GREENHOUSE GAS AND CRITERIA AIR POLLUTANT EMISSIONS INVENTORY FOR THE PORT AUTHORITY OF NEW YORK & NEW JERSEY

Calendar Year 2016

Final Report

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The Port Authority of New York & New Jersey

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September 2018

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

AC	air conditioning
AEDT	Aviation Environmental Design Tool
AMT	Auto Marine Terminal
APU	Auxiliary Power Unit
ATADS	Air Traffic Activity Data System
B20	20 percent biodiesel
Btus	British thermal units
CAD	Central Automotive Division
CAP	criteria air pollutant
ccf	100 cubic feet
CEMS	continuous emission monitoring system
CFCs	chlorofluorocarbons
CFR	Code of Federal Regulations
CH_4	methane
CHP	combined heat and power
CNG	compressed natural gas
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
Con Edison	Consolidated Edison Co. of N.Y., Inc.
ECRR	Essex County Resource Recovery
EDMS	Emission and Dispersion Modeling System
eGRID	Emissions & Generation Resource Integrated Database
E10	10 percent ethanol
E85	85 percent ethanol
EIA	U.S. Energy Information Administration
EPA	U.S. Environmental Protection Agency
EWR	Newark Liberty International Airport
EY	emission year
FAA	Federal Aviation Administration
FLIGHT	EPA’s Facility Level Information on GreenHouse Gases Tool
g	gram(s)
gal	gallon
GGRP	Greenhouse Gas Reporting Program
GHG	greenhouse gas
GRP	General Reporting Protocol
GSE	Ground Support Equipment
GW Bridge	George Washington Bridge
GWP	global warming potential
HCFC	hydrochlorofluorocarbon
HFCs	hydrofluorocarbons
hp	horsepower
hr	hour
hrs/yr	hours per year
HRSG	heat recovery steam generator
Hz	hertz
ICAO	International Civil Aviation Organization
IPCC	Intergovernmental Panel on Climate Change
JFK	John F. Kennedy International Airport
kg	kilogram
KIAC	Kennedy International Airport Cogeneration
kWh	kilowatt hour
LandGEM	EPA’s Landfill Gas Emissions Model
lbs	pounds

LF	load factor
LGA	LaGuardia Airport
LTO	landing and take-off
MARKAL	EPA's MARKet ALlocation database
MMBtu	million British thermal units
MOVES	EPA's MOtor Vehicle Emissions Simulator
MSW	municipal solid waste
MWh	megawatt hour(s)
Mlbs	thousand pounds
National Grid	National Grid USA Service Company, Inc.
NYNJLINA	New York/Northern New Jersey/Long Island Non-Attainment Area
N_2O	nitrous oxide
N/A	not applicable
No.	number
NO_x	nitrogen oxides
NPCC	Northeast Power Coordinating Council
NYC	New York City
NYCW	NPCC NYC/Westchester
NYUP	NPCC Upstate NY
ODS	ozone-depleting substance
PABT	Port Authority Bus Terminal
PATH	Port Authority Trans-Hudson
PCA	preconditioned air
PDF	portable document format
Pechan	former E.H. Pechan & Associates (now SC&A)
PFCs	perfluorocarbons
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
Port Authority	Port Authority of New York and New Jersey
ppm	parts per million
PSEG	Public Service Electric and Gas
QA/QC	quality assurance/quality control
RECs	renewable energy certificates
RFCE	Reliable First Corporation East
scf	standard cubic foot
SF_6	sulfur hexafluoride
SO_2	sulfur dioxide
SO_x	sulfur oxides
Southern	Southern Research Institute
SWF	Stewart International Airport
TCAP	Tenant Construction and Alteration Process manual
TCR	The Climate Registry
TEB	Teterboro Airport
TPY	tons per year of pollutant
VALE	Voluntary Airport Low Emissions Program
VMT	vehicle miles traveled
VOCs	volatile organic compounds
WFC	World Financial Center
WTC	World Trade Center

1.0 INTRODUCTION

1.1 BACKGROUND

The Port Authority of New York and New Jersey (Port Authority) owns, manages, and maintains bridges, tunnels, bus terminals, airports, the 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 Port Authority include John F. Kennedy International Airport (JFK), Newark Liberty International Airport (EWR), LaGuardia Airport (LGA), Stewart International Airport (SWF) and Teterboro Airport (TEB); the George Washington Bridge and Bus Station; the Lincoln and Holland tunnels; Port Newark; Howland Hook Marine Terminal; the Port Authority Bus Terminal (PABT); and the 16-acre World Trade Center (WTC) site in lower Manhattan.

In June 1993, the Port Authority issued its environmental policy affirming its long-standing commitment to provide transportation, terminal, and other facilities of commerce within its jurisdiction, to the greatest extent practicable, in an environmentally sound manner and consistent with applicable environmental laws and regulations. On March 27, 2008, the Board of Commissioners expanded the Port Authority's environmental policy to include a sustainability component that explicitly addresses the problem of climate change and ensures that the agency maintains an aggressive posture in its efforts to reduce greenhouse gas (GHG) emissions. The cornerstone of this policy is the dual goal of (a) reducing GHG emissions related to its facilities, including tenants and customers, by 80 percent from 2006 levels by 2050; and (b) pursuing a net zero GHG emissions goal for its operations (Port Authority 2008).

The Port Authority retained the services of SC&A, Inc. to conduct annual emission inventories covering GHGs and co-pollutants that are collectively referred to as criteria air pollutants (CAP). The Port Authority's inventories follow international best practices for defining the inventory boundary in terms of an organizational and operational boundary, and further characterizing the operational boundary in terms of scope 1, scope 2, and scope 3 emissions (WRI 2004). A thorough discussion of the Port Authority's inventory structure is provided in Section 1.2.

The Port Authority is publishing this 2016 GHG and CAP inventory as a tool for evaluating the effects of ongoing mitigation actions and informing the design of future environmental and sustainability initiatives.

1.2 INVENTORY STRUCTURE

The structure of the Port Authority's GHG and CAP inventory conforms to the corporate accounting and reporting standard (GHG Protocol) published by the World Resources Institute and World Business Council for Sustainable Development (WRI 2004). Per the GHG Protocol, the Port Authority defined the inventory boundary in relation to its organizational and operational boundaries. The Port Authority sets the organizational boundary using the operational control approach. The GHG Protocol defines operational control as an organization "[having] the full authority to introduce and implement its operating policies at the operation" (WRI 2004). The Port Authority's operational boundary encompasses direct and indirect emissions as follows:

- Direct Scope 1 emissions resulting from the combustion of fuels by or fugitive losses from sources operated by the Port Authority (e.g., Port Authority owned and controlled vehicles, air conditioning equipment, and emergency generators).
- Indirect Scope 2 emissions pertain to Port Authority energy acquisitions for the benefit of its operations but from sources not operated by the Port Authority (e.g., electricity purchases for the benefit of Port Authority operations).
- Indirect Scope 3 emissions relate to emissions from tenant and customer activities within or physically interacting with Port Authority owned facilities (e.g., aircraft movements during landing and take-off cycle below an altitude of 3,000 feet (ACRP 2009)), vehicular movements across bridges and tunnels). This scope also includes emissions from Port Authority employee commuting.

To clarify the extent to which the Port Authority has influence over scopes 1, 2, and 3 emitting activities, a carbon management dimension was added to the inventory boundary. At one end of the carbon management spectrum are activities over which the Port Authority has the most influence, such as energy acquisitions for the benefit of its own operations (e.g., natural gas, transportation fuels, electricity purchases). At the other end, there are activities over which the Port Authority has little influence, such as an employee's decision on mobility (e.g., use of personal vehicle versus mass transit for daily commuting). An illustration of the Port Authority's inventory boundary and key structural features is shown in Figure 1-1.

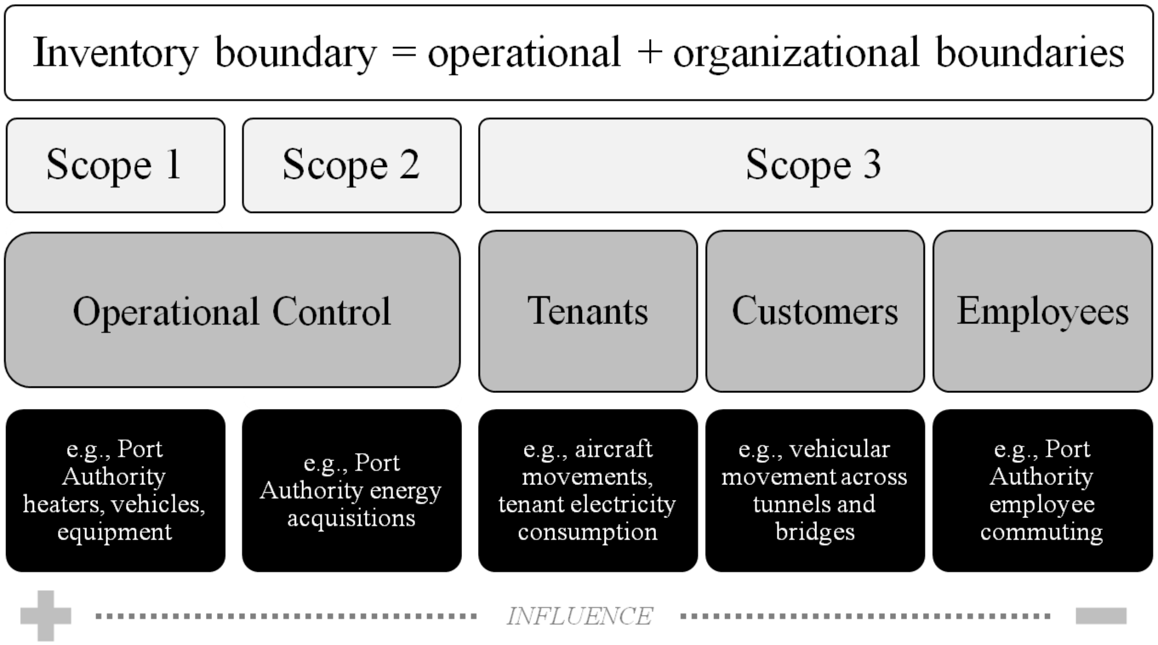

Figure 1-1. Schematic of the Port Authority's Inventory Boundary

1.2.1 Pollutant Coverage

The Port Authority inventory covers the six main GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Where applicable, the report also shows emissions in CO_2e, where the emissions of each pollutant are multiplied by their respective global warming potential (discussed in Section Global Warming Potentials) to express total radiative forcing effects in a single unit, with CO_2 as the reference gas. The inventory also quantifies key co-pollutants referred to collectively as criteria pollutants or CAPs; these include nitrogen oxides (NO_x), sulfur oxides (SO_x), particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}), and particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$).

1.2.2 Global Warming Potentials

The Intergovernmental Panel on Climate Change (IPCC) developed global warming potentials (GWPs) to quantify the globally averaged relative radiative forcing effects of a given GHG, using CO_2 as the reference gas. In 1996, the IPCC published a set of GWPs in its Second Assessment Report (IPCC 1996). In 2001, the IPCC published its Third Assessment Report (IPCC 2001), which adjusted the GWPs to reflect new information on atmospheric lifetimes and an improved calculation of the radiative forcing of CO_2. The IPCC adjusted these GWPs again during 2007 in its Fourth Assessment Report (IPCC 2007). However, Second Assessment Report GWPs are still used by international convention to maintain consistency with international practices, including by the United States and Canada when reporting under the United Nations Framework Convention on Climate Change. GWP values from the Second Assessment Report were used and are presented in Table 1-1.

Table 1-1: Global Warming Potential Factors for Reportable GHGs			
Common Name	**Formula**	**Chemical Name**	**GWP**
Carbon dioxide	CO_2	N/A	1
Methane	CH_4	N/A	21
Nitrous oxide	N_2O	N/A	310
Sulfur hexafluoride	SF_6	N/A	23,900
Hydrofluorocarbons (HFCs)			
HFC-23	CHF_3	trifluoromethane	11,700
HFC-32	CH_2F_2	difluoromethane	650
HFC-41	CH_3F	fluoromethane	150
HFC-43-10mee	$C_5H_2F_{10}$	1,1,1,2,3,4,4,5,5,5-decafluoropentane	1,300
HFC-125	C_2HF_5	pentafluoroethane	2,800
HFC-134	$C_2H_2F_4$	1,1,2,2-tetrafluoroethane	1,000
HFC134a	$C_2H_2F_4$	1,1,1,2-tetrafluoroethane	1,300
HFC-143	$C_2H_3F_3$	1,1,2-trifluoroethane	300
HFC-143a	$C_2H_3F_3$	1,1,1-trifluoroethane	3,800
HFC-152	$C_2H_4F_2$	1,2-difluoroethane	43
HFC-152a	$C_2H_4F_2$	1,1-difluoroethane	140
HFC-161	C_2H_5F	fluoroethane	12
HFC-227ea	C_3HF_7	1,1,1,2,3,3,3-heptafluoropropane	2,900
HFC-236cb	$C_3H_2F_6$	1,1,1,2,2,3-hexafluoropropane	1,300
HFC-236ea	$C_3H_2F_6$	1,1,1,2,3,3-hexafluoropropane	1,200
HFC-236fa	$C_3H_2F_6$	1,1,1,3,3,3-hexafluoropropane	6,300
HFC-245ca	$C_3H_3F_5$	1,1,2,2,3-pentafluoropropane	560
HFC-245fa	$C_3H_3F_5$	1,1,1,3,3-pentafluoropropane	950
HFC-365mfc	$C_4H_5F_5$	1,1,1,3,3-pentafluoropropane	890
Perfluorocarbons (PFCs)			
Perfluoromethane	CF_4	tetrafluoromethane	6,500
Perfluoroethane	C_2F_6	hexafluoroethane	9,200
Perfluoropropane	C_3F_8	octafluoropropane	7,000
Perfluorobutane	C_4F_{10}	decafluorobutane	7,000
Perfluorocyclobutane	$c\text{-}C_4F_8$	octafluorocyclobutane	8,700
Perfluoropentane	C_5F_{12}	dodecafluoropentane	7,500
Perfluorohexane	C_6F_{14}	tetradecafluorohexane	7,400

Source: IPCC 1996

1.2.3 Operational Control Emissions

Emissions that fall under the operational control of the Port Authority include direct scope 1 emissions and indirect scope 2 emissions as defined by the GHG Protocol (WRI 2004). The Port Authority sponsors annual assessments of scope 1 and scope 2 emissions for the purpose of tracking progress towards the goal of carbon neutrality for Port Authority operations. To that end, the Port Authority selects emission estimation methods that meet a materiality standard of 5 percent (i.e., the sum of errors and misstatements do not exceed 5 percent of total emissions). The Port Authority successfully registered the 2010, 2011, and 2012 scope 1 and scope 2 inventories with TCR. These GHG inventories were independently verified to be complete, transparent, and materially accurate. Since 2015, the Port Authority also voluntarily discloses its verified carbon footprint to CDP, a not-for-profit organization that provides a global system for companies and cities to measure, disclose, manage, and share vital environmental information, and has its GHG inventory independently verified by a third party on an annual basis.

The characterization of emission sources under the operational control of the Port Authority is presented in Table 1-2. Emission sources are grouped by general emission categories, including stationary and mobile combustion; purchased heating, cooling and steam; and fugitive emissions. In addition, a range of activities associated with these emission categories is provided. “Buildings” represents emissions from energy consumption (e.g., natural gas or electricity) at Port Authority facilities. “Emergency Generators and Fire Pumps” corresponds to emissions from fuel combustion by emergency response equipment. “Rail Systems” refers to emissions from energy acquisitions for the operation of the PATH light rail lines and stations. Emissions from combustion of transportation fuels by the Port Authority’s Central Automotive Division fleet broken down by two fleet segments, the “CAD Main Fleet,” and the “Executive Fleet.” Emissions from combustion of fuels for operation of non-road equipment along the PATH system are labeled “PATH Non-Road Equipment.” “Refrigeration/Fire Suppression” refers to unintentional releases of refrigerant from air conditioning equipment and intentional releases from specialty fire suppression systems. “Landfill Gas” is associated with fugitive emissions from a closed landfill on Port Elizabeth. “Welding” refers to emissions that stem from routine maintenance operations.

Table 1-2 also identifies for each emitting activity the corresponding scope and indicates whether biogenic emissions are also generated. For the Port Authority, biogenic emissions are the result of bioethanol and biodiesel fuel consumption by the CAD fleet and CO_2 fugitive emissions from the closed Elizabeth Landfill.

Table 1-2: Characterization of Sources under the Operational Control of the Port Authority

Emission Category	Activity	Scope		
		1	2	Biogenic
Stationary Combustion	Buildings	✓		
	Emergency Generators and Fire Pumps	✓		
	Welding	✓		
Mobile Combustion	CAD Main Fleet	✓		✓
	Executive Fleet	✓		✓
	PATH Non-Road Equipment	✓		
Purchased Electricity	Buildings		✓	
	Rail Systems		✓	
Purchased Cooling	Buildings		✓	
Purchased Heating	Buildings		✓	
Purchased Steam	Buildings		✓	
Fugitive Emissions	Landfill Gas	✓		✓
	Refrigeration/Fire Suppression	✓		

1.2.4 Scope 3 Emissions - Tenants

The Port Authority promotes commerce and regional economic development with the help of partners, tenants, and contractors (hereinafter referred to as “tenants”). In general, tenants conduct business within Port Authority facilities (e.g., operation of cargo handling equipment in maritime terminals) or interact directly with Port Authority infrastructure (e.g., aircraft movements). Emissions from tenant activities fall outside the Port Authority’s operational control, and therefore are classified as scope 3. Emission estimates for tenant sources are based on best available methods and data sources. In some cases, these estimates have a margin of error of less than 5 percent, but in most cases, tenant emission estimates do not subscribe to a 5 percent materiality standard. Assessing tenant emissions helps the Port Authority identify environmental and sustainability initiatives that can best be achieved in collaboration with its tenants.

The characterization of tenant emission sources is presented in Table 1-3. Emission sources are grouped by general emission categories, including stationary and mobile combustion; purchased heating, cooling and steam; and aircrafts. In addition, a range of activities associated with these emission categories is provided. “Buildings” corresponds to emissions from tenant energy consumption (e.g., natural gas or electricity). “Cargo Handling Equipment” points to emissions from fuel combustion by cargo processing equipment at maritime ports. “Ferry Movements” are mobile emissions from ferry operations that arrive to and depart from the Port Authority’s World Financial Center (WFC) terminal. “Rail Locomotive” refers to mobile emissions from such equipment on Port Authority property. “Rail Systems” refers to emissions from energy acquisitions for the AirTrain light rail lines and stations. “Shadow Fleet” corresponds to mobile emissions from vehicles owned by, but not operated by, the Port Authority. “Auto Marine Terminal, Vehicle Movements” are mobile emissions from staging imported vehicles on the premises of the Auto Marine Terminal (AMT). “Non-Road Diesel Engines” reflects emissions from diesel construction equipment activity on Port Authority sponsored sites. “Aircraft Movements” account for emissions from aircraft engines during a landing and take-off cycle. “Auxiliary Power Units” are emissions from aircraft auxiliary engines used to provide lighting and air conditioning at the terminal gate. Finally, “Ground Support Equipment” refers to emissions from equipment used to service aircrafts between flights.

Table 1-3: Characterization of Tenant Sources

Emission Category	Activity	Scope	
		3	Biogenic
Stationary Combustion	Buildings	✓	
Mobile Combustion	AMT, Vehicle Movements	✓	
	Ferry Movements	✓	
	Rail Locomotives	✓	
	Shadow Fleet	✓	✓
	Cargo Handling Equipment	✓	
Purchased Electricity	Buildings	✓	
	Rail Systems	✓	
Purchased Cooling	Buildings	✓	
	Rail Systems	✓	
Purchased Heating	Buildings	✓	
	Rail Systems	✓	
Construction	Non-Road Diesel Engines	✓	
Aircrafts	Aircraft Movements	✓	
	Auxiliary Power Units	✓	
	Ground Support Equipment	✓	

1.2.5 Scope 3 Emissions - Customers

The Port Authority promotes commerce and regional economic development for the benefit of the public (hereinafter referred to as "customers"). Emissions from customer activities fall outside the Port Authority's operational control and are therefore classified as scope 3. Emission estimates for customer sources are based on best available methods and data sources, but customer emission estimates do not subscribe to a 5 percent materiality standard. Assessing customer emissions helps the Port Authority consider carbon and air pollution impacts stemming from utilization of its infrastructure and may inform decision-makers on the selection and design of future capital projects.

The characterization of customer emission sources is presented in Table 1-4. Emission sources are grouped by general emission categories, including attracted travel and energy production. Attracted travel refers to customer motorized travel to access Port Authority infrastructure and includes a range of activities. The category "Drayage Trucks" covers emissions from drayage trucks moving cargo inland from the maritime ports. "Commercial Marine Vessels" refers to emissions from vessels that call on Port Authority ports. "Airport Passenger" accounts for emissions from motorized travel to access Port Authority air terminals. "Air Cargo" pertains to emissions associated with the distribution of cargo shipping to and from Port Authority airports. "Through Traffic" describes emissions from vehicles that travel across Port Authority tunnels, bridges and bus terminals. "Queued Traffic" accounts for emissions from vehicular congestion when the demand for a given tunnel or bridge exceeds its capacity. "Electricity Sold to Market" accounts for emissions from electricity that is generated in Port Authority-owned power plants but consumed downstream by a non-specified end-user through the electricity market. This category excludes electricity produced in a Port Authority-owned power plant and consumed by the Port Authority or a Port Authority tenant. Note that electricity production at the Essex County Resource Recovery plant is generated primarily from the combustion of municipal solid waste (MSW), which qualifies by federal and New Jersey state law as biogenic emissions. Finally, the "Energy Recovery Program" refers to the distribution of low-cost electricity to local business impacted by the events of September 11th, 2001.

Table 1-4: Characterization of Customer Sources

Emission Category	Activity	Scope	
		3	Biogenic
Attracted Travel	Air Cargo	✓	
	Airport Passenger	✓	
	Commercial Marine Vessels	✓	
	Drayage Trucks	✓	
	PATH Passenger	✓	
	Through Traffic	✓	
	Queued Traffic	✓	
Energy Production	Electricity Sold to Market	✓	✓
Purchased Electricity	Economic Recovery Program	✓	

1.2.6 Scope 3 Emissions - Employees

The Port Authority includes in its scope 3 boundary emissions associated with the commuting of its employees. The Port Authority regularly conducts anonymous employee surveys to collect information about commuting habits, including but not limited to distance, mode, origin and destination. Through these surveys, the Port Authority gathers feedback about proposed initiatives affecting employee commuting. The characterization of employee emission sources is presented in Table 1-5: Characterization of Employee Sources

Table 1-5: Characterization of Employee Sources

Emission Category	Activity	Scope	
		3	Biogenic
Mobile Combustion	Employee Commuting	✓	✓

1.3 SUMMARY OF GHG EMISSIONS RESULTS

This section presents the results of the 2016 GHG inventory for anthropogenic emissions, unless otherwise specified. CAP emissions were estimated as co-pollutants and those emissions results are presented thematically at the end of each chapter.

In 2016, the Port Authority had a total carbon footprint (scopes 1+2+3) of 5,909 thousand metric tons CO_2e. This represents an increase of 1.3 percent relative to the revised 2006 base year[1]. Since 2006, the Port Authority has achieved notable emission reductions in scope 2 emissions through the implementation of energy efficiency and energy conservation initiatives. Additionally, the Port Authority has kept scope 3 emission in check despite growing customer demand for Port Authority infrastructure over time. A comparison of the 2016 carbon footprint with the 2006 baseline is presented in Figure 1-2.

[1] In March 2018, the 2006 base year inventory was revised to reflect the best practices adopted by Port Authority's GHG inventory program. The revisions to the 2006 inventory are detailed in Appendix D of this report.

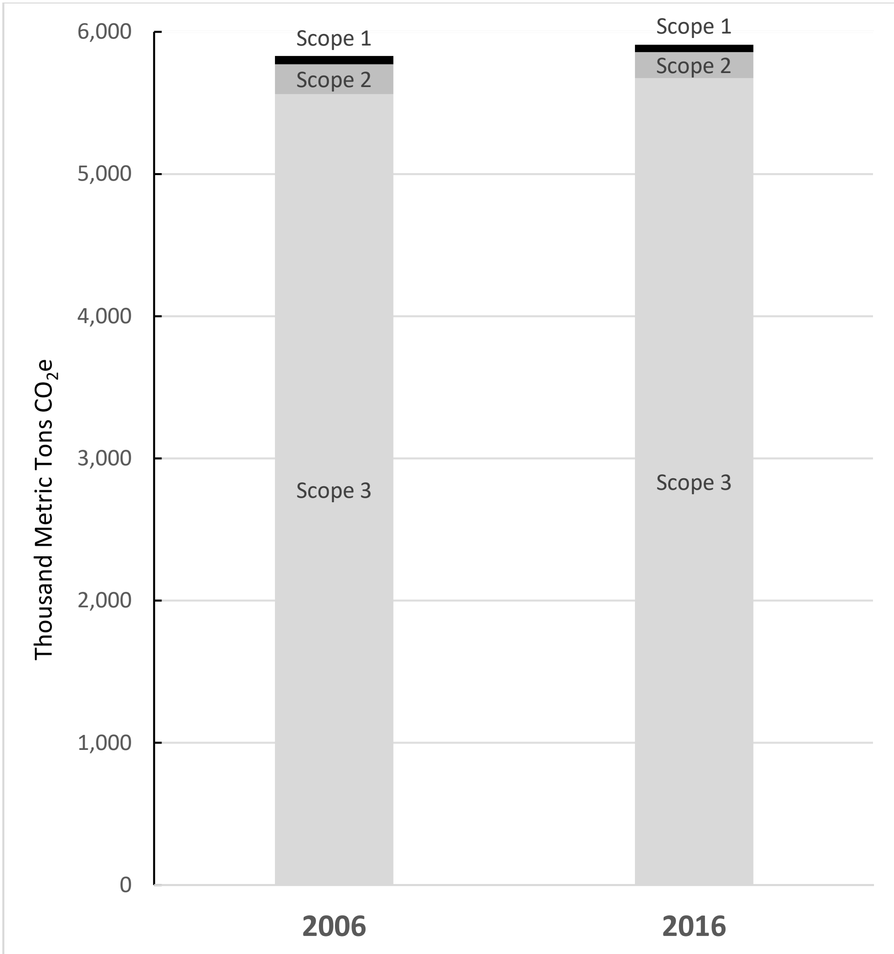

Figure 1-2. 2016 GHG Inventory Comparison with the 2006 Baseline

The carbon footprint of the Port Authority's operations (scopes 1+2) amounted to 234,657 metric tons of CO_2e in 2016. Since 2006, the Port Authority achieved a reduction of 34,921 metric tons CO_2e through changes in operations and implementation of numerous sustainability initiatives. This level of carbon mitigation corresponds to a 13 percent reduction relative to the 2006 base year. The goal of achieving carbon neutrality for Port Authority operations is attainable with the help of market instruments and additional operational improvements. Most notably, the Port Authority could mitigate 71 percent of operational control emissions by retiring renewable energy certificates (RECs) against 456,658.5 MWh consumed. An additional 5 percent of emissions could be mitigated by means of fuel switching to biofuels and/or further electrification of the CAD fleet. Residual emissions accounting for 23 percent of the operational control inventory could be offset with the purchases of high quality carbon credits in the voluntary carbon market. A comparison of the 2016 and 2006 operation control GHG emission inventories is shown in Figure 1-3.

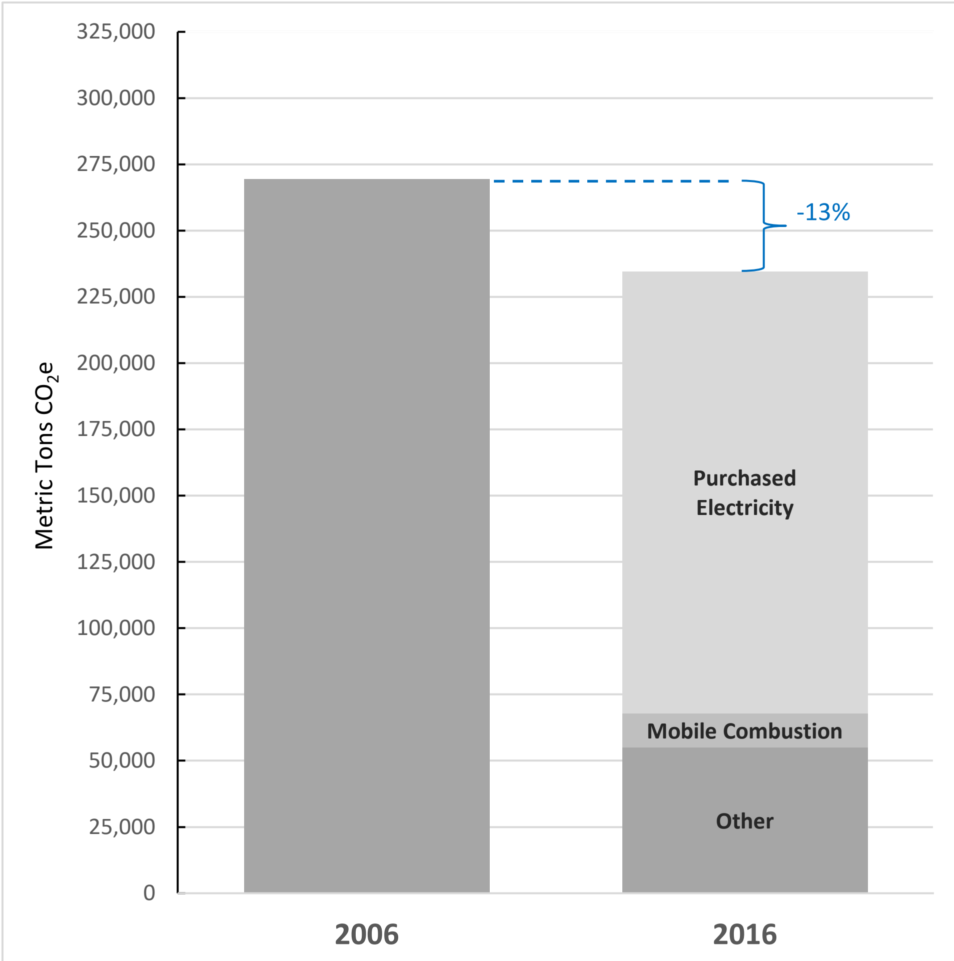

Figure 1-3. 2016 Operational Control GHG Emissions Comparison with the 2006 Baseline

The breakdown of emissions by carbon management level and scope is presented in Table 1-6. Total GHG emissions in the Port Authority's inventory are 5,909,185 metric tons CO_2e. Customer emissions account for half of total emissions (49.6 percent), followed by tenant emissions (46.1 percent). Operational control emissions are relatively small, amounting to just 4.0 percent. Employee emissions are the smallest, making up less than 1 percent of the entire Port Authority inventory. Note that the Port Authority inventory program requires that emissions from scope 1 and scope 2 sources be conducted annually and assessment of scope 3 emissions to be done periodically. For that reason, total scope 3 emissions of 5,674,529 metric tons CO_2e for 2016 represent a composite value of the most recent assessment for a given source. An account of scope 3 emission estimates by year of assessment is provided as supplemental information in Appendix A: Scope 3 GHG Emissions by Year of Assessment.

Table 1-6: Port Authority 2016 GHG Emissions Summary (metric tons CO_2e)					
Carbon Management Level	**Scope 1**	**Scope 2**	**Scope 3[a]**	**Total**	**Total %**
Operational Control	52,242	182,415		234,657	4.0%
Tenants			2,725,432	2,725,432	46.1%
Customers			2,928,601	2,928,601	49.6%
Employees			20,496	20,496	0.3%
TOTAL	**52,242**	**182,415**	**5,674,529**	**5,909,185**	**100%**

[a] The sum of scope 3 emissions reflects emission values for the most recent assessment of a given source.
Note: Totals may not match the column sums due to rounding.

In conformance with the GHG Protocol, the Port Authority reports biogenic emissions separately. Within the Port Authority inventory boundary, there are multiple sources of biogenic emissions, including CO_2 bi-product of municipal solid waste decomposition released from the closed Elizabeth Landfill and combustion of biofuels by the CAD main fleet, executive fleet, shadow fleet, and vehicles used by commuting employees. Most biogenic emissions come from energy recovery activities at the Essex County Resource Recovery facility, where municipal solid waste is combusted. A summary of biogenic emissions is presented in Table 1-7.

Table 1-7: Port Authority 2016 Biogenic GHG Emissions Summary			
Carbon Management Level	**Facility**	**Activity**	**Biogenic CO_2**
Operational Control	Elizabeth Landfill	Landfill Gas	557
	Fleet Vehicles	CAD Main Fleet	1,561
		Executive Fleet	14
Tenants	Multi-Facility	Shadow Fleet	1,190
Customers	Essex County Resource Recovery	Electricity Sold to Market	499,459
Employees	Multi-Facility	Employee Commuting	907
TOTAL			**503,689**

Note: Totals may not match the column sums due to rounding.

Table 1-8 presents anthropogenic emissions by line department and emissions categories across the carbon management spectrum. Sources grouped as “Multi-Department” include mobile combustion emissions from employees commuting to various Port Authority facilities and stationary combustion emissions from the maintenance and use of emergency generators and fire pumps located across the entire organization. Emissions from sources not expressly affiliated with one department such as electricity purchases and heating in support of central administrative functions are denoted as “Central Administration”.

Table 1-9 summarizes the Port Authority’s anthropogenic GHG emissions by emission category and emitting activity across the carbon management spectrum. For the Drayage Truck activity under “Attracted Travel”, this report accounts for emissions to the first point of rest to a maximum distance of 400 miles, which is about the distance travelled on a full tank of diesel by a drayage truck in a day. The first point of rest boundary reflects an industry good-practice for the management of GHG emissions (WPCI 2010). Drayage Truck emissions in this report compliments the results of the Port Commerce Department’s 2016 Multi-Facility Emission Inventory (Starcrest 2018) by estimating incremental emissions from the 16-county NYNJLINA boundary to the first point of rest.

Table 1-8: Port Authority 2016 GHG Emissions by Line Department (metric tons CO_2e)						
Department/Emissions Category	**Scope 1**	**Scope 2**	**Scope 3**			**Total**
	Ops. Control		*Tenants*	*Customers*	*Employees*	
Aviation	**26,853**	**83,725**	**2,370,363**	**771,434**		**3,252,375**
Aircraft			2,116,090			2,116,090
Attracted Travel				632,870		632,870
Energy Production				138,565		138,565
Fugitive Emissions	1,008					1,008
Purchased Cooling		6,146	14,746			20,892
Purchased Electricity		74,375	197,244			271,620
Purchased Heating		3,203	8,727			11,930
Stationary Combustion	25,845		33,557			59,401
Central Administration	**13,460**	**4,482**	**11,404**			**29,345**
Fugitive Emissions	215					215
Mobile Combustion	12,477		11,404			23,881
Purchased Electricity		4,482				4,482
Stationary Combustion	768					768
Engineering			**15,849**			**15,849**
Construction			15,849			15,849
Multi-Department	**898**				20,496	21,394
Mobile Combustion					20,496	20,496
Stationary Combustion	898					898
PATH	**4,438**	**43,176**	**99**	**60,064**		**107,777**
Attracted Travel				60,064		60,064
Fugitive Emissions	1,326					1,326
Mobile Combustion	550					550
Purchased Electricity		43,176	70			43,245
Stationary Combustion	2,562		30			2,592
Planning			**11,794**			**11,794**
Mobile Combustion			11,622			11,622
Purchased Electricity			123			123
Stationary Combustion			50			50
Port	**3,914**	**5,436**	**134,113**	**1,160,430**		**1,303,893**
Attracted Travel				1,160,430		1,160,430
Fugitive Emissions	3,503					3,503
Mobile Combustion			123,241			123,241
Purchased Electricity		5,436	7,615			13,052
Stationary Combustion	412		3,257			3,668
Real Estate	**428**	**2,541**	**146,626**	**368,299**		**517,894**
Energy Production				368,299		368,299
Purchased Electricity		2,541	102,256			104,796
Stationary Combustion	428		44,371			44,799
Tunnels, Bridges & Bus Terminals	**2,250**	**26,398**	**2,644**	**546,040**		**577,332**
Attracted Travel				546,040		546,040
Fugitive Emissions	10					10
Purchased Electricity		22,724	2,281			25,005
Purchased Steam		3,674				3,674
Stationary Combustion	2,240		364			2,603
World Trade Center		**16,658**	**32,539**	**22,334**		**71,532**
Purchased Electricity		13,949	32,539	22,334		68,822
Purchased Steam		2,709				2,709
TOTAL	**52,242**	**182,415**	**2,725,432**	**2,928,601**	**20,496**	**5,909,185**

Note: Totals may not match the column sums due to rounding.

Table 1-9: Port Authority 2016 GHG Emissions by Emissions Category and Activity (metric tons CO_2e)						
Emissions Category and Activity	**Scope 1**	**Scope 2**	**Scope 3**			**Total**
	Ops. Control		*Tenants*	*Customers*	*Employees*	
Aircraft			**2,116,090**			**2,116,090**
Aircraft Movements			1,904,446			1,904,446
Auxiliary Power Units			38,434			38,434
Ground Support Equipment			173,209			173,209
Attracted Travel				**2,399,404**		**2,399,404**
Air Cargo				57,181		57,181
Airport Passenger				575,689		575,689
Commercial Marine Vessels				192,596		192,596
Drayage Trucks [a]				282,801		282,801
Drayage Trucks [b]				685,034		685,034
PATH Passenger				60,064		60,064
Queued Traffic				22,107		22,107
Through Traffic				523,933		523,933
Construction			**15,849**			**15,849**
Non-Road Diesel Engines			15,849			15,849
Energy Production				**506,863**		**506,863**
Electricity Sold to Market				506,863		506,863
Fugitive Emissions	**6,061**					**6,061**
Landfill Gas	3,491					3,491
Refrigeration/Fire Suppression	2,570					2,570
Mobile Combustion	**13,027**		**146,267**		**20,496**	**179,790**
AMT, Vehicle Movements			402			402
CAD Main Fleet	12,276					12,276
Cargo Handling Equipment			102,513			102,513
Employee Commuting					20,496	20,496
Executive Fleet	201					201
Ferry Movements			11,622			11,622
PATH Non-Road Equipment	550					550
Rail Locomotives			20,326			20,326
Shadow Fleet			11,404			11,404
Purchased Cooling		**6,146**	**14,746**			**20,892**
Buildings		6,146	13,982			20,128
Rail Systems			764			764
Purchased Electricity		**166,683**	**342,127**	**22,334**		**531,144**
Economic Recovery Program				22,334		22,334
Buildings		128,721	317,939			446,660
Rail Systems		37,962	24,188			62,150
Purchased Heating		**3,203**	**8,727**			**11,930**
Buildings		3,203	8,024			11,227
Rail Systems			703			703
Purchased Steam		**6,383**				**6,383**
Buildings		6,383				6,383
Stationary Combustion	**33,153**		**81,626**			**114,780**
Buildings	32,255		81,626			113,881
Emergency Gen. and Fire Pumps	898					898
Welding	1					1
TOTAL	**52,242**	**182,415**	**2,725,432**	**2,928,601**	**20,496**	**5,909,185**

[a] Travel distance to NYNJLINA boundary.
[b] Travel distance from NYNJLINA boundary to first point of rest.
Note: Totals may not match the column sums due to rounding.

2.0 STATIONARY COMBUSTION (SCOPE 1)

This chapter covers direct emissions from the combustion of fossil fuels in stationary equipment under the operational control of the Port Authority. Stationary combustion emissions are further broken down by three activities: building heating, emergency generators and fire pumps, and welding emissions associated with routine building maintenance.

2.1 BUILDINGS

The 2016 inventory assesses fuel combusted in buildings to produce heat or hot water using equipment in a fixed location. Natural gas is the predominant fuel for building heating, followed by heating oil at select facilities, and propane. The latter is associated with fire training exercises at JFK.

2.1.1 Activity Data

The Port Authority's Office of Environmental and Energy Programs centrally collects information relating to natural gas purchases. This information was corroborated against natural gas invoices from suppliers, namely Central Hudson, Direct Energy, Great Eastern Energy, National Grid, and Public Service Electric & Gas (PSEG).

Table 2-1: Fuel Consumption in Buildings

Department	Facility	Commodity	Consumption	Units
Aviation	JFK Airport	Heating Oil	52,552	gal
		Natural Gas	1,774,703	therm
		Propane	142,671	gal
	LGA Airport	Heating Oil	34,316	gal
		Natural Gas	502,475	therm
	EWR Airport	Heating Oil	119,345	gal
		Natural Gas	1,872,619	therm
	SWF Airport	Natural Gas	84,055	therm
	TEB Airport	Natural Gas	68,967	therm
Central Administration	PANYNJ Leased Office Space NJ	Natural Gas	144,408	therm
PATH	PATH Buildings	Heating Oil	33,584	gal
		Natural Gas	416,025	therm
Port	NJ Marine Terminals	Natural Gas	41,566	therm
	NY Marine Terminals	Natural Gas	35,837	therm
Real Estate	Real Estate NJ	Natural Gas	60,847	therm
	Real Estate NY	Natural Gas	19,678	therm
Tunnels, Bridges & Bus Terminals	Bus Terminals	Natural Gas	123,641	therm
	Tunnels and Bridges	Natural Gas	297,434	therm

Additionally, natural gas consumption was prorated for the months of January and December to capture consumption within the calendar year of the assessment. Limited data filling was conducted when missing information was identified; all data substitution qualified as *de minimis.* Heating oil consumption is monitored at the facility level, and this information is collected from the facilities for the purposes of the inventory. Table 2-1 summarizes stationary fuel consumption in buildings by commodity.

2.1.2 Method

Emission estimates were developed in accordance with general reporting protocol (GRP) Chapter 12, "Direct Emissions from Stationary Combustion" (TCR 2013a). The GHG emission factors used to calculate the GHG emissions are shown in Table 2-2. The values in Table 2-2 are representative of U.S. pipeline-grade natural gas, No. 2 fuel oil (i.e., heating oil) and propane. The emission factors for CO_2 were then taken from GRP Table 12.1, and the emission factors for CH_4 and N_2O were taken from GRP Table 12.9 (TCR 2017). When applicable, unit conversion was applied to match the unit of measurement of the activity data. In order to maintain consistency with the CAP emission factors in Table 2-3, an average high heating value of 1,026 British thermal units (Btu) per standard cubic foot was taken from the U.S. Environmental Protection Agency's (EPA's) "AP-42 Compilation of Air Pollutant Emission Factors" (EPA 1995; hereafter referred to as "EPA AP-42"), Section 1.4.

Table 2-2: Stationary Combustion GHG Emission Factors

Commodity	Units	CO_2	CH_4	N_2O
Natural gas	kg/therm	5.31	4.70×10^{-4}	1.00×10^{-5}
Heating oil (No. 2 fuel oil)	kg/gal	10.35	1.40×10^{-3}	8.40×10^{-5}
Propane	kg/gal	5.66	9.00×10^{-4}	5.40×10^{-5}

The CAP emission factors are based on values recommended by EPA AP-42, Chapters 1.3, "Fuel Oil Combustion" and 1.4, "Natural Gas Combustion" (EPA 1995). The sulfur dioxide (SO_2) emission factor is based on assuming a 100 percent fuel sulfur conversion. The NO_x and particulate matter (PM) emission factors are based on the premise that the natural gas was combusted in small [<100 million Btus (MMBtu) per hour (hr)] uncontrolled boilers. These values are presented in Table 2-3.

Table 2-3: Stationary Combustion CAP Emission Factors

Commodity	Units	SO_2	NO_x	$PM_{2.5}$	PM_{10}
Natural gas	kg/therm	2.65×10^{-5}	4.42×10^{-3}	3.36×10^{-4}	3.36×10^{-4}
Heating oil (No. 2 fuel oil)	kg/gal	9.66×10^{-5}	9.07×10^{-3}	6.99×10^{-4}	1.04×10^{-3}
Propane	kg/gal	2.21×10^{-5}	5.90×10^{-3}	3.18×10^{-4}	3.18×10^{-4}

2.1.3 Results

Table 2-4 summarizes stationary combustion GHG emissions by facility and department. Table 2-5 presents stationary combustion CAP emissions.

Table 2-4: GHG Emissions from Stationary Combustion by Department (metric tons)					
Department	**Facility**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**
Aviation	JFK Airport	10,768	1.036	0.030	10,799
	LGA Airport	3,021	0.284	0.008	3,030
	EWR Airport	11,171	1.047	0.029	11,202
	SWF Airport	446	0.040	0.001	447
	TEB Airport	366	0.032	0.001	367
Central Administration	PANYNJ Leased Office Space NJ	766	0.068	0.001	768
PATH	PATH Buildings	2,555	0.243	0.007	2,562
Port	NJ Marine Terminals	221	0.020	0.000	221
	NY Marine Terminals	190	0.017	0.000	191
Real Estate	Real Estate NJ	323	0.029	0.001	324
	Real Estate NY	104	0.009	0.000	105
Tunnels, Bridges & Bus Terminals	Bus Terminals	656	0.058	0.001	658
	Tunnels and Bridges	1,578	0.140	0.003	1,582
TOTAL		**32,166**	**3.022**	**0.082**	**32,255**

Note: Totals may not match the column sums due to rounding.

Table 2-5: CAP Emissions from Stationary Combustion by Department (metric tons)					
Department	**Facility**	**SO_2**	**NO_x**	**$PM_{2.5}$**	**PM_{10}**
Aviation	JFK Airport	0.06	9.2	0.68	0.70
	LGA Airport	0.02	2.5	0.19	0.20
	EWR Airport	0.06	9.4	0.71	0.75
	SWF Airport	0.00	0.4	0.03	0.03
	TEB Airport	0.00	0.3	0.02	0.02
Central Administration	PANYNJ Leased Office Space NJ	0.00	0.6	0.05	0.05
PATH	PATH Buildings	0.01	2.1	0.16	0.17
Port	NJ Marine Terminals	0.00	0.2	0.01	0.01
	NY Marine Terminals	0.00	0.2	0.01	0.01
Real Estate	Real Estate NJ	0.00	0.3	0.02	0.02
	Real Estate NY	0.00	0.1	0.01	0.01
Tunnels, Bridges & Bus Terminals	Bus Terminals	0.00	0.5	0.04	0.04
	Tunnels and Bridges	0.01	1.3	0.10	0.10
TOTAL		**0.17**	**27.1**	**2.04**	**2.12**

Note: Totals may not match the column sums due to rounding.

2.2 EMERGENCY GENERATORS AND FIRE PUMPS

All facilities under Port Authority's operational control have stationary engine generators for use in emergency situations. These emergency generators and fire pumps are typically diesel fired, but the Port Authority does have some gasoline- and natural gas-fired generators. The emergency generators and fire pumps are tested periodically throughout the year.

2.2.1 Activity Data

The Port Authority provided annual runtime and fuel usage data for emergency generators and fire pumps at JFK, LGA, EWR, New York Marine Terminals, and New Jersey Marine Terminals. Actual annual runtime or fuel usage data for emergency generators and fire pumps were not available for other Port Authority facilities. Electricity usage data is a reasonable surrogate for emergency generator and fire pump usage data (a facility with higher electricity needs will maintain more back-up generators than a facility with lower electricity needs) and electricity usage data were available for all Port Authority facilities. For these facilities, estimated emissions were calculated using the surrogate emission factors described above and applying them against the electricity usages for each facility. These methodologies are based on engineering estimates and are qualified as *de minimis*.

2.2.2 Method

GHG and CAP emissions for the five facilities with actual activity data (i.e., JFK, LGA, EWR, New York Marine Terminals and New Jersey Marine Terminals) were estimated using standard emission factors (TCR 2017) and EPA AP-42, Section 3.3, "Gasoline and Diesel Industrial Engines" (EPA 1995). The emission factors are shown in Table 2-6.

Table 2-6: Emergency Generator and Fire Pump Emission Factors

Pollutant	Unit	Diesel Fuel	Gasoline	Natural Gas
CO_2	kg/MMBtu	72.93	60.77	53.10
CH_4	kg/MMBtu	4.29×10^{-03}	3.85×10^{-03}	4.70×10^{-03}
N_2O	kg/MMBtu	2.57×10^{-03}	2.31×10^{-03}	1.00×10^{-04}
NO_x	kg/MMBtu	2.00×10^{-00}	7.39×10^{-01}	1.85×10^{-00}
SO_x	kg/MMBtu	1.32×10^{-01}	3.81×10^{-02}	2.67×10^{-04}
PM	kg/MMBtu	1.41×10^{-01}	4.54×10^{-02}	4.57×10^{-03}

GHG and CAP emissions for the remaining Port Authority facilities were estimated using an engineering estimate. Alternate GHG and CAP emission factors were developed as the ratio of emergency generators and fire pump emissions and electricity consumption at JFK, LGA, EWR, New York Marine Terminals, and New Jersey Marine Terminals. Table 2-7 provides the relative emission factors for emergency generators and fire pumps applied to this assessment.

Table 2-7: Emergency Generator and Fire Pump Alternate Emission Factors

Pollutant	Unit	Emergency Generator	Fire Pump
CO_2	kg/MWh	1.63	0.32
CH_4	kg/MWh	9.62×10^{-05}	1.86×10^{-05}
N_2O	kg/MWh	5.73×10^{-05}	1.12×10^{-05}
NO_x	kg/MWh	4.48×10^{-02}	8.70×10^{-03}
SO_x	kg/MWh	2.93×10^{-03}	5.72×10^{-04}
$PM_{2.5}$	kg/MWh	3.13×10^{-03}	6.12×10^{-04}
PM_{10}	kg/MWh	3.13×10^{-03}	6.12×10^{-04}

2.2.3 Results

Total emergency generator and fire pump GHG and CAP emission estimates are shown in Table 2-8.

Table 2-8: GHG & CAP Emissions from Emergency Generators and Fire Pumps (metric tons)			
Pollutant	Emergency Generators	Fire Pumps	Total
CO_2	746.74	140.46	887.20
CH_4	0.04	0.01	0.05
N_2O	0.03	0.01	0.03
CO_2e	755.79	142.17	897.95
NO_x	20.49	2.38	22.87
SO_x	1.34	0.16	1.50
$PM_{2.5}$	1.43	0.17	1.60
PM_{10}	1.43	0.17	1.60

Note: Totals may not match the column sums due to rounding.

2.3 WELDING GASES

Limited welding activity takes place within the boundary for the Port Authority inventory, and its impact on Port Authority emissions is negligible. An engineering estimate was developed to quantify the level of welding gas emissions, correlating the emitting activity to the dollar amount of welding gas purchased. When surveyed for the 2010 inventory, LGA reported spending $866 on welding gas (Port Authority 2012a). Typically, acetylene costs $1.24 per standard cubic foot (WeldingWeb 2012). Assuming that all purchased welding gas was acetylene and that all purchased gas was used, it was determined by stoichiometry that 77.8 kg of CO_2 were emitted at LGA. Furthermore, assuming that the same level of welding activity occurred at all five airports and at the two marine terminals, total welding gas emissions at the Port Authority were estimated to be 0.5 metric tons of CO_2 in 2010. The same engineering emission estimate (or *de minimis*) was carried over to calendar year 2016.

3.0 MOBILE COMBUSTION (SCOPE 1)

Mobile combustion emissions result from the combustion of fuels by on-road vehicles, non-road vehicles, and portable equipment that is owned and operated by the Port Authority. The Port Authority's Central Automotive Division (CAD) oversees the procurement and maintenance of on-road vehicles, most non-road vehicles, and some portable equipment. Additionally, PATH operates and services a small number of non-road vehicles and portable equipment.

3.1 CENTRAL AUTOMOTIVE DIVISION FLEET

CAD is in charge of purchasing and maintaining the Port Authority's fleet of vehicles. CAD relies on records either from the fuel management system or from fuel vendor invoices—as in the case of compressed natural gas (CNG)—to track fleet fuel consumption. Additionally, CAD encourages on-road vehicle operators to log mileage information when filling up to better estimate methane, nitrous oxide and CAP emissions. The CAD fleet consumes conventional fuels like gasoline and diesel as well as alternative fuels such as compressed natural gas (CNG), gasoline with an 85 percent ethanol blend (E85), liquified petroleum gas (LPG), and diesel with a 20 percent biodiesel blend (B20). Table 3-1: CAD Fuel Consumption summarizes CAD fleet fuel consumption by fuel type in 2015 (Port Authority 2017a).

Table 3-1: CAD Fuel Consumption

Activity	Commodity	Units	Consumption
CAD Main Fleet	Biodiesel (B20)	gal	261,986
CAD Main Fleet	CNG	scf	7,108,412
CAD Main Fleet	Diesel	gal	32,274
CAD Main Fleet	LPG	gal	1,550
CAD Main Fleet	Gasoline (E10)	gal	1,155,923
CAD Main Fleet	E85	gal	82,112
Executive Fleet	Diesel	gal	28
Executive Fleet	Gasoline (E10)	gal	25,087

3.1.1 Activity Data

For the purpose of the fuel tracking, the CAD fleet is divided between the CAD Main Fleet and the Executive Fleet, which is a subset of vehicles assigned to specific functions within the Port Authority. The data flow for tracking transportation fuel consumption is shown in Figure 3-1. The main fleet is composed of 2,664 vehicles, which includes on-road and non-road vehicles as well as portable equipment. CAD retains the services of Sprague, a fuel management contractor, to track the volume of fuel dispensed from a network of authorized fuel stations by means of dedicated fuel cards. For each fuel type, the volume of fuel dispensed was used to calculate CO_2 emissions from the main fleet. The CAD also rents vehicles for various projects on an as-needed basis. There are approximately 250 such vehicles being rented at any given time (Port Authority 2016e). The fuel consumption from these rental vehicles is also tracked by Sprague and included in all CAD fuel consumption totals.

The Port Authority Office of the Treasury tracks fuel consumption for a subset of vehicles by means of branded fuel cards (e.g., Shell Fuel Card). This includes 25 vehicles used by executives, 35 security vehicles associated with the Port Authority's Inspector General's office, and two vehicles used in association with training activities in Morris County, New Jersey; collectively, all 62 vehicles are referred to in the inventory as the Executive Fleet. The Office of the Treasury maintains a financial record of fuel purchases. To convert expenditures to fuel volume, the 2016 annual average fuel price of $2.25 per gallon for the middle Atlantic region was applied (EIA 2017). This analysis also assumed that 99.9 percent of fuel consumption was gasoline and the remaining 0.1 percent was diesel based on the actual record for 2012, when information on fuel volume by fuel type was available.

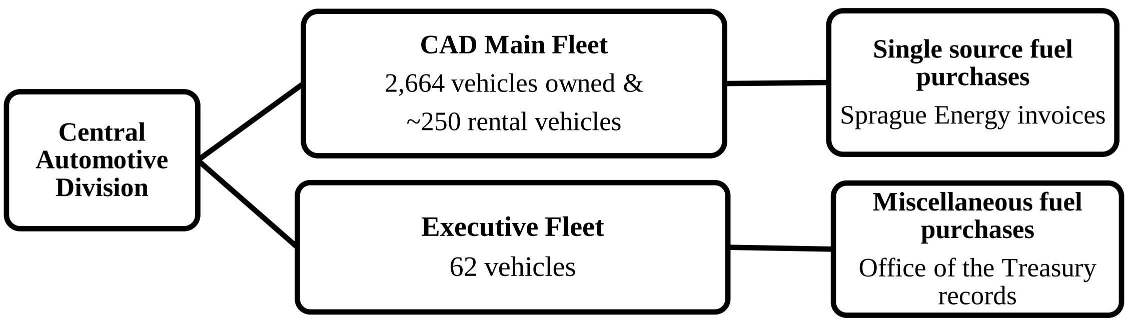

Figure 3-1. Fuel Tracking for the Port Authority Vehicle Fleet

Activity data for estimating CAP emissions came from CAD in the form of vehicle activity. Vehicle activity came in different units of measurement according to the specific segments of the fleet. For most highway vehicles, activity data consisted of recorded miles traveled. For smaller segments of the fleet, such as the executive fleet and non-highway vehicles (e.g., forklifts), fuel consumption served as the activity data. The selection of the best emission factor based on available activity data is discussed in Section 3.1.2 below for each fleet segment.

3.1.2 Method

GHG emission estimates were calculated as the product of fuel use and fuel-specific emission factors. Carbon dioxide emissions were estimated by multiplying the fuel use by the appropriate emission factor from GRP Table 13.1 (TCR 2017). The majority of fuel consumed by Port Authority contains some biofuel (either E10 or B20). For these biofuel blends, attention was given to distinguishing between anthropogenic and biogenic emissions. This was accomplished by correlating the fossil fuel-specific emission factor to the volume of fossil fuel consumed. For example, for a volume of 100 gallons of E10, anthropogenic CO_2 emissions equal:

$$100 \text{ gal of E10} \times 90 \text{ percent fossil fuel by volume} \times 8.78 \text{ kg } CO_2\text{/gal} = 790.2 \text{ kg } CO_2$$

Biogenic CO_2 emission estimates (i.e., those generated during the combustion or decomposition of biologically based material such as biodiesel or ethanol) are calculated by correlating the biofuel-specific emission factor to the volume of biofuel consumed. For example, for a volume of 100 gallons of E10, biogenic CO_2 emissions equal:

$$100 \text{ gal of E10} \times 10 \text{ percent ethanol by volume} \times 5.75 \text{ kg } CO_2\text{/gal} = 57.5 \text{ kg } CO_2$$

For all fuel types, CH_4 and N_2O emissions were assessed using an engineering estimate, based on the ratio of CO_2 to CH_4 and N_2O emissions taken from GRP Table 13.9 (TCR 2017). The emission factors used to calculate the emissions are presented in Table 3-2.

Table 3-2: Emission Factors for Onroad Transportation Fuels

Fuel Type	Percentage Biofuels	Fossil Fuel CO_2 (kg/gal or kg/ccf)	Biogenic CO_2 (kg/gal)	CH_4 (kg/kg of CO_2)	N_2O (kg/kg of CO_2)
Gasoline (E10)	10%	8.78	5.75	0.000059	0.000036
Diesel #2	0%	10.21	9.45	0.000059	0.000036
Biodiesel (B20)	20%	10.21	9.45	0.000059	0.000036
E85	85%	8.78	5.75	0.000059	0.000036
CNG	0%	5.4	0	0.000059	0.000036
Propane	0%	5.72	0	0.000059	0.000036

Because a number of commercial transportation fuels combine petroleum and biofuel products, it is necessary to adjust the standard emission factors to differentiate between anthropogenic and biogenic mobile combustion emissions. The latter corresponds to the combustion of the biofuel volume in a given commercial fuel blend. For instance, commercial gasoline (E10) is a mixture of a petroleum product (90 percent) and bioethanol (10 percent); therefore, the effective biogenic emission factor for commercial gasoline was calculated as the product of the ethanol carbon content and the concentration of ethanol in the commercial fuel blend. Table 3-3 shows the effective CO_2 emission factors for petroleum and biofuel blends consumed by the CAD fleet.

Table 3-3: Effective CO_2 Emission Factors of Biofuel Blends

Fuel Type	Percentage Biofuels	Anthropogenic CO_2 (kg/gal)	Biogenic CO_2 (kg/gal)
Gasoline (E10)	10%	7.90	0.58
Biodiesel (B20)	20%	8.17	1.89
E85	85%	1.32	4.89

CAP emission factors for highway vehicles are from the EPA MOtor Vehicle Emissions Simulator (MOVES 2014a) (EPA 2014a). These emission factors are expressed in units of grams per mile based on model year and vehicle type for the 2016 inventory. CAP emissions from diesel vehicles were assumed to come from B20 fuel, because that is the primary diesel fuel used at Port Authority. Similarly, CAP emissions from vehicles using E10 fuel used MOVES emission factors that were modeled with the properties of E10 fuel. Flex Fueled vehicles were assumed to be burning E85. These emission factors were then multiplied by the 2016 estimates of mileage per vehicle provided by the CAD to obtain CAP emissions. There was no mileage data available for the rental vehicles that CAD uses. Since these vehicles are primarily light duty pickups, the average VMT from CAD pickup trucks (6,752 miles in 2016) was used as a stand-in. This VMT is then multiplied by the number of rental vehicles (approximately 250) and the MOVES 2014a emissions factor for a 2016 light duty pickup truck to estimate CAP emissions from rental vehicles.

Non-highway CAP emissions were calculated by multiplying total fuel consumption by the national average emission factors from EPA's MARKet ALlocation (MARKAL) model database (Pechan 2010). CAP emissions for bulk CNG and propane were estimated by multiplying total fuel consumption by the appropriate MARKAL emission factors. The CAP estimates for the executive fleet and the security and training vehicles were based on the per-gallon emission factors from EPA's MARKAL database (Pechan 2010), because no information on mileage per vehicle was available.

3.1.3 Results

Table 3-4 presents GHG and CAP emission estimates for the CAD Main Fleet by fuel type. Table 3-5 shows the GHG and CAP emissions by fuel type from the Executive Fleet. The reliance on biofuel blends, the portion of biogenic CO_2 emissions for CAD is sizable amounting to 1,575 tCO2e in 2016.

Table 3-4: GHG & CAP Emissions from the CAD Main Fleet (metric tons)

Commodity	CO_2	CH_4	N_2O	CO_2e	SO_x	NO_x	$PM_{2.5}$	PM_{10}
Biodiesel (B20)	2,140	0.156	0.094	2,172	0.020	12.08	0.460	0.829
CNG	387	0.023	0.014	392	0.012	4.43	0.064	0.064
Diesel	330	0.019	0.012	334	0.005	0.36	0.030	0.031
E85	108	0.030	0.018	114	0.038	0.30	0.133	0.830
Gasoline (E10)	9,134	0.579	0.350	9,255	0.097	1.09	0.145	0.761
LPG	9	0.001	0.000	9	0.000	0.08	0.001	0.001
TOTAL	**12,108**	**0.808**	**0.488**	**12,276**	**0.172**	**18.35**	**0.833**	**2.517**

Note: Totals may not match the column sums due to rounding.

Table 3-5: GHG & CAP Emissions from the Executive Fleet (metric tons)

Commodity	CO_2	CH_4	N_2O	CO_2e	SO_x	NO_x	$PM_{2.5}$	PM_{10}
Diesel	0.284	0.000	0.000	0.287	0.000	0.000	0.000	0.000
Gasoline (E10)	198.2	0.013	0.008	200.9	0.069	1.139	0.293	0.318
TOTAL	**198.5**	**0.013**	**0.008**	**201.1**	**0.069**	**1.140**	**0.293**	**0.318**

Note: Totals may not match the column sums due to rounding.

3.2 PATH DIESEL EQUIPMENT

PATH owns and operates certain track maintenance vehicles that are not accounted for by the CAD. PATH equipment includes a small number of non-road vehicles and portable equipment.

3.2.1 Activity Data

PATH non-road and portable equipment burns diesel fuel exclusively. Annual fuel consumption is tracked for each individual piece of equipment. This information serves as the activity data for GHG and CAP emission assessments. For the 2016 inventory, diesel fuel consumption was provided by Port Authority (Port Authority 2017l).

3.2.2 Method

Carbon dioxide emission estimates are calculated based on the gallons of diesel fuel multiplied by the appropriate emission factor from GRP Table 13.1 (TCR 2017). Methane and nitrous oxide emission estimates are calculated based on the per-gallon diesel emission factor for non-highway equipment, from GRP Tables 13.7 and 13.8, respectively (TCR 2017).

The emission factors for CAP for diesel equipment used in the PATH system were calculated based on emission factors from the EPA MARKAL database (Pechan 2010).

3.2.3 Results

Total GHG and CAP emissions for PATH diesel equipment are shown in Table 3-6.

Table 3-6: GHG & CAP Emissions from PATH Diesel Equipment (metric tons)

CO_2	CH_4	N_2O	CO_2e	SO_x	NO_x	$PM_{2.5}$	PM_{10}
543	0.03	0.02	550	0.01	0.63	0.05	0.05

4.0 FUGITIVE EMISSIONS (SCOPE 1)

Fugitive emissions are intentional and unintentional releases of GHGs that are not the result of fossil fuel combustion. This chapter covers fugitive emissions from equipment or activities under the operational control of the Port Authority. More specifically, refrigeration and fire protection equipment charged with substitutes for ozone-depleting substances (ODSs), as well as biogas gas emanating from a historical landfill.

4.1 USE OF REFRIGERANTS

Emissions of HFCs and PFCs from stationary and mobile air conditioning (AC) equipment are the result of fugitive release over the operational life of the equipment. Note that not all refrigerants are reportable according to best carbon accounting practices. Ozone depleting substances such as refrigerants R-22, R-12, and R-11 are not required to be reported for carbon management purposes because their production is already being phased out under the Montreal Protocol.

4.1.1 Method

Emission estimates were developed in accordance with GRP Chapter 16, “Direct Fugitive Emissions from the Use of Refrigeration and Air Conditioning Equipment” (TCR 2013a). The 2016 approach for estimating refrigerant fugitive emissions is consistent with previous years’ assessments and follows the decision tree shown in Figure 4-1. The 2016 inventory leverages AC equipment surveys previously conducted for the EY2012 and EY2014. All refrigerant fugitive emission estimates were developed using method Option 2 with some adjustments that are described below, except for LGA, where a modified simple mass balance equation was applied (i.e., method Option 1). Note that all direct fugitive emissions from the use of refrigerants qualify as *de minimis*.

Option 1: The methodology relies on a mass-balance approach to account for changes in refrigerant inventory levels (additions as well as subtractions) and net increases in nameplate capacity.

Option 2: Refrigerant fugitive emission estimates using Option 2 rely on an AC equipment count and information about the type of refrigerant, typical annual utilization, the equipment’s nameplate refrigerant charge, and equipment’s application (e.g., chiller or residential/commercial AC, including heat pump). Rates of refrigerant release are then correlated to each AC equipment profile. The resulting emission estimates for each HFC and PFC are then converted to units of CO_2e using the appropriate GWP factors to determine total HFC and PFC emissions.

A substantial effort was made to ensure that refrigerant emissions for the 2016 inventory were estimated following a consistent procedure across all Port Authority facilities following the GRP equation 16e (TCR 2013a). For most Port

Authority facilities, the refrigerant charge or capacity was known based on information obtained from facility surveys. However, in certain cases, survey information provided only cooling equipment capacity. In those cases, existing available data were used to develop a correlation between the equipment capacity in tons of refrigeration and refrigerant charge in kg for various size units in Btu/hr. The following linear equation was developed and used to estimate the refrigerant capacity for those facilities where only the cooling capacity was available: y (kg of charge) = 0.574x (tons capacity) + 7.187.

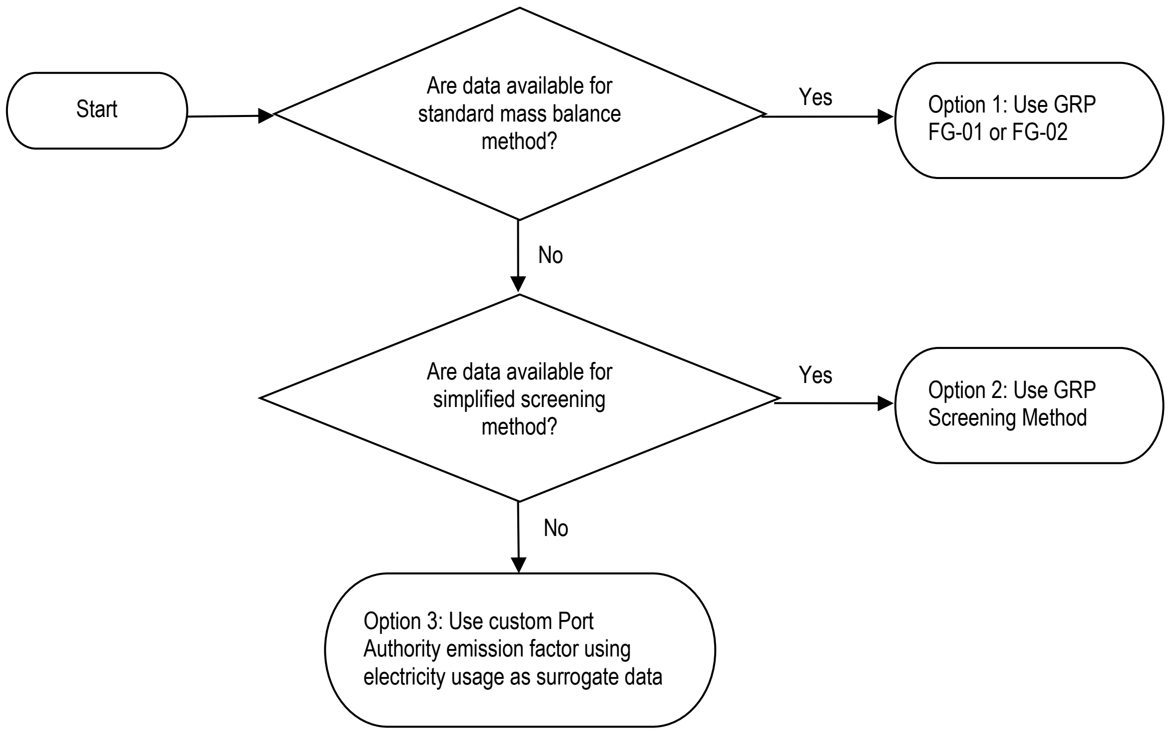

Figure 4-1. Method Selection to Quantify Fugitive Emissions from AC Equipment

4.1.2 Results

GHG emission estimates for refrigerants used by the Port Authority during 2016 are shown in Table 4-1. This table excludes non-reportable HCFCs and chlorofluorocarbons (CFCs), such as R-22. Shaded cells refer to facilities for which air conditioning systems have been previously surveyed and found not to contain any GHGs. Note that starting with EY2016, emissions are no longer being assessed for AirTrain JFK or AirTrain Newark because the AirTrain system was recategorized as a scope 3 source.

Table 4-1: Refrigerant Emissions by Facility and ODS Substitute (metric tons CO_2e)							
Facility	**HFC-134a**	**HFC-227ea**	**R-134A**	**R-404A**	**R-407C**	**R-410A**	**Total**
Central Automotive					214.8		214.8
JFK Airport							
LGA Airport			88.4			0.83	89.23
SWF Airport	2.3					1.7	4.1
EWR Airport	859.8	140					999.8
TEB Airport	0.1					3.9	4.0
Brooklyn Cruise Terminal							
Brooklyn Marine Terminal						2.4	2.4
Howland Hook/Port Ivory						2.4	2.4
Port Elizabeth Marine Terminal						1.5	1.5
Port Jersey			<0.1	<0.1		1.8	1.8
Port Newark Marine Terminal	0.1			0.3		3.1	3.6
George Washington Bridge	0.1			0.9		2.1	3.1
Holland Tunnel	<0.1						<0.1
Lincoln Tunnel	0.1						0.1
Staten Island Bridges							
GW Bridge Bus Station	<0.1			1.3		2.5	3.8
Port Authority Bus Terminal	3.1						3.1
PATH Trains					1,041.7		1,041.7
PATH Buildings	283.8						283.8
Bathgate Industrial Park							
The Teleport							
TOTAL	**1,149.4**	**1400**	**6.7**	**2.5**	**1,256.5**	**22.0**	**2,577.3**

Note: Totals may not match the column sums due to rounding.

4.2 USE OF FIRE SUPPRESSANTS

Fire protection systems charged with reportable ODS substitutes often service areas with specialized equipment such as high-value electronics, including server and communication rooms.

For previous inventory years, a survey was distributed to facility managers requesting a list of fire protection equipment (e.g., centralized system, hand-held devices), the nature of the fire suppressant used to charge such equipment, and the amount of fire suppressant purchased for equipment recharge (as a proxy for GHG releases). Based on the survey responses, CO_2 and FM-200® are the common GHGs to be reported in the event of equipment discharge. Previous surveys indicated that the following facilities use reportable GHGs as fire suppressants:

- LaGuardia (LGA) Airport: FM-200;
- Stewart (SWF) Airport: $CO_{2;}$
- Newark (EWR) Airport: $CO_{2;}$
- George Washington Bridge: FM-200;
- Holland Tunnel: FM-200;
- Lincoln Tunnel: FM-200;

- Staten Island Bridges: FM-200; and
- PATH Buildings: CO_2 and FM-200.

The first step in quantifying emissions from fire suppressants for the 2016 inventory year was to survey these facilities known to have fire protection equipment that uses reportable GHGs. In addition to the facilities listed above, a survey was also distributed to obtain information on firefighting equipment for George Washington Bridge Bus Station, which was previously unknown. Based on the survey response, there is fire protection equipment that uses FM-200 for fire suppression at George Washington Bridge Bus Station as well.

The Port Authority indicated that in 2016 there were fire suppressant releases totaling 111 kilograms of CO_2. The CO_2 emissions released in 2016 are attributed to portable fire extinguishers associated with the PATH Buildings. No other releases occurred from the facilities surveyed for the 2016 inventory year. Table 4-2 summarizes the results of the 2016 fire suppressant survey.

Table 4-2: Fugitive Emissions from Fire Protection Equipment (metric tons CO_2e)

Facility	CO_2	FM-200
LGA Airport	N/A	No release
SWF Airport	No release	N/A
EWR Airport	No release	N/A
George Washington Bridge	N/A	No release
Holland Tunnel	N/A	No release
Lincoln Tunnel	N/A	No release
Staten Island Bridges	N/A	No release
PATH Buildings	0.111	No release

4.3 HISTORIC ELIZABETH LANDFILL

The Port Authority property known as “Port Elizabeth” in Elizabeth, New Jersey, is part of the Port Commerce department. The Port Elizabeth property sits atop a former landfill site where household and industrial waste was dumped until the landfill closed in 1970. It is believed that dumping began at the Elizabeth Landfill (a.k.a. the Kapkowski Road Landfill) site sometime in the 1940s (Wiley 2002). Although the historic landfill boundary cannot be determined with certainty, the current landfill boundary based on land ownership is known and defined as the area south of Bay Avenue between the Conrail railroad tracks to the west and McLester Street to the east for a total surface area of 178 acres.

Although the Port Elizabeth property is leased to tenants, the Port Authority maintains shared operational control of property improvement activities. These activities are governed by the Tenant Construction and Alteration Process, which requires close coordination between the Port Authority and its business partners (i.e., tenants) when making “alterations and minor works at existing [Port Authority] facilities in addition to all new construction” (TCAP 2010, p. 1). Therefore, fugitive landfill gas emissions are reported as scope 1 emissions.

4.3.1 Activity Data

Air emissions from landfills come from gas generated by the decomposition of waste in the landfill. The composition of landfill gas is roughly 50 percent CH_4 and 50 percent CO_2 by volume, with additional relatively low concentrations of other air pollutants, including volatile organic compounds (VOCs). Activity data in the form of total solid waste deposited (short tons) in the historic Elizabeth Landfill were used to estimate the CH_4 emissions from the landfill using the first-order decay model.

Because of a lack of waste emplacement records, the annual mass of waste received at the site was calculated as the product of the average refuse depth of 8.33 feet as measured by a geological survey (Port Authority 1974), refuse density of 0.58 tons (EPA 1997), and the area of the historical landfill under current Port Authority operational control of 178 acres.[2] Thus, waste emplaced was estimated to be on the order of 1.39 million short tons. Assuming that the landfill operated from 1940 through 1970, the annual rate of waste emplacement was determined to be 44,735 tons per year.

4.3.2 Method

Emissions estimates were developed in accordance with "Local Government Operations Protocol," Chapter 9, "Solid Waste Management" (LGO 2010). Default values were applied for the percentage of waste that is anaerobically degradable organic carbon. The model runs with the assumptions that the CH_4 fraction of the landfill gas is 50 percent and that 10 percent of the CH_4 is oxidized prior to being emitted into the atmosphere. The decay constant (i.e., k-value) was set at 0.057, corresponding to areas that regularly receive more than 40 inches of annual rainfall. The model calculates biogenic CO_2 emissions, which are reported separately from anthropogenic emissions. A similar model, EPA's Landfill Gas Emissions Model (LandGEM) (EPA 2005), was used to estimate VOC emissions.

4.3.3 Results

The 2016 GHG and CAP emission estimates for the historic Elizabeth Landfill are shown in Table 4-3. Additionally, the historic Elizabeth Landfill emitted 557 tons of biogenic CO_2.

Table 4-3: GHG & CAP Emissions from the Historic Elizabeth Landfill (metric tons)

CH_4	CO_2e	VOC
166	3,491	0.7

[2] This value was measured in an ArcGIS environment from maps provided by Port Authority staff, titled "PNPEFacMap2007draft5-07.pdf" and "Refuse_fill_rev.pdf."

5.0 PURCHASED ELECTRICITY (SCOPE 2)

5.1 BUILDINGS

This section discusses electricity purchases for buildings and commercial space under the operational control of the Port Authority. For a total of five facilities (JFK, LGA, SWF, PABT and Teleport), electricity is purchased by the Port Authority and sub-billed to its tenants; therefore, the portion of electricity consumption attributed to the Port Authority is the difference between total electricity purchased and the amount sub-billed to tenants. Note that emissions resulting from electricity consumption by tenants is reported as a scope 3 source.

5.1.1 Activity Data

The Port Authority's Office of Environmental and Energy Programs centrally collects information relating to electricity purchases from utility invoices. This information was corroborated against monthly statements supplied by the electric utilities, namely, Central Hudson, Constellation Energy, New York Power Authority (NYPA), Public Service Electric & Gas (PSEG), and South Jersey Energy. Additionally, electricity consumption was prorated for the months of January and December to capture consumption within the calendar year of the assessment. Limited data filling was conducted when missing information was identified; all data substitution qualified as *de minimis*. Table 5-1: Building Electricity Consumption by Facility presents electricity consumption, where consumption is summed by taking into consideration the carbon content of the electricity supply as explained in Section Method.

5.1.2 Method

Emission estimates were developed in accordance with GRP Chapter 14, "Indirect Emissions from Electricity Use" (TCR 2013a). According to this methodology, the emissions factor corresponds to the carbon content of electricity delivered if that information is known by the supplier. This is the case of electricity delivered by the Kennedy International Airport Cogeneration (KIAC) to JFK. In all other cases, a reference carbon content from the Emissions & Generation Resource Integrated Database (eGRID) was assigned based on the geographical location of the end user (EPA 2017c). For facilities located in New York City, the emission factors for the Northeast Power Coordinating Council (NPCC) - New York City/Westchester (NYCW) eGRID subregion were used. For facilities located in upstate New York, the NPCC – Update State New York (NYUP) eGRID subregion factors were applied. For facilities located in New Jersey, the emission factors for the Reliable First Corporation East (RFCE) eGRID subregion were used. The emission factors used to estimate the GHG emissions associated with electricity consumption are shown in Table 5-2.

Table 5-1: Building Electricity Consumption by Facility			
Department	**Facility**	**eGRID Region/ Generator**	**Consumption (kWh)**
Aviation	JFK Airport	Electricity-KIAC	78,885,203
		Electricity-NYCW	13,898
	LGA Airport	Electricity-NYCW	25,711,517
	EWR Airport	Electricity-RFCE	82,178,864
	SWF Airport	Electricity-NYUP	3,857,170
	TEB Airport	Electricity-RFCE	2,597,497
Central Administration	PANYNJ Leased Office Space NJ	Electricity-RFCE	11,281,870
	PANYNJ Leased Office Space NY	Electricity-NYCW	698,327
PATH	PATH Buildings	Electricity-NYCW	2,022
		Electricity-RFCE	13,770,861
Port	NJ Marine Terminals	Electricity-RFCE	13,861,959
	NY Marine Terminals	Electricity-NYCW	626,652
Real Estate	Real Estate NJ	Electricity-RFCE	3,294,618
	Real Estate NY	Electricity-NYCW	4,276,907
Tunnels, Bridges & Bus Terminals	Bus Terminals	Electricity-NYCW	32,025,240
		Electricity-RFCE	0
	Tunnels and Bridges	Electricity-NYCW	17,086,395
		Electricity-RFCE	20,783,888
WTC	WTC	Electricity-NYCW	46,110,118
TOTAL			**357,063,006**

Note: Totals may not match the column sums due to rounding.

Table 5-2: Electricity Consumption GHG Emission Factors				
eGRID Subregion/Generator	**Unit**	**CO_2**	**CH_4**	**N_2O**
NYCW	kg/kWh	3.02×10^{-1}	1.11×10^{-5}	1.35×10^{-6}
NYUP	kg/kWh	1.67×10^{-1}	1.39×10^{-5}	1.88×10^{-6}
RFCE	kg/kWh	3.76×10^{-1}	3.35×10^{-5}	5.09×10^{-6}
KIAC	kg/kWh	4.26×10^{-1}	3.05×10^{-5}	7.23×10^{-6}

Table 5-3 shows the CAP emission factors used for the 2016 electricity emission estimates. eGRID provided SO_2 and NO_x emission factors for eGRID regions (EPA 2017c). Emission factors for PM were calculated in proportion to SO_2 emissions assessed by the 2014 EPA National Emissions Inventory (EPA 2017d). This is a reasonable approach because SO_2 is a significant contributor of total PM and thus a strong indicator of PM levels. To find the proportion to use, total emissions from all electric generating processes were summed for plants in each state for SO_2, $PM_{2.5}$, and PM_{10} in the 2014 NEI. PM emission factors were calculated as the product of statewide PM emissions and the SO_2 emission factor divided by the sum of statewide SO_2 emissions, as shown in Equation 5-1:

$$Ef_{PM} = Ef_{SO_2} x \frac{\sum_{State} PM}{\sum_{State} SO_2} \qquad (5\text{-}1)$$

Where:

Ef_{PM} = emission factor for either $PM_{2.5}$ or PM_{10}

Ef_{SO2} = emission factor for SO_2 provided by eGRID

PM = value of particulate matter state emissions for either $PM_{2.5}$ or PM_{10}

SO_2 = value of sulfur dioxide state emissions

Table 5-3: Electricity Consumption CAP Emission Factors					
eGRID Subregion/Generator	Unit	SO_2	NO_x	$PM_{2.5}$	PM_{10}
NYCW	kg/kWh	2.09×10^{-5}	1.41×10^{-4}	1.43×10^{-6}	1.92×10^{-6}
NYUP	kg/kWh	1.91×10^{-4}	1.82×10^{-4}	1.32×10^{-5}	1.76×10^{-5}
RFCE	kg/kWh	8.73×10^{-4}	3.76×10^{-4}	3.43×10^{-4}	3.58×10^{-4}
KIAC	kg/kWh	2.13×10^{-6}	9.09×10^{-5}	2.41×10^{-5}	2.41×10^{-5}

5.1.3 Results

Table 5-4 summarizes GHG emission from purchased electricity in buildings. CAP emission totals are presented in Table 5-5.

Table 5-4: GHG Emissions from Electricity Consumption in Buildings by Department (metric tons)					
Department	Facility	CO_2	CH_4	N_2O	CO_2e
Aviation	JFK Airport	33,638	2.41	0.57	33,865
	LGA Airport	7,761	0.28	0.03	7,778
	EWR Airport	30,918	2.76	0.42	31,106
	SWF Airport	640	0.05	0.01	643
	TEB Airport	977	0.09	0.01	983
Central Administration	PANYNJ Leased Office Space NJ	4,245	0.38	0.06	4,270
	PANYNJ Leased Office Space NY	211	0.01	0.00	211
PATH	PATH Buildings	5,182	0.46	0.07	5,213
Port	NJ Marine Terminals	5,215	0.46	0.07	5,247
	NY Marine Terminals	189	0.01	0.00	190
Real Estate	Real Estate NJ	1,240	0.11	0.02	1,247
	Real Estate NY	1,291	0.05	0.01	1,294
Tunnels, Bridges & Bus Terminals	Bus Terminals	9,667	0.35	0.04	9,688
	Tunnels and Bridges	12,977	0.89	0.13	13,036
WTC	WTC	13,919	0.51	0.06	13,949
TOTAL		**128,070**	**8.82**	**1.50**	**128,721**

Note: Totals may not match the column sums due to rounding.

Table 5-5: CAP Emissions for Electricity Consumption in Buildings by Department (metric tons)					
Department	Facility	SO_2	NO_x	$PM_{2.5}$	PM_{10}
Aviation	JFK Airport	0.17	7.17	1.90	1.90
Aviation	LGA Airport	0.54	3.62	0.04	0.05
Aviation	EWR Airport	71.76	30.94	28.17	29.38
Aviation	SWF Airport	0.74	0.70	0.05	0.07
Aviation	TEB Airport	2.27	0.98	0.89	0.93
Central Administration	PANYNJ Leased Office Space NJ	9.85	4.25	3.87	4.03
Central Administration	PANYNJ Leased Office Space NY	0.01	0.10	0.00	0.00
PATH	PATH Buildings	12.02	5.18	4.72	4.92
Port	NJ Marine Terminals	12.10	5.22	4.75	4.96
Port	NY Marine Terminals	0.01	0.09	0.00	0.00
Real Estate	Real Estate NJ	2.88	1.24	1.13	1.18
Real Estate	Real Estate NY	0.09	0.60	0.01	0.01

Table 5-5: CAP Emissions for Electricity Consumption in Buildings by Department (metric tons)					
Department	**Facility**	**SO_2**	**NO_x**	**$PM_{2.5}$**	**PM_{10}**
Tunnels, Bridges & Bus Terminals	Bus Terminals	0.67	4.50	0.05	0.06
Tunnels, Bridges & Bus Terminals	Tunnels and Bridges	18.50	10.23	7.15	7.46
WTC	WTC	0.96	6.48	0.07	0.09
TOTAL		**132.57**	**81.30**	**52.78**	**55.04**

Note: Totals may not match the column sums due to rounding.

5.2 RAIL SYSTEMS

The Port Authority owns three rail systems: PATH, AirTrain JFK, and AirTrain Newark. Port Authority maintains operational control of PATH, while the AirTrain systems are operated by Bombardier Transportation. This section covers the development of emissions resulting from indirect purchased electricity from the PATH system, which is under the operational control of the Port Authority. Emissions for the AirTrain systems are categorized as scope 3 and are discussed in Section 11.2.

5.2.1 Activity Data

The Port Authority's Office of Environmental and Energy Programs centrally collects information relating to electricity purchases from Constellation Energy and South Jersey Energy associated with electricity purchases for PATH trains. This information was corroborated against monthly statements supplied by the electric utility. Additionally, electricity consumption was prorated for the months of January and December to capture consumption within the calendar year of the assessment. Total consumption in 2016 amounted to 100,293,858 kWh.

5.2.2 Method

As described in Section 5.1.3, emission estimates are developed in accordance with GRP Chapter 14, "Indirect Emissions from Electricity Use" (TCR 2013a). The GHG emission factors used to calculate the GHGs associated with electricity consumption are shown in Table 5-2. For the PATH Rail System, the emission factors for the RFCE subregion were applied. Table 5-3 shows the CAP emission factors used for the 2016 electricity emission estimates.

5.2.3 Results

GHG emission estimates were developed from records of electricity consumption (i.e., utility statements). Table 5-6 summarizes GHG and CAP emissions associated with operation of the PATH rail system.

Table 5-6: GHG & CAP Emissions from Electricity Consumption in Rail Systems (metric tons)								
Activity	**CO_2**	**CH_4**	**N_2O**	**CO_2e**	**SO_2**	**NO_x**	**$PM_{2.5}$**	**PM_{10}**
PATH Rail System	37,734	3.36	0.51	37,962	87.57	37.76	34.37	35.86

6.0 PURCHASED STEAM, HEATING, AND COOLING (SCOPE 2)

This chapter discusses indirect emissions associated with energy purchases or acquisitions in the form of steam, heating, and cooling from the KIAC facility and Con Edison.

6.1 KIAC HEATING AND COOLING

The Port Authority purchases thermal energy in the form of heating and cooling from KIAC to service JFK. While the KIAC facility is owned by the Port Authority and sits within Port Authority property, emissions from the plant do not fall within the operational control boundary because the facility is operated by Calpine Corporation. On the other hand, the Port Authority reports emissions associated with thermal energy purchases. These are calculated as a function of energy purchases multiplied by a KIAC-specific emission metric.

6.1.1 Activity Data

The Port Authority provided separate monthly thermal energy purchase data for JFK. Thermal energy in the form of cooling and heating was billed separately. Thermal consumption for heating and cooling amounted to 51,018 and 97,908 MMBtu respectively.

6.1.2 Method

The heating and cooling GHG and PM emission factors for KIAC were determined as described in Section 7.1. The resulting heating and cooling emission factors are presented in Table 6-1: KIAC Thermal Emission Factors.

Table 6-1: KIAC Thermal Emission Factors

Metric	CO_2	CH_4	N_2O	SO_2	NO_x	$PM_{2.5}$	PM_{10}
Heating (kg/MMBtu)	62.35	4.47×10^{-3}	1.06×10^{-3}	3.12×10^{-4}	1.33×10^{-2}	3.52×10^{-3}	3.52×10^{-3}
Cooling (kg/MMBtu)	62.35	4.47×10^{-3}	1.06×10^{-3}	3.12×10^{-4}	1.33×10^{-2}	3.52×10^{-3}	3.52×10^{-3}

6.1.3 Results

Table 6-2 provides GHG and CAP emission estimates for the heating and cooling purchased from KIAC by the Port Authority to service JFK.

Table 6-2: GHG & CAP Emissions from KIAC Thermal Energy Purchases (metric tons)

Commodity	CO_2	CH_4	N_2O	CO_2e	SO_2	NO_x	$PM_{2.5}$	PM_{10}
Purchased Heating	3,181	0.23	0.05	3,203	0.02	0.68	0.18	0.18
Purchased Cooling	6,105	0.44	0.10	6,146	0.03	1.30	0.34	0.34
TOTAL	**9,286**	**0.67**	**0.16**	**9,349**	**0.05**	**1.98**	**0.52**	**0.52**

Note: Totals may not match the column sums due to rounding.

6.2 CON EDISON STEAM

The PABT and WTC purchase steam from Con Edison for building heating purposes. The attributes of the Con Edison 59th Street Generating Station were used to assess the carbon intensity of steam deliveries.

6.2.1 Activity Data

The Port Authority monitors monthly steam consumption data at PABT and WTC. Annual consumption in 2016 was 55,408 and 40,862 thousand pounds of steam (Mlbs) at PABT and WTC respectively.

6.2.2 Method

The attributes of the Con Edison 59th Street Generating Station served as the basis for calculating the emission factors associated with Con Edison steam purchases. For each pollutant, the emission factor was assessed as the ratio of station's emissions to its energy intake. The station's primary energy consumption was available from EPA's Facility Information on GreenHouse Gases Tool (FLIGHT) database (EPA 2017b). Plant emissions were retrieved from multiple sources. GHG emissions were retrieved from the FLIGHT database, while NO_X emissions came from EPA's Air Market Division Database (EPA 2017a). PM emissions were calculated using AP-42 emission factors for oil and natural gas fired boilers (EPA 1995). Table 6-3: Con Edison Steam Emission Factorspresents the emission factors for purchased steam as provided by Con Edison.

Table 6-3: Con Edison Steam Emission Factors

Metric	CO_2	CH_4	N_2O	SO_2	NO_x	$PM_{2.5}$	PM_{10}
Steam (kg/Mlbs)	66.22	1.42×10^{-3}	1.74×10^{-4}	3.67×10^{-4}	7.13×10^{-2}	4.74×10^{-3}	4.74×10^{-3}

6.2.3 Results

Table 6-4: GHG & CAP Emissions from Con Edison Steam Purchases (metric tons) presents GHG and CAP emissions associated with Con Edison purchased steam for PABT and WTC. Total may not add up due to rounding.

Table 6-4: GHG & CAP Emissions from Con Edison Steam Purchases (metric tons)

Facility	CO_2	CH_4	N_2O	CO_2e	SO_2	NO_x	$PM_{2.5}$	PM_{10}
PABT	3,669	0.08	0.01	3,674	0.02	3.95	0.26	0.26
WTC	2,706	0.06	0.01	2,709	0.02	2.91	0.19	0.19
TOTAL	**6,375**	**0.14**	**0.02**	**6,383**	**0.04**	**6.87**	**0.46**	**0.46**

Note: Totals may not match the column sums due to rounding.

7.0 ENERGY PRODUCTION (SCOPE 3)

This chapter discusses the emitting activities associated with two power generation plants owned by the Port Authority; namely, the Kennedy International Airport Cogeneration (KIAC) facility located in Queens County, New York, and the Essex County Resource Recovery (ECRR) facility located in Essex County, New Jersey.

7.1 KENNEDY INTERNATIONAL AIRPORT COGENERATION

This section describes how plant-level operational data were used to assess plant-level emissions, as well as the steps taken for distributing these emissions between end users, including the Port Authority, JFK airport tenants, and downstream consumers of KIAC electricity. The Port Authority leases the KIAC facility to KIAC Partners, a partnership wholly owned by the Calpine Corporation, pursuant to a long-term lease agreement expiring on January 31, 2020. KIAC Partners is responsible for the operation and maintenance of the KIAC facility. The current business model features an energy purchase agreement with the Port Authority for electricity and thermal energy needs of the JFK airport in which excess electricity is sold to market and excess thermal energy is resold to JFK tenants (Port Authority 2014b).

7.1.1 Activity Data

The KIAC facility is a combined-cycle power plant equipped with two identical gas combustion turbines and one steam generator fed by two heat recovery steam generators (HRSGs). The gas combustion turbines and HRSGs run on natural gas and jet “A” fuel. The KIAC facility produces both electricity and thermal energy.

The plant operator, Calpine Corporation, provided all necessary information to assess plant-specific electricity and thermal production metrics in terms of mass of air pollutants over electricity or thermal energy sold. Key operational data included fuel input, electric power output, and thermal production output (Calpine 2017).

7.1.2 Plant Emissions Method

This analysis used a fuel-based methodology, whereby the natural gas and jet “A” fuel inputs were converted to emissions using default emission factors. The CO_2 emission factors are fuel specific to natural gas and jet “A” fuel, and the N_2O and CH_4 emission factors are fuel type and power generation technology specific (e.g., combined cycle, natural gas combustion). PM emission factors were obtained from EPA AP-42, Chapter 3 Table 3.1-2a (EPA 1995), where the industry-average emission rate is expressed in terms of PM mass per unit of heat input. Note that PM_{10} and $PM_{2.5}$ emissions were assumed to be the same as a conservative measure. Emission factors used in the assessment are presented in Table 7-1 and Table 7-2. NO_x and SO_2 emissions were obtained from environmental compliance public records (EPA 2017a).

Table 7-1: Emission Factors for Natural Gas Combustion at Combined Cycle Power Plant			
Pollutant	**Value**	**Units**	**Source**
CO_2	53.06	kg/MMBtu	TCR 2017, Table 12.1
CH_4	3.8	g/MMBtu	TCR 2017, Table 12.5
N_2O	0.9	g/MMBtu	TCR 2017, Table 12.5
$PM_{2.5}$	0.0066	lbs/MMBtu	EPA 1995
PM_{10}	0.0066	lbs/MMBtu	EPA 1995

Table 7-2: Emission Factors for Jet "A" Fuel Combustion at Combined Cycle Power Plant			
Pollutant	**Value**	**Units**	**Source**
CO_2	72.22	kg/MMBtu	TCR 2017, Table 12.1
CH_4	0.9	g/MMBtu	TCR 2017, Table 12.5
N_2O	0.4	g/MMBtu	TCR 2017, Table 12.5
$PM_{2.5}$	0.01	lbs/MMBtu	EPA 1995
PM_{10}	0.01	lbs/MMBtu	EPA 1995

7.1.3 Electricity and Thermal Emission Factors

KIAC supplies electricity and thermal (heating and cooling) energy for the benefit of Port Authority operations and tenants. Best carbon accounting practices require that emissions from a combined heat and power (CHP) plant be allocated to end-users by means of electricity, heating, and cooling-specific emission factors. These emission factors were calculated first by allocating plant emissions in accordance with the specification of TCR (see Figure 7-1) to each useful energy output of the KIAC plant, and then dividing allocated emissions by the corresponding amount of useful energy. The resulting emission factors are presented in Table 7-3 for each useful energy output, namely electricity, heating, and cooling. These plant emission factors were used to estimate Port Authority indirect emissions from electricity and thermal energy consumption from KIAC, as described in Sections 5.1.2 and 6.1.2, respectively.

Equation 12k	Allocating CHP Emissions to Steam and Electricity

Step 1: $E_H = (H \div e_H) \div [(H \div e_H) + (P \div e_P)] \times E_T$

Step 2: $E_P = E_T - E_H$

Where:

E_H = Emissions allocated to steam production
H = Total steam (or heat) output (MMBtu)
e_H = Efficiency of steam (or heat) production
P = Total electricity output (MMBtu)
e_P = Efficiency of electricity generation
E_T = Total direct emissions of the CHP system
E_P = Emissions allocated to electricity production

Source: TCR 2013a.

Figure 7-1. CHP Distributed Emissions Methodology

Table 7-3: KIAC Electricity and Thermal Emission Factors by Pollutant							
Commodity	**CO_2**	**CH_4**	**N_2O**	**NO_x**	**SO_2**	**$PM_{2.5}$**	**PM_{10}**
Heating (kg/MMBtu)	62.35	4.47×10^{-3}	1.06×10^{-3}	3.12×10^{-4}	1.33×10^{-2}	3.52×10^{-3}	3.52×10^{-3}
Cooling (kg/MMBtu)	62.35	4.47×10^{-3}	1.06×10^{-3}	3.12×10^{-4}	1.33×10^{-2}	3.52×10^{-3}	3.52×10^{-3}
Electricity (kg/kWh)	0.43	3.05×10^{-5}	7.23×10^{-6}	2.13×10^{-6}	9.09×10^{-5}	2.41×10^{-5}	2.41×10^{-5}

7.1.4 Results

KIAC plant emissions are presented in Table 7-4. KIAC plant emissions distributed by energy stream and end-user are presented in Table 7-5.

Table 7-4: KIAC Plant GHG & CAP Emissions Summary (metric tons)							
CO_2	**CH_4**	**N_2O**	**CO_2e**	**NO_x**	**SO_2**	**$PM_{2.5}$**	**PM_{10}**
330,687	23.68	5.61	332,923	70.49	1.65	18.66	18.66

Table 7-5: KIAC Plant Emissions Distributed by End-User (metric tons)		
End-User	**Emission Category**	**CO_2e**
Port Authority	Purchased Electricity	33,861
	Purchased Cooling	6,146
	Purchased Heating	3,203
Tenants	Purchased Electricity	127,675
	Purchased Cooling	14,746
	Purchased Heating	8,727
Customers	Energy Production (electricity sold to market)	138,565
TOTAL		**332,923**

Note: Totals may not match the column sums due to rounding.

7.2 ESSEX COUNTY RESOURCE RECOVERY FACILITY

At the ECRR facility, GHG and CAP emissions result from energy recovery activities, including the combustion of MSW as the primary source of energy for electricity generation, and diesel fuel combustion as an auxiliary energy source. This emitting activity includes emissions from electricity generation and excludes emissions associated with hauling and tipping of waste. The ECRR facility consists of three mass-fired boilers with two turbine generators.

7.2.1 Method

The ECRR facility is subject to mandatory reporting of GHG and CAP emissions. For that reason, emissions for the ECRR facility were compiled from public sources.

Under EPA's Greenhouse Gas Reporting Program (GGRP), defined under Title 40 of the Code of Federal Regulations (40 CFR) Part 98, large electricity producers must report general combustion CO_2 emissions as well as biogenic CO_2, CH_4, and N_2O emissions. The ECRR facility is subject to 40 CFR Part 98 reporting and annually submits to EPA quality-assured data from continuous emission monitoring systems (CEMSs). Part 98 reporting data were accessed through EPA's Facility Level Information on GreenHouse Gases Tool (FLIGHT) database (EPA 2017b), for the "Covanta Essex Company" profile. A CEMS is the total equipment necessary for the determination of an emission rate using pollutant analyzer measurements at the stack. Emission estimates using CEMS are verified by EPA and meet the highest standard of accuracy under the GGRP. GHG emissions, heat rating, and hours of operation data collected under EPA's GGRP served as the basis of the GHG analysis presented in this chapter (EPA 2017b).

Additionally, the ECRR facility is subject to New Jersey's Emission Statement rule (N.J.A.C. 7:27-21) and annually reports to the New Jersey Department of Environmental Protection criteria pollutant emissions data. Criteria pollutant emissions for NO_x, SO_2, PM_{10}, and $PM_{2.5}$ were retrieved from the New Jersey Open Public Records Act Department of Environmental Protection Data Miner database (New Jersey 2017).

7.2.2 Results

Anthropogenic GHG emission from the ECRR facility are presented in Table 7-6. The ECCR facility uses MSW as primary fuel and No. 2 fuel oil as an auxiliary fuel. Emissions come almost exclusively from MSW combustion, with less than 0.8 percent resulting from No. 2 fuel oil combustion. The ECCR facility also had 499,459 tCO_2 of biogenic emissions from the combustion of organic materials in MSW. CAP emission estimates are summarized in Table 7-7.

Table 7-6: GHG Emissions from the Essex County Resource Recovery Facility (metric tons)

Fuel Type	CO_2	CH_4	N_2O	CO_2e
MSW	348,219	285.41	37.46	365,825
Distillate No. 2 fuel oil	2,465	0.10	0.02	2,474
TOTAL	**350,684**	**285.51**	**37.48**	**368,299**

Note: Totals may not match the column sums due to rounding.

Table 7-7: CAP Emissions from the Essex County Resource Recovery Facility (metric tons)

NO_x	SO_2	PM_{10}	$PM_{2.5}$
636.15	63.19	67.64	64.87

8.0 AIRCRAFT (SCOPE 3)

The Port Authority manages and operates the following airports:

- John F. Kennedy International Airport (JFK);
- Newark Liberty International Airport (EWR);
- LaGuardia Airport (LGA);
- Stewart International Airport (SWF); and
- Teterboro Airport (TEB).

JFK has been recognized for decades as the premier U.S. gateway for passengers and cargo. JFK is the busiest airport in the New York City metropolitan area. In 2016, the airport handled a record 58.9 million passengers, and more than 1.26 million tons of cargo. About 85 airlines operate out of the airport, serving about 165 nonstop destinations. EWR is among the busiest North American and international airports. In 2016, about 40.3 million passengers used the airport, an all-time record. About 33 airlines operate out of the airport, serving more than 166 nonstop destinations. LGA is one of the nation’s leading domestic gateways for business travel and is the primary business/ short-haul airport for New York City. LGA set a new all-time record in 2016 with more than 29.8 million passengers. Ten airlines serve 73 nonstop destinations at LGA. SWF is a convenient alternative to the New York/New Jersey metropolitan region’s airports. Several commercial and charter airlines operate at the airport, offering direct access to a number of major U.S. hubs. Stewart handled about 275,000 passengers and more than 22,000 tons of cargo in 2016. TEB, designated as a reliever airport for general aviation in the New York-New Jersey region, is a 24-hour public-use facility. The airport does not permit scheduled commercial operations and prohibits aircraft with operating weights in excess of 100,000 pounds (Port Authority 2017b).

This chapter covers emitting activities within the organizational boundary of the Port Authority associated with the operation of aircraft, auxiliary power units (APU), and ground support equipment (GSE). While the Port Authority maintains financial control over the airport’s infrastructure, it does not have operational control over aircraft movements or GSE operations. For that reason, greenhouse emissions reflected in this chapter correspond to tenant emissions (i.e., scope 3 emissions) over which the Port Authority has no operational control.

The primary modeling tool for assessing aircraft and GSE emissions is the Federal Aviation Administration’s (FAA’s) Aviation Environmental Design Tool (AEDT), version 2d, released September 2017 (AEDT 2017). This model replaces FAA’s Emission and Dispersion Modeling System (EDMS) model, which was used in developing all Port Authority aviation emission inventories prior to 2014.

AEDT models emissions as a function of the volume of operations (i.e., annual number of arrivals and departures) and aircraft fleet mix at each airport. Additional model inputs include annual average taxi in/out times, extent of gate electrification with preconditioned air (PCA) supply, and ground support equipment profiles. Because AEDT provides partial GHG emissions information limited to CO_2 emissions for aircraft, most emission factors for GHGs of interest, such as CH_4 and N_2O were developed using Intergovernmental Panel on Climate Change (IPCC) guidance. Supplemental emission factors were taken from The Climate Registry's General Reporting Protocol and EPA's MARKet ALlocation (MARKAL) database to improve the estimate for GSE. The general structure of the emissions inventory in terms of activity data, methods and emissions factor sources utilized to develop emissions estimates is presented in Figure 8-1. Schematic of the

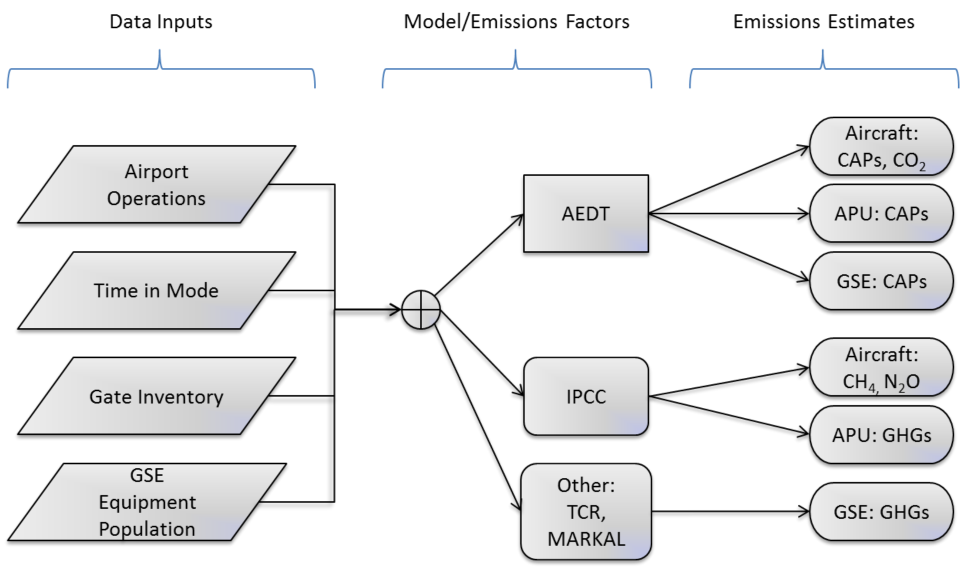

Figure 8-1. Schematic of the Aircraft, APU and GSE Inventory

8.1 AIRCRAFT MOVEMENTS AND AUXILIARY POWER UNITS

For aircraft emissions, the inventory boundary encompasses aircraft operations that FAA defines as itinerant and local. Itinerant operations are operations performed by an aircraft that lands at the airport, arriving from outside the airport area, or departs from the airport leaving the airport area. Local operations are those operations performed by aircraft that remain in the local traffic pattern, execute simulated instrument approaches or low passes at the airport, and the operations to or from the airport and a designated practice area within a 20-mile radius of the tower (FAA 2012). Additionally, the inventory boundary includes aircraft emissions associated with the following six times-in-mode that together constitute a Landing and Take-Off (LTO) cycle.

1. Approach – portion of the flight from the time that the aircraft reaches the mixing height (approximately 3,000 feet altitude) to touchdown on the runway.
2. Taxi In – the landing ground roll segment from touchdown to the runway exit of an arriving aircraft and the taxiing from the runway exit to a gate.
3. Startup – aircraft main engine startup emissions quantified for aircraft with ICAO certified engines.
4. Taxi Out – the taxiing from the gate to a runway end.
5. Takeoff – the portion from the start of the ground roll on the runway, through wheels off, and the airborne portion of the ascent up to cutback during which the aircraft operates at maximum thrust.
6. Climb out – the portion from engine cutback to the mixing height.

This chapter also covers emissions from the use of auxiliary power units APUs. These are on-board generators that provide electrical power to the aircraft while its engines are shut down. Excluded from this chapter are aircraft cruising emissions (i.e., emissions generated above mixing height between departure and arrival airports) because the study focuses on local emissions.

8.1.1 Activity Data

Operations data by aircraft type were provided for the five airports by the Aviation department (Port Authority 2017h). The data set for each airport contains the number of arrivals and departures grouped by ICAO aircraft code. As a quality assurance/quality control (QA/QC) measure, total operations for each airport are normalized using airport operations data as reported in the FAA Air Traffic Activity Data System (ATADS) (FAA 2017). For example, the Aviation department recorded 422,582 operations in 2016 for EWR. On the other hand, the ATADS database shows 431,214 operations (FAA 2017). For consistency with FAA records, operations are adjusted to match the ATADS database. Total 2016 operations and passenger count by airport are shown in Table 8-1.

Table 8-1: Port Authority Operations and Passenger Traffic by Airport

Airport	FAA ATADS Operations	Passenger Count [a]
JFK	458,707	59,105,513
EWR	431,214	40,563,285
LGA	374,487	29,786,769
SWF	43,851	275,421
TEB	177,606	No Data

[a] Port Authority 2017b

Figure 8-2 below presents a distribution of operations based on aircraft size as measured by their arrival weight. Small aircraft have a weight less than 50,000 pounds, medium aircraft have a weight between 50,000 and 100,000 pounds, and large aircraft have a weight greater than 100,000 pounds. The distribution of operations across the aircraft fleet mix is provided in Appendix B: 2016 Operations By Aircraft Code for each of the five Port Authority airports.

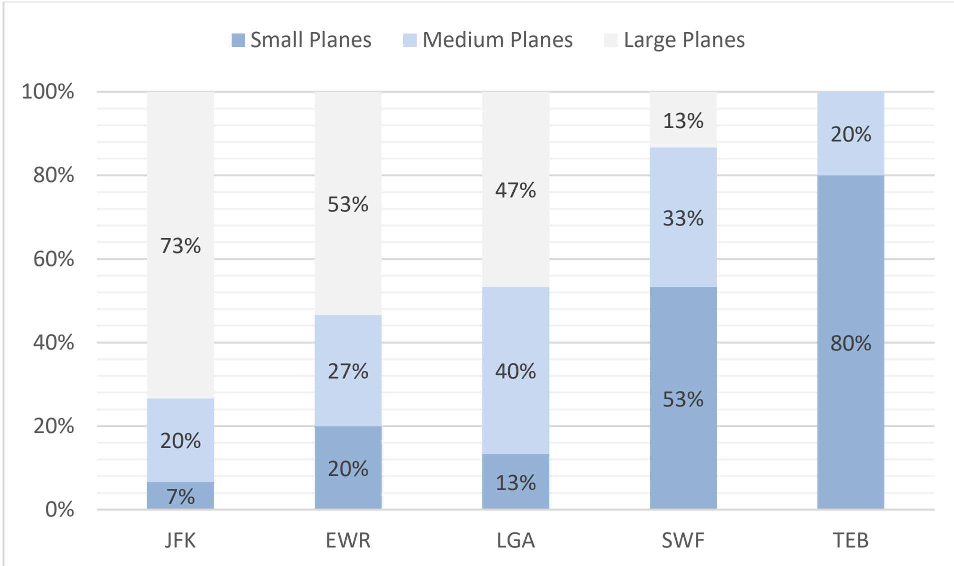

Figure 8-2. Aircraft Distribution by Size and Airport

Airport-specific taxi times for 2016 were provided by the Aviation department (Port Authority 2017i) and are displayed in Table 8-2: Average Taxi In and Taxi Out Times by Airport below. For EWR and LGA, these taxi times only include domestic operations by major (non-regional) domestic carriers. For JFK, only total taxi time was available, so that total time was allocated to taxi in and taxi out based on the ratio between taxi in and taxi out seen in 2015 at JFK (Port Authority 2016c).

Table 8-2: Average Taxi In and Taxi Out Times by Airport

Airport	Taxi In (minutes)	Taxi Out (minutes)
JFK	8:37	24:46
EWR	9:37	20:34
LGA	8:36	27:23
SWF	AEDT Default	
TEB	AEDT Default	

The percentage availability of PCA and gate electrification at each airport in 2016 was provided by the Port Authority. This information was used to postprocess AEDT APU results to reflect the decline of APU utilization with greater availability of PCA and gate electrification at the terminals. This information is summarized in Table 8-3: Gate Electrification and PCA Available at Port Authority Airports.

Table 8-3: Gate Electrification and PCA Available at Port Authority Airports

Airport	Percentage of gates with gate power (400hz)	Percentage of gates with preconditioned air
JFK	98%	92%
EWR	100%	75%
LGA	95%	47%
SWF	100%	100%
TEB	0%	0%

8.1.2 Method

AEDT models emissions as a function of the volume of operations (i.e., annual number of arrivals and departures) by aircraft type, as well as performance parameters, including the duration of each mode of operation (e.g., taxi in and taxi out).

A crosswalk was used to correlate aircraft types between the International Civil Aviation Organization (ICAO) aircraft codes to the AEDT aircraft codes. Operations for which an exact match was not found were distributed proportionately across the correlated aircraft mix to ensure that the sum of operations by AEDT aircraft code is consistent with ATADS. In all cases, more than 85% of all aircraft operations had a matching AEDT aircraft code. In general, this rate is higher at the three larger airports (greater than 95% match for EWR, LGA and JFK), whereas the rate is slightly lower for TEB (86%) and SWF (88%).

AEDT estimates emissions for CO_2, VOC, CO, NO_x, SO_x, PM_{10}, and $PM_{2.5}$. Because this study is also interested in CH_4 and N_2O emissions, these pollutant estimates were prepared using the Tier I methodology found in the 2006 IPCC Guidelines for National Greenhouse Gas Emissions Inventories (IPCC 2006), Volume 2, Chapter 3, Table 3.6.9. The Tier I methodology estimates CH_4 and N_2O emissions as a function of LTO. IPCC emission factors were correlated to the fleet mix by means of the ICAO designators. Because the IPCC emission factors list is incomplete, there were instances where a match could not be established. Instead, a default CH_4 and N_2O emission factor was calculated for each airport as the average of emission factors for matching aircraft types at that airport and was applied to the total number of LTOs at that airport. The average aircraft CH_4 and N_2O emission factors by airport are presented in Table 8-4: Average Aircraft CH_4 and N_2O Emission Factors.

Table 8-4: Average Aircraft CH_4 and N_2O Emission Factors

Airport	CH_4	N_2O	Unit
JFK	0.110	0.132	kg/LTO
EWR	0.089	0.102	kg/LTO
LGA	0.079	0.099	kg/LTO
SWF	0.106	0.103	kg/LTO
TEB	0.077	0.089	kg/LTO

APUs are most often on-board generators that provide electrical power to the aircraft while its engines are shut down. The on-board APU is, in effect, a small jet engine and the emissions assessment is similar to that of an aircraft engine operating in one power setting only. For a given aircraft, APU emissions are modeled as the product of operations, APU running time, and engine emission factors. APU CAP emissions were modeled in AEDT as a function of operations with default APU assignments by aircraft code. GHG emissions for APUs are not included in AEDT, and therefore were estimated outside of the model. CO_2 emissions were estimated using the CO_2/SO_2

stoichiometric ratio as evaluated for aircraft engine emissions. CH_4 and N_2O emissions were estimated based on the CH_4/CO_2 and N_2O/CO_2 airport-wide emission ratios assessed for aircraft engine.

Based on guidance from the Federal Aviation Administration (FAA) Voluntary Airport Low Emissions Program (VALE), 2016 APU estimates were revised downward in cases where PCA and gate electrification are available. When gate power and PCA are both provided to the parked aircraft, APU emissions are eliminated except for the default of 7 minutes needed on average to connect and disconnect gate services. In all other cases, the default APU run time of 26 minutes was applied.

The percentage availability of PCA and gate electrification at each airport is displayed in Table 8-3. In cases where both gate power and PCA are less than 100 percent, the lower of the two figures is used for calculations (for example, JFK is assumed to have 92 percent of gates with both gate power and PCA).

8.1.3 Results

Emission estimates from aircraft engines are summarized by airport in Table 8-5: GHG & CAP Emissions from Aircraft by Airport (metric tons). In general, GHG emissions were relatively stable between 2015 and 2016, with JFK CO_2e emissions declining by 5 percent, and the other four airports showing modest growth. EWR emissions increased by 12 percent, primarily as a result of a 21 percent increase in taxi times and a 3 percent increase in operations.

Table 8-5: GHG & CAP Emissions from Aircraft by Airport (metric tons)

Airport	CO_2	CH_4	N_2O	CO_2e	SO_2	NO_x	$PM_{2.5}$	PM_{10}
JFK	884,889	25.3	30.3	894,801	328.5	3,718.8	25.5	25.5
EWR	517,824	19.2	22.1	525,069	192.2	1,838.7	14.8	14.8
LGA	391,665	14.8	18.5	397,713	145.4	1,059.7	11.8	11.8
SWF	22,271	2.1	2.0	22,938	8.3	75.8	0.8	0.8
TEB	61,326	6.9	7.9	63,926	22.8	152.6	2.3	2.3
TOTAL	**1,877,974**	**68.1**	**80.8**	**1,904,446**	**697**	**6,846**	**55.2**	**55.2**

Note: Totals may not match the column sums due to rounding.

APU GHG and CAP emissions are displayed in Table 8-6: GHG & CAP Emissions from APU by Airport (metric tons) . These results reflect the effects of PCA and gate electrification where installed, which decreases the demand of running APUs and lowers emissions compared to a scenario without supplied PCA and gate electrification.

Table 8-6: GHG & CAP Emissions from APU by Airport (metric tons)

Airport	CO_2	CH_4	N_2O	CO_2e	SO_2	NO_X	$PM_{2.5}$	PM_{10}
JFK	10,381	0.3	0.4	10,498	3.9	31.7	3.6	3.6
EWR	10,763	0.4	0.5	10,914	4.0	29.6	3.3	3.3
LGA	13,101	0.5	0.6	13,303	4.9	30.1	4.8	4.8
SWF	312	0.0	0.0	321	0.1	0.8	0.1	0.1
TEB	3,260	0.4	0.4	3,398	1.2	8.1	1.1	1.1

Table 8-6: GHG & CAP Emissions from APU by Airport (metric tons)								
Airport	**CO_2**	**CH_4**	**N_2O**	**CO_2e**	**SO_2**	**NO_X**	**$PM_{2.5}$**	**PM_{10}**
TOTAL	**37,818**	**1.6**	**1.9**	**38,434**	**14.0**	**100.3**	**12.9**	**12.9**

Note: Totals may not match the column sums due to rounding.

8.2 GROUND SUPPORT EQUIPMENT

GSE service aircrafts upon arrival and prior to departure from the date. During aircraft arrivals, GSE are used to unload baggage and service the lavatory and cabin. Prior to aircraft departure, GSE are present to load baggage, food and fuel. Additionally, a tug may be used to push or tow the aircraft away from the gate and to the taxiway (AEDT 2017).

8.2.1 Activity Data

GSE inventories were provided by the Port Authority (Port Authority 2016c) for the three large international airports (i.e., JFK, EWR and LGA). These inventories are based on airlines' responses to GSE surveys for equipment they operate and served as the primary input for GSE emissions modeling. The inventories provide information about the make-up of the GSE fleet, the number of units by equipment type, and model year (e.g., 2 counts of a 2005 model year, diesel, TUG MA 50 Tractor).

Additionally, a crosswalk was developed to establish a direct correspondence between equipment types as reported by airlines and the equivalent equipment type from the GSE menu in AEDT. This crosswalk enables the assignment of default GSE parameters, most notably the average annual utilization hours per equipment and engine load.
It was noted that AEDT does not have an equipment profile for diesel deicers. Because there are a significant number of diesel deicers at Port Authority airports, these emissions were modeled separately, using the equipment profile of the most similar unit in AEDT's GSE menu with regard to horsepower (hp) and load factor (LF).

Because GSE inventorying efforts have not yet been conducted at TEB and SWF, their GSE equipment counts were developed using EDMS default GSE assignments, which correspond to each airport's unique aircraft mix. In general, EDMS assigns a greater number of GSEs and utilization values (i.e., minutes per operation) to large and medium size aircraft than to regional or business jets. Note that EDMS default GSE assignments were used at TEB and SWF because the current version of AEDT does not have an equivalent function. The default assignments for TEB and SWF from EDMS CY2013 were used to create an estimate of what the GSE inventory at these airports is expected to be in 2016. The hours of operation from this 2013 EDMS inventory were then scaled to CY2016 based on the ratio of 2016 to 2013 LTOs and input into AEDT to estimate emissions for CY2016 (FAA 2017).

Appendix C: 2016 Ground Support Equipment Profiles provides a summary GSE profiles and utilization for all five airports.

8.2.2 Method

GSE CAP emissions were modeled in AEDT using the activity data described in the Section Activity Data. The GSE module in AEDT is a variation of EPA's NONROAD2008 model, which estimates GSE emissions as a function of equipment type (e.g., aircraft tractor and belt loader), utilization (i.e., hours per year), fuel type (e.g., diesel or gasoline), engine capacity, average load, model year, and emission rates.

Table 8-7: Emissions Ratios Applied to AEDT GSE Output

Concept	Fuel Type	Ratio Value
CO_2/SO_2	Gasoline	4,560
CH_4/CO_2	Gasoline	0.000057
N_2O/CO_2	Gasoline	0.000025
CO_2/SO_2	Diesel	144,199
CH_4/CO_2	Diesel	0.000057
N_2O/CO_2	Diesel	0.000025
CO_2/SO_2	LPG	51,481
CH_4/CO_2	LPG	0.000057
N_2O/CO_2	LPG	0.000025
CO_2/SO_2	CNG	45,268
CH_4/CO_2	CNG	0.000057
N_2O/CO_2	CNG	0.000025

When available, model year information was specified as a parameter in AEDT. In all other cases, a default model year value was applied based on the EPA-derived national fleet average age for a given equipment type.

AEDT generates estimates of criteria pollutants associated with GSE, but does not provide estimates of CO_2, CH_4 or N_2O. For that reason, GHG emissions were assessed based on the quantitative relationship (i.e., stoichiometry) between SO_2 emissions and CO_2 emissions. This relationship was used because both SO_2 and CO_2 emissions are directly proportional to the mass of fuel combusted. That is, for any given concentration of sulfur, the CO_2/SO_2 ratio is constant. Then, CH_4/CO_2 and N_2O/CO_2 emission ratios—derived from standard fuel-based emission factors—were applied to CO_2 emissions to determine CH_4 and N_2O emissions.

The SO_2 emission factors used in AEDT are based on NONROAD 2008, which assumes a gasoline sulfur content of 339 ppm. Because the current gasoline sulfur limit is 30 ppm (EPA 2016), gasoline SO_2 emissions modeled in AEDT were multiplied by a factor of 0.09 to properly reflect the current federal gasoline sulfur standard. At 339 ppm, the CO_2/SO_2 ratio for gasoline equals 4,560. This ratio was applied to the AEDT unadjusted SO_2 gasoline emissions to estimate CO_2. At the current diesel sulfur concentration of 11 ppm, the CO_2/SO_2 ratio for diesel combustion equals 144,199 (EPA 2009b). The CO_2/SO_2 ratio for other fuels (e.g., liquefied petroleum gas, LPG) was derived from EPA's MARKAL model (Pechan 2010) and applied to AEDT SO_x estimates in order to calculate

CO_2 emissions[3]. Then, CH_4/CO_2 and N_2O/CO_2 ratios—derived from standard non-highway vehicle emission factors—were applied to CO_2 emissions in order to determine CH_4 and N_2O emissions (TCR 2017). All GHG emissions ratios applied in developing GSE emissions are shown in Table 8-7: Emissions Ratios Applied to AEDT GSE Output.

8.2.3 Results

Table 8-8: GHG & CAP Emissions from GSE by Airport (metric tons) shows the GHG and CAP emission estimates for GSE by airport.

Table 8-8: GHG & CAP Emissions from GSE by Airport (metric tons)

Airport	CO_2	CH_4	N_2O	CO_2e	SO_2	NO_x	$PM_{2.5}$	PM_{10}
JFK	73,470	4.18	1.86	74,134	0.91	524	40.40	41.76
EWR	30,600	1.74	0.77	30,876	0.34	213	15.82	16.36
LGA	66,553	3.79	1.68	67,152	0.99	773	33.11	34.37
SWF	421	0.02	0.01	425	0.01	2	0.12	0.12
TEB	616	0.03	0.02	621	0.01	4	0.20	0.20
TOTAL	**171,659**	**9.76**	**4.34**	**173,209**	**2.26**	**1,516**	**89.64**	**92.82**

Note: Totals may not match the column sums due to rounding.

[3] Sulfur oxides (SO_x) is the term referring to a set of compounds of sulfur and oxygen, of which sulfur dioxide (SO_2) is the predominant form found in the lower atmosphere. When estimating GSE CO_2 emissions, it was assumed that all SO_x was in the form of SO_2.

9.0 ATTRACTED TRAVEL (SCOPE 3)

Attracted travel refers to customer motorized travel to access Port Authority infrastructure and includes a range of activities. For the EY2016, attracted travel assessment were limited to Aviation department activities, namely, airport passenger and air cargo attracted travel.

9.1 AIRPORT PASSENGERS

For attracted travel related to passenger access to airports (excluding cargo-related vehicles), the established boundary includes the trip to or from the airport up to a maximum of 100 miles. This boundary was developed based on the trip origin data received from the Port Authority's Aviation department (Port Authority 2017f). The airport passengers portion includes emissions associated with all vehicle trips that are attracted by airport facilities. Vehicle types (also referred to as travel mode) include privately-owned vehicles, taxis, buses, rental cars, limousines, vans, shuttle buses, public buses, Uber/Lyft, parking at the airport, dropped off by personal car, and off-airport parking. Vehicle miles traveled (VMTs) for the airport facilities were calculated by mode, and for the trip to or from the airport.

9.1.1 Activity Data

The data inputs to the attracted travel analysis were the 2016 passenger survey data (Port Authority 2017f), which provided the passenger origin/destination information, the 2016 total passenger data (Port Authority 2017b) for information on the total number of passengers, and data on average travel party size (Excellent et al. 2008; Airlink et al. 2008; Port Authority 2017e).

The 2016 total passenger data were adjusted to exclude in-transit passengers (passengers with a connection in a Port Authority airport prior to their destination) because these passengers do not induce attracted travel. The percentage of passengers on connecting flights by airport (Port Authority 2017g) used to adjust total passenger volumes is presented in Table 9-1: Percentage of Total Passengers on Connecting Flights.

Table 9-1: Percentage of Total Passengers on Connecting Flights

Airport	Percent of Passengers
JFK	22%
EWR	32%
LGA	17%
SWF	2%
TEB	0%

Passengers are assumed to take a one-way trip (either to or from the airport) to their destination. For JFK, EWR and LGA, personal car trips were divided between those where passengers were dropped off at an airport and those where passengers parked at an airport. Trips where the passenger parked at the airport use a one-way distance, whereas drop-offs use the round-trip distance. For SWF, there was no subdivision of the personal car category, and therefore, passengers who are arriving/departing via personal car were assumed to be a pickup/drop off and therefore the round-trip distance is used. This assumption is made to be more conservative, and because pickup/drop-off is more common than parking at the airport at JFK, EWR and LGA.

9.1.2 Method

For each airport, except TEB, the number of passengers was allocated by travel mode and trip origin prior to estimating the number of vehicles. The number of vehicles by travel mode and trip origin was estimated using the number of passengers, trip distributions by travel mode to each passenger origin, average travel party size, and estimated distance traveled. Trip distributions by mode to each passenger origin were obtained from the Port Authority's Aviation department (Port Authority 2017f). Information on the estimated trip distances and average travel party size are listed in Table 9-2: One-Way Travel Distances Associated with Airport Facilitiesand Table 9-3: Average Travel Party Size by Travel Mode and Facility, respectively.

Table 9-2: One-Way Travel Distances Associated with Airport Facilities lists the trip origins for airport attracted travel with the corresponding estimated one-way travel distances by airport, except for TEB. Trip origin and travel mode data were not available for TEB. The methodologies used to estimate attracted travel emissions for TEB are discussed in a separate section later in this chapter. Distances reported in Table 9-2: One-Way Travel Distances Associated with Airport Facilitieswere estimated using Google Maps roadway trip lengths. The surrogate location associated with each origin/destination represents the most populous locality within the county or jurisdiction.

Table 9-2: One-Way Travel Distances Associated with Airport Facilities

Origin/Destination		Miles to/from [b]			
County/Jurisdiction	**Surrogate Location**	**JFK**	**LGA**	**EWR**	**SWF**
New York City					
Bronx	Bronx	17	10	27	
Brooklyn	Brooklyn	11	16	20	
Manhattan <14th St.	E. 10th St., NYC	18	10	14	66
Manhattan 14th–96th Sts.	E. 50th St., NYC	17	9	17	65
Manhattan > 96th St.	E. 110th St., NYC	18	7	20	64
Nassau	Mineola	13	17	45	
Queens	Queens	8	7	26	
Staten Island	Staten Island	28	26	13	
Suffolk	Hauppauge	42	40	59	
Westchester	Yonkers	27	17	29	54
Other NY Counties					
Allegheny	Wellsville	100			
Albany	Albany	100	100	100	90
Broome	Binghamton	100	100	100	
Cayuga	Auburn		100		
Cattaraugus	Olean		100		

Table 9-2: One-Way Travel Distances Associated with Airport Facilities					
Origin/Destination		Miles to/from [b]			
County/Jurisdiction	**Surrogate Location**	**JFK**	**LGA**	**EWR**	**SWF**
Chemung	Elmira		100		
Clinton	Plattsburgh	100		100	
Cortland	Cortland			100	
Delaware	Sidney			100	
Dutchess	Poughkeepsie	89	82	87	26
Essex	North Elba	100			100
Madison	Oneida	100			
Monroe	Rochester	100			100
Onondaga	Syracuse	100	100	100	
Oneida	Utica	100			100
Orange	Newburgh	100		71	6
Orleans	Albion			100	
Putnam	Carmel			69	35
Rensselaer	Troy	100			
Rockland	Nanuet	45	31	40	38
Saratoga	Saratoga Springs	100	100	100	
Steuben	Corning		100		
Sullivan	Monticello	100		100	39
Tompkins	Ithaca			100	
Ulster	Kingston	100	100	100	40
Washington	Kingsbury	100			
Warren	Glen Falls			100	
Yates	Milo	100		100	100
Other NY[a]			100	100	
NJ Counties					
Atlantic	Egg Harbor Township	100	100	100	
Bergen	Hackensack	29	18	20	55
Burlington	Evesham Township			76	
Camden	Camden			76	
Cape May	Cape May			100	
Cumberland	Vineland	100		100	
Essex	Newark	44	25	12	
Gloucester	Washington Township			91	
Hudson	Union City	22	15	13	
Hunterdon	Raritan Township	83		49	
Mercer	Hamilton Township	76	76	50	
Middlesex	Edison	46	46	20	
Monmouth	Middletown	57		32	
Morris	Parsippany-Troy Hills	51	50	24	
Ocean	Lakewood Township	95		48	
Passaic	Paterson	36	46	20	
Somerset	Franklin Township	53	66	27	
Sussex	Vernon Township		65	59	
Union	Elizabeth	32	42	4	
Warren	Philipsburg			60	
Other NJ		100	100	100	
CT Counties					
Fairfield	Bridgeport	62	55	76	
Hartford	Hartford	100	100	100	
Litchfield	Torrington	100	100		

Table 9-2: One-Way Travel Distances Associated with Airport Facilities					
Origin/Destination		Miles to/from [b]			
County/Jurisdiction	Surrogate Location	JFK	LGA	EWR	SWF
Middlesex	Middletown		100		
New Haven	New Haven	80	73	95	
New London	New London	100			
Other CT		100	100	100	
PA Counties					
Allegheny	Pittsburgh	100	100		
Armstrong		100			
Berks	Reading			100	
Bradford	Towanda			100	
Bucks	Bensalem	100		67	
Cameron	Emporium			100	
Centre	Bellefonte	100		100	
Chester	West Chester	100		100	
Cumberland	Carlisle			100	
Dauphin	Harrisburg		100	100	
Delaware	Chester			100	
Franklin	Chambersburg			100	
Lackawanna	Scranton	100		100	
Lancaster	Lancaster	100		100	
Lawrence	New Castle			100	
Lehigh	Allentown	100		82	
Luzerne	Wilkes-Barre	100		100	
Monroe	Stroudsburg		100	77	
Montgomery	Lower Merion	100	100	91	
Northampton	Bethlehem	100		72	
Philadelphia	Philadelphia	100		83	37
Pike	Matamoros	100			
Washington	Washington			100	
Wayne	Honesdale	100		100	
Other PA[a]		100	100	100	100
Other U.S. [a]		100	100	100	100

[a] These are cases where no county information was provided by survey respondent, and consequently a default distance was assigned.
[b] Trip distances are capped at a maximum of 100 miles.

Table 9-3: Average Travel Party Size by Travel Mode and Facility				
Travel Mode	Average Travel Party Size by Facility			
	JFK	LGA	EWR	SWF
Personal Car[a]	N/A	N/A	N/A	2.4
Rental Car[a]	2.4	1.9	2.7	2.4
Taxi[a]	2.4	1.9	2.5	2.2
Limo/Towncar[a]	2.8	2.4	2.7	2.6
Shared-Ride Van[c]	10.8	10.8	10.8	10.8
Airport/Charter/Tour Bus[b]	45.9	45.9	45.9	45.9
Public/City Bus[b]	45.9	45.9	45.9	45.9
Hotel/Motel Shuttle Van[c]	10.8	10.8	10.8	10.8
Off-Airport Parking[a]	2.4	1.9	2.7	2.4
Uber/Lyft[a]	2.0	1.7	2.2	N/A
Dropped Off via Pers. Car[a]	2.5	2.0	2.9	N/A
On-Airport Parking[a]	2.0	1.4	1.4	N/A

[a] Port Authority 2017e
[b] Excellent et al. 2008.
[c] Airlink et al. 2008.

The trip distance data presented in Table 9-2 and the average party size data, which are shown in Table 9-3, along with the trip distribution data, were applied to develop the total VMT accumulated due to airport attracted travel. The methodology for estimating VMT is consistent for private cars, limousines, chartered buses, hotel/motel/off-airport shuttle buses, Uber/Lyft, parking at airport, and van services vehicle categories, and is estimated using Equation 9-1. Airport drop-offs also use this methodology, but the trip length is the round-trip distance, since the drop-off vehicle would need to return home in that single trip.

$$VMT = \frac{N \times \%D}{P} \times L \tag{9-1}$$

Where:

VMT = vehicle miles traveled

N = number of passengers

%D = percent distribution by trip origin and travel mode

P = travel party size or vehicle occupancy in case of buses and shuttles

L = trip length (one-way, miles)

The calculation of VMT for taxis and rental cars are based on the number of vehicle trips rather than the number of passengers, since the number of these vehicles is known. For taxis servicing JFK, LGA and EWR, the number of taxis dispatched was provided by Port Authority (Port Authority 2017c), and data on total rental car transactions for these airports were also provided by the Port Authority (Port Authority 2017d). These numbers of vehicle trips are allocated by trip origin/destination utilizing the percentage of airport passengers by trip origin/destination. The number of vehicle trips is then multiplied by the one-way trip distance for each origin/destination location to estimate rental car or taxi VMT. Taxi and rental car transactions data from SWF were not available, so VMT from taxis and rental cars at SWF are estimated like other travel modes. Because no vehicle travel attraction statistics were available for TEB, based on the types of flights that use TEB, the number of passengers at TEB was estimated as the number of aircraft movements (Port Authority 2017b). TEB attracted travel VMT was estimated assuming an average trip length of 16.2 miles, based on the distance from TEB to Manhattan, with all trips assigned to personal cars at a vehicle occupancy of 1.0.

Once VMT estimates were developed for all attracted travel modes, VMT was summed by facility and mode. Emission factors for attracted travel at airports were calculated using EPA's MOVES model (EPA 2014a) based on input data for the ten New York metropolitan counties (NYMTC 2016). For personal vehicle travel (personal car, rental car, taxi, limo/town car, off-airport parking), the emission factors were based on the weighted average of the MOVES passenger car, passenger truck, and motorcycle vehicle types over the 10 counties. Emission factors for shared-ride van and hotel/motel shuttle van were based on the 10-county weighted average small/medium truck emission factors. Emission factors for public/city bus and airport/charter/tour bus were based on the 10-county weighted average transit bus emission factors. Emissions estimates for all pollutants were developed by multiplying VMT by the corresponding emission factors (in grams per mile).

Cold-start emissions associated with the startup of a cooled vehicle engine were estimated for the following travel modes: personal car, dropped off via personal car, on-airport parkers, rental cars, and off-airport parking. Vehicle emissions for this category were calculated by multiplying the number of vehicle trips by the corresponding weighted cold-start emission factor for each vehicle type, assuming one cold start per trip. Total vehicle trips were estimated by dividing the total number of passengers for each affected travel mode by the vehicle occupancy for that mode for each airport/travel mode combination. The exception was for rental cars, where vehicle trips were assumed to be equivalent to the number of rental car transactions. The cold-start emission factors (in grams per start) by vehicle type were derived from the EPA MOVES model (EPA 2014a).

9.1.3 Results

Total airport attracted travel GHG emission estimates are displayed in Table 9-4 below. Carbon dioxide accounted for more than 99% of all attracted travel CO_2e emissions. Figure 9-1shows the CO_2 emissions broken down by both travel mode and airport. The travel modes are simplified into four broad categories: Personal Car (including on airport parking and drop-offs), rental cars, taxi/limo/Uber/Lyft, and Other (including buses, shuttle vans and off-airport parking). Total GHG and CAP emission estimates are broken down by airport, as shown in Table 9-5. JFK airport has the most GHG and CAP emissions, although EWR and LGA also account for a significant portion of the total.

Table 9-4: Airport Passenger Attracted Travel GHG Emissions by Mode (metric tons)				
Travel Mode	**CO_2e**	**CO_2**	**CH_4**	**N_2O**
Personal Car[4]	4,332	4,316	0.1	0.0
Dropped Off Via Pers. Car	303,227	302,234	3.4	3.0
On-Airport Parkers	61,289	61,075	0.7	0.6
Rental Car	35,540	35,420	0.4	0.4
Taxi	61,324	61,162	0.6	0.5
Limo/Town Car	28,943	28,866	0.3	0.2
Uber/Lyft	49,359	49,229	0.5	0.4
Shared-Ride Van	4,263	4,233	0.2	0.1
Mass Transit to AirTrain	0	0	0.0	0.0
Airport/Charter/Tour Bus	2,720	2,697	0.9	0.0
Public/City Bus	2,291	2,272	0.7	0.0
Hotel/Motel Shuttle Van	4,086	4,057	0.2	0.1
Off-Airport Parking	18,315	18,253	0.2	0.2
TOTAL	**575,689**	**573,814**	**8.2**	**5.5**

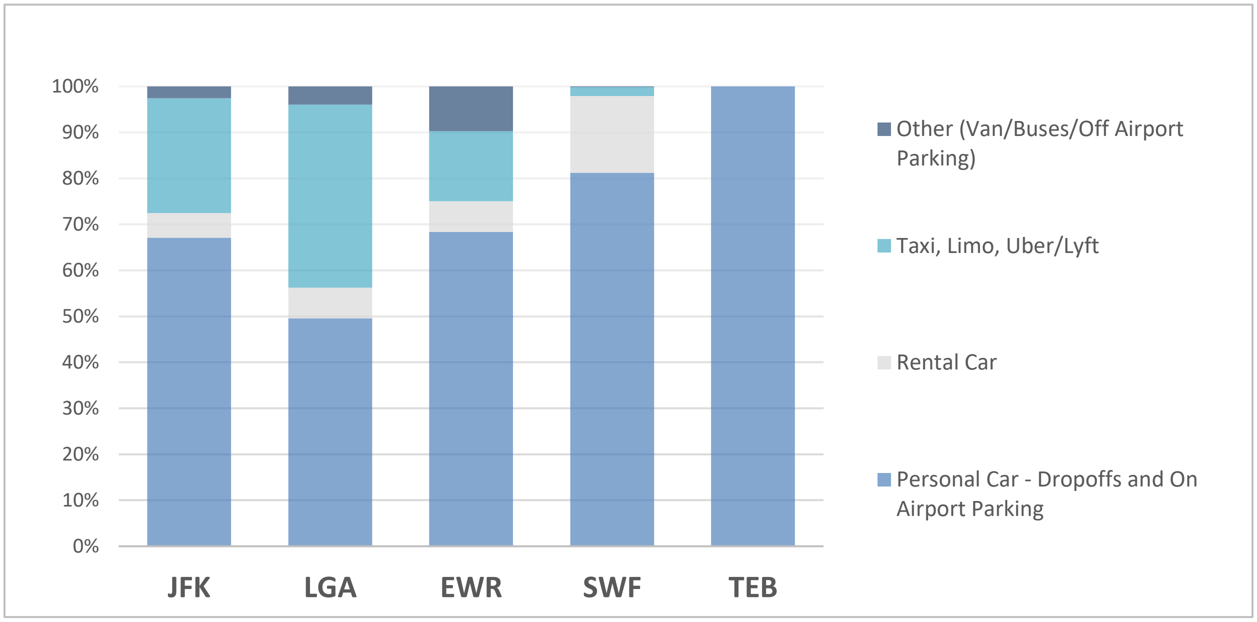

Figure 9-1. Attracted Travel Emissions Distributed by Mode

Table 9-5: Airport Passenger Attracted Travel GHG & CAP Emissions by Airport (metric tons)								
Airport	**CO_2e**	**CO_2**	**CH_4**	**N_2O**	**SO_2**	**NO_x**	**$PM_{2.5}$**	**PM_{10}**
JFK	237,266	236,493	3.1	2.3	4.7	146.4	8.7	36.8
EWR	212,889	212,198	3.0	2.0	4.2	139.2	8.2	33.4
LGA	120,516	120,124	2.0	1.1	2.4	87.1	5.1	19.5
SWF	3,651	3,639	0.04	0.03	0.1	2.0	0.1	0.6
TEB	1,366	1,360	0.02	0.02	0.03	0.8	0.05	0.2
TOTAL	**575,689**	**573,814**	**8.2**	**5.5**	**11.3**	**375.4**	**22.3**	**90.5**

Note: Totals may not match the column sums due to rounding.

[4] The Personal Car total is only for SWF and TEB, as this broad category is not used at EWR, JFK and LGA.

9.2 AIR CARGO

In addition to direct passenger service, Port Authority airports handle air cargo. The movement of air cargo to and from the air terminals induce vehicular traffic near the airports. The boundary is defined as the roadway distance between the airport and the first access/egress route as shown in Figure 9-2. Attracted Travel Air Cargo Boundary for JFK.

Figure 9-2. Attracted Travel Air Cargo Boundary for JFK

9.2.1 Activity Data

The primary data source for estimating attracted travel emissions from cargo shipments at the airports is a 2002 air cargo truck movement study for JFK (URS 2002). This provides data detailing cargo trips by route and vehicle type and is used as a surrogate for cargo shipping at all Port Authority airports.

9.2.2 Method

JFK VMT for cargo-related travel was derived by multiplying the number of cargo trips by the estimated trip length of the access and egress routes obtained from the air cargo truck movement study conducted for JFK airport (URS 2002). Trip length by origin was estimated using Google Maps (see Table 9-6).

Table 9-6: One-Way Travel Distance at JFK Airport for Cargo Travel	
Origin/Destination	**Miles to/from**
Van Wyck	5.1
On Airport	6.7
Rockway Blvd	2.8
Belt Parkway/Southern State	8.2
Other Routes	5.7

Note: Only passenger vehicles are permitted on the Belt Parkway/Southern State Parkway. Therefore, only cargo trips using cars or mini-vans were allocated to this route.

Source: Google Maps Average distance based on Van Wyck, On Airport, Rockaway Blvd., and Belt Parkway/Southern State trip length.

The number of cargo trips at JFK in 2016 was estimated by scaling the number of trips estimated from the 2002 study by vehicle type based on the ratio of 2016 to 2002 freight cargo at JFK (Port Authority 2006; Port Authority 2017b). The resulting 2016 cargo VMT for JFK by vehicle type was then scaled to LGA, EWR and SWF airports using the 2016 ratio of cargo tons from JFK to the cargo tons at LGA, EWR and SWF airports (Port Authority 2017b). EY2016 air cargo tonnage by airport is displayed in Table 9-7: Air Cargo Tonnage by Airport below.

Table 9-7: Air Cargo Tonnage by Airport	
Airport	**Annual Cargo Tonnage**
JFK	1,315,385
EWR	746,771
LGA	7,586
SWF	18,729
TEB	0
TOTAL	**2,088,471**

Note: Totals may not match the column sums due to rounding.

GHG and CAP g/mi and g/start emission factors come from EPA's MOVES model (EPA 2014a). There are three different vehicle types included: light duty vehicles, small trucks (such as single unit trucks and 3 and 4 axle tractor trailers) and large trucks (5 and 6 axle tractor trailers). VMT was divided between these vehicle types based on the results of the JFK freight cargo survey (URS 2002). This analysis assumes a roundtrip VMT, and two starts per trip.

9.2.3 Results

The GHG and CAP emission estimates from cargo trucks by airport are summarized in Table 9-8: GHG & CAP Emissions from Air Cargo Attracted Travel by Airport (metric tons) below. JFK accounts for the majority of emissions from cargo shipments. TEB has no cargo shipments, and LGA and SWF have only a small amount.

Table 9-8: GHG & CAP Emissions from Air Cargo Attracted Travel by Airport (metric tons)								
Airport	**CO_2e**	**CO_2**	**CH_4**	**N_2O**	**SO_2**	**NO_X**	**$PM_{2.5}$**	**PM_{10}**
JFK	36,014	35,798	1.5	0.6	0.5	79.3	4.5	9.8
EWR	20,446	20,323	0.8	0.3	0.3	45.0	2.6	5.5
LGA	208	206	0.0	0.0	0.0	0.5	0.0	0.1
SWF	513	510	0.0	0.0	0.0	1.1	0.1	0.1
TEB	0	0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**57,181**	**56,837**	**2.3**	**0.9**	**0.8**	**125.8**	**7.2**	**15.5**

Note: Totals may not match the column sums due to rounding.

10.0 MOBILE COMBUSTION (SCOPE 3)

10.1 SHADOW FLEET

The shadow fleet consists of vehicles that are owned by the Port Authority but are operated on a day-to-day basis by contractors. Because they are not operated by the Port Authority directly, they do not fall within the purview of the CAD (discussed in Chapter 3.0) and are therefore considered scope 3 sources. In EY2016, only Shadow Fleet emissions associated with the Aviation department were assessed to support carbon management initiatives at Port Authority airports.

10.1.1 Activity Data

Data on the shadow fleet were provided by the Port Authority (Port Authority 2017j). In 2016, the shadow fleet consisted of fuel trucks and shuttle buses at JFK, EWR and LGA, as well as a few vehicles at SWF and TEB.

10.1.2 Method

Port Authority provided diesel and gasoline fuel consumption from the shadow fleet. These were then multiplied by the appropriate TCR emission factors to estimate GHG emissions and MARKAL emission factors to estimate the criteria pollutants (TCR 2017 and Pechan 2010).

10.1.3 Results

GHG and CAP emission estimates are summarized by airport in Table 10-1 below. The majority of shadow fleet emissions come from shuttle buses and fuel trucks at JFK and EWR.

Table 10-1: GHG & CAP Emissions from Shadow Fleet by Airport (metric tons)

Airport	CO_2	CH_4	N_2O	CO_2e	SO_2	NO_x	$PM_{2.5}$	PM_{10}
JFK	5,323	0.3	0.2	5,389	0.4	39.8	2.3	2.4
EWR	4,571	0.3	0.2	4,633	0.3	38.4	2.0	2.1
LGA	2,577	0.2	0.1	2,609	0.1	26.9	0.8	0.8
SWF	693	0.0	0.0	702	0.1	2.3	0.5	0.6
TEB	158	0.0	0.0	159	0.0	0.3	0.1	0.1
TOTAL	**13,321**	**0.8**	**0.5**	**13,492**	**1.0**	**107.8**	**5.6**	**6.0**

Note: Totals may not match the column sums due to rounding.

11.0 TENANT ENERGY CONSUMPTION (SCOPE 3)

Chapter 11 discusses tenant energy consumption and emissions assessments for the Aviation department. Tenants include airlines, airport concessions, fixed-base operators, and the AirTrain (JFK and Newark) systems operated by Bombardier Transportation. The assessment of tenant energy consumption covers three commodities: electricity, natural gas, and thermal energy.

11.1 BUILDINGS

11.1.1. Electricity

Building energy consumption was either compiled from metered electricity consumption statements or assessed from the share of building space corresponding to tenant occupancy. Table 11-1 presents a summary of tenant electricity consumption in 2016.

Table 11-1: Tenant Electricity Consumption by Airport

Airport	Electricity Usage (MWh)
EWR	85,654
JFK	262,019
LGA	72,403
SWF	10,735
TEB	8,097
TOTAL	**438,899**

Note: Totals may not match the column sums due to rounding.

The Port Authority sub-bills tenants for their electricity consumption at JFK and LGA, so metered electricity consumption informed the assessments at these two airports. For other airports, electricity consumption was estimated based on tenant building occupancy. Electricity consumption emissions were calculated as the product of energy consumption (C) and emission per unit of energy consumed for any given pollutant (i.e., the emission factor, EF_i), as shown in Equation 11-1. The GHG and CAP emission factors utilized with Equation 11-1 correspond to those used for the estimation of scope 2 purchased electricity emissions and listed on Table 5-2: Electricity Consumption GHG Emission Factors and Table 5-3: Electricity Consumption CAP Emission Factors.

$$Emissions = C \times EF_i \qquad (11\text{-}1)$$

Where:

C = consumption of electricity (kWh)

EF_i = electricity emission factor for pollutant i (kg pollutant/kWh)

i = GHG or CAP pollutant

At EWR, SWF and TEB, tenant electricity consumption was assessed as the product of tenant occupied space, energy consumption intensity, and the fraction of energy consumption attributable to electricity consumption. This method is presented in Equation 11-2. Tenant occupied space was compiled for the purposes of the inventory and is summarized on Table 11-2. The only change between tenant occupancy in 2015 and 2016 was at LGA airport. LGA opened a new Terminal B, and on June 1, 2016, it became tenant space. Therefore, tenant emissions were estimated for this 1.3-million square footage terminal for seven months of the year (Port Authority 2017k). The values used for energy consumption intensity (*Ij*) and fraction of total energy consumption attributable to electricity usage (*Sj*) are summarized in Table 11-3.

$$C = \left(\sum_J A_j \times I_j \times S_j\right) \times K \tag{11-2}$$

Where:

C = consumption of electricity (kWh)

A = tenant occupancy area specific to building activity j (square foot)

I_j = total energy consumption intensity for building activity j (kBtu/square foot)

S_j = share of total energy consumption attributable to electricity usage specific to building activity j (unitless)

K = conversion factor from kBtu to kWh

Table 11-2: Tenant Occupancy by Airport (square foot)

Building Activity	EWR	SWF	TEB	JFK	LGA	Total
Office	38,910	191,653	356,791	78,212	25,926	691,492
Airport Terminal Buildings	2,673,723	0	0	0	2,019,100	4,692,823
Medical Office	0	0	0	0	0	0
Non-refrigerated warehouse	2,573,864	1,230,593	795,316	4,358,694	310,100	9,268,567
Retail store	89,230	0	0	90,320	33,386	212,936
Parking	197,600	0	0	88,500	0	286,100
Energy/Power Station	0	0	0	0	0	0
Transportation Terminal/Station	0	0	0	0	0	0
Convenience store with gas station	2,110	0	0	10,000	3,440	15,550
Other-utility	20,015	1,733	0	1,100	2,925	25,773
Food service	132,440	20,000	0	625,312	48,600	826,352
Hotel	547,462	142,337	0	0	0	689,799
Other-public service	0	0	0	1,795	0	1,795
Vacant	0	182,094	0	0	0	182,094
Other	0	11,168	0	2,680	0	13,848
Other-services	0	0	0	8,450	0	8,450
Bank Branch	0	0	0	12,500	0	12,500
Fire station	0	0	0	15,760	352	16,112
TOTAL	**6,275,354**	**1,779,578**	**1,152,107**	**5,293,323**	**2,443,829**	**16,944,191**

Note: Totals may not match the column sums due to rounding.

Table 11-3: Energy Use Intensities by Building Activity		
Building Activity	**EUI (kBtu/square foot/year)**	**Electricity Percentage**
Office	67.3	62%
ATB: Large Hub, Moderate Climate	158.2	50%
Non-refrigerated warehouse	28.5	56%
Retail store	47.1	64%
Convenience store with gas station	192.9	50%
Other-utility	78.8	52%
Food service	266.8	43%
Hotel	73.4	43%
Other-public service	78.8	56%
Vacant	20.9	31%
Other	164.4	50%
Other-services	49.6	52%
Bank Branch	87.0	52%
Fire station	88.3	44%

Source: ACRP 2016 and Energy Star 2016 (for Site EUI) and EIA 2003 (for Electric Percentage).

Application of the methodology with best available activity data resulted in the GHG and CAP emission estimates presented in Table 11-4.

Table 11-4: GHG & CAP Emissions from Tenant Electricity Consumption in Buildings (metric tons)								
Airport	**CO_2**	**CH_4**	**N_2O**	**CO_2e**	**SO_2**	**NO_x**	**$PM_{2.5}$**	**PM_{10}**
JFK	111,714	8.0	1.9	112,470	23.8	0.6	6.3	6.3
LGA	21,856	0.8	0.1	21,903	1.5	10.2	0.1	0.1
EWR	33,357	1.0	0.4	33,517	54.8	31.0	21.5	22.4
SWF	1,991	0.1	0.0	1,998	3.2	1.3	0.2	0.3
TEB	3,153	0.1	0.0	3,168	5.2	2.9	2.0	2.1
TOTAL	**172,071**	**10.0**	**2.5**	**173,056**	**88.5**	**46.0**	**30.2**	**31.3**

Note: Totals may not match the column sums due to rounding.

11.1.2. Natural Gas

The tenant emissions from natural gas consumption were estimated based on the amount of space occupied by tenants in Port Authority-owned facilities. Table 11-2 summarizes tenant occupancy by building activity and airport. Note that at JFK, heating is also supplied in the form of thermal energy from KIAC, consequently, only JFK tenants who are not serviced by KIAC are included in the tenant natural gas consumption assessment.

Natural gas consumption was assessed as the product of tenant occupancy in terms of square footage, the energy consumption intensity per unit area of occupied space, and the fraction of energy consumption attributable to natural gas consumption (EIA 2003). This methodology assumes that energy use not attributable to electricity consumption pertains to natural gas consumption. This assumption is informed by the energy supply profile of Port Authority facilities where the Port Authority has operational control. The methodology is summarized in Equation 11-3. The values used for energy consumption intensity (I_j) and share of total energy consumption attributable to electricity usage (S_j) are listed in Table 11-3.

$$G = \left(\sum_j A_j \times I_j \times \left[1 - S_j\right]\right) \times L \quad (11\text{-}3)$$

Where:

G = consumption of natural gas (therms)

A = tenant occupancy area specific to building activity j (square foot)

I_j = total energy consumption intensity for building activity j (kBtu/square foot)

S_j = share of total energy consumption attributable to electricity usage specific to building activity j (unitless)

L = conversion factor from kBtu to therm

The GHG and CAP emission factors utilized with Equation 11-3 correspond to those used for the estimation of scope 1 stationary combustion emissions and listed on Table 2-2: Stationary Combustion GHG Emission Factors and Table 2-3: Stationary Combustion CAP Emission Factors. Table 11-5 shows the GHG and CAP emissions estimates from natural gas broken down by facility.

Table 11-5: GHG & CAP Emissions from Tenant Natural Gas Consumption in Buildings (metric tons)

Airport	CO_2	CH_4	N_2O	CO_2e	SO_2	NO_x	$PM_{2.5}$	PM_{10}
JFK	8,274	1.38	0.03	8,312	0.04	6.9	0.52	0.52
LGA	6,835	0.76	0.02	6,856	0.03	5.7	0.43	0.43
EWR	15,300	0.86	0.02	15,323	0.08	12.8	0.97	0.97
SWF	1,746	0.49	0.01	1,759	0.01	1.5	0.11	0.11
TEB	1,011	0.21	0.00	1,017	0.01	0.8	0.06	0.06
TOTAL	**33,166**	**3.70**	**0.08**	**33,267**	**0.17**	**27.6**	**2.10**	**2.10**

Note: Totals may not match the column sums due to rounding.

11.1.3. Thermal

JFK is the only location where tenant thermal energy consumption occurs for heating and cooling applications. Tenant thermal energy consumption information was available from Port Authority sub-billing records.

Emissions from thermal energy consumption were estimated as the product of energy consumption and the pollutant intensity of the thermal energy delivered (i.e., the emission factor). The emission factors are specific to the KIAC facility, which is the supplier of thermal energy. The derivation of these emission factors is discussed in detail in Chapter 7 (see Table 7-3: KIAC Electricity and Thermal Emission Factors by Pollutant). These emission factors are shown in Table 7-3: KIAC Electricity and Thermal Emission Factors by Pollutant.

Port Authority records indicate that there were nearly 128,000 MMBtu of thermal heating and close to 223,000 MMBtu of thermal cooling consumed by JFK tenants. Associated GHG and CAP emissions are shown in Table 11-6.

Table 11-6: GHG &CAP Emissions from Tenant Thermal Consumption in Buildings (metric tons)								
Commodity	**CO_2**	**CH_4**	**N_2O**	**CO_2e**	**SO_2**	**NO_x**	**$PM_{2.5}$**	**PM_{10}**
KIAC Heating	7,970	0.57	0.14	8,024	1.70	0.04	0.45	0.45
KIAC Cooling	13,888	0.10	0.24	13,982	2.96	0.07	0.78	0.78

11.2 RAIL SYSTEMS

The Port Authority owns the AirTrain JFK and AirTrain Newark, but these monorail systems are operated by Bombardier Transportation, thus reported as a scope 3 source. AirTrain JFK operates with service between JFK and two passenger stations in Queens. AirTrain Newark operates with service between EWR and the Northeast Corridor transfer station.

11.2.1 Electricity

For electricity consumption of the AirTrain systems, the Port Authority provided consumption data by month for each service location in kWh. Emission estimates were assessed on the basis of metered electricity consumption in combination with the most relevant set of emission factors listed in Table 5-2: Electricity Consumption GHG Emission Factors, and Table 5-3: Electricity Consumption CAP Emission Factors. For AirTrain JFK, two separate sets of emission factors were applied. When electricity was sourced from KIAC, plant-level emission factors were applied. In all other instances, the NYCW emission factors were used for AirTrain JFK. For AirTrain Newark, the RFCE emission factors for were applied. Table 11-7 presents GHG and CAP emissions associated with train electricity usage for each system.

Table 11-7: GHG & CAP Emissions from Tenant Electricity Consumption in Rail Systems (metric tons)								
Facility	**CO_2**	**CH_4**	**N_2O**	**CO_2e**	**SO_2**	**NO_x**	**$PM_{2.5}$**	**PM_{10}**
AirTrain JFK	16,831	1.14	0.26	16,936	3.34	0.88	0.85	0.85
AirTrain Newark	7,203	0.52	0.12	7,252	1.54	0.04	0.41	0.41
TOTAL	**24,033**	**1.66**	**0.39**	**24,188**	**4.87**	**0.92**	**1.26**	**1.26**

Note: Totals may not match the column sums due to rounding.

11.2.2 Thermal

The Port Authority has a record of thermal energy in the form of heating and cooling delivered by KIAC for consumption at AirTrain JFK. This record of consumption is multiplied by the KIAC-specific emission factors shown in Table 6-1: KIAC Thermal Emission Factors to estimate emissions. Table 11-8 summarize emissions from thermal energy consumption by AirTrain.

Table 11-8: GHG & CAP Emissions from Tenant Thermal Consumption in Rail Systems (metric tons)								
Commodity	**CO_2**	**CH_4**	**N_2O**	**CO_2e**	**SO_2**	**NO_x**	**$PM_{2.5}$**	**PM_{10}**
KIAC Heating	698	0.05	0.01	703	0.15	0.0	0.04	0.04
KIAC Cooling	759	0.05	0.01	764	0.16	0.0	0.04	0.04
TOTAL	**1,457**	**0.10**	**0.02**	**1,467**	**0.31**	**0.0**	**0.08**	**0.08**

Note: Totals may not match the column sums due to rounding.

12.0 REFERENCES

ACRP 2009. Airport Cooperation Research Program. *Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories.* Airport Cooperative Research Program, Report 11. Available at http://www.trb.org/Publications/Blurbs/160829.aspx.

ACRP 2016. Airport Cooperation Research Program. *Airport Terminal Building Energy Use Intensity Benchmarking Tool*. Available at: http://www.trb.org/Publications/Blurbs/173795.aspx.

AEDT 2017. Aviation Environmental Design Tool, version 2d. Released September 2017. Available at: https://aedt.faa.gov/2d_information.aspx.

Airlink et al. 2008. *Shared-Ride/Van Service Passenger Capacity*, available at Airlink Shuttle, Carmel and Limousine Service, and Classic Limousine websites. October 2008.

Calpine 2017. File prepared by Wayne Goonan, Calpine, *QF2016PA.xlsx*, sent to K. Darlow, SC&A Inc. August 24, 2017.

EIA 2003. *Commercial Buildings Energy Consumption Survey, Table E2. Major Fuel Consumption (Btu) Intensities by End Use for Non-Mall Buildings*, U.S. Energy Information Administration. Revised December 2008. Available at http://www.eia.gov/consumption/commercial/data/2003/pdf/e02a.pdf.

EIA 2017. *EIA Weekly Retail Data, for Middle Atlantic Region*, U.S. Energy Information Agency. Available at http://www.eia.gov/oil_gas/petroleum/data_publications/wrgp/mogas_history.html.

Energy Star 2016. Energy Star PortfolioManager. Technical Reference: U.S. Energy Use Intensity by Property Type. March 2016. Available at https://portfoliomanager.energystar.gov/pdf/reference/US%20National%20Median%20Table.pdf.

EPA 1995. *AP-42 Compilation of Air Pollutant Emission Factors*, U.S. Environmental Protection Agency, Office of Transportation and Air Quality. January 1995. Available at https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors.

EPA 1997. *Emission Factor Documentation for AP-42 Section 2.4: Municipal Solid Waste Landfills (Revised)*, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. August 1997.

EPA 2005. *Landfill Gas Emissions Model (LandGEM) Version 3.02, User's Guide,* Publication No. 600/R-05/047, U.S. Environmental Protection Agency. 2005.

EPA 2009b. *Suggested Nationwide Average Fuel Properties*, EPA-420-B-09-018, U.S. Environmental Protection Agency, Assessment and Standards Division, Office of Transportation and Air Quality. April 2009.

EPA 2014a. *"Motor Vehicle Emissions Simulator MOVES2014,* U.S. Environmental Protection Agency. Released December 2014. For more information, see http://www.epa.gov/otaq/models/moves/.

EPA 2016, *Gasoline Sulfur Standards*. EPA-420-B-16-004. U.S. Environmental Protection Agency Office of Transportation and Air Quality. March 2016. Available at https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100O9ZH.pdf.

EPA 2017a. *2017 Air Markets Program Data*, U.S. Environmental Protection Agency. Accessed August 25, 2017. Available at http://ampd.epa.gov/ampd/.

EPA 2017b. *2017 Greenhouse Gas Emissions from Large Facilities*, EPA Flight Database. Accessed October 20, 2017. Available at: http://ghgdata.epa.gov/ghgp/main.do.

EPA 2017c. *eGRID 2014 revised released (v2),* U.S. Environmental Protection Agency. Accessed February 27, 2017. Available at https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid.

EPA 2017d. *2014 National Emissions Inventory Data*, U.S. Environmental Protection Agency. Available at https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-documentation.

Excellent et al. 2008. *Chartered Bus Passenger Capacity*, available at Excellent Bus Service Inc., Leprechaun Bus Line, and Classic Limousine websites. October 2008.

FAA 2012. *Glossary*, Federal Aviation Administration. Available at http://aspmhelp.faa.gov/index.php/Glossary.

FAA 2017. Federal Aviation Administration, online Air Traffic Activity System. Accessed November 2017. Available at: https://aspm.faa.gov/opsnet/sys/Airport.asp.

IPCC 1996. *Working Group I: The Science of Climate Change*, Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge and New York. 1996.

IPCC 2001. *Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change*, Watson, R.T. and the Core Writing Team (eds.). Cambridge University Press, Cambridge and New York. 2001.

IPCC 2006. *2006 IPCC Guidelines for National Greenhouse Gas Emission Inventories*, Intergovernmental Panel on Climate Change, Hayama, Kanagawa, Japan. 2006. Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.

IPCC 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* Core Writing Team, Pachauri, R.K., and Reisinger, A. (eds.). Intergovernmental Panel on Climate Change, Geneva, Switzerland. 2007.

LGO 2010. *Local Government Operations Protoco*l, Version 1.1, The Climate Registry. May 2010.

New Jersey 2017. *DEP Data Miner - Air Emission Statement Annual Report*, New Jersey Open Public Records Act Department of Environmental Protection. Accessed October 20, 2017. Available at https://www13.state.nj.us/DataMiner/Search/SearchByCategory?isExternal=y&getCategory=y&catName=Air+Quality+Permitting+and+Reporting.

NYMTC 2016. New York Metropolitan Transportation Council provided MOVES emission factors for NY Area in a personal email communication between Thusitha Chandra and Jackson Schreiber in September 2016.

Pechan 2010. *Documentation of MARKAL Emission Factor Updates*, Draft Memorandum prepared by E.H. Pechan & Associates, Inc., to Dan Loughlin, EPA Office of Research and Development, Contract No. EP-D-07-097, Work Assignment 4-07. December 1, 2010.

Port Authority 1974. *Elizabeth Port Authority Marine Terminal Annex, Area West of Kapkowski Road, Geological Profiles*, Drawing No. EPAMT-SL-068. January 3, 1974.

Port Authority 2006. *2006 Annual Airport Traffic Report*, Port Authority of New York & New Jersey. 2006.

Port Authority 2008. *Environmental Sustainability Policy*, Port Authority of New York and New Jersey. 2008.

Port Authority 2012a. *RE: GHG Inventory Verification Question*, email communication from Rubi Rajbanshi, Port Authority, to Juan Maldonado, TranSystems, December 19, 2012.

Port Authority 2014b. *Request for Information for Replacement, Rehabilitation or Redesign of the Cogeneration Plant and Related Infrastructure at John F. Kennedy International Airport*, Port Authority of New York & New Jersey. May 8, 2014. Available at http://www.panynj.gov/business-opportunities/pdf/RFIDOC_37799.pdf.

Port Authority 2016c. 2015 GHG Inventory Master Spreadsheet Jun 2016.xlsx. Received by email 8/30/2016.

Port Authority 2016e. Email communication between Jeff Trilling at Central Automotive and Jackson Schreiber at SC&A, Inc. 11/16/2016.

Port Authority 2017a. Central Automotive Division spreadsheets were: 2016 GHG.xlsx; 2016 CNG Useage.xlsx; Port Authority of NY NJ Customer Volume 1.2016 to 12.2016 FLEETCONTROL.xlsx and PANYNJ Customer Volume 1.2016 to 7.2016 FUELCARD.NET.xlsx. Files provided in email communications in June through September 2017.

Port Authority 2017b. *Airport Traffic Report 2016*. April 2017. Available at: https://www.panynj.gov/airports/pdf-traffic/ATR2016.pdf.

Port Authority 2017c. Email communication received from Nate Kimball, Port Authority. "Fw EY2016 Inventory – Taxis" received 10-6-17.

Port Authority 2017d. Email communication received from Nate Kimball, Port Authority. Multiple email spreadsheets provided: "JFK Comparison 2015 -2017.xlsx", "LaGuardia Comparison 2015 -2017.xlsx" "Newark Comparison 2015-2017.xlsx", "NY and NJ Transaction Data Report.xlsx", "NY Port Authority Airport transaction data - Sept 2017 request.xlsx", "Port Authority Transactions & Days Avis Budget Payless rental data 2007 – 2017.xlsx". Received October 2017.

Port Authority 2017e. "2016 TxT CSS Dep O-D Party Size By Select Airport Access Modes.xlsx". Provided by Port Authority 9/29/17.

Port Authority 2017f. "2016 TxT Dep O-D Pax Transportation Mode By Trip Origin.xlsx". Provided by Port Authority 9/29/17.

Port Authority 2017g. "2016 TxT Dep O-D-Conn Pax Share Trended By Airport.xlsx". Provided by Port Authority 9/29/17.

Port Authority 2017h. Email communication received from Nate Kimball, Port Authority. Multiple email spreadsheets provided: "EWR type 2016.xlsx", "JFK TYPE AIRCRAFT 2016.xlsx", "LGA type list.xlsx", SWF Fleet Counts data for 2016.xlsx", "TEB aircraft movements by type 2016.xlsx". Provided by email October and November 2017.

Port Authority 2017i. Email communication received from Nate Kimball, Port Authority. Multiple files provided: "FW PPT's (EWR and LGA Taxi times)" and JFK taxi time comparison.jpg". Provided October 2017.

Port Authority 2017j. Email communication received from Nate Kimball, Port Authority. Multiple files provided: "2016 Auto Gas & Diesel - LGA Fuel Trucks.xlsx"; "Auto Diesel Bio Usage Receipt History 2016 vs. 2017 (EWR Fuel Trucks).pdf"; "Aviation Data Email EWR Shadow Fleet- 9-22-17.msg"; "Copy of JFK Mobile Com Emissions Bus Fleet Fuel Use-2016 JFK.xlsx"; "Copy of LGA Shadow Fleet Mobile Combustion Reques 2016.xslx"; "Fw: Collecting Data for 2016 Aviation Sustainability Report (TEB Shadowfleet).msg"; "JFK Fuel Truck Fuel 2016.msg", "SWF-Sustainability-Metrics_2016.xlsx". Provided October 2017.

Port Authority 2017k. Email communication received from Nate Kimball, Port Authority. "RE: Tenant space collected for EY2014 and 2015 assessment". 10/19/17.

Port Authority 2017l. "PATH 2016 Diesel.pdf". Provided by Port Authority 11/6/17.

Starcrest 2018. Starcrest Consulting Group, LLC, *The Port of New York and New Jersey Port Commerce Department 2016 Multi Facility Emissions Inventory of Cargo Handling Equipment, Heavy Duty Diesel Vehicles, Railroad Locomotives and Commercial Marine Vessels* Prepared for the Port Authority of New York and New Jersey. January 2018.

TCAP 2010. *Tenant Construction and Alteration Process Manual*, Port Authority of New York & New Jersey. January 2010.

TCR 2013a. *General Reporting Protocol – Version 2.0*, The Climate Registry March 2013. Available at http://www.theclimateregistry.org/wp-content/uploads/2014/11/TCR_GRP_Version_2.0-1.pdf.

TCR 2017. *2017 Climate Registry Default Emission Factors.* March 2017.

URS 2002. *John F. Kennedy International Airport – Air Cargo Truck Movement Study*, URS Corporation. Prepared for Port Authority of New York & New Jersey Traffic Engineering. May 2002.

WeldingWeb 2012. *Acetylene Prices*. Accessed December 20, 2012. Available athttp://www.weldingweb.com/showthread.php?t=62953.

Wiley 2002. Wiley III, Joseph B. *Redevelopment Potential of Landfills: A Case Study of Six New Jersey Projects.* Presented to Federation of New York Solid Waste Associations, Solid Waste/Recycling Conference, Lake George, NY. May 6, 2002.

WPCI 2010: World Ports Climate Initiative. "Carbon Footprinting for Ports, Guidance Document". Prepared by Carbon Footprinting Working Group. June 2010.

WRI 2004. World Resources Institute and World Business Council for Sustainable Development. *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard, Revised Edition*. March 2004.

APPENDIX A: SCOPE 3 GHG EMISSIONS BY YEAR OF ASSESSMENT

Department	Emission Category	Activity	Year of Last Assessment
Aviation	Aircraft	Aircraft Movements	2016
		Auxiliary Power Units	2016
		Ground Support Equipment	2016
	Attracted Travel	Air Cargo	2016
		Airport Passenger	2016
	Energy Production	Electricity Sold to Market	2016
	Purchased Cooling	Buildings	2016
		Rail Systems	2016
	Purchased Electricity	Buildings	2016
		Rail Systems	2016
	Purchased Heating	Buildings	2016
		Rail Systems	2016
	Stationary Combustion	Buildings	2016
Central Administration	Mobile Combustion	Shadow Fleet	2016
Engineering	Construction	Non-Road Diesel Engines	2013
Multi-Department	Mobile Combustion	Employee Commuting	2015
PATH	Attracted Travel	PATH Passenger	2012
	Purchased Electricity	Buildings	2013
	Stationary Combustion	Buildings	2013
Planning	Mobile Combustion	Ferry Movements	2014
	Purchased Electricity	Buildings	2013
	Stationary Combustion	Buildings	2013
Port Commerce	Attracted Travel	Commercial Marine Vessels	2016
		Drayage Trucks - to NYNJLINA boundary	2016
		Drayage Trucks - from NYNJLINA to first point of rest	2012
	Mobile Combustion	Auto Marine Terminal, Vehicle Movements	2012
		Cargo Handling Equipment	2016
		Rail Locomotives	2016
	Purchased Electricity	Buildings	2013
	Stationary Combustion	Buildings	2013
Real Estate	Energy Production	Electricity Sold to Market	2016
	Purchased Electricity	Buildings	2013
	Stationary Combustion	Buildings	2013
Tunnels, Bridges & Bus Terminals	Attracted Travel	Queued Traffic	2012
		Through Traffic	2014
	Purchased Electricity	Buildings	2013
	Stationary Combustion	Buildings	2013
World Trade Center	Purchased Electricity	Buildings	2016
	Purchased Electricity	Economic Recovery Program	2016

APPENDIX B: 2016 OPERATIONS BY AIRCRAFT CODE

Airport	ICAO Code	Description	Model	Operations
		JFK		
JFK	A124	BOEING 707-320B/JT3D-7	Antonov 124 Ruslan	6
JFK	A306	A300-622R\PW4168	Airbus A300F4-600 Series	532
JFK	A310	A310-304\GE CF6-80 C2A2	Airbus A310-200 Series	124
JFK	A318	A319-131\IAE V2522-A5	Airbus A318-100 Series	963
JFK	A319	A319-131\IAE V2522-A5	Airbus A319-100 Series	14,256
JFK	A320	A320-211\CFM56-5A1	Airbus A320-200 Series	69,352
JFK	A321	A321-232\V2530-A5	Airbus A321-100 Series	47,480
JFK	A332	A330-301\GE CF6-80 E1A2	Airbus A330-200 Series	10,250
JFK	A333	A330-301\GE CF6-80 E1A2	Airbus A330-300 Series	12,165
JFK	A342	A340-211\CFM56-5C2	Airbus A340-200 Series	24
JFK	A343	A340-211\CFM56-5C2	Airbus A340-300 Series	450
JFK	A345	A340-642\Trent 556	Airbus A340-500 Series	30
JFK	A346	A340-642\Trent 556	Airbus A340-600 Series	4,959
JFK	A388	A380-841\RR trent970	Airbus A380-800 Series/Trent 970	7,118
JFK	AEST	BARON 58P/TS10-520-L	Aerostar PA-60	3
JFK	ASTR	ASTRA 1125/TFE731-3A	Israel IAI-1125 Astra	12
JFK	B190	BEECH 1900D / PT6A67	Raytheon Beech 1900-C	413
JFK	B350	DASH 6/PT6A-27	Raytheon Super King Air 300	195
JFK	B712	BOEING 717-200/BR 715	Boeing 717-200 Series	9,144
JFK	B721	BOEING 727-100/JT8D-7	Boeing 727-100 Series	4
JFK	B722	BOEING 727-200/JT8D-7	Boeing 727-200 Series	9
JFK	B732	BOEING 737/JT8D-9	Boeing 737-200 Series	5
JFK	B733	BOEING 737-300/CFM56-3B-1	Boeing 737-300 Series	464
JFK	B734	BOEING 737-400/CFM56-3C-1	Boeing 737-400 Series	143
JFK	B735	BOEING 737-500/CFM56-3C-1	Boeing 737-500 Series	4
JFK	B736	BOEING 737-700/CFM56-7B24	Boeing 737-600 Series	39
JFK	B737	BOEING 737-700/CFM56-7B24	Boeing 737-700 Series	694
JFK	B738	BOEING 737-800/CFM56-7B26	Boeing 737-800 Series	53,490
JFK	B739	BOEING 737-700/CFM56-7B24	Boeing 737-900 Series	4,056
JFK	B741	BOEING 747-100/JT9D-7QN	Boeing 747-100 Series	7
JFK	B742	BOEING 747-200/JT9D-7	Boeing 747-200 Series	115
JFK	B743	BOEING 747-200/JT9D-7A	Boeing 747-300 Series	3
JFK	B744	BOEING 747-400/PW4056	Boeing 747-400 Series	10,590
JFK	B748	Boeing 747-8F/GEnx-2B67	7478	4,203
JFK	B74S	BOEING 747SP/JT9D-7	Boeing 747-SP	4
JFK	B752	BOEING 757-200/PW2037	Boeing 757-200 Series	26,364
JFK	B753	BOEING 757-300/RB211-535E4B	Boeing 757-300 Series	253
JFK	B762	BOEING 767-300/PW4060	Boeing 767-200 ER	1,186
JFK	B763	BOEING 767-300/PW4060	Boeing 767-300 Series	25,140
JFK	B764	BOEING 767-400ER/CF6-80C2B(F)	Boeing 767-400	3,504
JFK	B772	BOEING 777-200ER/GE90-90B	Boeing 777-200 Series	11,013
JFK	B773	BOEING 777-300/TRENT892	Boeing 777-300 Series	1,634
JFK	B772	BOEING 777-300/TRENT892	Boeing 777-200-LR	1,449
JFK	B77W	Boeing 777-300ER/GE90-115B-EIS	Boeing 777-300 ER	17,025
JFK	B788	Boeing 787-8/T1000-C/01 Family Plan Cert	B787-8R	5,989
JFK	B789	Boeing 787-8/T1000-C/01 Family Plan Cert	Boeing 787-900 Dreamliner	2,199
JFK	BE10	DASH 6/PT6A-27	Raytheon King Air 100	4
JFK	BE20	DASH 6/PT6A-27	Raytheon C-12 Huron	153
JFK	B36T	Cessna 208 / PT6A-114	Raytheon Beech Bonanza 36	12
JFK	BE40	LEAR 25/CJ610-8	Raytheon Beechjet 400	260
JFK	BE55	BARON 58P/TS10-520-L	Raytheon Beech 55 Baron	7
JFK	BE58	BARON 58P/TS10-520-L	Raytheon Beech Baron 58	23
JFK	B74D	BOEING 747-400/PW4056	Boeing 747-400 Series Freighter	24
JFK	C17	F117-PW-100 NM	Boeing C-17A	74
JFK	C172	CESSNA 172R / LYCOMING IO-360-L2A	Cessna 172 Skyhawk	8
JFK	C182	Cessna 182H / Continental O-470-R	Cessna 182	6
JFK	C206	1985 1-ENG VP PROP	Cessna 206	3
JFK	C208	Piper PA-42 / PT6A-41	Cessna 208 Caravan	29
JFK	C10T	1985 1-ENG VP PROP	Cessna 210 Centurion	3
JFK	C25A	CIT 2/JT15D-4	Cessna 525 CitationJet	209
JFK	C25C	CIT 2/JT15D-4	Cessna 525C CitationJet	39
JFK	C310	BARON 58P/TS10-520-L	Cessna 310	15

Airport	ICAO Code	Description	Model	Operations
JFK	C340	BARON 58P/TS10-520-L	Cessna 340	5
JFK	C402	BARON 58P/TS10-520-L	Cessna 402	2
JFK	C14T	BARON 58P/TS10-520-L	Cessna 414	13
JFK	C421	BARON 58P/TS10-520-L	Cessna 421 Golden Eagle	11
JFK	C441	CONQUEST II/TPE331-8	Cessna 441 Conquest II	6
JFK	C500	CIT 2/JT15D-4	Cessna 500 Citation I	2
JFK	C510	510 CITATION MUSTANG	CESSNA CITATION 510	5
JFK	C550	CESSNA 550 CITATION BRAVO / PW530A	Cessna 550 Citation II	57
JFK	C560	Cessna Citation Ultra 560 / JT15D-5D	Cessna 560 Citation V	142
JFK	C560	Cessna Citation Ultra 560 / JT15D-5D	Cessna 560 Citation Excel	488
JFK	C650	CIT 3/TFE731-3-100S	Cessna 650 Citation III	17
JFK	C680	Cessna Model 680 Sovereign / PW306C	Cessna 680 Citation Sovereign	218
JFK	C750	CITATION X / ROLLS ROYCE ALLISON AE3007C	Cessna 750 Citation X	249
JFK	CL30	CL600/ALF502L	Bombardier Challenger 300	310
JFK	CL60	CL600/ALF502L	Bombardier Challenger 600	301
JFK	CRJ2	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-200	5,866
JFK	CRJ7	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-700	4,730
JFK	CRJ9	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-900	32,546
JFK	D328	Dornier 328-100 / PW119C	Dornier 328-100 Series	9
JFK	DC10	DC10-30/CF6-50C2	Boeing DC-10-30 Series	163
JFK	DC91	DC9-10/JT8D-7	Boeing DC-9-10 Series	2
JFK	DH8D	DASH 8-100/PW121	DeHavilland DHC-8-100	64
JFK	E120	EMBRAER 120 ER/ PRATT & WHITNEY PW118	Embraer EMB120 Brasilia	12
JFK	E135	EMBRAER 145 ER/ALLISON AE3007	Embraer Legacy	29
JFK	E145	EMBRAER 145 ER/ALLISON AE3007	Embraer ERJ145	20,167
JFK	E170	ERJ170-100	Embraer ERJ170	4,106
JFK	E190	ERJ190-100	Embraer ERJ190	31,099
JFK	E50P	510 CITATION MUSTANG	Embraer 500	28
JFK	E55P	CESSNA 550 CITATION BRAVO / PW530A	Embraer 505	221
JFK	EA50	Eclipse 500 / PW610F	Eclipse 500 / PW610F	15
JFK	F2TH	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dassault Falcon 2000	239
JFK	F900	1985 BUSINESS JET	Dassault Falcon 900	170
JFK	FA10	FEDX 727-200/JT8D-15	Dassault Mercure 100	5
JFK	FA20	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dassault Falcon 200	36
JFK	FA50	1985 BUSINESS JET	Dassault Falcon 50	74
JFK	FA7X	CITATION X / ROLLS ROYCE ALLISON AE3007C	Falcon 7X	44
JFK	G150	ASTRA 1125/TFE731-3A	Gulfstream G150	38
JFK	GALX	CITATION X / ROLLS ROYCE ALLISON AE3007C	Gulfstream G200	61
JFK	GL5T	GULFSTREAM GV/BR 710	Bombardier Global Express Business	43
JFK	GLEX	GULFSTREAM GV/BR 710	Bombardier Global Express	171
JFK	GLF3	GULFSTREAM GIV-SP/TAY 611-8	Gulfstream G300	6
JFK	GLF4	GULFSTREAM GIV-SP/TAY 611-8	Gulfstream G400	227
JFK	GLF5	GULFSTREAM GV/BR 710	Gulfstream G500	206
JFK	GLF6	GULFSTREAM GV/BR 710	GULFSTREAM AEROSPACE Gulfstream G650	50
JFK	H25A	LEAR 36/TFE731-2	Hawker HS-125 Series 1	1
JFK	H25B	FALCON 20/CF700-2D-2	Hawker HS-125 Series 700	551
JFK	H25C	LEAR 36/TFE731-2	Raytheon Hawker 1000	18
JFK	HA4T	CITATION X / ROLLS ROYCE ALLISON AE3007C	Raytheon Hawker 4000 Horizon	61
JFK	IL76	AIRBUS A300B4-200/CF6-50C2	Ilyushin 76 Candid	4
JFK	IL96	BOEING 747-200/JT9D-7	Ilyushin 96	4
JFK	J328	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dornier 328 Jet	4
JFK	LJ31	LEAR 36/TFE731-2	Bombardier Learjet 31	21
JFK	LJ35	LEAR 36/TFE731-2	Bombardier Learjet 35	373
JFK	LJ40	LEAR 36/TFE731-2	Bombardier Learjet 40	19
JFK	LJ45	LEAR 36/TFE731-2	Bombardier Learjet 45	128
JFK	LJ55	LEAR 36/TFE731-2	Bombardier Learjet 55	11
JFK	LJ60	LEAR 36/TFE731-2	Bombardier Learjet 60	82
JFK	M20T	1985 1-ENG VP PROP	Mooney M20-K	1
JFK	MD11	MD-11/CF6-80C2D1F	Boeing MD-11	991
JFK	MD82	MD-82/JT8D-217A	Boeing MD-82	6
JFK	MD83	MD-83/JT8D-219	Boeing MD-83	9
JFK	MD88	MD-83/JT8D-219	Boeing MD-88	5,711
JFK	MD90	MD-90/V2525-D5	Boeing MD-90	26
JFK	MU2	DASH 6/PT6A-27	Mitsubishi MU-2	1
JFK	P180	DASH 6/PT6A-27	Piaggio P.180 Avanti	22
JFK	P28A	1985 1-ENG FP PROP	Piper PA-28 Cherokee Series	4
JFK	P46T	1985 1-ENG FP PROP	Piper PA46-TP Meridian	9

Airport	ICAO Code	Description	Model	Operations
JFK	PA27	BARON 58P/TS10-520-L	Piper PA-27 Aztec	3
JFK	PA31	BARON 58P/TS10-520-L	Piper PA-31 Navajo	18
JFK	P32R	1985 1-ENG VP PROP	Piper PA-32 Cherokee Six	16
JFK	PA34	BARON 58P/TS10-520-L	Piper PA-34 Seneca	18
JFK	PAY1	CONQUEST II/TPE331-8	Piper PA-31T Cheyenne	13
JFK	PC12	Cessna 208 / PT6A-114	Pilatus PC-12	272
JFK	PRM1	CESSNA 550 CITATION BRAVO / PW530A	Raytheon Premier I	15
JFK	B722	FEDX 727-200/JT8D-15	Boeing 727-200 Series Super 27	2
JFK	SBR1	LEAR 36/TFE731-2	Rockwell Sabreliner 65	4
JFK	SR20	1985 1-ENG COMP	Cirrus SR20	3
JFK	SR22	1985 1-ENG COMP	Cirrus SR22	69
JFK	SW3	DASH 6/PT6A-27	Fairchild SA-227-AC Metro III	5
JFK	SW4	DASH 6/PT6A-27	Fairchild Metro IVC	2
JFK	T154	BOEING 727-200/JT8D-17	Tupolev 154 Careless	3
JFK	TBM7	1985 1-ENG VP PROP	EADS Socata TBM-700	12
JFK	TBM8	CONQUEST II/TPE331-8	SOCATA TBM 850	8
JFK	WW24	HS748/DART MK532-2	Gulfstream I	3
EWR				
EWR	B748	Boeing 747-8F/GEnx-2B67	7478	390
EWR	A306	A300-622R\PW4168	Airbus A300F4-600 Series	3,504
EWR	A310	A310-304\GE CF6-80 C2A2	Airbus A310-200 Series	7
EWR	A319	A319-131\IAE V2522-A5	Airbus A319-100 Series	5,194
EWR	A320	A320-211\CFM56-5A1	Airbus A320-200 Series	34,092
EWR	A321	A321-232\V2530-A5	Airbus A321-100 Series	1,500
EWR	A332	A330-301\GE CF6-80 E1A2	Airbus A330-200 Series	1,019
EWR	A333	A330-301\GE CF6-80 E1A2	Airbus A330-300 Series	3,418
EWR	A343	A340-211\CFM56-5C2	Airbus A340-300 Series	523
EWR	A345	A340-642\Trent 556	Airbus A340-500 Series	4
EWR	A346	A340-642\Trent 556	Airbus A340-600 Series	1,281
EWR	AT75	HS748/DART MK532-2	ATR 72-500	434
EWR	B788	Boeing 787-8/T1000-C/01 Family Plan Cert	B787-8R	839
EWR	B712	BOEING 717-200/BR 715	Boeing 717-200 Series	6,199
EWR	B721	BOEING 727-100/JT8D-7	Boeing 727-100 Series	5
EWR	B722	BOEING 727-200/JT8D-7	Boeing 727-200 Series	558
EWR	B732	BOEING 737/JT8D-9	Boeing 737-200 Series	12
EWR	B733	BOEING 737-300/CFM56-3B-1	Boeing 737-300 Series	352
EWR	B734	BOEING 737-400/CFM56-3C-1	Boeing 737-400 Series	349
EWR	B735	BOEING 737-500/CFM56-3C-1	Boeing 737-500 Series	5
EWR	B737	BOEING 737-700/CFM56-7B24	Boeing 737-700 Series	26,738
EWR	B738	BOEING 737-800/CFM56-7B26	Boeing 737-800 Series	39,967
EWR	B739	BOEING 737-700/CFM56-7B24	Boeing 737-900 Series	38,695
EWR	B741	BOEING 747-100/JT9D-7QN	Boeing 747-100 Series	6
EWR	B744	BOEING 747-400/PW4056	Boeing 747-400 Series	209
EWR	B752	BOEING 757-200/PW2037	Boeing 757-200 Series	38,289
EWR	B753	BOEING 757-300/RB211-535E4B	Boeing 757-300 Series	538
EWR	B762	BOEING 767-300/PW4060	Boeing 767-200 ER	588
EWR	B763	BOEING 767-300/PW4060	Boeing 767-300 Series	11,240
EWR	B764	BOEING 767-400ER/CF6-80C2B(F)	Boeing 767-400	5,976
EWR	B772	BOEING 777-200ER/GE90-90B	Boeing 777-200 Series	10,583
EWR	B772	BOEING 777-300/TRENT892	Boeing 777-200-LR	750
EWR	B77W	Boeing 777-300ER/GE90-115B-EIS	Boeing 777-300 ER	1,795
EWR	B773	BOEING 777-300/TRENT892	Boeing 777-300 Series	67
EWR	B789	Boeing 787-8/T1000-C/01 Family Plan Cert	Boeing 787-900 Dreamliner	1,288
EWR	DC10	DC10-30/CF6-50C2	Boeing DC-10-30 Series	532
EWR	DC93	DC9-30/JT8D-9	Boeing DC-9-30 Series	10
EWR	MD11	MD-11/CF6-80C2D1F	Boeing MD-11	4,402
EWR	MD81	MD-81/JT8D-217	Boeing MD-81	14
EWR	MD82	MD-82/JT8D-217A	Boeing MD-82	609
EWR	MD83	MD-83/JT8D-219	Boeing MD-83	897
EWR	MD87	MD-83/JT8D-219	Boeing MD-87	2
EWR	MD88	MD-83/JT8D-219	Boeing MD-88	2,868
EWR	MD90	MD-90/V2525-D5	Boeing MD-90	38
EWR	CL30	CL600/ALF502L	Bombardier Challenger 300	272
EWR	CL60	CL600/ALF502L	Bombardier Challenger 600	730
EWR	CRJ1	CL600/ALF502L	Bombardier CRJ-100	135
EWR	CRJ2	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-200	5,610
EWR	CRJ7	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-700	4,367

Airport	ICAO Code	Description	Model	Operations
EWR	CRJ9	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-900	4,901
EWR	DH8A	DASH 8-100/PW121	Bombardier de Havilland Dash 8 Q100	1,262
EWR	DH8C	DASH 8-300/PW123	Bombardier de Havilland Dash 8 Q300	4,796
EWR	GLEX	GULFSTREAM GV/BR 710	Bombardier Global Express	218
EWR	GL5T	GULFSTREAM GV/BR 710	Bombardier Global Express Business	74
EWR	LJ31	LEAR 36/TFE731-2	Bombardier Learjet 31	28
EWR	LJ35	LEAR 36/TFE731-2	Bombardier Learjet 35	52
EWR	LJ40	LEAR 36/TFE731-2	Bombardier Learjet 40	18
EWR	LJ45	LEAR 36/TFE731-2	Bombardier Learjet 45	66
EWR	LJ55	LEAR 36/TFE731-2	Bombardier Learjet 55	14
EWR	LJ60	LEAR 36/TFE731-2	Bombardier Learjet 60	80
EWR	C208	Piper PA-42 / PT6A-41	Cessna 208 Caravan	4,106
EWR	C310	BARON 58P/TS10-520-L	Cessna 310	1
EWR	C340	BARON 58P/TS10-520-L	Cessna 340	4
EWR	C14T	BARON 58P/TS10-520-L	Cessna 414	5
EWR	C421	BARON 58P/TS10-520-L	Cessna 421 Golden Eagle	4
EWR	C441	CONQUEST II/TPE331-8	Cessna 441 Conquest II	10
EWR	C25A	CIT 2/JT15D-4	Cessna 525 CitationJet	140
EWR	C25C	CIT 2/JT15D-4	Cessna 525C CitationJet	14
EWR	C550	CESSNA 550 CITATION BRAVO / PW530A	Cessna 550 Citation II	29
EWR	C560	Cessna Citation Ultra 560 / JT15D-5D	Cessna 560 Citation Excel	380
EWR	C560	Cessna Citation Ultra 560 / JT15D-5D	Cessna 560 Citation V	151
EWR	C650	CIT 3/TFE731-3-100S	Cessna 650 Citation III	16
EWR	C680	Cessna Model 680 Sovereign / PW306C	Cessna 680 Citation Sovereign	223
EWR	C750	CITATION X / ROLLS ROYCE ALLISON AE3007C	Cessna 750 Citation X	214
EWR	SR20	1985 1-ENG COMP	Cirrus SR20	8
EWR	SR22	1985 1-ENG COMP	Cirrus SR22	10
EWR	FA20	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dassault Falcon 200	11
EWR	F2TH	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dassault Falcon 2000	207
EWR	FA50	1985 BUSINESS JET	Dassault Falcon 50	78
EWR	F900	1985 BUSINESS JET	Dassault Falcon 900	103
EWR	DH8D	DASH 8-100/PW121	DeHavilland DHC-8-100	22,360
EWR	D328	Dornier 328-100 / PW119C	Dornier 328-100 Series	2
EWR	EA50	Eclipse 500 / PW610F	Eclipse 500 / PW610F	24
EWR	E50P	510 CITATION MUSTANG	Embraer 500	10
EWR	E55P	CESSNA 550 CITATION BRAVO / PW530A	Embraer 505	220
EWR	E145	EMBRAER 145 ER/ALLISON AE3007	Embraer ERJ145	53,089
EWR	E145	EMBRAER 145 LR / ALLISON AE3007A1	Embraer ERJ145-LR	22,822
EWR	E170	ERJ170-100	Embraer ERJ170	49,396
EWR	E190	ERJ190-100	Embraer ERJ190	6,484
EWR	E135	EMBRAER 145 ER/ALLISON AE3007	Embraer Legacy	21
EWR	FA7X	CITATION X / ROLLS ROYCE ALLISON AE3007C	Falcon 7X	74
EWR	GLF6	GULFSTREAM GV/BR 710	GULFSTREAM AEROSPACE Gulfstream G650	68
EWR	G150	ASTRA 1125/TFE731-3A	Gulfstream G150	64
EWR	GALX	CITATION X / ROLLS ROYCE ALLISON AE3007C	Gulfstream G200	55
EWR	GLF3	GULFSTREAM GIV-SP/TAY 611-8	Gulfstream G300	12
EWR	GLF4	GULFSTREAM GIV-SP/TAY 611-8	Gulfstream G400	398
EWR	GLF5	GULFSTREAM GV/BR 710	Gulfstream G500	284
EWR	WW24	HS748/DART MK532-2	Gulfstream I	4
EWR	H25A	LEAR 36/TFE731-2	Hawker HS-125 Series 1	2
EWR	H25B	FALCON 20/CF700-2D-2	Hawker HS-125 Series 700	310
EWR	ASTR	ASTRA 1125/TFE731-3A	Israel IAI-1125 Astra	16
EWR	MU2	DASH 6/PT6A-27	Mitsubishi MU-2	2
EWR	P180	DASH 6/PT6A-27	Piaggio P.180 Avanti	6
EWR	PC12	Cessna 208 / PT6A-114	Pilatus PC-12	180
EWR	PA31	BARON 58P/TS10-520-L	Piper PA-31 Navajo	15
EWR	PAY1	CONQUEST II/TPE331-8	Piper PA-31T Cheyenne	11
EWR	P32R	1985 1-ENG VP PROP	Piper PA-32 Cherokee Six	28
EWR	PA34	BARON 58P/TS10-520-L	Piper PA-34 Seneca	12
EWR	P46T	1985 1-ENG FP PROP	Piper PA46-TP Meridian	6
EWR	B190	BEECH 1900D / PT6A67	Raytheon Beech 1900-C	2
EWR	BE58	BARON 58P/TS10-520-L	Raytheon Beech Baron 58	11
EWR	BE40	LEAR 25/CJ610-8	Raytheon Beechjet 400	198
EWR	BE20	DASH 6/PT6A-27	Raytheon C-12 Huron	36
EWR	H25C	LEAR 36/TFE731-2	Raytheon Hawker 1000	12
EWR	HA4T	CITATION X / ROLLS ROYCE ALLISON AE3007C	Raytheon Hawker 4000 Horizon	26
EWR	BE10	DASH 6/PT6A-27	Raytheon King Air 100	10

Airport	ICAO Code	Description	Model	Operations
EWR	BE9L	DASH 6/PT6A-27	Raytheon King Air 90	62
EWR	PRM1	CESSNA 550 CITATION BRAVO / PW530A	Raytheon Premier I	12
EWR	B350	DASH 6/PT6A-27	Raytheon Super King Air 300	124
EWR	S76	Sikorsky S-76 Spirit	Sikorsky S-76 Spirit	258
EWR	TBM8	CONQUEST II/TPE331-8	SOCATA TBM 850	2
LGA				
LGA	A319	A319-131\IAE V2522-A5	Airbus A319-100 Series	14,028
LGA	A320	A320-211\CFM56-5A1	Airbus A320-200 Series	34,934
LGA	A321	A321-232\V2530-A5	Airbus A321-100 Series	11,026
LGA	B350	DASH 6/PT6A-27	Raytheon Super King Air 300	127
LGA	B712	BOEING 717-200/BR 715	Boeing 717-200 Series	13,446
LGA	B733	BOEING 737-300/CFM56-3B-1	Boeing 737-300 Series	317
LGA	B734	BOEING 737-400/CFM56-3C-1	Boeing 737-400 Series	76
LGA	B736	BOEING 737-700/CFM56-7B24	Boeing 737-600 Series	2,686
LGA	B737	BOEING 737-700/CFM56-7B24	Boeing 737-700 Series	27,000
LGA	B738	BOEING 737-800/CFM56-7B26	Boeing 737-800 Series	31,435
LGA	B739	BOEING 737-700/CFM56-7B24	Boeing 737-900 Series	4,051
LGA	B752	BOEING 757-200/PW2037	Boeing 757-200 Series	293
LGA	B753	BOEING 757-300/RB211-535E4B	Boeing 757-300 Series	477
LGA	B763	BOEING 767-300/PW4060	Boeing 767-300 Series	43
LGA	BE10	DASH 6/PT6A-27	Raytheon King Air 100	5
LGA	BE20	DASH 6/PT6A-27	Raytheon C-12 Huron	43
LGA	BE40	LEAR 25/CJ610-8	Raytheon Beechjet 400	178
LGA	BE55	BARON 58P/TS10-520-L	Raytheon Beech 55 Baron	8
LGA	BE58	BARON 58P/TS10-520-L	Raytheon Beech Baron 58	14
LGA	BE9L	DASH 6/PT6A-27	Raytheon King Air 90	19
LGA	C150	1985 1-ENG FP PROP	Cessna 150 Series	1
LGA	C172	CESSNA 172R / LYCOMING IO-360-L2A	Cessna 172 Skyhawk	6
LGA	C208	Piper PA-42 / PT6A-41	Cessna 208 Caravan	14
LGA	C10T	1985 1-ENG VP PROP	Cessna 210 Centurion	4
LGA	C25A	CIT 2/JT15D-4	Cessna 525 CitationJet	118
LGA	C25C	CIT 2/JT15D-4	Cessna 525C CitationJet	12
LGA	C310	BARON 58P/TS10-520-L	Cessna 310	4
LGA	C340	BARON 58P/TS10-520-L	Cessna 340	1
LGA	C14T	BARON 58P/TS10-520-L	Cessna 414	10
LGA	C441	CONQUEST II/TPE331-8	Cessna 441 Conquest II	4
LGA	C500	CIT 2/JT15D-4	Cessna 500 Citation I	769
LGA	C510	510 CITATION MUSTANG	CESSNA CITATION 510	23
LGA	C550	CESSNA 550 CITATION BRAVO / PW530A	Cessna 550 Citation II	22
LGA	C560	Cessna Citation Ultra 560 / JT15D-5D	Cessna 560 Citation V	155
LGA	C560	Cessna Citation Ultra 560 / JT15D-5D	Cessna 560 Citation Excel	541
LGA	C680	Cessna Model 680 Sovereign / PW306C	Cessna 680 Citation Sovereign	286
LGA	C750	CITATION X / ROLLS ROYCE ALLISON AE3007C	Cessna 750 Citation X	512
LGA	CL30	CL600/ALF502L	Bombardier Challenger 300	357
LGA	CL60	CL600/ALF502L	Bombardier Challenger 600	165
LGA	CRJ1	CL600/ALF502L	Bombardier CRJ-100	6
LGA	CRJ2	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-200	26,914
LGA	CRJ7	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-700	37,728
LGA	DC91	DC9-10/JT8D-7	Boeing DC-9-10 Series	2
LGA	DH8D	DASH 8-100/PW121	DeHavilland DHC-8-100	31
LGA	E135	EMBRAER 145 ER/ALLISON AE3007	Embraer Legacy	47
LGA	E145	EMBRAER 145 ER/ALLISON AE3007	Embraer ERJ145	22,109
LGA	E170	ERJ170-100	Embraer ERJ170	55,087
LGA	E190	ERJ190-100	Embraer ERJ190	25,461
LGA	E145	EMBRAER 145 LR / ALLISON AE3007A1	Embraer ERJ145-LR	1,322
LGA	E50P	510 CITATION MUSTANG	Embraer 500	2
LGA	E55P	CESSNA 550 CITATION BRAVO / PW530A	Embraer 505	393
LGA	EA50	Eclipse 500 / PW610F	Eclipse 500 / PW610F	5
LGA	F2TH	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dassault Falcon 2000	298
LGA	F900	1985 BUSINESS JET	Dassault Falcon 900	317
LGA	FA10	FEDX 727-200/JT8D-15	Dassault Mercure 100	2
LGA	FA20	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dassault Falcon 200	5
LGA	FA50	1985 BUSINESS JET	Dassault Falcon 50	32
LGA	FA7X	CITATION X / ROLLS ROYCE ALLISON AE3007C	Falcon 7X	26
LGA	G150	ASTRA 1125/TFE731-3A	Gulfstream G150	14
LGA	GALX	CITATION X / ROLLS ROYCE ALLISON AE3007C	Gulfstream G200	46
LGA	GL5T	GULFSTREAM GV/BR 710	Bombardier Global Express Business	158

Airport	ICAO Code	Description	Model	Operations
LGA	GLEX	GULFSTREAM GV/BR 710	Bombardier Global Express	332
LGA	GLF3	GULFSTREAM GIV-SP/TAY 611-8	Gulfstream G300	4
LGA	GLF4	GULFSTREAM GIV-SP/TAY 611-8	Gulfstream G400	631
LGA	GLF5	GULFSTREAM GV/BR 710	Gulfstream G500	404
LGA	GLF6	GULFSTREAM GV/BR 710	GULFSTREAM AEROSPACE Gulfstream G650	102
LGA	H25B	FALCON 20/CF700-2D-2	Hawker HS-125 Series 700	431
LGA	H25C	LEAR 36/TFE731-2	Raytheon Hawker 1000	11
LGA	HA4T	CITATION X / ROLLS ROYCE ALLISON AE3007C	Raytheon Hawker 4000 Horizon	205
LGA	J328	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dornier 328 Jet	2
LGA	LJ31	LEAR 36/TFE731-2	Bombardier Learjet 31	14
LGA	LJ35	LEAR 36/TFE731-2	Bombardier Learjet 35	14
LGA	LJ40	LEAR 36/TFE731-2	Bombardier Learjet 40	13
LGA	LJ45	LEAR 36/TFE731-2	Bombardier Learjet 45	67
LGA	LJ55	LEAR 36/TFE731-2	Bombardier Learjet 55	7
LGA	LJ60	LEAR 36/TFE731-2	Bombardier Learjet 60	50
LGA	MD81	MD-81/JT8D-217	Boeing MD-81	1
LGA	MD82	MD-82/JT8D-217A	Boeing MD-82	12
LGA	MD83	MD-83/JT8D-219	Boeing MD-83	16
LGA	MD88	MD-83/JT8D-219	Boeing MD-88	15,628
LGA	MD90	MD-90/V2525-D5	Boeing MD-90	7,838
LGA	PC12	Cessna 208 / PT6A-114	Pilatus PC-12	333
SWF				
SWF	B748	Boeing 747-8F/GEnx-2B67	7478	7
SWF	AEST	BARON 58P/TS10-520-L	Aerostar PA-60	199
SWF	A306	A300-622R\PW4168	Airbus A300F4-600 Series	793
SWF	A310	A310-304\GE CF6-80 C2A2	Airbus A310-200 Series	494
SWF	FA20	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dassault Falcon 200	14
SWF	A320	A320-211\CFM56-5A1	Airbus A320-200 Series	533
SWF	A321	A321-232\V2530-A5	Airbus A321-100 Series	39
SWF	A332	A330-301\GE CF6-80 E1A2	Airbus A330-200 Series	3
SWF	A333	A330-301\GE CF6-80 E1A2	Airbus A330-300 Series	7
SWF	A343	A340-211\CFM56-5C2	Airbus A340-300 Series	7
SWF	A346	A340-642\Trent 556	Airbus A340-600 Series	3
SWF	A388	A380-841\RR trent970	Airbus A380-800 Series/Trent 970	3
SWF	E170	ERJ170-100	Embraer ERJ170	14
SWF	B712	BOEING 717-200/BR 715	Boeing 717-200 Series	7
SWF	GLF3	GULFSTREAM GIV-SP/TAY 611-8	Gulfstream G300	14
SWF	PA23	BARON 58P/TS10-520-L	Piper PA-23 Apache/Aztec	14
SWF	B736	BOEING 737-700/CFM56-7B24	Boeing 737-600 Series	3
SWF	B737	BOEING 737-700/CFM56-7B24	Boeing 737-700 Series	142
SWF	B738	BOEING 737-800/CFM56-7B26	Boeing 737-800 Series	167
SWF	FA10	FEDX 727-200/JT8D-15	Dassault Mercure 100	17
SWF	B744	BOEING 747-400/PW4056	Boeing 747-400 Series	64
SWF	B752	BOEING 757-200/PW2037	Boeing 757-200 Series	3,547
SWF	B762	BOEING 767-300/PW4060	Boeing 767-200 ER	71
SWF	DH8D	DASH 8-100/PW121	DeHavilland DHC-8-100	17
SWF	A319	A319-131\IAE V2522-A5	Airbus A319-100 Series	17
SWF	DH8C	DASH 8-300/PW123	Bombardier de Havilland Dash 8 Q300	17
SWF	C17	F117-PW-100 NM	Boeing C-17A	10
SWF	MD83	MD-83/JT8D-219	Boeing MD-83	519
SWF	MD88	MD-83/JT8D-219	Boeing MD-88	85
SWF	CL30	CL600/ALF502L	Bombardier Challenger 300	370
SWF	CL60	CL600/ALF502L	Bombardier Challenger 600	1,889
SWF	CRJ2	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-200	3,935
SWF	C421	BARON 58P/TS10-520-L	Cessna 421 Golden Eagle	17
SWF	CRJ9	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-900	49
SWF	DH8A	DASH 8-100/PW121	Bombardier de Havilland Dash 8 Q100	5,807
SWF	DH8B	DASH 8-300/PW123	Bombardier de Havilland Dash 8 Q200	3
SWF	HA4T	CITATION X / ROLLS ROYCE ALLISON AE3007C	Raytheon Hawker 4000 Horizon	17
SWF	GL5T	BD-700-1A11\BR700-710A2-20	Bombardier Global 5000 Business	384
SWF	GLEX	BD-700-1A10\BR700-710A2-20	Bombardier Global Express	551
SWF	LJ31	LEAR 36/TFE731-2	Bombardier Learjet 31	81
SWF	LJ35	LEAR 36/TFE731-2	Bombardier Learjet 35	92
SWF	A124	BOEING 747-200/JT9D-7Q	Antonov 124 Ruslan	21
SWF	LJ45	LEAR 36/TFE731-2	Bombardier Learjet 45	878
SWF	C310	BARON 58P/TS10-520-L	Cessna 310	21
SWF	LJ60	LEAR 36/TFE731-2	Bombardier Learjet 60	427

Airport	ICAO Code	Description	Model	Operations
SWF	C150	1985 1-ENG FP PROP	Cessna 150 Series	35
SWF	C172	CESSNA 172R / LYCOMING IO-360-L2A	Cessna 172 Skyhawk	1,064
SWF	C182	Cessna 182H / Continental O-470-R	Cessna 182	224
SWF	C206	1985 1-ENG VP PROP	Cessna 206	67
SWF	C208	Piper PA-42 / PT6A-41	Cessna 208 Caravan	53
SWF	PA27	BARON 58P/TS10-520-L	Piper PA-27 Aztec	21
SWF	C337	BARON 58P/TS10-520-L	Cessna 337 Skymaster	3
SWF	CRJ7	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-700	21
SWF	LJ40	LEAR 36/TFE731-2	Bombardier Learjet 40	21
SWF	C425	CONQUEST II/TPE331-8	Cessna 425 Conquest I	88
SWF	C340	BARON 58P/TS10-520-L	Cessna 340	21
SWF	C500	CIT 2/JT15D-4	Cessna 500 Citation I	10
SWF	C501	CIT 2/JT15D-4	Cessna 501 Citation ISP	46
SWF	C25A	CIT 2/JT15D-4	Cessna 525 CitationJet	373
SWF	C25C	CIT 2/JT15D-4	Cessna 525C CitationJet	334
SWF	C550	CESSNA 550 CITATION BRAVO / PW530A	Cessna 550 Citation II	480
SWF	C560	Cessna Citation Ultra 560 / JT15D-5D	Cessna 560 Citation V	683
SWF	C650	CIT 3/TFE731-3-100S	Cessna 650 Citation III	99
SWF	C680	Cessna Model 680 Sovereign / PW306C	Cessna 680 Citation Sovereign	1,067
SWF	C750	CITATION X / ROLLS ROYCE ALLISON AE3007C	Cessna 750 Citation X	1,192
SWF	C510	510 CITATION MUSTANG	CESSNA CITATION 510	352
SWF	SR20	1985 1-ENG COMP	Cirrus SR20	238
SWF	SR22	1985 1-ENG COMP	Cirrus SR22	505
SWF	C441	CONQUEST II/TPE331-8	Cessna 441 Conquest II	21
SWF	TBM7	1985 1-ENG VP PROP	EADS Socata TBM-700	21
SWF	F2TH	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dassault Falcon 2000	409
SWF	EA50	Eclipse 500 / PW610F	Eclipse 500 / PW610F	21
SWF	F900	1985 BUSINESS JET	Dassault Falcon 900	131
SWF	B772	BOEING 777-200ER/GE90-90B	Boeing 777-200 Series	24
SWF	DHC6	DASH 6/PT6A-27	DeHavilland DHC-6-300 Twin Otter	7
SWF	AC95	CONQUEST II/TPE331-8	COMMANDER980/1000	24
SWF	J328	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dornier 328 Jet	3
SWF	TRIN	1985 1-ENG VP PROP	EADS Socata TB-20 Trinidad	3
SWF	E135	EMBRAER 145 ER/ALLISON AE3007	Embraer Legacy	24
SWF	ASTR	ASTRA 1125/TFE731-3A	Israel IAI-1125 Astra	24
SWF	B734	BOEING 737-400/CFM56-3C-1	Boeing 737-400 Series	28
SWF	E55P	CESSNA 550 CITATION BRAVO / PW530A	Embraer 505	384
SWF	E145	EMBRAER 145 ER/ALLISON AE3007	Embraer ERJ145	394
SWF	E50P	510 CITATION MUSTANG	Embraer 500	28
SWF	E190	ERJ190-100	Embraer ERJ190	5,003
SWF	PA30	PIPER TWIN COMANCHE PA-30 / IO-320-B1A	Piper PA-30 Twin Comanche	28
SWF	FA7X	CITATION X / ROLLS ROYCE ALLISON AE3007C	Falcon 7X	60
SWF	GLF6	GULFSTREAM GV/BR 710	GULFSTREAM AEROSPACE Gulfstream G650	562
SWF	G150	ASTRA 1125/TFE731-3A	Gulfstream G150	202
SWF	GALX	CITATION X / ROLLS ROYCE ALLISON AE3007C	Gulfstream G200	99
SWF	TBM8	CONQUEST II/TPE331-8	SOCATA TBM 850	28
SWF	GLF4	GULFSTREAM GIV-SP/TAY 611-8	Gulfstream G400	1,434
SWF	GLF5	GULFSTREAM GV/BR 710	Gulfstream G500	1,281
SWF	WW24	HS748/DART MK532-2	Gulfstream I	56
SWF	GLF2	GULFSTREAM GII/SPEY 511-8	Gulfstream II	3
SWF	H25B	LEAR 36/TFE731-2	Hawker HS-125 Series 700	459
SWF	FA50	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dassault Falcon 50	32
SWF	C130	C-130H/T56-A-15	Lockheed C-130 Hercules	74
SWF	L29B	LEAR 36/TFE731-2	Lockheed L-1329 Jetstar II	7
SWF	PA24	1985 1-ENG VP PROP	Piper PA-24 Comanche	32
SWF	M20T	1985 1-ENG VP PROP	Mooney M20-K	60
SWF	P180	DASH 6/PT6A-27	Piaggio P.180 Avanti	74
SWF	PC12	Cessna 208 / PT6A-114	Pilatus PC-12	1,629
SWF	P46T	1985 1-ENG FP PROP	Piper PA46-TP Meridian	32
SWF	B722	BOEING 727-200/JT8D-7	Boeing 727-200 Series	42
SWF	B739	BOEING 737-700/CFM56-7B24	Boeing 737-900 Series	42
SWF	P28A	1985 1-ENG FP PROP	Piper PA-28 Cherokee Series	423
SWF	B763	BOEING 767-300/PW4060	Boeing 767-300 Series	42
SWF	PA31	BARON 58P/TS10-520-L	Piper PA-31 Navajo	181
SWF	P32R	1985 1-ENG VP PROP	Piper PA-32 Cherokee Six	3
SWF	PA34	BARON 58P/TS10-520-L	Piper PA-34 Seneca	64
SWF	PAY3	Piper PA-42 / PT6A-41	Piper PA-42 Cheyenne Series	3

Airport	ICAO Code	Description	Model	Operations
SWF	B764	BOEING 767-400ER/CF6-80C2B(F)	Boeing 767-400	42
SWF	B190	BEECH 1900D / PT6A67	Raytheon Beech 1900-C	7
SWF	BE55	BARON 58P/TS10-520-L	Raytheon Beech 55 Baron	96
SWF	BE58	BARON 58P/TS10-520-L	Raytheon Beech Baron 58	373
SWF	BE40	MU300-10/JT15D-5	Raytheon Beechjet 400	405
SWF	BE20	DASH 6/PT6A-27	Raytheon C-12 Huron	202
SWF	H25C	LEAR 36/TFE731-2	Raytheon Hawker 1000	3
SWF	LJ55	LEAR 36/TFE731-2	Bombardier Learjet 55	42
SWF	BE10	DASH 6/PT6A-27	Raytheon King Air 100	7
SWF	MU2	DASH 6/PT6A-27	Mitsubishi MU-2	110
SWF	BE9L	DASH 6/PT6A-27	Raytheon King Air 90	110
SWF	B350	DASH 6/PT6A-27	Raytheon Super King Air 300	430
SWF	R44	Robinson R44 Raven / Lycoming O-540-F1B5	Robinson R44 Raven / Lycoming O-540-F1B5	3
SWF	AC50	BARON 58P/TS10-520-L	Rockwell Commander 500	7
SWF	AC90	DASH 6/PT6A-27	Rockwell Commander 690	7
SWF	SBR1	LEAR 36/TFE731-2	Rockwell Sabreliner 65	10
SWF	SB20	HS748/DART MK532-2	Saab 2000	7
SWF	SF34	SF340B/CT7-9B	Saab 340-A	7
SWF	S76	Sikorsky S-76 Spirit	Sikorsky S-76 Spirit	3
SWF	PRM1	CESSNA 550 CITATION BRAVO / PW530A	Raytheon Premier I	110
TEB				
TEB	AEST	BARON 58P/TS10-520-L	Aerostar PA-60	46
TEB	A109	Agusta A-109	Agusta A-109	182
TEB	A318	A319-131\IAE V2522-A5	Airbus A318-100 Series	1
TEB	A321	A321-232\V2530-A5	Airbus A321-100 Series	42
TEB	A343	A340-211\CFM56-5C2	Airbus A340-300 Series	1
TEB	B788	Boeing 787-8/T1000-C/01 Family Plan Cert	B787-8R	2
TEB	B461	BAE146-200/ALF502R-5	BAE 146-100	2
TEB	JS31	DASH 6/PT6A-27	BAE Jetstream 31	81
TEB	B06	Bell 206L Long Ranger	Bell 206 JetRanger	112
TEB	B407	Bell 407	Bell 407 / Rolls-Royce 250-C47B	2,962
TEB	B722	BOEING 727-200/JT8D-7	Boeing 727-200 Series	1
TEB	B737	BOEING 737-700/CFM56-7B24	Boeing 737-700 Series	90
TEB	B739	BOEING 737-700/CFM56-7B24	Boeing 737-900 Series	26
TEB	B764	BOEING 767-400ER/CF6-80C2B(F)	Boeing 767-400	4
TEB	B764	BOEING 767-400ER/CF6-80C2B(F)	Boeing 767-400 ER	4
TEB	B77W	Boeing 777-300ER/GE90-115B-EIS	Boeing 777-300 ER	6
TEB	C17	F117-PW-100 NM	Boeing C-17A	1
TEB	DC3	DC3/R1820-86	Boeing DC-3	1
TEB	DC86	DC8-60/JT8D-7QN	Boeing DC-8 Series 60	19
TEB	DC93	DC9-30/JT8D-9	Boeing DC-9-30 Series	2
TEB	MD11	DC10-10/CF6-6D	Boeing MD-10-1	2
TEB	CL30	CL600/ALF502L	Bombardier Challenger 300	10,278
TEB	CL60	CL600/ALF502L	Bombardier Challenger 600	9,995
TEB	CRJ1	CL600/ALF502L	Bombardier CRJ-100	30
TEB	CRJ2	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-200	865
TEB	CRJ7	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-700	90
TEB	CRJ9	CL-600-2D15/CL-600-2D24/CF34-8C5	Bombardier CRJ-900	33
TEB	DH8A	DASH 8-100/PW121	Bombardier de Havilland Dash 8 Q100	9
TEB	DH8B	DASH 8-300/PW123	Bombardier de Havilland Dash 8 Q200	27
TEB	DH8C	DASH 8-300/PW123	Bombardier de Havilland Dash 8 Q300	5
TEB	GL5T	BD-700-1A11\BR700-710A2-20	Bombardier Global 5000 Business	2,737
TEB	GLEX	BD-700-1A10\BR700-710A2-20	Bombardier Global Express	5,684
TEB	LJ24	LEAR 25/CJ610-8	Bombardier Learjet 24	6
TEB	LJ25	LEAR 25/CJ610-8	Bombardier Learjet 25	1
TEB	LJ31	LEAR 36/TFE731-2	Bombardier Learjet 31	687
TEB	LJ35	LEAR 36/TFE731-2	Bombardier Learjet 35	1,672
TEB	LJ40	LEAR 36/TFE731-2	Bombardier Learjet 40	555
TEB	LJ45	LEAR 36/TFE731-2	Bombardier Learjet 45	3,436
TEB	LJ55	LEAR 36/TFE731-2	Bombardier Learjet 55	742
TEB	LJ60	LEAR 36/TFE731-2	Bombardier Learjet 60	3,944
TEB	C212	DASH 6/PT6A-27	CASA 212-100 Series	177
TEB	C150	1985 1-ENG FP PROP	Cessna 150 Series	3
TEB	C172	CESSNA 172R / LYCOMING IO-360-L2A	Cessna 172 Skyhawk	340
TEB	C182	Cessna 182H / Continental O-470-R	Cessna 182	155
TEB	C206	1985 1-ENG VP PROP	Cessna 206	112
TEB	C208	Piper PA-42 / PT6A-41	Cessna 208 Caravan	182

Airport	ICAO Code	Description	Model	Operations
TEB	C10T	1985 1-ENG VP PROP	Cessna 210 Centurion	2
TEB	C310	BARON 58P/TS10-520-L	Cessna 310	118
TEB	C337	BARON 58P/TS10-520-L	Cessna 337 Skymaster	2
TEB	C340	BARON 58P/TS10-520-L	Cessna 340	60
TEB	C402	BARON 58P/TS10-520-L	Cessna 402	16
TEB	C404	BARON 58P/TS10-520-L	Cessna 404 Titan II	1
TEB	C421	BARON 58P/TS10-520-L	Cessna 421 Golden Eagle	268
TEB	C425	CONQUEST II/TPE331-8	Cessna 425 Conquest I	29
TEB	C441	CONQUEST II/TPE331-8	Cessna 441 Conquest II	342
TEB	C500	CIT 2/JT15D-4	Cessna 500 Citation I	118
TEB	C501	CIT 2/JT15D-4	Cessna 501 Citation ISP	82
TEB	C25A	CIT 2/JT15D-4	Cessna 525 CitationJet	1,465
TEB	C25C	CIT 2/JT15D-4	Cessna 525C CitationJet	629
TEB	C550	CESSNA 550 CITATION BRAVO / PW530A	Cessna 550 Citation II	1,160
TEB	C551	CESSNA 550 CITATION BRAVO / PW530A	Cessna 551 Citation IISP	2
TEB	C560	Cessna Citation Ultra 560 / JT15D-5D	Cessna 560 Citation V	3,808
TEB	C650	CIT 3/TFE731-3-100S	Cessna 650 Citation III	799
TEB	C680	Cessna Model 680 Sovereign / PW306C	Cessna 680 Citation Sovereign	5,719
TEB	C750	CITATION X / ROLLS ROYCE ALLISON AE3007C	Cessna 750 Citation X	8,922
TEB	C510	510 CITATION MUSTANG	CESSNA CITATION 510	466
TEB	SR20	1985 1-ENG COMP	Cirrus SR20	69
TEB	SR22	1985 1-ENG COMP	Cirrus SR22	1,700
TEB	AC95	CONQUEST II/TPE331-8	COMMANDER980/1000	13
TEB	FA20	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dassault Falcon 200	406
TEB	F2TH	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dassault Falcon 2000	8,311
TEB	FA20	FALCON 20/CF700-2D-2	Dassault Falcon 20-C	83
TEB	FA50	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dassault Falcon 50	1,836
TEB	F900	1985 BUSINESS JET	Dassault Falcon 900	5,444
TEB	FA10	FEDX 727-200/JT8D-15	Dassault Mercure 100	247
TEB	DH2T	1985 1-ENG VP PROP	DeHavilland DHC-2 Mk III Beaver	48
TEB	J328	CITATION X / ROLLS ROYCE ALLISON AE3007C	Dornier 328 Jet	63
TEB	D328	Dornier 328-100 / PW119C	Dornier 328-100 Series	17
TEB	TRIN	1985 1-ENG VP PROP	EADS Socata TB-20 Trinidad	2
TEB	TBM7	1985 1-ENG VP PROP	EADS Socata TBM-700	184
TEB	EA50	Eclipse 500 / PW610F	Eclipse 500 / PW610F	463
TEB	E50P	510 CITATION MUSTANG	Embraer 500	1,150
TEB	E55P	CESSNA 550 CITATION BRAVO / PW530A	Embraer 505	4,884
TEB	E110	DASH 6/PT6A-27	Embraer EMB110 Bandeirante	6
TEB	E120	EMBRAER 120 ER/ PRATT & WHITNEY PW118	Embraer EMB120 Brasilia	24
TEB	E145	EMBRAER 145 ER/ALLISON AE3007	Embraer ERJ145	141
TEB	E45X	EMBRAER 145 ER/ALLISON AE3007	Embraer ERJ145-XR	62
TEB	E190	ERJ190-100	Embraer ERJ190	77
TEB	E135	EMBRAER 145 ER/ALLISON AE3007	Embraer Legacy	1,139
TEB	SW4	DASH 6/PT6A-27	Fairchild Metro IVC	9
TEB	SW3	DASH 6/PT6A-27	Fairchild SA-227-AC Metro III	16
TEB	FA7X	CITATION X / ROLLS ROYCE ALLISON AE3007C	Falcon 7X	1,308
TEB	GLF6	GULFSTREAM GV/BR 710	GULFSTREAM AEROSPACE Gulfstream G650	1,641
TEB	G150	ASTRA 1125/TFE731-3A	Gulfstream G150	1,005
TEB	GALX	CITATION X / ROLLS ROYCE ALLISON AE3007C	Gulfstream G200	2,272
TEB	GLF3	GULFSTREAM GIV-SP/TAY 611-8	Gulfstream G300	412
TEB	GLF5	GULFSTREAM GV/BR 710	Gulfstream G500	18,779
TEB	WW24	HS748/DART MK532-2	Gulfstream I	153
TEB	GLF2	GULFSTREAM GII/SPEY 511-8	Gulfstream II	155
TEB	GLF2	GULFSTREAM GIIB/GIII - SPEY 511-8	Gulfstream II-SP	2
TEB	H25A	LEAR 36/TFE731-2	Hawker HS-125 Series 1	61
TEB	H25B	LEAR 36/TFE731-2	Hawker HS-125 Series 700	11,502
TEB	COUR	1985 1-ENG VP PROP	Helio U-10 Super Courier	3
TEB	H500	Hughes 500D	Hughes OH-6 Cayuse	113
TEB	IL96	A340-211\CFM56-5C2	Ilyushin 96	1
TEB	ASTR	ASTRA 1125/TFE731-3A	Israel IAI-1125 Astra	451
TEB	L29B	LEAR 36/TFE731-2	Lockheed L-1329 Jetstar II	41
TEB	MU2	DASH 6/PT6A-27	Mitsubishi MU-2	65
TEB	MU30	MU300-10/JT15D-5	Mitsubishi MU-300 Diamond	24
TEB	M20T	1985 1-ENG VP PROP	Mooney M20-K	141
TEB	P180	DASH 6/PT6A-27	Piaggio P.180 Avanti	550
TEB	PC12	Cessna 208 / PT6A-114	Pilatus PC-12	7,576
TEB	PA23	BARON 58P/TS10-520-L	Piper PA-23 Apache/Aztec	18

Airport	ICAO Code	Description	Model	Operations
TEB	PA24	1985 1-ENG VP PROP	Piper PA-24 Comanche	70
TEB	PA27	BARON 58P/TS10-520-L	Piper PA-27 Aztec	94
TEB	P28A	1985 1-ENG FP PROP	Piper PA-28 Cherokee Series	145
TEB	PA30	PIPER TWIN COMANCHE PA-30 / IO-320-B1A	Piper PA-30 Twin Comanche	48
TEB	PA31	BARON 58P/TS10-520-L	Piper PA-31 Navajo	471
TEB	PAY1	CONQUEST II/TPE331-8	Piper PA-31T Cheyenne	53
TEB	P32R	1985 1-ENG VP PROP	Piper PA-32 Cherokee Six	61
TEB	PA34	BARON 58P/TS10-520-L	Piper PA-34 Seneca	438
TEB	PAY3	Piper PA-42 / PT6A-41	Piper PA-42 Cheyenne Series	16
TEB	P46T	1985 1-ENG FP PROP	Piper PA46-TP Meridian	175
TEB	B190	BEECH 1900D / PT6A67	Raytheon Beech 1900-C	13
TEB	BE55	BARON 58P/TS10-520-L	Raytheon Beech 55 Baron	72
TEB	BE60	BARON 58P/TS10-520-L	Raytheon Beech 60 Duke	4
TEB	BE58	BARON 58P/TS10-520-L	Raytheon Beech Baron 58	747
TEB	BE40	MU300-10/JT15D-5	Raytheon Beechjet 400	6,180
TEB	BE20	DASH 6/PT6A-27	Raytheon C-12 Huron	1,240
TEB	H25C	LEAR 36/TFE731-2	Raytheon Hawker 1000	802
TEB	HA4T	CITATION X / ROLLS ROYCE ALLISON AE3007C	Raytheon Hawker 4000 Horizon	1,117
TEB	BE10	DASH 6/PT6A-27	Raytheon King Air 100	353
TEB	BE9L	DASH 6/PT6A-27	Raytheon King Air 90	1,141
TEB	PRM1	CESSNA 550 CITATION BRAVO / PW530A	Raytheon Premier I	472
TEB	B350	DASH 6/PT6A-27	Raytheon Super King Air 300	3,408
TEB	R22	Hughes 500D	Robinson R22	2,099
TEB	R44	Robinson R44 Raven / Lycoming O-540-F1B5	Robinson R44 Raven / Lycoming O-540-F1B5	19
TEB	AC50	BARON 58P/TS10-520-L	Rockwell Commander 500	17
TEB	AC90	DASH 6/PT6A-27	Rockwell Commander 690	55
TEB	SBR1	LEAR 36/TFE731-2	Rockwell Sabreliner 65	118
TEB	SBR2	NA SABRELINER 80	Rockwell Sabreliner 80	13
TEB	NAVI	1985 1-ENG VP PROP	Ryan Navion B	5
TEB	SB20	HS748/DART MK532-2	Saab 2000	4
TEB	SF34	SF340B/CT7-9B	Saab 340-A	6
TEB	S76	Sikorsky S-76 Spirit	Sikorsky S-76 Spirit	2,097
TEB	TBM8	CONQUEST II/TPE331-8	SOCATA TBM 850	344
TEB	T38	NORTHRUP TALON T-38A NM	T-38 Talon	83

APPENDIX C: 2016 GROUND SUPPORT EQUIPMENT PROFILES

Fuel Type/Equipment Name	Annual Utilization (hours)				
	JFK	EWR	LGA	SWF	TEB
Diesel	**1,556,883**	**829,313**	**579,711**	**8,461**	**5,007**
(None specified. EPA default data used.) - Generator	3,260			448	263
(None specified. EPA default data used.) - Lift	11,935	10,571	4,774	37	22
(None specified. EPA default data used.) - Other	304,510	49,380	9,876		
ACE 180 - Air Start	9,990	8,991	6,993	183	31
ACE 300/400 - Air Start				7	
ACE 802 - Air Conditioner	67,872	72,720	62,216		
Deicer - Use Diesel Stewart Stevenson Tug GT-35 MC in Separate Run	63,500	12,000	19,000		
Eagle Bobtail / F350 - Bobtail	18,670	1,867			
F250 / F350 - Hydrant Truck	16,797	13,743	6,108	478	88
F250 / F350 - Service Truck	146,160	42,000	33,600	792	465
F750 Dukes Transportation Services DART 3000 to 6000 gallon - Fuel Truck		2,256	16,920	1,634	1,904
FMC Commander 15 - Cargo Loader	4,400	48,400	1,100	1,008	
Hi-Way / TUG 660 chasis - Cabin Service Truck				280	263
Hi-Way / TUG 660 chasis - Catering Truck		121,600			
Hi-Way F650 - Cabin Service Truck				1,188	137
Stewart & Stevenson TUG 660 - Belt Loader	267,800	62,400	107,900	132	118
Stewart & Stevenson TUG GT-35 MC - Aircraft Tractor	234,400	120,000	149,600	90	44
Stewart & Stevenson TUG GT-50H - Aircraft Tractor				52	9
Stewart & Stevenson TUG MA 50 - Baggage Tractor	135,000	88,500	72,000		
Stewart & Stevenson TUG MC - Aircraft Tractor				299	328
Stewart & Stevenson TUG MT - Cargo Tractor	66,101	1,349			
Stewart & Stevenson TUG T-750 - Aircraft Tractor				97	
Tennant - Sweeper			24		
TLD 1410 - Lavatory Truck				350	213
TLD 28 VDC - Ground Power Unit	185,600	161,600	89,600	896	876
Wollard TLS-770 / F350 - Lavatory Truck	20,888	11,936		303	27
TLD, 400 Hz AC - Ground Power Unit				187	219
Gasoline	**667,784**	**822,557**	**200,584**	**6,746**	**4,120**
(None specified. EPA default data used.) - Lift	18,048	30,832	4,512		
(None specified. EPA default data used.) - Other	8,680	10,416	5,208		
Eagle Bobtail / F350 - Bobtail	7,468				
F250 / F350 - Hydrant Truck	16,797	13,743	10,689		
F250 / F350 - Service Truck	108,117	87,084	45,387		
F750 Dukes Transportation Services DART 3000 to 6000 gallon - Fuel Truck	1,128	564	564		
FMC Tempest II Single engine - Deicer	500	5,500	16,000		
Hi-Way / TUG 660 chasis - Catering Truck		43,200			
Stewart & Stevenson TUG 660 - Belt Loader	130,000	179,400	14,300	1,762	880
Stewart & Stevenson TUG GT-35 MC - Aircraft Tractor	106,400	330,400	44,000		
Stewart & Stevenson TUG MA 50 - Baggage Tractor	229,500	100,500	27,000	3,584	1,445
Stewart & Stevenson TUG MT - Cargo Tractor	16,188	2,698			
Taylor Dunn - Cart		100	100	37	22
Tennant - Sweeper	1,086				
TLD - Ground Power Unit				1,307	1,707
TLD 1410 - Lavatory Truck				56	66
TLD 28 VDC - Ground Power Unit		3,200			
Wollard TLS-770 / F350 - Lavatory Truck	23,872	14,920	32,824		
LPG	**77,786**	**43,285**	**23,765**		
(None specified. EPA default data used.) - Lift	682	341	341		
Toyota 5000 lb - Fork Lift	77,104	42,944	23,424		
CNG	**369**		**369**		
F250 / F350 - Service Truck	369		369		

Fuel Type/Equipment Name	Annual Utilization (hours)				
	JFK	EWR	LGA	SWF	TEB
Electric	**152,048**	**115,506**	**93,837**	**1,150**	**138**
(None specified. EPA default data used.) - Lift	2,387	6,479	2,387		
(None specified. EPA default data used.) - Other	15,255	7,119	53,901		
ACE 180 - Air Start	333		666		
ACE 802 - Air Conditioner	7,272		808		
Dukes Transportation Services THS-400 - Hydrant Cart		1,527			
F250 / F350 - Hydrant Truck		1,528			
F250 / F350 - Service Truck	1,476	13,653	2,583		
Gate Service - Water Service				336	39
None - Air Conditioner				814	99
Stewart & Stevenson TUG 660 - Belt Loader	28,800	26,400	4,800		
Stewart & Stevenson TUG GT-35 MC - Aircraft Tractor	76,800	48,000	9,600		
Stewart & Stevenson TUG MA 50 - Baggage Tractor	3,000	6,000			
Stewart & Stevenson TUG MT - Cargo Tractor	12,141				
TLD 28 VDC - Ground Power Unit	1,600	4,800	17,600		
Wollard TLS-770 / F350 - Lavatory Truck	2,984		1,492		
TOTAL	**2,454,870**	**1,810,661**	**898,266**	**16,357**	**9,265**

Note: Totals may not match the column sums due to rounding.

APPENDIX D: REVISIONS TO THE 2006 BASE YEAR

1. Objective

Enable a like-for-like comparison of GHG emissions across the temporal series, and more importantly, against the 2006 base year.

2. Attracted Travel Methodology

For this reanalysis, emissions were calculated in a manner as consistent as possible with the most recent methodology used. For most attracted travel categories, the most recent inventory year was 2012, although aviation attracted travel was calculated in the 2016 inventory. These more recent inventories have included the use of MOVES2014a emission factors for all attracted travel categories and pollutants. Unlike the predecessor MOBILE emission factor models, MOVES can provide emission factors for all pollutants of interest as well as emission factors for all activities of interest including vehicle travel, short term idling, extended idling, and starts.

MOVES inputs for this 2006 reanalysis were developed starting with activity data gathered for the original 2006 attracted travel emissions analysis. These data were reformatted as needed for input to MOVES. MOVES inputs that were not available from the original 2006 analysis used MOVES default data specific to the New York metropolitan area. Updated emission factors were calculated for a 2006 calendar year in a manner consistent with the latest attracted travel estimates. Also, where possible, the emission calculation templates from the most recent attracted travel analyses were used as the starting point for the updated 2006 analyses.

For several of the attracted travel categories, additional revisions were necessary to make the 2006 estimates more consistent with the latest estimates. These revisions are described by category below. For attracted travel categories not included here, the only revisions included the change to MOVES-based emission factors.

2.1. Attracted Travel – Aviation

Several significant changes were made to the 2006 activity used in the aviation attracted travel calculations.

- Through passengers (i.e., those continuing on to another flight) were excluded from the passenger counts used in calculating attracted travel emissions.
- The attracted travel trips for most travel modes were calculated as round-trip distances in the original 2006 analysis. This was changed such that only the Personal Car Dropped Off At Airport mode of travel included a round trip distance and all others were calculated as one way trips.
- The 2006 travel data did not include a breakdown of the personal car travel mode by dropped off at airport or parked at airport. Therefore, the 2016 share of these two modes was applied to break out the 2006 personal car travel mode into these two categories, using data specific to each airport.
- Starts from parked cars were no longer calculated separately, as these trip starts are accounted for in the trip starts from personal vehicles parked at the airport.

2.2. Attracted Travel – PATH

The PATH Passenger Travel Study used to estimate the modes of travel by PATH passengers by station was updated from the 2004 study to the 2007 study. Bus travel to and from Journal Square was added to the 2006 PATH attracted travel estimate, consistent with the 2012 calculations.

2.3. Attracted Travel – Tunnels and Bridges

Consistent with later year estimates, the number days of queueing was revised from 260 (weekdays only) to 365 (weekdays and weekends) days per year. Outbound queueing delays were added for the Holland Tunnel, as these were included in the 2012 analysis but were not in the original 2006 analysis.

2.4. Attracted Travel – Ports, Drayage Trucks

The key changes made in the port commerce attracted travel include:

- Updating to MOVES-based emission factors;
- Updating to the improved estimate of the average trip length for drayage trucks; and
- Simplifying the emissions calculation methodology to account for strictly the onroad emissions that occur outside of the NYNJLINA nonattainment area.

The Port Authority commissions two drayage truck emission assessments, one conducted by Starcrest Consulting for the Ports department, and the other conducted by SC&A for OEEP. To ensure consistency between these two independent assessments, SC&A uses the Starcrest-derived emissions total for drayage trucks. Therefore, estimates for truck travel on the port terminals, truck idling, and travel from the terminals up to the point of the nonattainment border (the boundary of the Starcrest emissions inventory) were obtained from the 2006 Starcrest report. SC&A builds upon this estimate to assess drayage truck emissions from the nonattainment area boundary to the first point of rest (as is typical in GHG inventories), up to a maximum of 400 miles.

Thus, in revising the 2006 Ports attracted travel emissions to account for MOVES-based emission factors and to maintain a consistent analysis approach across analysis years, SC&A updated the estimates of onroad drayage truck emissions from the nonattainment area boundary to the first point of rest. We accounted for these emissions using data and assumptions consistent with those used in the Starcrest drayage truck emission inventory calculations.

Emissions from the portion of the drayage truck trips that extend from the nonattainment area boundary to the first point of rest are calculated as the product of three data components. These are: 1) the number of drayage truck trips to the container terminals, 2) the average drayage truck trip distance outside of the nonattainment area to the first point of rest, and 3) a MOVES-based CO_2e emission factor representative of onroad drayage truck travel.

Drayage Truck Trips to Container Terminals. The number of 2006 drayage truck trips to container terminals is provided in the 2006 Starcrest report.

Drayage Truck Trip Distance Outside of Nonattainment Area. For the 2012 GHG inventory report, SC&A had estimated the total trip length of port drayage trucks to be 46.4 miles one way, using a methodology that made improvements upon the estimate originally used in the 2006 GHG inventory. We use Starcrest data to determine the portion of this average trip distance that occurs within the nonattainment area. The Starcrest reports do not separately itemize the average onroad trip length traveled by drayage trucks servicing the container terminals. However, these reports provide the number of drayage truck trips to the container terminals and the total off-terminal VMT of these trucks within the nonattainment area. We estimated the average VMT per container truck trip by dividing the total VMT of these trucks by the total number of the drayage truck trips to the container terminals which resulted in an average per-trip estimate of 32.7 miles (roundtrip) in 2006 within the nonattainment area. Thus, the total average mileage traveled by a truck servicing the container terminals from the nonattainment area boundary to the first point of rest would be 60.1 miles (46.4 miles/one-way $_{\text{to First Point of Rest}}$ * 2 one-way/roundtrip – 32.7 miles/roundtrip $_{\text{Non-Attainment Area}}$ = 60.1 miles/roundtrip $_{\text{Incremental from Non-Attainment Area}}$) in 2006. Both the SC&A trip distance and the data underlying Starcrest's VMT estimate were based on data from the Port Authority Marine Container Terminals Truck Origin/Destination Survey 2005 prepared by Vollmer which has not been updated since that time. Total VMT outside the nonattainment area to the first point of rest was calculated by multiplying the trip length outside the nonattainment area by the number of container truck trips.

MOVES CO_2e Emission Factor. The 2006 Starcrest report used MOBILE6 emission factors in calculating drayage truck emissions. As with the other attracted travel categories, SC&A used the latest version of the MOVES model to estimate a 2006 CO_2e emission factor applicable to drayage trucks.

Table D-1 summarizes the resulting data components in 2006. This table also shows the emissions for the portion of drayage truck trips between the nonattainment area boundary and the first point of rest, calculated as the product of the three data components listed in Table D-1. These emissions should then be added to the port commerce truck emissions reported in the 2006 Starcrest report to obtain the total port commerce attracted travel emissions from heavy-duty trucks.

Table D-1. Data Components for Drayage Trucks from the Nonattainment to First Point of Rest Boundary	
Data Component	**2006**
Number of Truck Trips to Container Terminals	3,062,660
VMT by Container Trucks Outside of Nonattainment Area (mi)	60.1
MOVES-based CO_2e Onroad Emission Factor for Drayage Trucks (g/mi)	2,176
Drayage Truck CO_2e Emissions from Nonattainment Area to First Point of Rest (metric tons)	400,173

It should be noted that the 2006 inventory does not include emissions associated with drayage truck travel to the Global Marine Terminal, as the Port Authority did not own that terminal in 2006. Emissions associated with this terminal are included in other analysis years.

3. Other Methodologies

3.1. Fugitive Emissions, Refrigerants

The initial base year only had a partial assessment and many data points were incongruent with later inventories known to have higher quality activity data. From EY2010 to EY2014, the inventory program made a strong push to have a full picture of refrigerant emissions by inventorying air conditioning (AC) equipment and their key characteristics, such as refrigerant type, charge, and cooling capacity. So, for the revised base year, the value from the 2012 to 2014 period that met the following two conditions was selected: a) the value was derived from a refrigerant survey, and b) the utilization coefficient was less than a full year, since AC equipment only runs in the warm season.

Application of this method resulted in the revision of all entries in the Scopes Table associated with the "Refrigerant and Fire Suppressants" activity, except for Ports NJMT, for which the original estimate was in line with subsequent years.

3.2. Energy Production, Essex County Resource Recovery Facility

The initial base year was calculated as a function of waste tonnage and a national profile of waste composition, yielding a low confidence assessment. For the revised base year, we tapped on GHG data collected by EPA per 40 CFR Part 98 since 2010, and supplemented that information with GHG and CAP data as retrieved from eGRID for 2007 to recreate an 8-year data series; note the eGRID library does not have 2006 data. SC&A performed a trend analysis and observed that plant emissions fell within a band. To fill in for 2006, SC&A assigned the median value of the 8-year period for each pollutant. For instance, biogenic CO_2 ranged from 368 kilotons to 530 kilotons, of which the median value was 381 kilotons.

Application of this method resulted in the revision of Energy Production emissions in the Scopes Table associated with the "Essex County Resource Recovery facility" short facility name.

3.3. Biogenic Emissions - Central Automotive Division, Employee Commuting, Elizabeth Landfill

The 2006 GHG inventory did not estimate biogenic emissions. For all three of these categories, biogenic emissions are estimated based on the 2006 estimate of anthropogenic emissions. For all three categories, the first year where biogenic emissions were estimated was used to establish a ratio of biogenic emissions to anthropogenic emissions for each category. For the Central Automotive division, 2010 was used for the ratio, and for Employee Commuting and Elizabeth Landfill, 2013. This ratio was then applied to the 2006 estimate of anthropogenic emissions to estimate biogenic emissions in 2006.

3.4. Aircraft Emissions – Aircraft Movements

2006 Aircraft emissions were initially estimated using IPCC emission factors, which are very conservative and may potentially overestimate emissions. This analysis instead re-estimates these aircraft using the FAA's EDMS model (version 5.1.3), which was the standard tool for estimating aircraft emissions until it was replaced by the AEDT model. The 2006 aircraft list was converted into EDMS inputs using each aircraft's IPCC aircraft code. These aircraft totals were then normalized to match the FAA's ATADS database of total flights occurring at each airport in

2006 (as is done in all aircraft inventories from 2011 forward). EDMS then provides an emissions estimate of CO_2 and the CAPs. CH_4 and N_2O emissions were estimated in post processing based on the IPCC kg/LTO emission factors. For aircraft with no IPCC emission factors available, a weighted emission factor of kg/LTO was applied for each airport.

3.5. Aircraft Emissions – Ground Support Equipment

Ground Support Equipment (GSE) was not estimated in the initial 2006 inventory. There is no GSE equipment inventory available for 2006, so instead emissions are estimated based on the default assignment of GSE based on aircraft type in EDMS. This provides an estimate of CAP emissions from GSE, but not GHGs. To estimate CO_2 emissions, first we calculated a ratio of diesel and gasoline GSE for each airport from EDMS. Then CO_2 emissions from gasoline and diesel were estimated based on stoichiometry (that is the ratio between gasoline/diesel SO2 and gasoline/diesel CO_2 emissions). Then CH4 and N2O emissions were estimated using the ratio of CO_2 to CH4/N2O emissions seen in aircraft emissions.

3.6. Aircraft Emissions – APUs

Auxiliary Power Units (APUs) were not estimated in the initial 2006 inventory. There is no available information on APU units in 2006, so instead emissions are estimated based on the default assignment of APUs based on aircraft type in EDMS. This provides an estimate of CAP emissions from APUs, but not GHGs. To estimate CO_2 emissions, we use the ratio of SO2 to CO_2 emissions seen in aircraft emissions multiplied by the SO2 emissions from APUs. Then CH4 and N2O emissions were estimated using the ratio of CO_2 to CH4/N2O emissions seen in aircraft emissions. No adjustments were made for Ground Power Units or Pre-conditioned air at any of the airports, because we do not have information about when these units were installed at each airport.

3.7. Filling in Missing Data from the 2006 Dataset

Many emissions categories were omitted from the 2006 inventory that need to be included. In many cases, there is not sufficient data to re-estimate emissions for these categories, so instead a later analysis year is used to fill in these missing emissions. Table D-2 below shows the emissions categories that were filled in with the first available analysis year.

Table D-2. List of Sources Added to the Revised EY2006 Inventory

Department	Emission Category	Scope	Activity	Facility Name
Aviation	Stationary Combustion	1	Buildings	Teterboro Airport
Aviation	Purchased Electricity	2	Buildings	Teterboro Airport
Aviation	Stationary Combustion	3	Buildings	AirTrain JFK
Aviation	Stationary Combustion	3	Buildings	John F. Kennedy International Airport
Central Administration	Mobile Combustion	1	Executive Fleet	Fleet Vehicles
Multi-Department	Stationary Combustion	1	Emergency Generators and Fire Pumps	Emergency Generators and Fire Pumps
Multi-Department	Stationary Combustion	1	Welding	Multi-Facility
PATH	Stationary Combustion	1	Buildings	PATH Buildings
PATH	Fugitive Emissions	1	Refrigeration/Fire Suppression	PATH Trains
Planning	Stationary Combustion	3	Buildings	World Financial Center Terminal
Planning	Purchased Electricity	3	Buildings	World Financial Center Terminal
Port	Stationary Combustion	1	Buildings	NJ Marine Terminals
Port	Stationary Combustion	1	Buildings	NY Marine Terminals
Port	Fugitive Emissions	1	Refrigeration/Fire Suppression	NY Marine Terminals
Port	Purchased Electricity	2	Buildings	NJ Marine Terminals
Port	Purchased Electricity	2	Buildings	NY Marine Terminals
Real Estate	Stationary Combustion	1	Buildings	Real Estate NY
Real Estate	Purchased Electricity	2	Buildings	Real Estate NY
Real Estate	Purchased Electricity	3	Buildings	Industrial Park at Elizabeth
Real Estate	Purchased Electricity	3	Buildings	Queens West Waterfront Development
Real Estate	Purchased Electricity	3	Buildings	The South Waterfront
Real Estate	Stationary Combustion	3	Buildings	Industrial Park at Elizabeth

Table D-2. List of Sources Added to the Revised EY2006 Inventory				
Department	**Emission Category**	**Scope**	**Activity**	**Facility Name**
Real Estate	Stationary Combustion	3	Buildings	Queens West Waterfront Development
Real Estate	Stationary Combustion	3	Buildings	The South Waterfront
Tunnels, Bridges & Bus Terminals	Stationary Combustion	1	Buildings	Bus Terminals
Tunnels, Bridges & Bus Terminals	Fugitive Emissions	1	Refrigeration/Fire Suppression	Bus Terminals
Tunnels, Bridges & Bus Terminals	Purchased Steam	2	Buildings	Bus Terminals
Tunnels, Bridges & Bus Terminals	Purchased Electricity	2	Buildings	Bus Terminals

3.8. Filling in Questionable Data from the 2006 Dataset

There were also some emissions categories that had an emissions estimate in 2006 that is not in line with later estimates. We believe these estimates are not accurate and are most likely the result of incomplete data or different assumptions in the 2006 analysis. The first historical estimate where emissions are in line with later estimates was used to fill in the 2006 estimate. Table D-3 shows the emissions categories where the 2006 estimate was replaced with an estimate from a later year.

Table D-3. List of EY2006 Sources Aligned to the Historical Emissions Trend				
Scope	**Department**	**Emission Category**	**Activity**	**Facility Name**
1	Aviation	Stationary Combustion	Buildings	Newark Liberty International Airport
2	Aviation	Purchased Electricity	Buildings	John F. Kennedy International Airport
3	Aviation	Purchased Electricity	Buildings	John F. Kennedy International Airport
3	Aviation	Stationary Combustion	Buildings	Newark Liberty International Airport
3	Aviation	Purchased Electricity	Buildings	Newark Liberty International Airport
3	Aviation	Stationary Combustion	Buildings	Teterboro Airport
3	Aviation	Purchased Electricity	Buildings	Teterboro Airport

3.9. Mobile Combustion – Ferry Movements

Mr. Amit Bhowmick, General Manager for the Ferry Transportation Program, confirmed that the World Financial Center (WFC) Terminal was operational in 2006. Furthermore, Mr. Bhowmick provided 2006 route information as well as schedule information on each active route. Combined, these data served as input to the 2006 revision.

SC&A reused the 2014 ferry movements analysis spreadsheet, with the following adjustments:

- Replaced 2014 with 2006 route and schedule information
- Maintained the same average engine age as in the 2014 analysis, namely 10.8 years
- Kept all other engine specifications the same as in 2014.

A comparison between 2014 and 2006 show that routes and schedules were virtually identical, except that the Belford-WFC route was not operational in 2006. This is the main reason why 2006 emissions were lower by 5.4% from 2014.

3. Results

The overall effect of the 2006 base year revision resulted in an slight increase of scope 1 emissions, a similar decrease in scope 2 emissions, and a more significant increase in scope 3 emissions. The net change across all scoped from the original base year was 63,603 metric tons CO_2e, or 1.1 percent of the agency's total carbon footprint. Table D-4 shows a complete anthropogenic emissions comparison by scope and department between the original and revised 2006 base year.

Table D-4. Comparison of the Original and Revised 2006 Base Year					
Scope	**Department**	**Original EY 2006**	**Revised EY 2006**	**Net Change**	**Percent Change from Grand Total**
1	Aviation	18,316	32,014	13,698	0.2%
1	Central Administration	14,872	15,176	304	0.0%
1	Multi-Department	0	655	655	0.0%
1	PATH	302	4,396	4,094	0.1%
1	Port	4,239	4,733	495	0.0%
1	Real Estate	0	162	162	0.0%
1	Tunnels, Bridges & Bus Terminals	697	1,785	1,088	0.0%
1 Total		**38,426**	**58,921**	**20,495**	**0.4%**
2	Aviation	166,136	112,676	-53,460	-0.9%
2	Central Administration	9,660	9,660	0	0.0%
2	PATH	53,571	53,571	0	0.0%
2	Port	0	2,859	2,859	0.0%
2	Real Estate	0	875	875	0.0%
2	Tunnels, Bridges & Bus Terminals	17,537	31,015	13,478	0.2%
2 Total		**246,904**	**210,657**	**-36,247**	**-0.6%**
3	Aviation	3,411,533	3,101,898	-309,634	-5.3%
3	Central Administration	0	5,663	5,663	0.1%
3	Engineering	48,287	48,287	0	0.0%
3	Multi-Department	27,080	27,080	0	0.0%
3	PATH	27,805	38,824	11,019	0.2%
3	Planning	0	11,164	11,164	0.2%
3	Port	886,580	1,026,399	139,819	2.4%
3	Real Estate	524,820	514,218	-10,602	-0.2%
3	Tunnels, Bridges & Bus Terminals	390,965	607,784	216,819	3.7%
3	WTC	165,423	180,531	15,108	0.3%
3 Total		**5,482,493**	**5,561,848**	**79,355**	**1.4%**
Grand Total		**5,767,823**	**5,831,426**	**63,603**	**1.1%**