



# GREENHOUSE GAS (GHG) AND CRITERIA AIR POLLUTANT (CAP) EMISSION INVENTORY (EI) FOR THE PORT AUTHORITY OF NEW YORK & NEW JERSEY

## 2008 SUMMARY AND 2006-2008 TRENDS



## 2008 GHG AND CAP EMISSIONS INVENTORY

The Port Authority of New York and New Jersey (PANYNJ) manages and maintains the bridges, tunnels, bus terminals, airports, Port Authority Trans-Hudson (PATH) commuter rail system, and marine terminals that are critical to the metropolitan New York and New Jersey region's trade and transportation capabilities. Major facilities owned, managed, operated, or maintained by the PANYNJ include John F. Kennedy International (JFK), Newark Liberty International (EWR), and LaGuardia airports (LGA); the George Washington Bridge; the Lincoln and Holland tunnels; Port Newark and the Howland Hook Marine Terminal; the Port Authority Bus Terminal; and the 16-acre World Trade Center site in Lower Manhattan.

In 2007, PANYNJ adopted a comprehensive greenhouse gas (GHG) Sustainability Policy. The policy sets four goals:

- **Reduce total PA GHG emissions by 80% by 2050 (using a 2006 baseline)**
- **For those emissions that cannot be directly reduced, purchase carbon offsets on an annual basis,**
- **Encourage customers, tenants, and partners to conduct business in a more sustainable manner, and**
- **Develop a climate change adaptation policy**

To establish the initial baseline required to monitor progress, PANYNJ conducted a GHG emissions inventory (EI) of Port Authority facilities and operations for calendar year 2006, documented in the report *Greenhouse Gas Emission Inventory for the Port Authority of New York & New Jersey, Calendar Year 2006*. Annual GHG EIs allow the PA to quantify overall emissions, track annual trends, and identify areas to reduce GHG emissions. The inventory also tracks Port Authority criteria air pollutant (CAP) emissions to ensure GHG reduction measures maintain and enhance CAP reduction strategies.

The 2008 GHG and CAP EI report provides an update of the PANYNJ's GHG and CAP emissions for calendar year 2008. The inventory includes direct PANYNJ emissions (e.g. energy use at administration buildings and employee travel) plus the emissions of PANYNJ tenants (e.g., airlines and container terminals) and patrons (e.g., airport passengers and PATH riders). The GHG EI measures six GHG identified by the Intergovernmental Panel on Climate Change (IPCC): carbon dioxide (CO<sub>2</sub>); methane (CH<sub>4</sub>); nitrous oxide (N<sub>2</sub>O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulfur hexafluoride (SF<sub>6</sub>). The CAP EI measures oxides of nitrogen (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), and particulate matter (PM). This summary report presents an overview of 2008 results and trends from 2006-2008.

### GHG Measured

CO<sub>2</sub>: carbon dioxide  
 CH<sub>4</sub>: methane  
 N<sub>2</sub>O: nitrous oxide  
 HFCs: hydrofluorocarbons  
 PFCs: perfluorocarbons  
 SF<sub>6</sub>: sulfur hexafluoride

### CAP Measured:

NO<sub>x</sub>: oxides of nitrogen  
 SO<sub>2</sub>: sulfur dioxide  
 PM: particulate matter

## OBJECTIVES

- Account for all six GHGs identified by the Intergovernmental Panel on Climate Change (IPCC): CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs and SF<sub>6</sub>.
- Account for the following CAPs: NO<sub>x</sub>, SO<sub>2</sub>, and PM.
- Include direct (Scope 1 and 2) and indirect emissions (Scope 3).
- Maximize flexibility to prepare for future regulatory regimes (e.g., track emissions by department, facility, and type of emission, expressing emissions in absolute and normalized terms).
- Ensure transparency.
- Estimate (inventory through modeling past events) emissions rather than rely on direct measurement (air monitoring).
- Refine the system established for the calendar year 2006 inventory to allow for ease in annual reporting.
- Adhere to the IPCC guidelines for conducting national GHG emission inventories and incorporate expert techniques in the inventory of corporate emissions, as well as of airports, marine terminals, and other transportation facilities. This includes the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
- Express GHG emissions in tons of CO<sub>2</sub> equivalent units (CO<sub>2</sub>e) as well as separately for each of the individual gases. Express CAP emissions in metric tons.

## EMISSIONS INVENTORY BOUNDARIES: GEOGRAPHICAL AND ORGANIZATIONAL

One of the first steps in the development of this, and any other, GHG EI is determining the organizational and geographical boundaries for reporting emissions, i.e. determining who is responsible for the emissions (organizational boundary) and under what area are emissions measures (geographical boundary). The PANYNJ acts as both a direct operator and a property owner at its owned facilities. The PANYNJ also acts as a tenant at its leased facilities. The objective of this exercise was to assign an ownership to all emissions based on the PANYNJ's role as a direct operator, landlord, or tenant at each PANYNJ owned or operated facility using criteria for submittal to the California Climate Action Registry (CCAR) (or the equivalent Registry for New York and New Jersey – which currently is The Climate Registry [TCR]). CCAR is based on the requirements of the accepted guidelines and principles in the World Resources Institute (WRI) GHG protocol

**Scope 1:** Direct emissions from sources owned or operated by the PANYNJ

**Scope 2:** Indirect emissions from purchased and consumed electricity

**Scope 3:** Indirect emissions from sources not owned or operated by the PANYNJ but indirectly controlled by the PANYNJ via operating agreements, leases, contracts and provided services.

Using WRI protocol guidelines, the EI reports GHG emissions as Scope 1, Scope 2 or Scope 3 emissions. Examples of Scope 1 sources for PANYNJ would be emissions from any PANYNJ-owned or operated vehicles or equipment, such as the PANYNJ's vehicle pool, or direct emissions from the PATH and AirTrain systems. Scope 2 emissions would be indirect GHG emissions from electricity consumption at PANYNJ facilities, such as the electricity consumed in PANYNJ administrative offices or by the PATH system. Scope 3 emissions are the emissions "owned" by tenants, contractors, or patrons indirectly controlled by the PANYNJ through leases, operating agreements, contracts or provided services. For example, because the PANYNJ generally does not own the ships, main line locomotives, airplanes, trucks, or construction equipment operated at its leased facilities, these mobile sources are considered Scope 3 emissions. Scope 3 emissions would be reported as Scope 1 emissions by the tenant, contractor, or patron.

Table 1 summarizes the boundaries applied in this study for the departments and facilities included in the 2008 emission inventory. The boundaries established for GHGs were also applied to CAPs and will differ based on the operational and organizational structure of each facility.

**Table 1. Boundaries for each Department in the GHG and CAP Emissions Inventory**

Department	Boundary
Aviation	<ul style="list-style-type: none"> <li>• Civil and commercial use of airplanes, up to 3,000 feet</li> <li>• Aircraft ground support equipment</li> <li>• Vehicle trips attracted by the airport, including those of private vehicles, taxis, and buses</li> <li>• Aviation Terminal Buildings (excluding those leased to tenants and accounted for under Real Estate and Development)</li> <li>• AirTrain System</li> </ul>
Port Commerce	<ul style="list-style-type: none"> <li>• All vessels that call on and support vessels that call on Port Authority facilities within the three-mile demarcation line off the eastern coast of the United States</li> <li>• Cargo handling equipment /Automotive Shipping/On-Dock Locomotive Switchers</li> <li>• Drayage trucks/Rail freight to the first point of rest</li> <li>• Marine Terminal Buildings (excluding those leased to tenants and accounted for under Real Estate and Development)</li> </ul>
Tunnels, Bridges, & Terminals (TB&T)	<ul style="list-style-type: none"> <li>• Emissions based on vehicle volume, the roadway length of each facility, and the vehicle hours of delay in toll lane queues</li> <li>• Terminals include all vehicle travel within the terminal property</li> </ul>
PATH	<ul style="list-style-type: none"> <li>• Traction power</li> <li>• Commuters' vehicle trips to PATH stations</li> <li>• Fuel consumption of Utility Track Vehicles and other diesel equipment</li> <li>• PATH Terminal Buildings</li> </ul>
Real Estate & Development	<ul style="list-style-type: none"> <li>• Office space leased by the Port Authority</li> <li>• Buildings leased to tenants (operating and capital leases)</li> <li>• Excludes real estate projects that the Port Authority does not manage or operate</li> </ul>
Construction	<ul style="list-style-type: none"> <li>• Construction equipment used in Port Authority capital projects</li> </ul>
Vehicle Fleet	<ul style="list-style-type: none"> <li>• Fuel consumption of PA owned and/or operated vehicles</li> </ul>
Employee Commuting	<ul style="list-style-type: none"> <li>• Vehicle trips to and from work by Port Authority employees</li> </ul>

Table 2 lists the PANYNJ facilities that are included in this emission inventory. The table is organized by department first, then by facility.

**Table 2. Port Authority Facilities Included in the 2008 GHG Emission Inventory**

<p><b>AVIATION</b></p> <ul style="list-style-type: none"> <li>• John F. Kennedy International Airport</li> <li>• LaGuardia Airport</li> <li>• Newark Liberty International Airport</li> <li>• Teterboro Airport</li> <li>• Stewart International Airport</li> <li>• Downtown Manhattan Heliport</li> <li>• AirTrain JFK / AirTrain Newark</li> <li>• KIAC Cogeneration Plant</li> </ul>	<p><b>TUNNELS, BRIDGES, &amp; TERMINALS</b></p> <ul style="list-style-type: none"> <li>• George Washington Bridge</li> <li>• Bayonne Bridge</li> <li>• Goethals Bridge</li> <li>• Outerbridge Crossing</li> <li>• Lincoln Tunnel</li> <li>• Holland Tunnel</li> <li>• George Washington Bridge Bus Station</li> <li>• Port Authority Bus Terminal</li> </ul>
<p><b>REAL ESTATE &amp; DEVELOPMENT</b></p> <ul style="list-style-type: none"> <li>• Bathgate Industrial Park</li> <li>• The Teleport</li> <li>• The Legal Center</li> <li>• World Trade Center</li> <li>• Essex County Resource Recovery Facility</li> <li>• PA leased space:               <ul style="list-style-type: none"> <li>• 225/233 Park Avenue South</li> <li>• One Madison Avenue</li> <li>• 115 Broadway</li> <li>• Gateway Plaza I, II, III</li> <li>• 5 Marine View</li> <li>• 777 Jersey Avenue</li> <li>• Port Authority Technical Center</li> <li>• KAL Building at JFK</li> </ul> </li> </ul>	<p><b>PORT COMMERCE</b></p> <ul style="list-style-type: none"> <li>• Port Newark / Elizabeth PA Marine Terminal</li> <li>• Howland Hook Marine Terminal and Port Ivory</li> <li>• Brooklyn PA Marine Terminal</li> <li>• Auto Marine Terminal and Greenville Yard</li> <li>• Elizabeth Landfill</li> </ul> <p><b>PATH</b></p> <ul style="list-style-type: none"> <li>• PATH Rapid Transit System               <ul style="list-style-type: none"> <li>• 13.8 route miles</li> <li>• 13 stations</li> <li>• Journal Square Transportation Center</li> <li>• Harrison Car Maintenance Facility</li> <li>• Waldo Yard Buildings</li> </ul> </li> </ul>

## RESULTS SUMMARIES

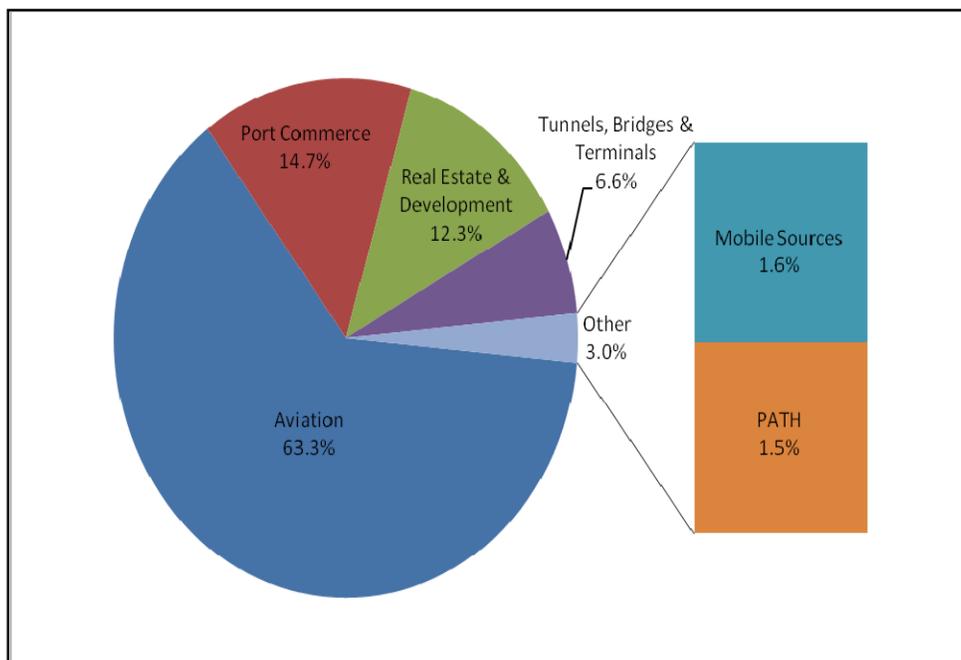
### GHG RESULTS

This section of the report summarizes the key results of the GHG emission estimates in CO<sub>2</sub>e terms. The GHG EI for calendar year 2008 estimates that PANYNJ GHG direct and indirect emissions total approximately 5.88 million metric tons of CO<sub>2</sub>e. The Aviation Department has the highest GHG emissions (63.3%), followed by Port Commerce (14.7%), and Real Estate and Development (12.3%). Tunnels, Bridges and Terminals, PATH and mobile sources contribute the remaining 9.6% of 2008 GHG emissions. Figures 1 and 2 show how the department-level emissions break down when sorted according to whether they are direct GHG emissions, indirect electricity emissions, or other indirect GHG emissions.

**Table 3. Total (Scope 1, 2, and 3) PANYNJ CO<sub>2</sub> Equivalent Emissions in 2008 (metric tons)**

Department	Direct GHG Emissions Scope 1	Indirect Electricity GHG Emissions Scope 2	Other Indirect GHG Emissions Scope 3	Totals
Aviation	19,195	169,837	3,534,382	<b>3,723,414</b>
Port Commerce	4,394	0	862,877	<b>867,271</b>
Tunnels and Bridges	2,513	10,600	355,842	<b>368,955</b>
Bus Terminals	23	0	18,212	<b>18,235</b>
PATH	703	55,177	31,597	<b>87,477</b>
Mobile Sources	66,800	0	24,949	<b>91,749</b>
Real Estate & Development	3,117	9,404	713,177	<b>725,698</b>
<b>Total</b>	<b>96,745</b>	<b>245,018</b>	<b>5,541,036</b>	<b>5,882,799</b>

**Figure 1. Total (Scope 1, 2, and 3) PANYNJ CO<sub>2</sub> Equivalent Emissions by Department**



**Figure 2. Share of Scope 1, Scope 2 and Scope 3 CO<sub>2</sub> Equivalent Emissions by Department**

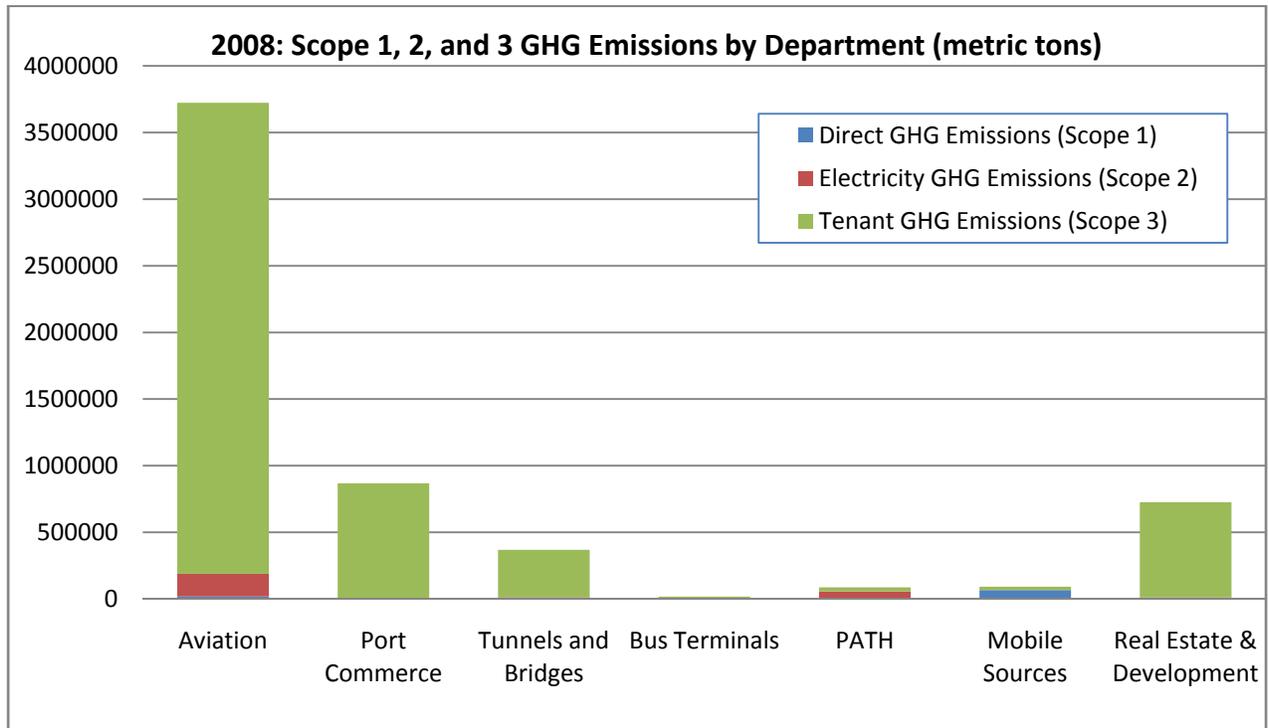


Figure 3 shows the contributions of the different departments to Scope 1 and Scope 2 GHG emissions during 2008. This figure shows that the Aviation Department produced 55.3% of the PANYNJ’s Scope 1 and 2 GHG emissions, which is largely the electricity usage in airport buildings.

The next largest Scope 1 and Scope 2 GHG emitter within the Port Authority was Mobile Sources, which is comprised of fleet vehicles and construction equipment. PATH produces 16.4% of the PANYNJ’s Scope 1 and 2 emissions. This is primarily due to the electricity purchased to run the PATH trains. The remainder of the Scope 1 and 2 GHG emissions were divided between Tunnels, Bridges, and Terminals and Real Estate and Development, dominated by fleet vehicles and buildings emissions, and Port Commerce, dominated by landfill gas emissions.

Figure 3. CO<sub>2</sub> Equivalent Scope 1 and 2 GHG Emissions, by Department

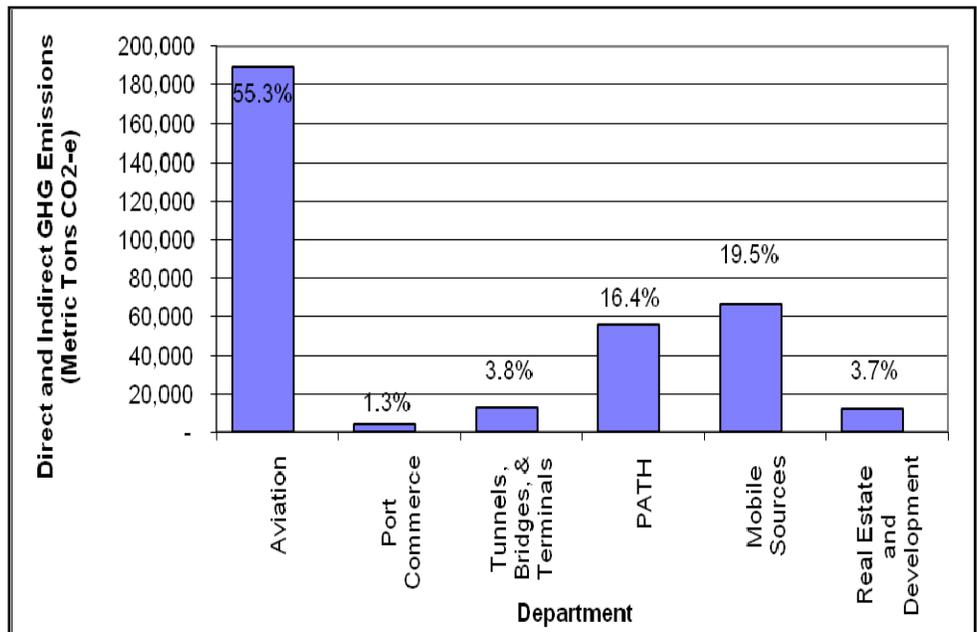


Figure 4 displays the Port Authority’s 2008 calendar year Scope 3 GHG emission estimates by department. The following departments dominate the Scope 3 emissions: Aviation (63.8%); Port Commerce (15.6 %); and Real Estate and Development (12.9%). Aviation GHG emissions result predominantly from aircraft landing and takeoffs (LTO), as well as

the attracted vehicle travel to the airports. Aircraft ground support equipment (GSE) is only a minor contributor to the Aviation Department’s GHG emissions. Within Port Commerce, commercial marine vessels, cargo handling equipment, and attracted vehicle travel are all important contributors to the GHG emissions.

**Figure 4. CO<sub>2</sub> Equivalent Scope 3 GHG Emissions, by Department**

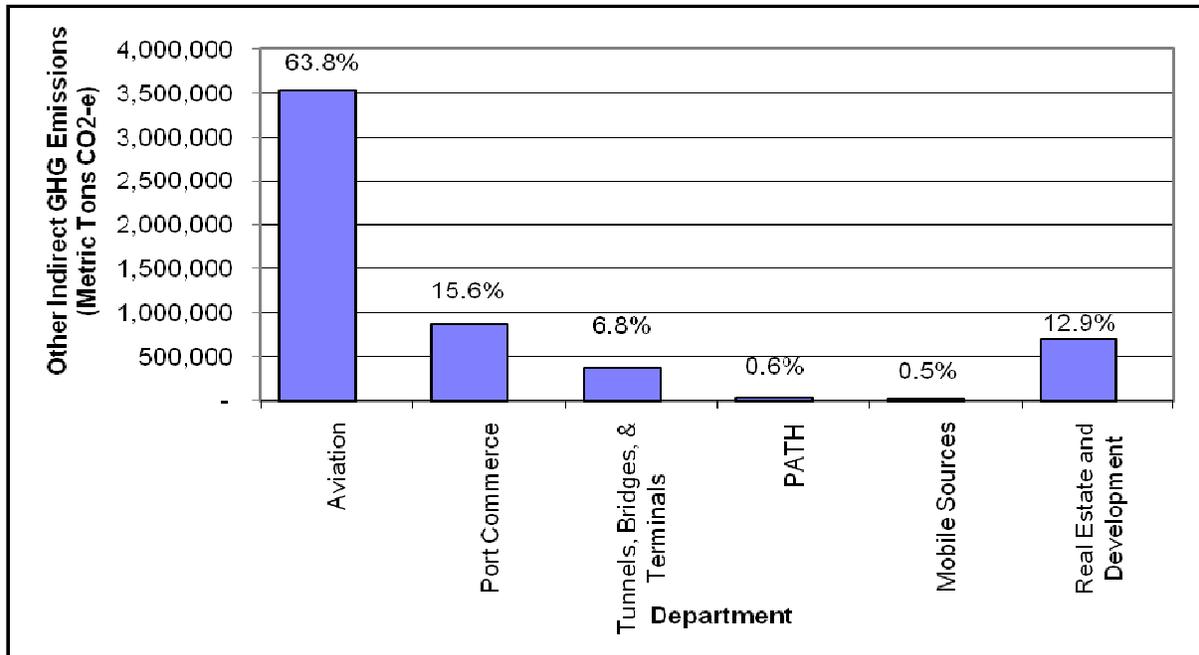
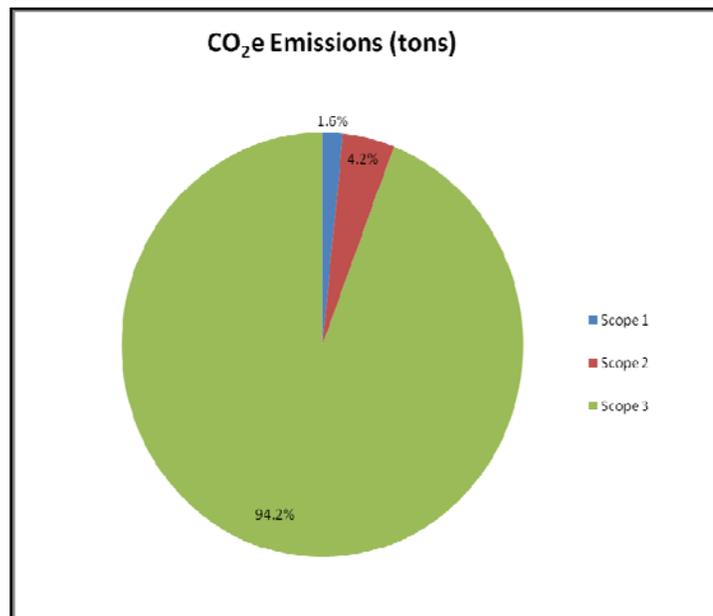


Figure 5 provides the relative GHG emissions by scope. As shown, Scope 3 emissions dominate total emissions. Figures 6 and 7 illustrate emissions sources for Scopes 1, 2 and 3 GHG emissions. Scope 1 and 2 GHG emissions are largely indirect electricity use (approximately 71.7% of total Scope 1 and 2 emissions; 17% of which is from PATH trains). The second most important Scope 1 and 2 emissions source is construction equipment operated at PANYNJ funded projects (approximately 18.3%). Most of this construction equipment is diesel-powered. Port Authority fleet vehicles also make a significant contribution to emissions (approximately 3.4%). Another important Scope 1 and 2 emissions source is heating fuel (primarily natural gas) combustion at facilities under direct PANYNJ management control (approximately 5.1%). Attracted vehicle travel to PANYNJ facilities accounts for approximately 37.4%, and aircraft emissions account for approximately 37.1%, of Scope 3 emissions. The remaining 25.4% of these emissions are fairly evenly spread among the Essex County Resource Recovery facility, indirect electricity use in buildings, commercial marine vessels, and cargo handling equipment.

**Figure 5. Port Authority 2008 GHG Emissions by Scope**



**Figure 6. GHG Emissions under Direct Management Control**

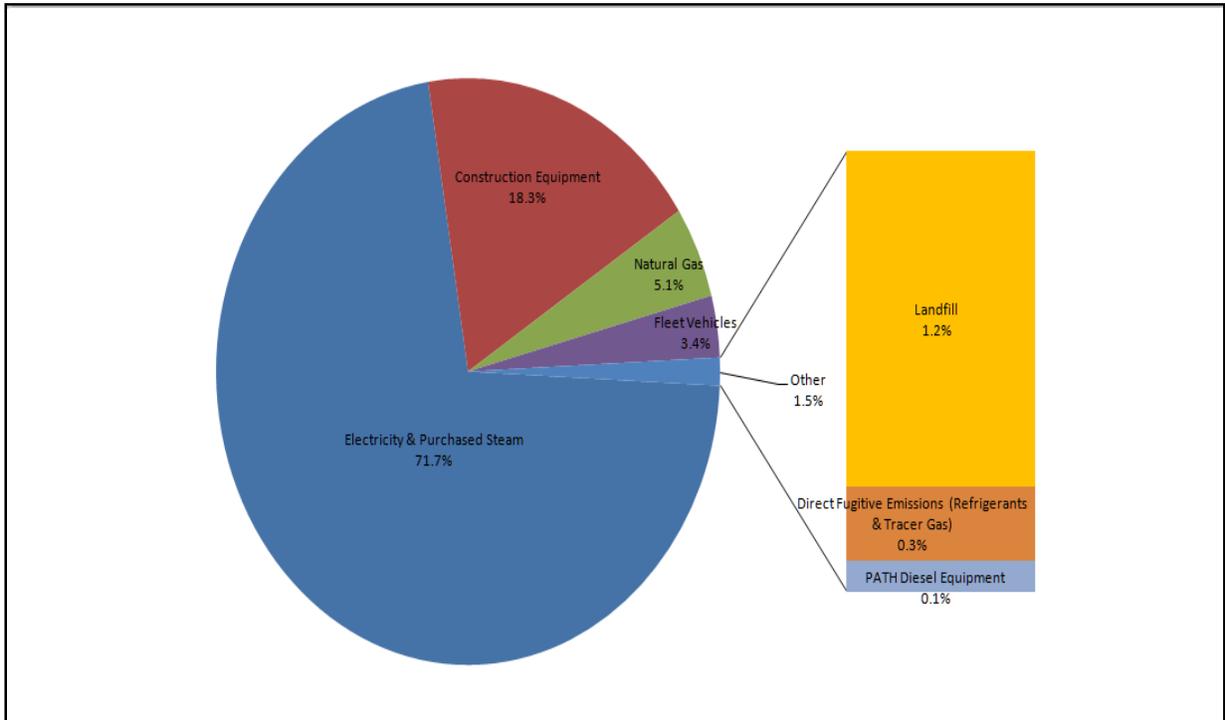


Figure 7. GHG Emissions outside Management Control

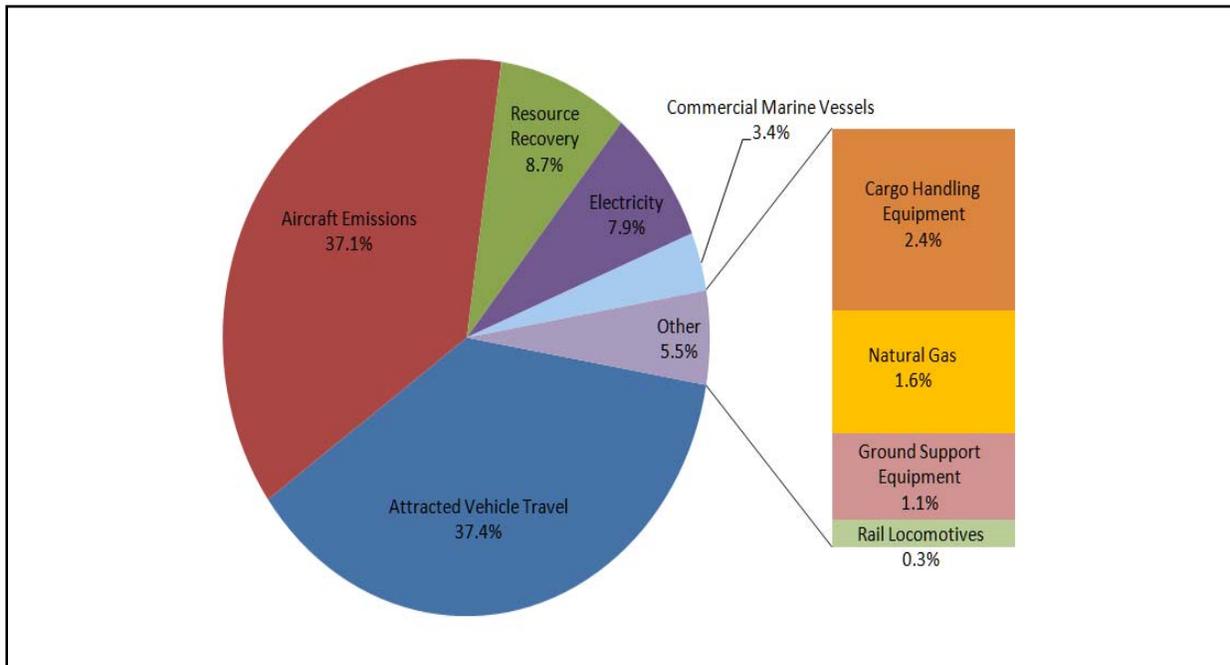


Table 4 provides Scope 1, 2, and 3 GHG emissions reported by department and broken down by sector. The table also shows how the GHG emissions from energy use in buildings is allocated among direct energy use in PANYNJ-occupied space (Scope 1 emissions), indirect electricity usage in PANYNJ-occupied space (Scope 2 emissions) and direct energy and indirect electricity usage in tenant-occupied space (Scope 3 emissions). The table shows that Scope 3 GHG emissions comprise 94.2% of the total organizational emissions.

Table 4. PANYNJ CO<sub>2</sub> Equivalent Emissions in 2008 (metric tons)

Department	Direct GHG Emissions Scope 1	Indirect Electricity GHG Emissions Scope 2	Other Indirect GHG Emissions Scope 3	Totals
<b>Aviation</b>				
Aircraft	0	0	2,058,306	2,058,306
AirTrain	0	29,219	0	29,219
Ground Support Equipment	0	0	62,974	62,974
Attracted Travel	0	0	1,185,261	1,185,261
Buildings	14,449	140,618	167,724	322,791
JFK Co-generation Plant	0	0	60,117	60,117
Fleet Vehicles	4,233	0	0	4,233
Direct Fugitive Emissions (Refrigerants)	513	0	0	513
<b>Port Commerce</b>				
Commercial Marine Vessels	0	0	187,943	187,943
Cargo Handling Equipment	0	0	131,863	131,863
Rail Locomotives	0	0	19,233	19,233
Heavy-Duty Vehicles	0	0	469,873	469,873
Buildings	0	0	53,965	53,965
Landfill	4,011	0	0	4,011
Fleet Vehicles	383	0	0	383
<b>Tunnels and Bridges</b>				
Attracted Travel	0	0	332,377	332,377
Queuing	0	0	23,465	23,465
Buildings	720	10,600	0	11,320
Direct Fugitive Emissions (Refrigerants)	20	0	0	20
Fleet Vehicles	1,773	0	0	1,773
<b>Bus Terminals</b>				
In Terminal Vehicle Emissions	0	0	4,676	4,676
Buildings	0	0	13,536	13,536
Fleet Vehicles	23	0	0	23
<b>PATH</b>				
Trains	0	42,194	0	42,194
Attracted Travel	0	0	31,597	31,597
Buildings	0	12,983	0	12,983
Direct Fugitive Emissions (Refrigerants)	39	0	0	39
Diesel Equipment including Utility Track Vehicles and Generators	373	0	0	373
Fleet Vehicles	291	0	0	291
<b>Mobile Sources</b>				

<b>Department</b>	<b>Direct GHG Emissions Scope 1</b>	<b>Indirect Electricity GHG Emissions Scope 2</b>	<b>Other Indirect GHG Emissions Scope 3</b>	<b>Totals</b>
Fleet Vehicles	66	0	0	66
Public Safety Department Fleet Vehicles	3,853	0	0	3,853
Direct Fugitive Emissions (Refrigerants)	295	0	0	295
Construction Equipment	62,586	0	0	62,586
Employee Commuting	0	0	24,949	24,949
<b>Real Estate &amp; Development</b>				
Buildings	2,101	9,404	232,381	243,886
Resource Recovery Facility	0	0	480,796	480,796
Fleet Vehicles	1,004	0	0	1,004
<b>Engineering</b>	12	0	0	12
<b>Total</b>	<b>96,745</b>	<b>245,018</b>	<b>5,541,036</b>	<b>5,882,799</b>

## COMPARISON WITH PREVIOUS STUDY YEARS

This section compares the 2008 calendar year GHG emission estimates for the PANYNJ with those developed previously for calendar years 2006 and 2007. The overall CO<sub>2</sub> equivalent emissions went from 5,752,987 metric tons in 2006 to 5,882,799 metric tons in 2008, a 2% increase. Scope 1 plus Scope 2 emissions decreased by 7.3% from 2006 to 2007 as slightly higher fuel use being reported for heat at buildings in 2007 was offset by reduced electricity plus steam use in these buildings, and then increased slightly between 2007 and 2008, so that CY2008 GHG emissions are 4.0% below 2006 baseline levels. GHG mobile sources emissions are the only ones that have risen each year during the three-year period, and this appears attributable to construction equipment fuel usage.

**Table 5. Comparison of Scope 1 and 2 CO<sub>2</sub> Equivalent Emissions by Department**

Department	Total CO <sub>2</sub> e Emissions (Metric Tons)				Percent Difference (2008-2006)
	2006 (Baseline)	2007	2008	Difference (2008-2006)	
Aviation	214,334	183,841	189,032	(25,302)	-11.8%
Port Commerce	4,550	4,395	4,394	(156)	-3.4%
Tunnels, Bridges & Terminals	19,737	19,024	13,136	(6,601)	-33.4%
PATH	49,363	53,299	55,880	6,517	13.2%
Mobile Sources	54,611	60,414	66,800	12,190	22.3%
Real Estate & Development	13,275	9,009	12,509	(766)	-5.8%
Engineering	0	8	12	12	N/A
<b>Total</b>	<b>355,870</b>	<b>329,990</b>	<b>341,763</b>	<b>(14,107)</b>	<b>-4.0%</b>

Table 6 compares the 2006, 2007, and 2008 total Scope 3 GHG emissions associated with each Port Authority department. Overall, Scope 3 GHG emissions increased by 2.5% from 2006 to 2008.

**Table 6. Comparison of Scope 3 CO<sub>2</sub> Equivalent Emissions by Department**

Department	Total CO <sub>2</sub> e Emissions (Metric Tons)				Percent Difference (2008-2006)
	2006	2007	2008	Difference (2008-2006)	
Aviation	3,384,615	3,556,431	3,534,382	149,767	4.4%
Port Commerce	886,579	904,811	862,877	(23,702)	-2.7%
Tunnels, Bridges & Terminals	390,965	382,735	374,054	(16,911)	-4.3%
PATH	27,805	30,662	31,597	3,792	13.6%
Mobile Sources	27,080	27,198	24,949	(2,131)	-7.9%
Real Estate & Development	690,243	662,622	713,177	22,934	3.3%
<b>Total</b>	<b>5,407,287</b>	<b>5,564,459</b>	<b>5,541,036</b>	<b>133,749</b>	<b>2.5%</b>

Table 7 compares the total GHG emissions for 2006, 2007, and 2008 by Department and source type which is important when assessing success towards eventual reduction goals and identifying reduction strategies

**Table 7. Comparison of Overall CO<sub>2</sub>e Emissions by Department and Source**

Department/Source	Total CO <sub>2</sub> e Emissions (Metric Tons)				Percent
	2006	2007	2008	Difference (2008-2006)	Difference (2008-2006)
<b>Aviation</b>					
Aircraft	1,963,359	2,085,041	2,058,306	94,947	4.8%
AirTrain	26,919	29,219	29,219	2,300	8.5%
Ground Support Equipment	63,575	61,502	62,974	(601)	-0.9%
Attracted Travel	1,169,468	1,208,804	1,185,261	15,793	1.4%
Buildings	301,305	294,112	322,791	21,486	7.1%
JFK Co-generation Plant	71,360	57,815	60,117	(11,243)	-15.8%
Fleet Vehicles	2,963	3,779	4,233	1,270	42.9%
Direct Fugitive Emissions (Refrigerants)	-	-	513	513	N/A
<b>Port Commerce</b>					
Commercial Marine Vessels	227,735	211,788	187,943	(39,792)	-17.5%
Cargo Handling Equipment	130,223	133,905	131,729	1,506	1.2%
Rail Locomotives	13,345	18,226	19,233	5,888	44.1%
Heavy-Duty Vehicles	449,871	471,399	469,873	20,002	4.4%
Buildings	50,569	53,774	53,965	3,396	6.7%
Direct Fugitive Emissions (Refrigerants)	18	-	-	(18)	-100.0%
Landfill	4,221	3,958	4,011	(210)	-5.0%
Fleet Vehicles	311	437	383	72	23.2%
<b>Tunnels and Bridges</b>					
Attracted Travel	344,281	340,330	332,377	(11,904)	-3.5%
Queuing	24,050	23,954	23,465	(585)	-2.4%
Buildings	18,199	17,166	11,320	(6,879)	-37.8%
Direct Fugitive Emissions (Refrigerants)	35	18	20	(15)	-43.5%
Fleet Vehicles	1,491	1,827	1,773	282	18.9%
<b>Bus Terminals</b>					
In Terminal Vehicle Emissions	6,345	4,588	4,676	(1,669)	-26.3%
Buildings	16,289	13,863	13,536	(2,753)	-16.9%

Department/Source	Total CO <sub>2</sub> e Emissions (Metric Tons)				Percent
	2006	2007	2008	Difference (2008-2006)	Difference (2008-2006)
Fleet Vehicles	12	13	23	11	91.7%
<b>PATH</b>					
Trains	40,828	40,206	42,194	1,366	3.3%
Attracted Travel	27,805	30,662	31,597	3,792	13.6%
Buildings	12,743	12,632	12,983	240	1.9%
Direct Fugitive Emissions (Refrigerants)	18	35	39	21	120.3%
Diesel Equipment including Utility Track Vehicles and Generators	284	272	373	89	31.2%
Fleet Vehicles	156	154	291	135	86.5%
<b>Mobile Sources</b>					
Fleet Vehicles	364	136	66	(298)	-81.9%
Public Safety Department Fleet Vehicles	5,252	8,259	3,853	(1,399)	-26.6%
Direct Fugitive Emissions (Refrigerants)	708	637	295	(413)	-58.3%
Construction Equipment	48,287	51,382	62,586	14,299	29.6%
Employee Commuting	27,080	27,198	24,949	(2,131)	-7.9%
<b>Real Estate &amp; Development</b>					
Buildings	222,075	195,856	243,886	21,811	9.8%
Resource Recovery Facility	480,073	474,668	480,796	723	0.2%
Fleet Vehicles	1,370	1,107	1,004	(366)	-26.7%
<b>Engineering</b>	0	8	12	12	N/A
<b>Total</b>	<b>5,752,987</b>	<b>5,878,730</b>	<b>5,882,799</b>	<b>129,812</b>	<b>2.3%</b>

The PANYNJ also considers changes to operations, such as operational expansions and market conditions. For example, Aircraft emissions increased by about 5% from 2006 to 2008. This increase really occurred between 2006 and 2007, when JFK increased the number of allowable flights per hour and LTOs increased. In addition, PANYNJ took over responsibility for Stewart Airport in November 2007, but including the LTOs from this airport in the GHG emissions during 2008 was less of a factor in the overall increase in aircraft GHGs than the LTO increases at JFK and increased helicopter activity at the downtown Manhattan Heliport. Newark, Teterboro, and LaGuardia airports all had lower GHG emissions in 2008 than in 2006.

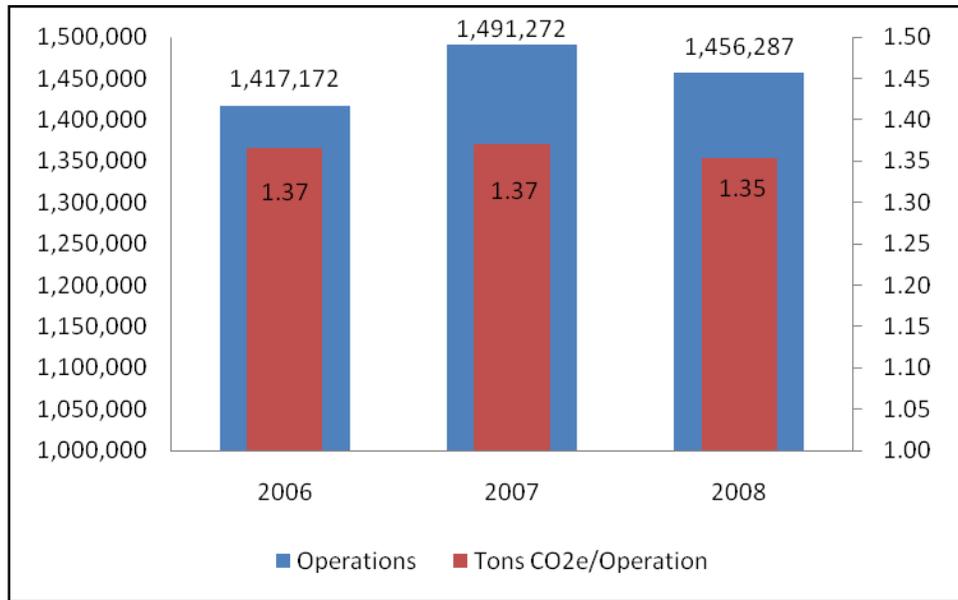
A summary of some important trends affecting GHG emissions is as follows:

- Some increases in aviation attracted travel and buildings GHG emissions occurred between 2006 and 2008, but these increases were smaller in magnitude than the aircraft emission increases. The JFK Cogeneration plant GHG emissions (direct emissions from energy not used at the airport) dropped by 16% from 2006 to 2008 as KIAC burned a lower amount of natural gas in 2008 compared with 2006.

- Port Commerce GHG emissions are fairly stable (a 1% overall reduction) over the 2006 to 2008 period as estimated increases in heavy-duty vehicle activity and buildings energy use is offset by reductions in commercial marine vessel emissions and cargo handling equipment emissions. Commercial marine vessel emission reductions are mostly attributable to reduced dredging activity in 2008.
- TB&T GHG emissions in 2008 are below 2006 levels primarily because of lower vehicle volumes on bridges and tunnels and because building energy consumption for this department declined significantly from 2007 to 2008.
- PATH train and attracted travel GHG emissions increased 6.6% from 2006 to 2008. It should be recognized that this PATH system utilization provides a net GHG emission reduction for the New York City region because PATH train travel is more GHG efficient than passenger car travel.
- Overall increases in mobile source GHG emissions from 2006 to 2008 are attributable mostly to construction equipment. Construction equipment GHG emissions are estimated using construction spending as a surrogate for activity and emissions. Construction equipment GHG emissions increased by 30% from 2006 to 2008.
- In the mobile sources category, there are significant year-to-year changes in the public safety department vehicle GHG emission estimates with a significant increase between 2006 and 2007, and a large drop from 2007 to 2008. This suggests that there are anomalies in the fuel use and vehicle-miles traveled (VMT) reporting for this vehicle category in the reporting period.
- Changes in Real Estate and Development Department GHG emissions between 2006 and 2008 (almost a 10% increase) are directly related to changes in buildings energy consumption. Essex County Resource Recovery Facility GHG emissions and activity are constant across the analysis years.

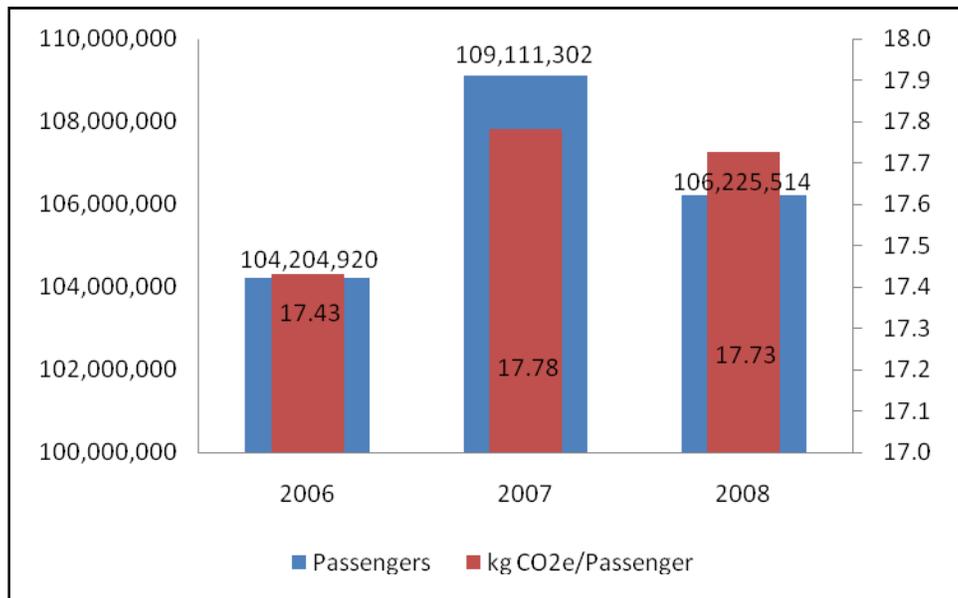
The GHG emission estimation methods used for 2006-2008 account for differences in the aircraft types that used these airports, but it does not capture differences in operations that may be occurring to save fuel or the differences in market activity that may influence total number of flights. For this reason, it is important to normalize emissions based on a number of metrics, for example, emissions per passenger, to identify trends and reduction strategies. The following discussion presents further information on trends at the Airports and Port Commerce.

Figure 8 provides an evaluation of the Port Authority airport GHG emissions from 2006 to 2008 and how these emissions have changed on a per operations basis. At the four major airports operated by the Port Authority during 2006-2008, the number of operations increased from 1.42 million in 2006 to 1.46 million in 2008. The CO<sub>2</sub>e emissions at these four airports increased from 1.936 million metric tons to 1.971 million metric tons. However, on a per aircraft operations basis, the GHG emissions declined from 1.366 tonnes per passenger to 1.354 tonnes. This is a 1% drop in the per aircraft operations GHG emission rate over these three years.



**Figure 8. Aircraft Emissions per Operation at JFK, Newark, LaGuardia, and Teterboro**

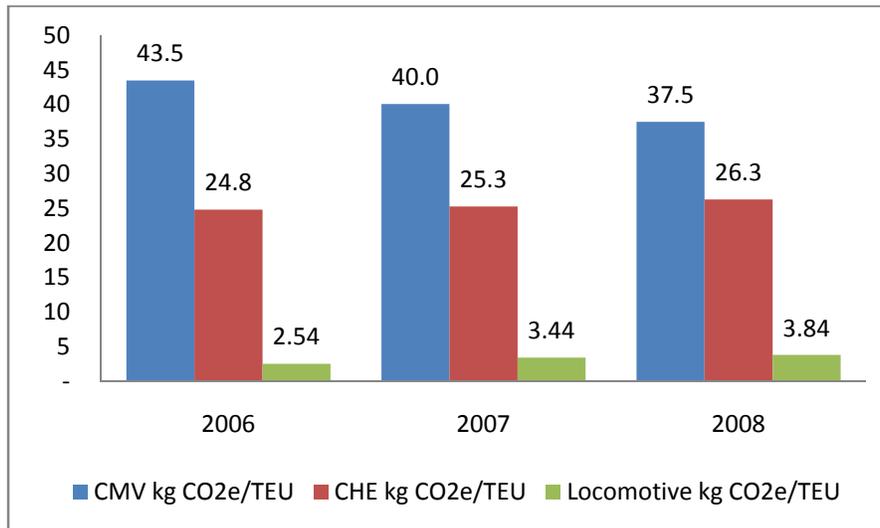
Passenger data for the three analysis years is only available for Newark, LaGuardia, and JFK airports, so the per passenger GHG analysis shown in Figure 9 is limited to these three airports. The number of passengers at these three airports was 104.2 million during 2006, increasing to 107.2 million in 2007, and decreasing to 106.2 million in calendar year 2008. The per passenger GHG emission rates changed from 17.43 kg per person in 2006 to 18.1 kg per person in 2007, and then declined to 17.72 kg per passenger in 2008 as shown in Figure 1-9.



**Figure 1-9. Aircraft Emissions per Passenger at JFK, Newark, and LaGuardia**

Figure 10 shows how Port Commerce source category GHG emissions have changed from 2006 to 2008 using an indicator of the amount of cargo being handled in the port terminals as a metric for examining GHG emissions per unit of cargo handled. Figure 1-10 shows CO<sub>2</sub>e emissions for the three years per twenty foot equivalent unit (TEU) for the three most

prominent GHG emission sources within these port terminals – commercial marine vessels, cargo handling equipment, and locomotives. CO<sub>2</sub>e emissions for commercial marine vessels drop from 43.5 kg CO<sub>2</sub>e per TEU in 2006 to 37.5 kg CO<sub>2</sub>e per TEU in 2008. This decline is probably attributable to reduced dredging activity. Cargo handling equipment emissions when expressed per TEU, increase from 24.8 kg CO<sub>2</sub>e to 26.3 kg CO<sub>2</sub>e in 2008 – a 6% increase. Locomotive emissions per TEU increased during this period – as shown in Figure 1-10 – because rail locomotives were used more frequently as an option for moving freight from the port terminals in 2007 and 2008 than during 2006. Rail is a more GHG efficient travel mode than moving freight by truck, so changing the travel mix to favor rail is providing overall GHG emission reductions.



**Figure 10. Port Commerce Emissions Per Twenty Foot Equivalent Units (TEU) Handled**

Future EIs will include a larger discussion on metrics to attempt to normalize GHG emission trends while also measuring total reductions and progress towards the 2050 80% reduction goal.

## CRITERIA AIR POLLUTANTS

Table 8 summarizes the Port Authority CAP emission estimates by pollutant for 2006 through 2008.

**Table 8. Port Authority Annual Criteria Air Pollutant Emissions (metric tons)**

Year	NO <sub>x</sub>	SO <sub>2</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>
2006	23,978	5,457	1,134	1,021
2007	24,274	5,954	1,153	1,360
2008	23,327	6,138	1,328	1,156

The criteria pollutant emission estimates have remained relatively stable over this analysis period. NO<sub>x</sub> is probably the most important of these pollutants because of its importance as an ozone precursor and the New York City area's continuing ozone nonattainment area status. NO<sub>x</sub> emissions in 2008 from Port Authority owned and operated facilities in 2008 are slightly less than they were estimated to be in 2006. The Port Authority's NO<sub>x</sub> emissions are dominated by Aviation and Port Commerce emission sources. Key sources include aircraft, airport attracted travel, commercial marine vessels and Port Commerce-cargo handling equipment. The slight upward trend in SO<sub>2</sub> emissions from 2006 to 2008 (a 12% increase) is mostly attributable to buildings energy use increases in 2008. Commercial marine vessels are the largest SO<sub>2</sub> source in the inventory, but commercial marine vessel emissions in 2008 are just below what they were during 2006.