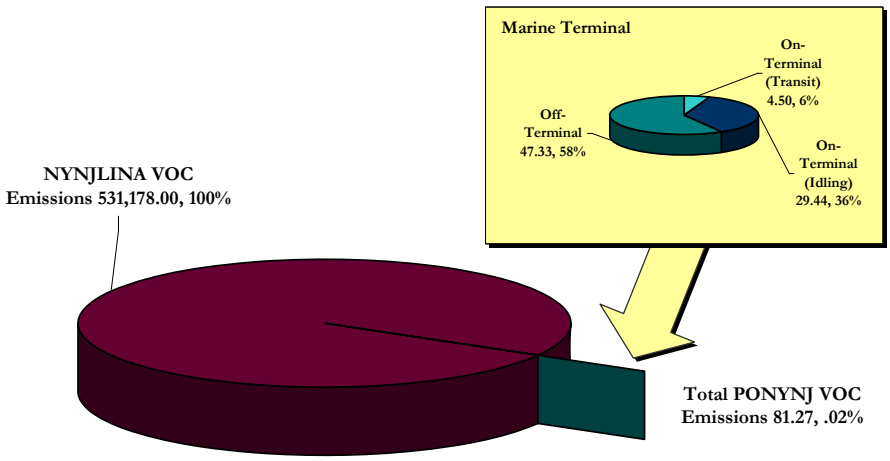


Figure 1.19: Comparison of On-Terminal and Off-Terminal Marine Terminal HDDV CO Emission Estimates to NYNJLINA CO Emissions

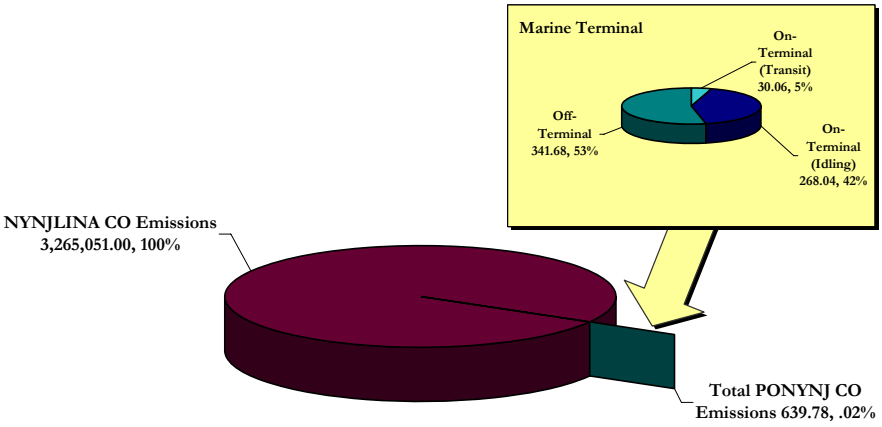


Figure 1.20: Comparison of On-Terminal and Off-Terminal Marine Terminal HDDV NOx Emission Estimates to NYNJLINA NOx Emissions

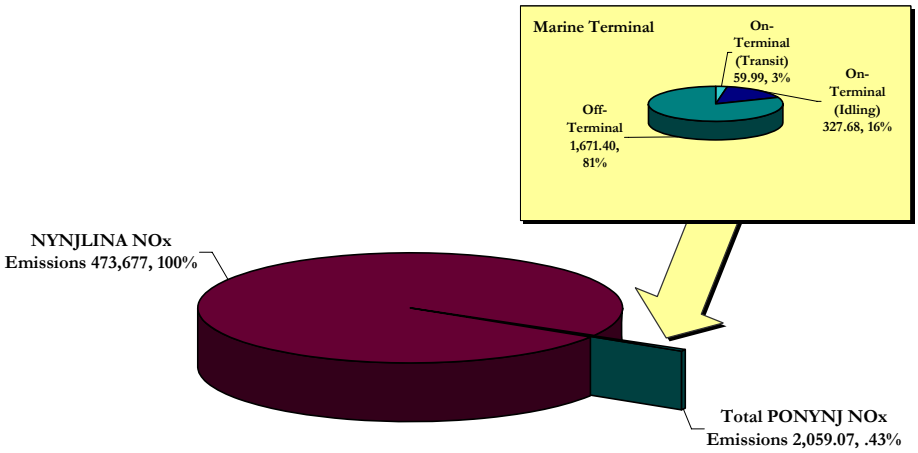


Figure 1.21: Comparison of On-Terminal and Off-Terminal Marine Terminal HDDV PM_{10} Emission Estimates to NYNJLINA PM_{10} Emissions

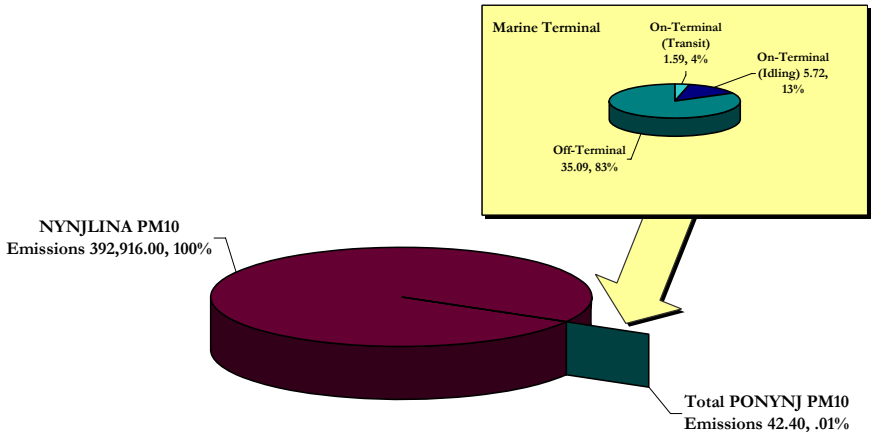


Figure 1.22: Comparison of On-Terminal and Off-Terminal Marine Terminal HDDV $PM_{2.5}$ Emissions to NYNJLINA $PM_{2.5}$ Emissions

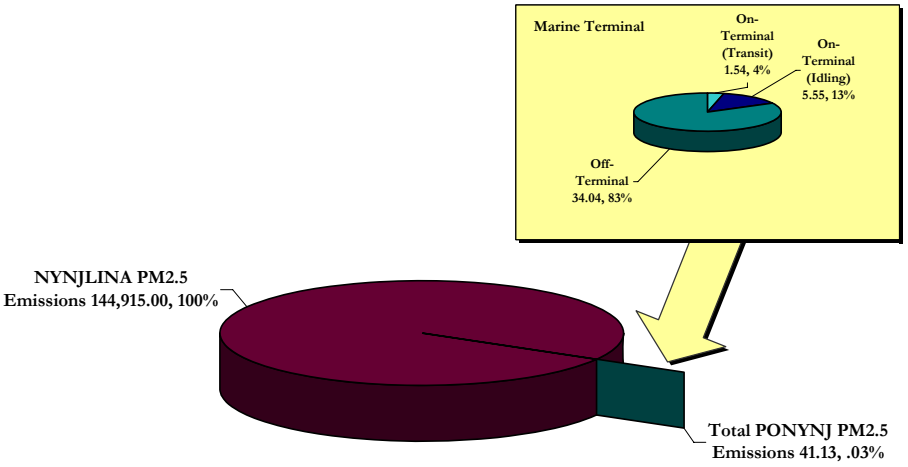
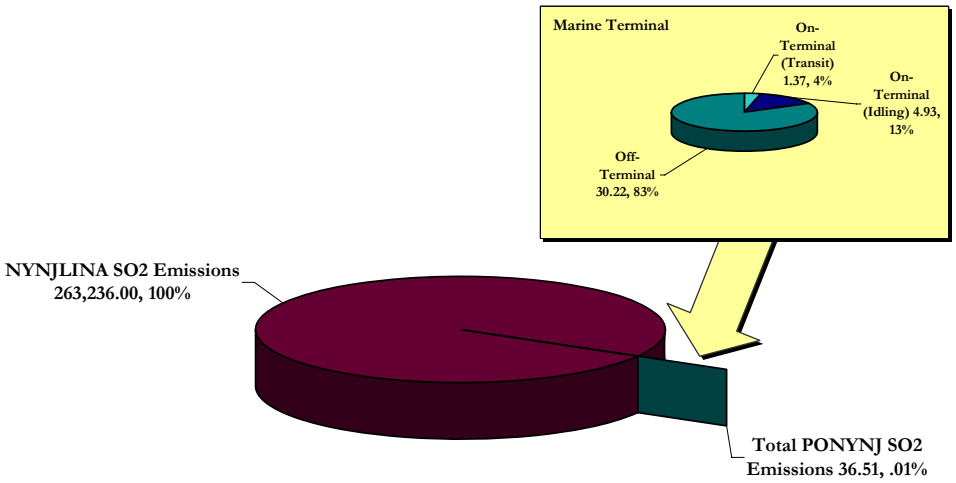


Figure 1.23: Comparison of On-Terminal and Off-Terminal Marine Terminal HDDV SO_2 Emission Estimates to NYNJLINA SO_2Emissions



1.6 Conclusion

The results of this survey quantify the contribution of PONYNJ HDDV maritime emissions to NYNJLINA emissions by pollutant. This study shows that, overall, emissions of all estimated pollutants from on and off terminal HDDV maritime activity contribute between 0.01% and 0.03% to all NYNJLINA emissions of the same group of pollutants. For the criteria pollutant NOx, which is the diesel-related pollutant that contributes most strongly to the formation of ozone, the non-attainment pollutant for the NYNJLINA, the total contribution of PONYNJ HDDV Maritime emissions is 0.43% .

This quantification of the contribution from HDDV maritime activity to the total emissions within the NYNJLINA will be used to support the case for appropriate funding through grants or other programs to improve regional air quality.

1.7 Strengths, Limitations and Recommendations

This section provides a discussion of the strengths and the limitations of the data and results.

Strengths

- During the course of the project, consultants and/or Port Authority staff visited or evaluated all of the marine terminals, and interviewed terminal/facility operators. This process in data collection ensured that people having the most familiarity with the operations had the opportunity to provide their knowledge and expertise. This approach should have the effect of enhancing accuracy in the data obtained, thereby providing the most valid emission estimates available.

- As mentioned in the report, the Port Authority and Starcrest provided outreach to the tenants on behalf of the program by organizing a meeting that educated tenants on the purpose and goals of the project. This opportunity to meet with the tenants in person facilitated a more comfortable approach ensuring trust and clear communication on the data collection process. The meeting also allowed the consultant to review the survey with the tenants and take suggestions where tenants believed a question could be changed or added to better acquire necessary information.

- The process of conducting this study led to improved relationship building between the Port Authority and its tenants. While contacting each terminal, the Port Authority had the opportunity to speak with the top leadership on issues directly concerning the maritime community. This one on one communication with the tenants promoted effective education and outreach on port-related air quality issues.

- The Port Authority and consultant worked closely on a daily basis to discuss best approaches and methods to obtain data from tenants. This also included regular follow-up with tenants on the progress of completing the HDDV survey. In addition, the Port Authority provided reports that were very useful in the data-collection process (example: Vollmer Origin-Destination Study).

- Two additional project strengths include the use of terminal/facility specific information provided by terminal/facility operators and the use of the nationally standard emission-estimating model, MOBILE6.2.

Limitations

- Due to the short project period and the time of the year, obtaining surveys from warehouse and auto-handling operators was a challenge. Most of the outreach and data-collection took place during the month of December, which for many of these businesses is the busiest time of the year. Many of the tenants had end-of-the-year reports due and other deadlines that took priority over the HDDV survey.

- Estimates were made for speed limits for data obtained from the origin-destination study. Speed limits were estimated by researching common speeds along the major roads and highways to and from the marine terminals. Travel time to and from the city was also taken under consideration in relation to slow downs by traffic and road congestion. More specific information on average speeds on specific roadways would enhance the accuracy of the emission estimates.

Recommendations

This study provides a good overview of the emissions associated with marine terminal related HDVV operations and puts them in context with overall area-wide emissions. Yet, there are potential data collection enhancements that could help improve the Port Authority's understanding the scope of diesel emissions from secondary off-terminal HDDV activity, such as from the landside distribution of re-packaged and palletized freight leaving on-terminal warehousing.

Recommendations include:

- Expand origin-destination study to target secondary moves, such as automobile hauling trucks and HDDVs that service repackaged goods leaving warehouses;
- Include intermodal activity between HDDVs to locomotives and vice versa; and
- Research more information on warehouse and auto-handling operations such as: the transaction process for a truck operator – where the operator picks up cargo; the procedure taken to deliver cargo; time it takes to enter, drop off and pick up, and exit a maritime hub complex; and how transaction is reported to the facility (warehouse or auto-handling).

APPENDIX A

Heavy Duty Diesel Vehicle (HDDV) Truck Survey – 2006

CONFIDENTIAL***INTERNAL USE ONLY***CONFIDENTIAL

Port Authority of New York and New Jersey

Auto-handling/Warehouse Operators

Heavy Duty Diesel Vehicle (HDDV) Truck Survey – 2006

Name of Contact:
Marine Terminal Location:
Facility Name:
Address:
Phone:
FAX:
Email Address:

I. HDDVs Terminal/Facility Visits

1. a) What is your annual gate count?
Response:

b) How many trucks visit your terminal/facility daily/weekly/monthly? (Specify units.)
Response:

2. What is your normal operating schedule at the gate?
Days/week_____hrs/day____ _____

3. Weekend schedule? hrs/day_____no_____

4. What are the gate peak hours? Are there special holidays or days where the peak hours are different? If so, please explain.
Response:

II. On-Terminal/Facility HDDV Activity

1. What is the distance traveled while on terminal?
Response:

2. What is the average time on terminal/ turn time?
Response:

3. What is the average speed when driving on terminal?
Response:

4. Are trips made within the terminal that may or may not be counted at the gate?
(ex: trucks that make trips between port facilities only)
If so, please describe (give number or percentage of total gate moves).
Response:

5. Does the turn time include wait time at exit gate?
Response:

6. a) Does the wait time at the **entry gate** exceed five minutes? If yes, how many minutes?
Response:

b) Does the average wait time **in the termina**l exceed five minutes? If yes, how many minutes?
Response:

c) Does the average wait time at the **exit gate** exceed five minutes? If yes, how many minutes?
Response:

7. While loading and unloading the vehicle, is the main engine on or off?
Response:

8. a) Other than the NY or NJ State idling restrictions, does your facility have additional policies or practices in place to reduce idling?
Response:

b) If so, what are they?
Response:

9. Please describe any programs you have in place at your facility that promote fuel efficiency and/or diesel emission reductions.
Response:

III. Off-Terminal HDDV Origin Destination Activity

1. Do you record HDDV origin/destination information for trucks that call at your terminal/facility?

If yes, please attach records, which represent a typical week/month, to this survey.
Response:

2. a) What is the percentage of trucks that travel to and from the 1st point of rest that is local (within 50 miles of your terminal/facility)? Please include estimated miles traveled.

From your terminal/facility to the 1st point of rest:
Response:

Trip to your terminal/facility :
Response:

b) What is the percentage of trucks that travel to and from the 1st point of rest that is regional (over 50 miles and within 500 miles of your terminal/facility)? Please include estimated miles traveled.

From your terminal/facility to the 1st point of rest:
Response:

Trip to your terminal/facility:
Response:

What is the percentage of trucks that travel to and from the 1st point of rest that is interstate (beyond 500 miles)? Please include estimated miles traveled.

From your terminal/facility to the 1st point of rest:
Response:

Trip to your terminal/facility:
Response:

V. HDDV Characterization

Step 1 - Do you record vehicle characteristics of entering trucks that we could use to estimate age distribution (such as model year or age of truck)?

If yes, please attach records, which represent a typical day, to this survey. If no, please go to Step 2.
Response:

Step 2 - Do you record license plate numbers of entering trucks that we could use (with DMV assistance) to estimate age distribution? If yes, please attach records, which represent a typical day, to this survey. If no, please go to step 3.
Response:

Step 3 – If none of the above are available, please include typical HDDV characteristics to the best of your ability: Kindly include as many vehicle types that visit your facility.

Vehicle Type (Container Trucks, Flatbeds, Auto-Carrier, Bobtail, etc.):

Model Year (If exact years are not available give an estimated age for example; 5, 10, 15 years of age):

Gross Vehicle Weight Rating (GVWR) Range (>60,000 lbs, 33,000 – 60,000 lbs, etc.):

YOUR TIME AND EFFORT ARE MUCH APPRECIATED. THANK YOU!