Greenhouse Gas Emissions Inventory

Philadelphia International Airport
April 2017

Prepared by:

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Executive Summary

ES.1 Objective

This greenhouse gas (GHG) emissions inventory was completed for Philadelphia International Airport (PHL) for the year 2016. The main objective of the inventory is to assist PHL with identifying, quantifying, and managing the Airport's emissions of GHGs in accordance with its commitment to sustainability and environmental stewardship.

The inventory was prepared following guidance established by the U.S. Environmental Protection Agency (USEPA), the Intergovernmental Panel on Climate Change (IPCC), and the Energy Information Administration (EIA). The assessment also utilized guidance produced by the Transportation Research Board (TRB) Airport Cooperative Research Program (ACRP). The most up-to-date operational data and other information specific to PHL representing 2016 conditions were used to the fullest extent possible.

ES.2 Summary of Results

The 2016 GHG emissions inventory for PHL is summarized in **Table ES-1.** This table lists emissions by scope, which indicate the operational boundaries of the Airport, tenants, and the public. Consistent with the IPCC guidelines, this emissions inventory addresses the three primary GHGs identified in the Kyoto Protocol[1]: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The remaining three Kyoto GHGs, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), occur at airports – from refrigeration and air-conditioning usage – but to a far lesser extent. The results are reported in units of metric tons (MT) of carbon dioxide equivalents (CO_2e) on an annual basis.

As shown in **Table ES-1**, GHG emissions associated with Scope 3 (Indirect and Optional) – specifically, aircraft engine emissions – are by far the highest emitting sources at the Airport. Motor vehicles across all three categories are the second-highest emitting sources. Airport-owned and controlled sources (Scope 1) comprise only one percent of the total GHG emissions.

[1] The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC). The primary directive of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries (of which the U.S. is a signatory, but has not yet ratified the Protocol) and the European community to limit their emissions of the six greenhouse gases (i.e., carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride).

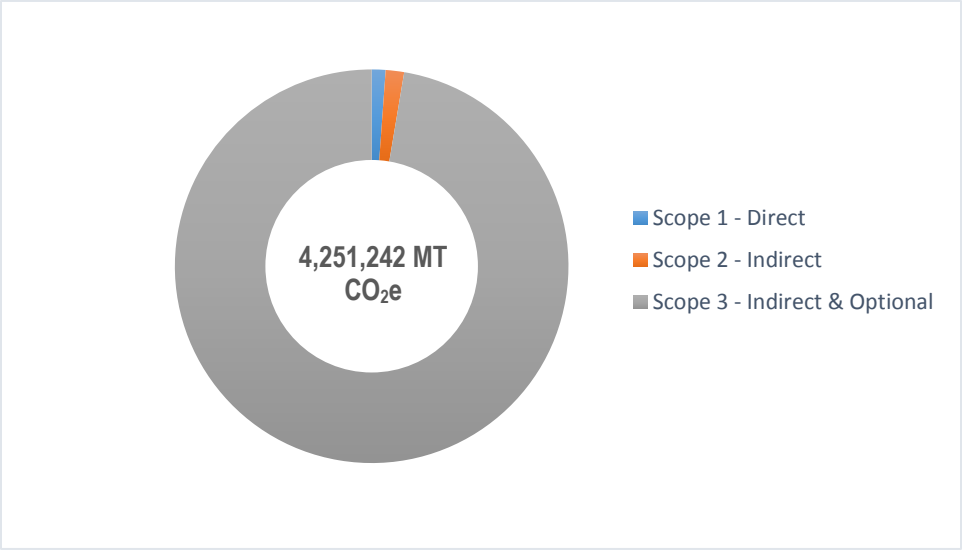
Table ES-1. PHL GHG Emissions Inventory for 2016

Scope	Emission Source	MT CO_2e
1 – Direct	Ground Access Vehicles[1]	27,326
	Stationary Sources	15,840
	Contracted Shuttles	2,201
	Construction	1,852
	Ground Support Equiment[1]	722
	Fire Training Facility	172
	Refrigerants	147
	Subtotal	**48,259 (1%)**
2 – Indirect	Electrical Usage – Airport	33,994
	Electrical Usage – Tenant	30,287
	Subtotal	**64,281 (2%)**
3 – Indirect & Optional	Aircraft[3]	3,785,517
	Ground Access Vehicles[4]	284,506
	SEPTA – Public Transit[5]	30,717
	Ground Support Equipment[6]	21,562
	Auxiliary Power Units	12,351
	Aircraft Engine Startup	2,351
	Contracted Shuttles	1,698
	Subtotal	**4,138,702 (97%)**
	Total[8]	**4,251,242 (100%)**

Notes: **APU** – Auxiliary Power Unit, **GAV** – Ground Access Vehicles, **GSE** – Ground Support Equipment, and **SEPTA** – Southeastern Pennsylvania Transportation Authority, **MT** – Metric Tons.
1. GAV include airport fleet vehicles, employee vehicles, vehicles traveling within parking facilities, and vehicles traveling on-airport roadways.
2. GSE includes only airport snow removal equipment.
3. Aircraft includes taxi, above the ground to 3,000 feet and cruise mode to destination.
4. GAV include tenant fleet vehicles, employee vehicles, passenger vehicles, vehicles traveling within parking facilities, and vehicles traveling off-airport roadways.
5. SEPTA public transit includes those commuter rail and bus routes servicing the airport.
6. GSE includes tenant operated equipment such as belt loaders, baggage tractors, etc.
7. Values may reflect rounding.

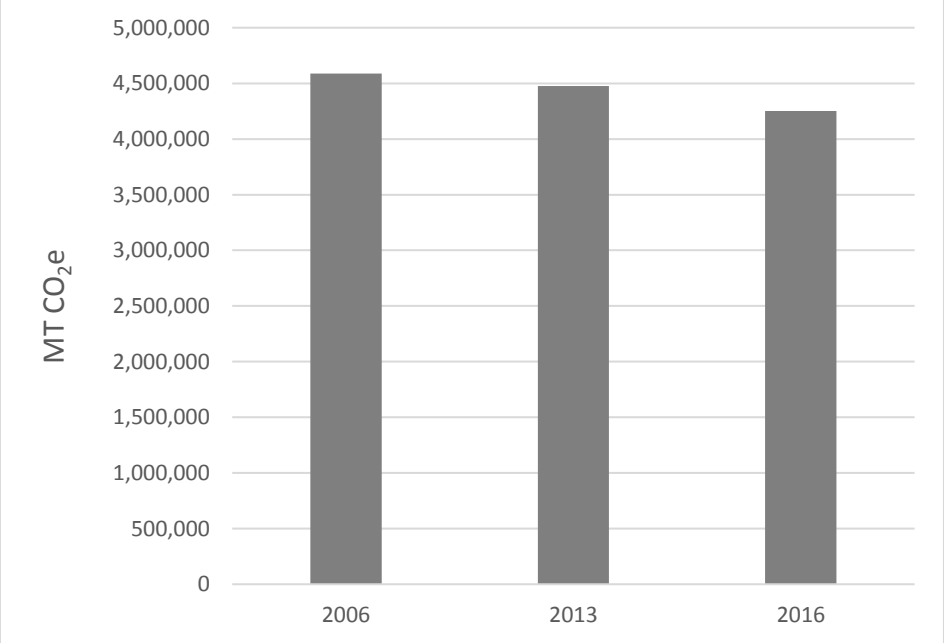
For ease of comparison, the results are also presented graphically by scope in **Figures ES-1.** Whereas Scope 1 emissions only comprise one percent of the total GHG inventory, Scope 2 and 3 comprise 1 percent and 98 percent of GHG emissions, respectively.

Figure ES-1. GHG Emissions by Scope



In 2016, PHL reduced its GHG emissions by 4,700 MT CO_2e as a result of waste management practices, by diverting materials from landfills (due to recycling initiatives by the Airport and tenants). Furthermore, compared to the Airport's previous 2013 GHG emissions inventory, the 2016 inventory shows an overall reduction in GHG emissions of approximately five percent. **Figure ES-2** presents the emission reductions compared to previous years. This reduction is primarily due to a decrease in aircraft operations and passenger activity during this timeframe.

Figure ES-2. Comparison of 2006, 2013, and 2016 Emissions Inventories



1 Introduction

1.1 Motivation and Purpose for this Update

There is presently a broad scientific consensus that greenhouse gases (GHG) associated with human activities are contributing to changes in the earth's atmosphere. These GHGs, brought about principally by the combustion of fossil fuels, decomposition of waste materials, changes in land uses, and deforestation, are linked to an increase in the earth's average temperature by means of a phenomenon called the "greenhouse effect".[2]

Aerial View of Philadelphia International Airport

As GHG emissions from human activities increase, they contribute to the greenhouse effect and warming of the climate, which in turn leads to other changes in the atmosphere, on land, and in the oceans. These changes have potential for both positive and negative effects on humans, plants, and animals. Because many GHGs remain in the atmosphere for tens to hundreds of years after being released, their warming effects on the climate could become long lasting.

With the growing concern of climate change and the potential impacts on airports, Philadelphia International Airport (PHL) is committed to addressing this issue. PHL conducted its first GHG emission inventory in 2009 using 2006 as baseline year.[3] An update was published in 2015 using 2013 as a baseline year. The purpose of this updated 2016 GHG emissions inventory is to:

- Identify the principal sources of GHGs associated with the operation of the Airport;
- Quantify GHG emissions under current conditions; and
- Help guide the development of sustainability initiatives to manage and reduce GHG emissions.

PHL is among numerous airports nationwide that are undertaking proactive efforts to manage GHGs associated with their facilities. These assessments have been initiated despite evidence that aviation accounts for only 2% of all anthropogenic CO_2 emissions worldwide.[4]

[2] The phenomenon whereby certain gases in the atmosphere, primarily carbon dioxide, water vapor, and methane, allow incoming sunlight to pass through, but trap, absorb, and retain heat radiated back from the earth's surface.

[3] Philadelphia International Airport, Greenhouse Gas Emissions Inventory, Final Report June 2009, http://www.phl.org/AboutPHL/Environmentalinitiatives/SustainabilityInitiatives/Documents/GHGinventoryFinalSH.pdf.

[4] ICAO Environment Report 2016: Aviation and Climate Change. Montréal: International Civil Aviation Organization, 2016. http://www.icao.int/environmental-protection/Documents/ICAO%20Environmental%20Report%202016.pdf

1.2 Approach and Methodology

This GHG emissions inventory was prepared based on three commonly used and widely accepted guidelines for assessing GHG emissions associated with the aviation sector, in general, and airports in particular:

- Transportation Research Board, Airport Cooperative Research Program (ACRP) Report 11, *Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories*[5];
- U.S. Environmental Protection Agency (USEPA) *Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance, Optional Emissions from Commuting, Business Travel and Product Transport*[6]*;* and the
- Intergovernmental Panel on Climate Change (IPCC) *Guidelines for National Greenhouse Gas Inventories*. [7]

The majority of the technical analysis was accomplished using the latest version of the Federal Aviation Administration (FAA) Aviation Environmental Design Tool (AEDT version 2c Service Pack 1)[8] and the USEPA Motor Vehicle Emission Simulator[9] (MOVES version 2014a). Other emission factors used to compute the GHG emissions inventory were obtained from a variety of references as they are specific to the individual source type, fuel type and/or activity level.

1.3 Current Emissions Reduction Efforts

Over the past several years, PHL has initiated a number of emission reduction measures through the FAA's Voluntary Airport Low Emissions (VALE) Program[10]. The VALE Program allows airport sponsors to use Airport Improvement Program (AIP) funds and Passenger Facility Charges (PFC) to finance low emission vehicles, refueling and charging stations, gate electrification, and other airport air quality improvements. The emission reduction measures implemented at PHL include:

- Purchase of hybrid vehicles.
- Installation of pre-conditioned air on 11 Terminal A East electrified jet bridges.
- Installation of pre-conditioned air on 24 electrified jet bridges within Terminal F.
- Purchase and installation of more than 230 charging stations to support electric ground

Electric Belt Loaders and Charging Stations

[5] Transportation Research Board, ACRP Report 11, *Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories*, 2009, http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_011.pdf.

[6] U.S. Environmental Protection Agency, Climate Leaders *Greenhouse Gas Inventory Protocol Core Module Guidance, Optional Emissions from Commuting, Business Travel and Product Transport*, May 2008, http://www.epa.gov/climateleadership/documents/resources/commute_travel_product.pdf.

[7] IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, 2006, www.ipcc-ippc nggip.iges.or.jp/public/gl/invs5.htm.

[8] FAA, Emissions Dispersion Modeling System (AEDT), https://aedt.faa.gov/.

[9] USEPA, MOVES (Motor Vehicle Emission Simulator), http://www.epa.gov/otaq/models/moves/.

[10] City of Philadelphia to Pennsylvania Department of Environmental Protection, Airport Emission Reduction Credit Statements, Philadelphia International Airport, April 7, 2011.

support equipment (eGSE) associated with United Airlines and American Airlines.

- Purchase and installation of 5 ground power units (GPU) at the American Airlines (formerly US Airways) Maintenance Hangar.

Additional GHG reduction initiatives implemented at PHL include:

- Reducing the Airport's energy consumption through Energy Conservation Measures (ECMs).
- Ground transportation improvements geared to improve ground circulation, reduce air emissions, and reduce dependence on fossil fuels and single-occupancy vehicles.
- US Airways (now American Airlines) completed construction of a new ground support equipment (GSE) maintenance building - the first LEED Silver certified facility to be constructed at PHL.
- Construction of the new Terminal F baggage claim building was completed for American Airlines commuter passengers. This building achieved LEED Gold certification.
- Implementation of the Waste Reduction Program which is a single-stream recycling program for solid waste within public terminal areas and airport offices.

American Airlines LEED Certified GSE Building

2 Regulatory Context

This section presents an overview of the most prominent GHG regulatory actions that have been enacted or proposed to reduce GHG emissions at a national, regional, statewide, and local level. Presently, there are no GHG-related regulations specifically directed at airports in the United States.

2.1 National

Historically, GHG emissions have not been regulated under the Federal Clean Air Act (CAA) as air pollutants. However, after the U.S. Supreme Court in 2007 clarified that CO_2 is an "air pollutant" subject to regulation under the CAA, the U.S. Environmental Protection Agency (USEPA) embarked on developing requirements and standards for GHG emissions from mobile and stationary sources under the CAA. The following summarizes the main GHG regulatory initiatives recently undertaken by the USEPA.

In 2009, USEPA issued the *Mandatory Reporting of Greenhouse Gases Rule* which requires reporting of GHG data and other relevant information from large sources and suppliers in the United States. The purpose of the rule is to collect accurate and timely GHG data to inform future policy decisions. Suppliers of certain products that would result in GHG emissions if released, combusted or oxidized; direct emitting source categories; and facilities that inject CO_2 underground for geologic sequestration or any purpose other than geologic sequestration, are covered. Facilities that emit 25,000 metric tons (MT) or more per year of GHGs are required to submit annual reports to the USEPA. For some source categories (e.g., power plants, concrete manufacturing), reporting began in 2010. For reporting year 2012, over 8,000 facilities and suppliers reported to the greenhouse gas reporting program. Importantly, PHL does not fall within these criteria.

USEPA is also responsible for developing and implementing regulations to ensure that transportation fuel sold in the United States contains a minimum volume of renewable fuel. By 2022, the *Renewable Fuel Standard (RFS) Program*, which was created under the Energy Policy Act (EPAct) of 2005, anticipates reducing GHG emissions by 138 million MT, equivalent to the annual emissions of 27 million passenger vehicles. Additionally, USEPA and the National Highway Traffic Safety Administration (NHTSA) are taking coordinated steps to enable the production of a new generation of clean vehicles, through the reduction of GHG emissions and improved fuel use.

Currently, aviation-related GHG emissions are not specifically addressed under the CAA. Nearly all aviation-related emission sources are independently regulated through equipment-specific regulations, standards and recommended practices, and operational guidelines, which are established by organizations such as USEPA, FAA, and ICAO. In fact, in June 2012, the U.S. Government submitted to the ICAO an *Aviation Greenhouse Gas Emissions Reduction Plan*[11] which identifies actions and progress toward GHG emissions reductions in areas such as: aircraft and engine technology Improvement, operational improvements, alternative fuels development and deployment, policies, standards, and measures, and scientific understanding and modeling/analysis.

At the international level, the Airports Council International (ACI) aims at promoting professional excellence in airport management and operations to provide the public with a safe, efficient and environmentally responsible air transport system. ACI spearheads the Airport Carbon Accreditation (ACA) program which is an independent, voluntary program for airports focused at measuring, managing, and reducing carbon emissions from their operations, with the ultimate goal of becoming carbon neutral.

[11] USG, Aviation Greenhouse Gas Emissions Reduction Plan, June 2012, http://www.faa.gov/about/office_org/headquarters_offices/apl/environ_policy_guidance/policy/media/Aviation_Greenhouse_Gas_Emissions_Reduction_Plan.pdf.

2.2 Regional

Pennsylvania is an observer to the Regional Greenhouse Gas Initiative (RGGI). RGGI was established in 2005, and is a cooperative effort by nine Northeast and Mid-Atlantic states (i.e., Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont) to establish the design of a regional cap-and-trade program initially covering CO_2 emissions from power plants in the region. Three Canadian provinces (i.e., Ontario, New Brunswick, and Quebec) also act as observers.

RGGI was the first mandatory cap-and-trade program in the United States. RGGI requires fossil fuel power plants over 25 megawatts (MW) in participating states to obtain an allowance for each ton of CO_2 emitted annually. Power plants within the region may comply with the cap by purchasing allowances from quarterly auctions, other generators within the region, or offset projects. RGGI administered its first auction of CO_2 emissions allowances in 2008. By 2020, the RGGI CO_2 cap is projected to contribute to a 45 percent reduction in the region's annual power-sector CO_2 emissions from 2005 levels, or between 80 and 90 million short tons (tons) of CO_2.

The Delaware Valley Regional Planning Commission (DVRPC) is the designated Metropolitan Planning Organization (MPO) for the Greater Philadelphia Region. DVRPC works to promote regional cooperation in a nine-county, bi-state region. The region includes Bucks, Chester, Delaware, Montgomery, and Philadelphia counties in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer counties in New Jersey. The DVRPC facilitates city, county and state representatives of this region to address key concerns such as transportation, land use, environmental protection and economic development. The DVRPC conducts a regional Energy Use and Greenhouse Gas Emissions Inventory on a 5-year interval, with the most recent inventory reflecting year 2010 conditions.[12]

2.3 Statewide

Pennsylvania has developed various regulations to address GHG emissions. The following summarizes the main actions undertaken by Pennsylvania:

- *Alternative Energy Portfolio Standard (AEPS) Act of 2004* – the Act was signed on November 30, 2004, and requires all electricity suppliers in Pennsylvania to provide 18 percent of their energy from advanced energy sources within 15 years (2019-2020); specifically, eight percent should come from Tier I sources and 10 percent from Tier II sources. Tier I includes solar, wind, low-impact hydropower, geothermal energy, fuel cells, biomass, and coal mine methane sources. Tier II includes demand-side management, distributed generation systems, large scale hydropower, waste coal, municipal solid waste (MSW), byproducts of wood-pulping and manufacturing, and integrated combined coal gasification technology. On July 19, 2007, Governor Rendell signed into law Act 35 of 2007 amending portions of the AEPS Act.
- *Energy Efficiency Standards* - Pennsylvania requires new residential and commercial buildings to meet energy efficiency standards. Residential and commercial buildings statewide are required to meet the 2009 International Energy Conservation Code (IECC) and ANSI/ASHRAE/IESNA[13] Standard 90.1-2007.[14]
- *Fuel Economy Standards* - Pennsylvania imposes automobile fuel economy standards similar to California's, which include mandates to regulate GHG emissions from new vehicles. On

[12] DVRPC, Regional Energy Use and Greenhouse Gas Emissions Inventory, http://www.dvrpc.org/energyclimate/inventory.htm.

[13] American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning/Illuminating Engineering Society of North America ANSI/ASHRAE/IESNA

[14] For the residential build community, states must meet or exceed the 2009 IECC or achieve equivalent or greater energy savings. For the commercial build community, states must meet or exceed ANSI/ASHRAE/IESNA Standard 90.1-2007 or achieve equivalent or greater energy savings to qualify to receive federal funding.

September 19, 2006, the state's Environmental Quality Board approved the *Clean Vehicles Program* to adopt California's vehicle emissions standards.

- *GHG Reporting* – Pennsylvania is a member of the Climate Registry, a collaboration aimed at developing and managing a common GHG emissions reporting system across states, provinces, and tribes. Members released a final General Reporting Protocol in May 2008. The Climate Registry began accepting data in June 2008. Pennsylvania has no mandatory GHG reporting requirements beyond USEPA's mandatory GHG reporting rule.

Additionally, on July 9, 2008, Governor Rendell signed the *Pennsylvania Climate Change Act (Act 70).* Among a number of goals, Act 70 directed the state Department of Environmental Protection (DEP) with coordination of the Pennsylvania Climate Change Advisory Committee (CCAC) to submit an Action Plan for lowering GHG emissions to the Governor within 15 months of the effective date of Act 70 and every three years thereafter. The first Action Plan was submitted to the Governor and General Assembly on December 18, 2009. The plan calls for a 30 percent reduction in GHG emissions by 2020. In combination with other state and federal environmental initiatives, the recommendations outlined in the action plan could reduce emissions by more than 40 percent. The first *Pennsylvania Climate Change Action Plan Update* was submitted to Governor and General Assembly on December 31, 2013, with the next update due on October 9, 2015.[15]

2.4 Local

The City of Philadelphia is strongly committed to reducing GHG emissions. The key programs/initiatives the City has partaken since 1999 include the following:

- *Cities for Climate Protection (CCP) Campaign sponsored by the International Council for Local Environmental Initiatives (ICLEI) local Governments for Sustainability* - In 1999, the City of Philadelphia agreed to a goal to reduce its GHG emissions by 10 percent from 1990 levels by 2010.
- *U.S. Mayors' Climate Protection Agreement sponsored by the U.S. Conference of Mayors (USCM)* - In 2005, the City of Philadelphia aimed at meeting or surpassing the United States' GHG reduction targets recommended under the Kyoto Protocol (i.e., 7 percent from 1990 levels), and to urge state and federal governments to enact stronger policies and programs.
- *Large Cities Climate Leadership Group and Clinton Climate Initiative (CCI)* - In 2006, the City of Philadelphia joined an international group of major cities committed to reduce urban CO_2 emissions and adapt to climate change.
- *Local Action Plan for Climate Change* - In April 2007 the City of Philadelphia completed the Local Action Plan for Climate Change which aimed at ensuring that the broader community and the City government meet or exceed the CCP commitment to reduce GHG emissions by 10 percent by 2010 and to help Philadelphia prepare for the responsibilities and opportunities of GHG reduction and adaptation beyond 2010.
- *Philadelphia's Greenhouse Gas Inventory* - In 2015, Philadelphia's Greenhouse Gas Inventory was updated, which looked at CO_2 emissions for Philadelphia from a community level for 2012 as well as a municipal government level for 2013.
- *Greenworks Philadelphia* - Mayor Michael Nutter established the city's first Office of Sustainability and released in 2009 "Greenworks Philadelphia", the city's first comprehensive sustainability plan. The 2015 Greenworks Progress Report, was the last report under Mayor Nutter and reflects the culmination of five years of work toward the energy, environment,

[15] Pennsylvania DEP, Pennsylvania Climate Change Action Plan Update, December 2013, http://files.dep.state.pa.us/Energy/Office%20of%20Energy%20and%20Technology/OETDPortalFiles/Climate%20Change%20Advisory%20Committee/Final_Climate_Change_Action_Plan_Update.pdf.

equity, economy, and engagement targets established in the initial 2009 plan. The City of Philadelphia released a new "Greenworks: A Vision for a Sustainable Philadelphia" under Mayor Jim Kenney in 2016, which sets a goal of reducing greenhouse gas emissions 80 percent by 2050.[16]

[16] Mayor's Office of Sustainability, City of Philadelphia, http://www.phila.gov/green/PDFs/Greenworksprogressreport.pdf.

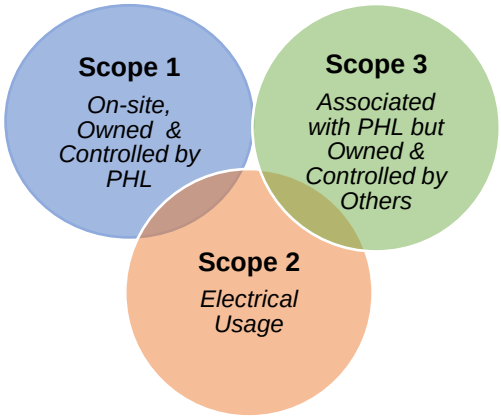
3 Boundaries and Scope

Defining boundaries and source categories aids in interpreting emissions inventory results and indicates the degree of ownership and control the airport owner may have on particular sources. The following section outlines these concepts and how they are applied to the PHL GHG emissions inventory.

3.1 Scope (Operational Boundaries)

Once the ownership and control boundaries were determined, the operational boundaries (or scopes) were also set. Consistent with the guidelines of *ACRP Report 11*, operational boundaries were established as described below.

- **Scope 1 –** GHG emissions from sources that are owned and controlled by the reporting entity (i.e., PHL). These include on-airport owned and controlled stationary sources (e.g., boilers, emergency generators, etc.), fleet vehicles, and vehicles using on-airport roadways and associated areas.
- **Scope 2 –** GHG emissions associated with the generation of electricity consumed by the reporting entity and its tenants.
- **Scope 3 –** GHG emissions that are attributed to activities at PHL, but are associated with sources that are owned and controlled by others. These include aircraft-related emissions, emissions from airport tenant's activities, and public ground transportation to and from the Airport.



4 Sources of GHG Emissions

4.1 Types of GHG Emissions

According to the IPCC, there are six GHGs: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), and the fluorinated gases hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Due to the fact that CO_2, CH_4, and N_2O are by-products of fuel combustion, they are also the predominant GHGs at airports. These gases arise from the combustion of fossil fuels such as jet fuel, aviation gasoline (Avgas), gasoline, and diesel and are emitted as by-products contained in the engine exhausts. Emissions of HFCs, PFCs, and SF_6 occur at airports, but to a far lesser extent, and are typically related to refrigeration, air conditioning, and other coolants. **Table 2** presents the characteristics of these GHGs.

Table 2. Types of Greenhouse Gases

Pollutant	Characteristics
Carbon Dioxide (CO_2)	CO_2 enters the atmosphere through the burning of fossil fuels such as coal, natural gas and oil; solid waste; trees and wood products; as well as certain chemical reactions. CO_2 is removed from the atmosphere when it is absorbed by plants as part of the biological carbon cycle.
Nitrous Oxide (N_2O)	N_2O is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.
Methane (CH_4)	CH_4 is emitted during the production and transport of coal, natural gas, and oil. In addition, CH_4 emissions result from livestock and other agricultural practices, and by the decay of organic waste in municipal solid waste landfills.
Fluorinated Gases	HFCs, PFCs and SF_6 are synthetic GHGs that are emitted from a variety of industrial processes. These gases are typically emitted in smaller quantities, but due to their potency, they are sometimes referred to as high Global Warming Potential (GWP) gases.

Source: USEPA, Overview of Greenhouse Gases, 2014. https://www.epa.gov/ghgemissions/overview-greenhouse-gases.

4.2 Sources of GHG Emissions

The primary sources of GHG emissions at PHL include aircraft; ground access vehicles (GAVs) such as vehicles operating on-airport roadways, parking facilities and terminal curbsides, and off-airport roadways; GSEs and APUs; construction vehicles and equipment; and an assortment of stationary sources. Emissions from these sources arise primarily from the combustion of fossil fuels (i.e., jet fuel, Avgas, diesel, gasoline, compressed natural gas, etc.) and are emitted as by-products contained in the engine exhaust. Additional sources such as electricity consumed by PHL and its tenants (but generated elsewhere by the burning of coal, oil, and natural gas) as well as refrigerants used in vehicles, refrigeration, heating and air-conditioning systems and waste management practices were also included as sources.

It is important to note that GHG emissions associated with the “supply chains” or “life cycles” (e.g., production, consumption and/or disposal of goods and materials such as paper, plastic and waste products, foodstuffs, and building materials) by either airport facilities or tenant facilities are not included in this analysis. **Table 3** summarizes the sources of GHG emissions at PHL.

Table 3. Sources of Greenhouse Gases

Source Category	Characteristics
Aircraft	Exhaust products of fuel combustion that vary depending on aircraft engine type (i.e., turbo-jet, turbo-prop, etc.), fuel type (Jet-A, avgas), number of engines, power setting (i.e., taxi/idle, take-off, cruise), and amount of fuel burned.
Ground Access Vehicles	Exhaust products of fuel combustion from passenger and airport/tenant employee vehicles using airport parking facilities and on- and off-airport roadways. These include motor vehicles, taxis, limousine, vans, rental cars, buses, shuttles as well as airport owned vehicles. Emissions vary depending on vehicle type (i.e., gasoline, diesel, etc.) and the amount of fuel consumed.
Ground Support Equipment/Auxiliary Power Units	Exhaust products of fuel combustion from equipment used by airport operators (e.g., snow removal, maintenance equipment, etc.) and tenants (e.g., aircraft service trucks, aircraft tractors, tow tugs, belt loaders and other portable equipment). Emissions are also emitted by auxiliary power units used to furnish power to aircraft when main engines are off.
Stationary Sources	Exhaust products of fossil fuel combustion from boilers, emergency generators, and space heating.
Electrical Usage	Emissions associated with the production of electricity at off-site utilities that use coal, oil, or natural gas.
Construction	Exhaust products of fuel combustion associated with construction equipment (e.g., excavators, forklifts, etc.) and vehicles (e.g., dump trucks, water trucks, etc.) during construction activities.
Refrigerants	A range of chemicals used for refrigeration, air conditioning, and other coolants that are comprised of substances possessing global warming characteristics (e.g., Freon, chlorofluorocarbons, etc.).
Waste Management	Emissions associated with the solid waste generated at the Airport; and, the reduction in emissions associated with recycling and solid waste disposal practices employed by the Airport.

Source: KBE, 2017.

5 GHG Calculation Methodology

The information, data and recommendations contained in this report were developed in accordance with procedures and practices that are current and considered appropriate for this application. As discussed above, the GHG emissions inventory was conducted following three commonly used and industry-wide accepted guidelines for assessing GHG emissions: ACRP, IPCC, and USEPA. This section details the sources of data for the GHG inventory and the inputs and assumptions to the models used for the inventory.

5.1 Data Collection

The information and data collected for the preparation of the PHL GHG emissions inventory came from a variety of sources and were considered to be the most up-to-date and appropriate for this application. To the extent data were available, this information reflects actual conditions at PHL such as: aircraft activity levels, GSE fleet characteristics, motor vehicle traffic volumes, fuel utilization throughput, and electrical usage. For those instances where data was not readily available, reasonable assumptions and engineering judgment were applied. **Table 4** presents the sources of data and information used in the PHL GHG emissions inventory.

Table 4. Sources of Data and Information

Source Category	Sources of Data and Information
Aircraft	▪ *Total operations and fleet mix* – PHL Airport Noise and Operations Monitoring System and FAA Tower Counts, 2016 Aviation Activity Report ▪ *Time-in-Mode* – Bureau of Transportation Statistics ▪ *Emission factors* – AEDT2c and USEPA GHG Emissions Factors Hub ▪ *Jet A/AvGas Fuel Usage* – PHL 2016 Fuel Usage Data
Ground Access Vehicles	▪ *Fleet Vehicles' Fuel Usage* – PHL Aviation Vehicle Usage Report 2016 ▪ *Employee Vehicles VMT* – Derived from Active Badge Report with zip codes ▪ *Total Number of Employees* – PHL Active Badge Report ▪ *On- and off-airport VMT (passenger vehicles, taxis, shuttles, etc.)* – Terminal Approaches Class Counts and 2016 RAC Shuttle Fleet Data ▪ *Parking Facilities* – 2016 Aviation Annual Disclosure Report ▪ *Public Transit* – SEPTA 2016 Route Statistics ▪ *Emission Factors* – MOVES2014a and USEPA GHG Emissions Factors Hub
Ground Support Equipment/Auxiliary Power Units	▪ *Emission factors* – AEDT2c and USEPA GHG Emissions Factors Hub ▪ *GSE types and operating times* – AEDT2c Defaults ▪ *GSE Gasoline/Diesel Usage* - PHL 2016 Fuel Usage Data and 2016 Snow Billing Data ▪ *APU types and operating times* – PHL Jetbridge Survey and Inventory ▪ *Engine and fuel types* –AEDT2c Defaults
Stationary Sources	▪ *Source and fuel types and throughput volumes* – Pennsylvania Department of Environmental Protection 2013 Emission Inventory Production report and email dated February 21, 2017 ▪ *Emission factors* – USEPA Climate Leadership
Electrical Usage	▪ *Electrical usage* – Emailed dated February 21, 2017 and PHL Square Footage ▪ *Emission factors* – USEPA Year 2010 eGRID 9th edition Version 1.0 February 2014
Construction	▪ *Construction equipment and operating times* – Daily Construction Logs ▪ *Emission factors* – MOVES2014a and USEPA Emissions Factors Hub
Refrigerants	▪ *Refrigerant usage* – Based on 2013 data (PHL Email dated September 11, 2014) ▪ *Emission factors* – USEPA GHG Emissions Factors Hub
Waste Management	▪ *Solid waste and recycling tonnage* – Based on 2013 data (PHL 2013 Annual Recycling Report, dated June 2014) ▪ *Emission factors* – USEPA Waste Reduction Model (WARM Version 13, date June 2014)

5.2 Pertinent Inputs, Assumptions, and Emission Factors

The pertinent input data, assumptions, and emission factors used to prepare the 2016 PHL GHG emissions inventory are summarized in **Table 5**. Details on the specific sources and data used in the GHG analysis are further described in **Appendix C**.

Table 5. Pertinent Inputs, Assumptions, and Emission Factors

Source Category	Source	Description	Ownership	Assumptions	Input Data	Emission Factors
Aircraft	Aircraft Ground Taxi	Includes taxi-in, taxi-out and ground-based delay emissions.	Tenant	Data consisted of most up-to-date operational data and other information specific to PHL. ANOMS, AEDT default fuel flow rates, AGL time-in-mode, and airline specific ground travel time.	Aircraft Activity Levels (arrival and departures), Aircraft Type, Engine Type, Fuel Type, Times-in-mode data	**USEPA[1]/AEDT[2]**
	Aircraft Above Ground Level (AGL)	Ground to 3,000 feet which includes takeoff, climb out, and approach emissions up to a height of 3,000 feet.	Tenant			**USEPA[1]/AEDT[2]**
	Aircraft Cruise Mode	Includes emissions above 3,000 feet from airport to destination.	Tenant			**USEPA[1]/AEDT[2]**
	Aircraft Engine Startup	Engine startup mode occurs within the terminal gate area prior to the aircraft departure.	Tenant			**USEPA[1]/AEDT[2]**
	Aircraft APU	Consist of small turbine engines used by many commercial aircraft to start the main engine(s), provide electrical power, and to power the onboard HVAC systems.	Tenant	AEDT default fuel flow rates and APU assignment.		**USEPA[1]/AEDT[2]**
Ground Access Vehicles	Fleet Vehicles	Includes airport-owned vehicles traveling within the Airport boundaries.	Airport/Tenant	Data consistent with City Government GHG Emissions Inventory.	Fuel Usage	**MOVES[3]**
	Employee Vehicles	Includes airport/tenant employee vehicles travelling on- and off-airport roadways.	Airport/Tenant	Derived roundtrip distance of 30 miles for tenants and Airport employees from zip code data.	Number of Employees/VMT	**MOVES[3]**
	Parking Facilities	Includes airport/tenant employee and passenger vehicles using airport parking facilities.	Airport/Tenant	Assumed a 0.25 mile round trip distance.	Vehicle ticket counts	**MOVES[3]**
	Vehicles - On-Airport Roadways	Includes passenger autos, taxis, limousine, rental car shuttles, parking courtesy shuttles, hotel shuttles, van services, charter buses, rental cars travelling on-airport roadways.	Airport	Assumed vehicle travel 3 miles within the Airport boundaries.	VMT/Fuel Usage	**MOVES[3]**
	Vehicles - Off-Airport Roadways	Includes passenger autos, taxis, limousine, hotel shuttles, van services, charter buses, and rental cars, and other miscellaneous vehicles traveling on off-airport roadways.	Tenant/Public	Assumed travel distance for specific type of vehicle such as 44 miles	Traffic volume and VMT	**MOVES[3]**

Source Category	Source	Description	Ownership	Assumptions	Input Data	Emission Factors
				for passenger trips and 17 miles for limos.		
Ground Access Vehicles	Contracted Shuttle Buses	Includes shuttles that provide airport/tenant employee and passenger transportation to and from airport parking lots.	Airport/Tenant	Assumed these buses to include First Transit and COBUS 3000 at PHL.	Fuel Usage	**EPA**[1]
	SEPTA – Public Transit	SEPTA public transit servicing the Airport (i.e., Commuter Rail and Bus Lines).	Public	Distance from farthest station/stop servicing the Airport.	Ridership/VMT	**EPA**[1]
Ground Support Equipment	Tenant-operated equipment	Includes baggage tugs, belt loaders, aircraft tugs, cargo lifts, lavatory service trucks, water trucks, ground power units, air start units, general service trucks etc. operated along the airside.	Tenant	Fuel usage for ASIG supported airlines and AEDT default GSE assignments and fuel usage for non-ASIG supported airlines.	GSE Type, Fuel Type, Fuel Usage, Operating Times	**USEPA**[1]**/AEDT**[2]
	Snow Removal	Equipment used to remove snow to keep airside and landside areas clear and operational.	Airport	Hours of operations during 2015/2016 winter season. Fuel rates for specific equipment per NONROAD.	Fuel Usage	**EPA**[1]
Stationary Sources	Boilers/Heaters[4]	Stationary sources that help provide service, comfort, and/or security to passengers within airport limits.	Airport	Data consistent with City Government GHG Emissions Inventory.	Fuel Usage	**EPA**[1]
	Generators	Emergency generators are available to provide back-up power in the event of a blackout at the Airport.	Airport	Data consistent with PHL's 2016 Emission Inventory Production Report submitted to Pennsylvania DEP.	Fuel Usage	**EPA**[1]
	Fire Training Facility	Emergency response staff must train regularly to be ready for any emergency that may arise at the Airport. As part of staff training, propane fires are purposely set and extinguished.	Airport	Propane usage in 2016 by ARFF services.	Fuel Usage	**EPA**[1]
Construction		Construction activities result from the operation of heavy equipment in the process of	Airport	Taxiway H Realignment, Runway E	Construction Activities/	**MOVES**[3]

Source Category	Source	Description	Ownership	Assumptions	Input Data	Emission Factors
		grading, paving, materials handling and transportation, and other related activities.				
Electrical Usage		Electrical power is used throughout the Airport for heating, cooling, lighting, and electric services such as escalators, elevators, etc.	Airport/Tenant	Airport and tenant usage based on square footage.	Electrical usage in kilowatts	**EPA[6]**
Refrigerants		A range of chemicals used in refrigeration and HVAC systems that are comprised of substances possessing global warming characteristics.	Airport	Included R11 in Chillers No. 3 and 4.	Pounds of refrigerant	**EPA[7]**
Waste Management[9]		Waste management activities associated with airport/tenant employee and passenger activities within the Airport.	Airport	Consistent with data reported in PHL 2013 Annual Recycling Report.	Waste tonnage	**WARM[8]**

Notes: **ANOMS** - Airport Noise and Operations Monitoring System, **ARFF** - aircraft rescue and firefighting services, **DEP** - Department of Environmental Protection, **HVAC** - heating, ventilation, and air conditioning, **SEPTA** - Southeastern Pennsylvania Transportation Authority, **VMT –** Vehicle-Mile-Travelled.

1. USEPA, GHG Emissions Factors Hub (November 2015), https://www.epa.gov/climateleadership.
2. FAA, Aviation Environmental Design Tool (AEDT) Version 2c Service Pack 1, https://aedt.faa.gov/.
3. USEPA, MOVES2014a, http://www.epa.gov/oms/models/moves.
4. This source category also includes door heaters, roof heaters, air handlers, etc. For a detailed list of sources see PHL's Synthetic Minor Operating Permit No. S12-041.
5. TRB, ACRP Report 102, http://www.trb.org/ACRP/Blurbs/170234.aspx.
6. USEPA, Emissions & Generation Resource Integrated Database (eGRID) 9th edition Version 1.0, February 2014, http://www.epa.gov/climateleadership/documents/emission-factors.pdf.
7. USEPA, Direct HFC and PFC Emissions from Use of Refrigeration and Air Conditioning Equipment, May 2008 [EPA-430-K-03-004b], http://www.epa.gov/climateleadership/documents/resources/mfgrfg.pdf.
8. USEPA, Waste Reduction Model (WARM) Version 12, Updated March 2015, http://epa.gov/epawaste/conserve/tools/warm/index.html.
9. **Recycling quantities are not inclusive of all tenants at PHL.**

6 Results

6.1 Overview of Results

An overview of the 2016 GHG emission inventory results for PHL is reported in this section. Consistent with IPCC guidelines, the results are reported in units of MT of CO_2e by source and on an annual basis. **Table 6** presents the GHG emissions by scope and their respective emission sources. As shown, the majority of the GHG emissions are classifiable as Scope 3, and are primarily associated with aircraft activities – sources that are not owned and controlled by PHL.

Table 6. PHL GHG Emissions Inventory for 2016

Scope	Ownership	Emission Source	MT CO_2e
1	Airport	Ground Access Vehicles[1]	27,326
		Stationary Sources	15,840
		Contracted Shuttles	2,201
		Construction	1,852
		Ground Support Equipment[1]	722
		Fire Training Facility	172
		Refrigerants	147
		Subtotal	**48,259 (1%)**
2	Airport/Tenant	Electrical Usage – Airport	33,994
		Electrical Usage – Tenant	30,287
		Subtotal	**64,281 (2%)**
3	Tenant/Public	Aircraft[3]	3,785,517
		Ground Access Vehicles[4]	284,506
		SEPTA – Public Transit[5]	30,717
		Ground Support Equipment[6]	21,562
		Auxiliary Power Unit	12,351
		Aircraft Engine Startup	2,351
		Contracted Shuttles	1,698
		Subtotal	**4,138,702 (97%)**
		Total[8]	**4,251,242 (100%)**

Notes: **APU** – Auxiliary Power Unit, **GAV** – Ground Access Vehicles, **GSE** – Ground Support Equipment **SEPTA** – Southeastern Pennsylvania Transportation Authority and **MT** – Metric Tons.
1. GAV include airport fleet vehicles, employee vehicles, vehicles traveling within parking facilities, and vehicles traveling on-airport roadways.
2. GSE includes only airport snow removal equipment.
3. Aircraft includes taxi, above the ground to 3,000 feet and cruise mode to destination.
4. GAV include tenant fleet vehicles, employee vehicles, passenger vehicles, vehicles traveling within parking facilities, and vehicles traveling off-airport roadways.
5. SEPTA public transit includes those commuter rail and bus routes servicing the airport.
6. GSE includes tenant operated equipment such as belt loaders, baggage tractors, etc.
7. Values may reflect rounding.

For ease of comparison, the results are also presented graphically by scope in **Figures 1 through 3. Figure 1** presents the emissions within Scope 1 which represent the emissions owned and controlled by the Airport. As shown, ground access vehicles (57 percent) and stationary sources (33 percent) represent the largest sources of GHG emissions within this scope, followed by contracted shuttles and construction (5 percent and percent, respectively). GHG emissions related to waste management practices at PHL were estimated

as part of the analysis; however, they were not included in **Figure 1** as they represent an emissions reduction and would not have been properly represented in the chart.

Figure 1. GHG Emissions within Scope 1 - Direct

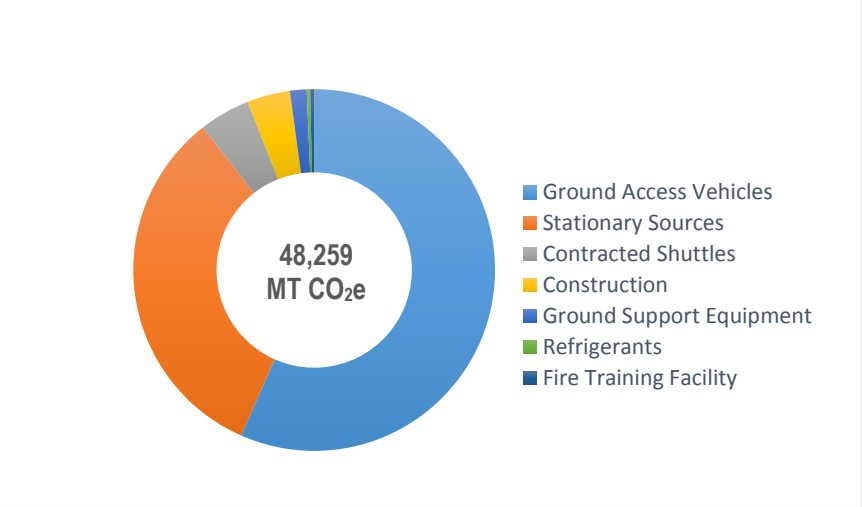


Figure 2 presents the emissions within Scope 2 which represent the emissions generated from purchased electricity consumed by the Airport and tenants. As shown, electrical usage is the only source of emissions in this scope.

Figure 2. GHG Emissions within Scope 2 - Indirect

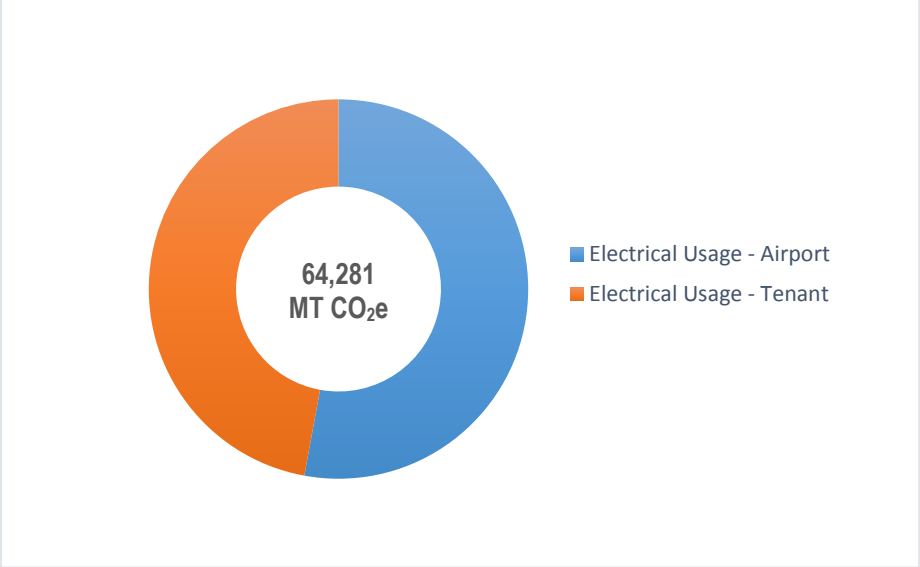


Figure 3 presents the emissions within Scope 3 which comprises GHG emissions attributable to sources that are owned and controlled by tenant and public sources. As shown, aircraft comprise the majority of the GHG emissions amounting to 92% of the scope, followed by ground access passenger vehicles travelling on off-airport roadways at 7%.

Figure 3. GHG Emissions within Scope 3 – Indirect & Optional

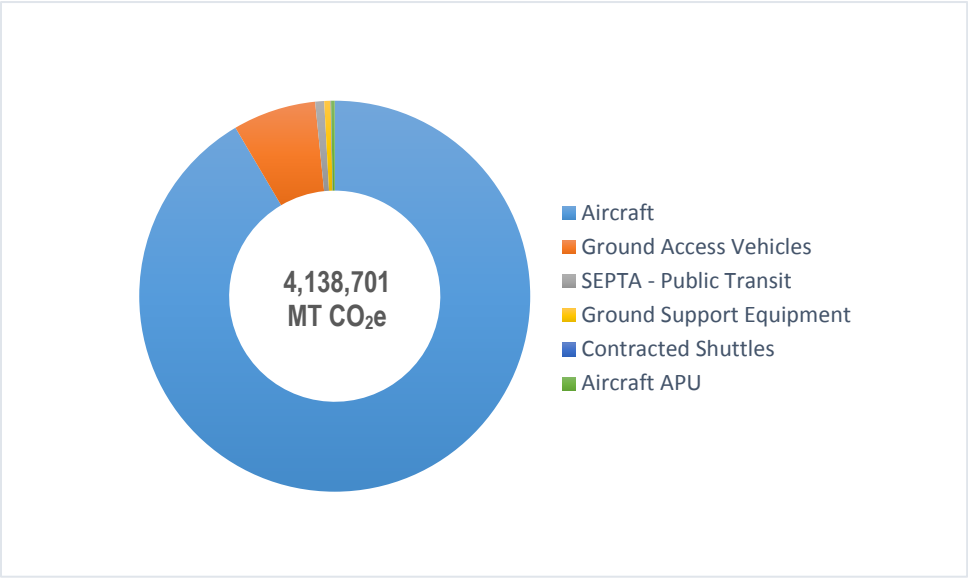
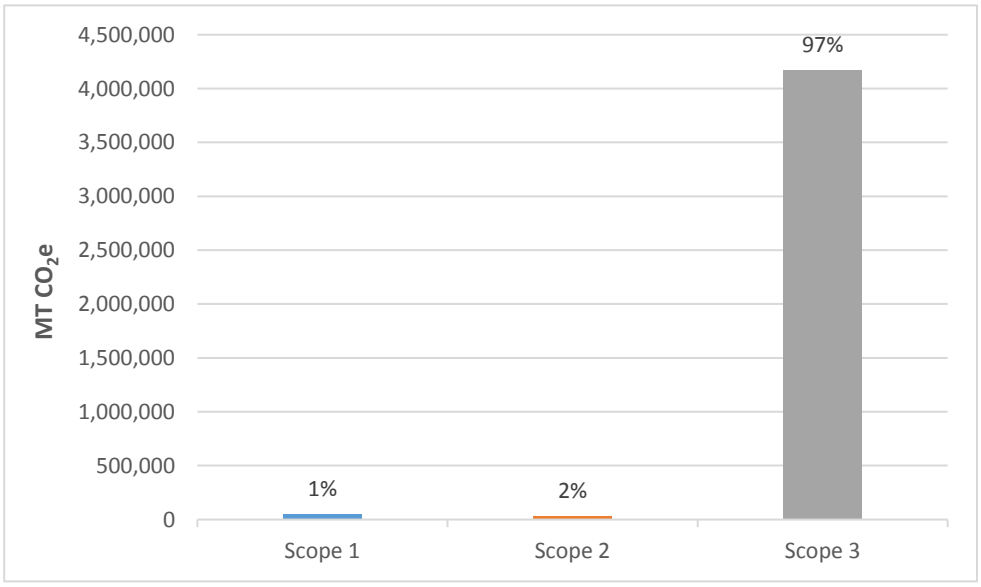


Figure 4 presents the GHG emissions by scope in terms of percentages. As shown, the majority of the GHG emissions are classifiable as Scope 3 (97 percent), followed by Scope 2 (2 percent), and Scope 1 (1 percent). Notably, the Airport only owns and controls Scope 1 sources, but exerts control over the demand for Scope 2 sources (i.e., electrical usage).

Figure 4. GHG Emissions by Scope



6.2 Detailed Results

This section presents the detailed results of all the sources included in the PHL GHG emissions inventory, as shown in **Table 7**. The sources were grouped within six categories: aircraft, GAV, GSE, stationary sources, electrical usage, and other sources (construction activities, refrigerants, and waste management).

Table 7. GHG Emissions by Source

Source		MT CO_2e
Aircraft		
	Aircraft - Ground Taxi	211,766
	Aircraft – Above the Ground to 3,000 feet	172,844
	Aircraft – Cruise Mode to Destination	3,400,906
	Aircraft Engine Startup	2,351
	Auxiliary Power Units (APU)	12,351
Ground Access Vehicles (GAV)		
Fleet Vehicles	Airport Fleet Vehicles	1,276
	Tenant Fleet Vehicles	508
Employee Vehicles	Airport Employee Vehicles	2,585
	Tenant Employee Vehicles	57,134
Vehicles Parking Facilities	Airport Parking Facilities (i.e., employee lot)	73
	Tenant Parking Facilities (i.e., economy, garage parking and short-term)	442
Off-Airport Roadways	Passenger Autos	170,251
	Taxis	3,263
	Limos/ Sedan Service	877
	SEPTA Rail off-site	26,111
	SEPTA Bus	4,606
	Hotel Shuttle	736
	Van Service	2,242
	Charter Bus	760
	Rental Cars	48,294
On-Airport Roadways	Passenger Autos	11,608
	Taxis	1,958
	Limos/ Sedan Service	155
	Rental Car Shuttles	2,928
	Parking Courtesy Shuttle	3,774
	Hotel Shuttle	442
	Van Service	292
	Charter Bus	52
	Small Service Truck	784
	Others	160
	Rental Cars	1,238
Contracted Shuttles	First Transit Contracted Employee Lot Shuttles	2,201
	First Transit Contracted Economy Lot Shuttles	1,100
	COBUS 3000 leased by US Airways (on-airport passenger shuttles)	597
Ground Support Equipment (GSE)		
	Airport GSE (i.e., Snow Removal Equipment)	722
	Tenant GSE (i.e., aircraft tractors, baggage tractors, belt loaders, etc.)	21,562

Source	MT CO_2e
Stationary	
Generators	211
Boilers/Space Heaters	15,629
Fire Training Facility	172
Electrical Usage	
Airport Electrical Usage	33,994
Tenant Electrical Usage	30,287
Other Sources	
Construction	1,852
Refrigerant	147
Waste Management	*- 4,700*
Total[1]	**4,251,242**

Note[1]: Values may reflect rounding. Total does not take into account waste reduction.

The GHG emissions related to waste management practices at PHL were also estimated as part of the GHG emissions inventory as they represent a portion of PHL's emissions reduction initiatives. The negative results shown in **Table 7** represent the difference in emissions between a baseline scenario, which assumes all waste is landfilled with no methane treatment, and PHL's actual waste management conditions, where portions of waste are recycled and portions are landfilled requiring methane treatment. The GHG emission reductions due to recycling and landfill avoidance is approximately 4,700 MT of CO_2e, a large portion of which was associated with single-stream recycling management practices.[17]

6.3 Comparison to Prior GHG Emissions Inventories

GHG emissions inventories previously conducted for PHL for the analysis years 2006 and 2013. **Table 8** and **Figure 5** present a comparison of the 2006 and 2013 GHG emissions to the 2016 inventory, delineated by scope. As shown, the total GHG emissions in 2013 were estimated to be 4,475,027 MT of CO_2e, compared to the 2016 emission inventory results at 4,251,242 MT of CO_2e. This amounts to a reduction of approximately five percent overall, which is due in part to the Airport's emissions reduction initiatives as well as a decrease in passenger activity and aircraft operations over this timeframe. From 2013 to 2016, passengers decreased by 1% and aircraft operations decreased by 13%. The difference in emissions is also due to slight differences in methodology, assumptions, and available data between the two analysis years. In summary, GHG emissions associated with Airport, tenant, and public sources decreased 2% from 2006 to 2013, and decreased 5% from 2013 to 2016.

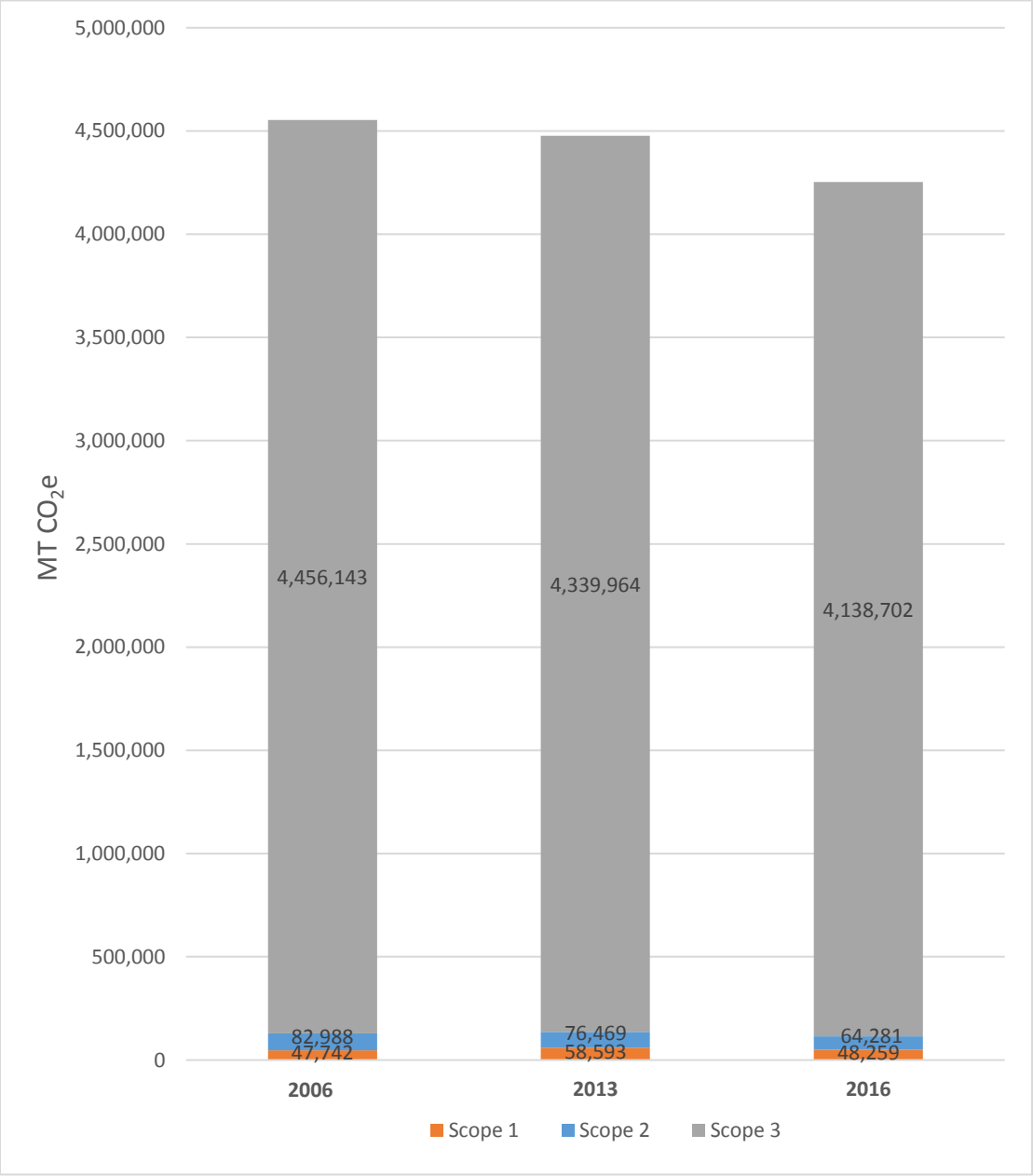
Table 8. Comparison of 2013 and 2016 GHG Emissions Inventory (MT CO_2e)

Scope	2006	2013	2016	Difference from 2006-2016	Percent Difference from 2006-2016
1	47,742	58,593	48,259	517	1%
2	82,988	76,469	64,281	-18,707	-23%
3	4,456,143	4,339,964	4,138,702	-317,442	-7%
Total[1]	**4,586,873**	**4,475,027**	**4,251,242**	**-335,633**	**-7%**

Note: Totals may reflect rounding.

[17] Emissions estimates based on data available from the City of Philadelphia's Division of Aviation (DOA), US Airways, and Marketplace Philadelphia. Recycling quantities are not inclusive of all tenants at PHL.

Figure 5. Comparison of 2013 and 2016 GHG Emissions Inventory

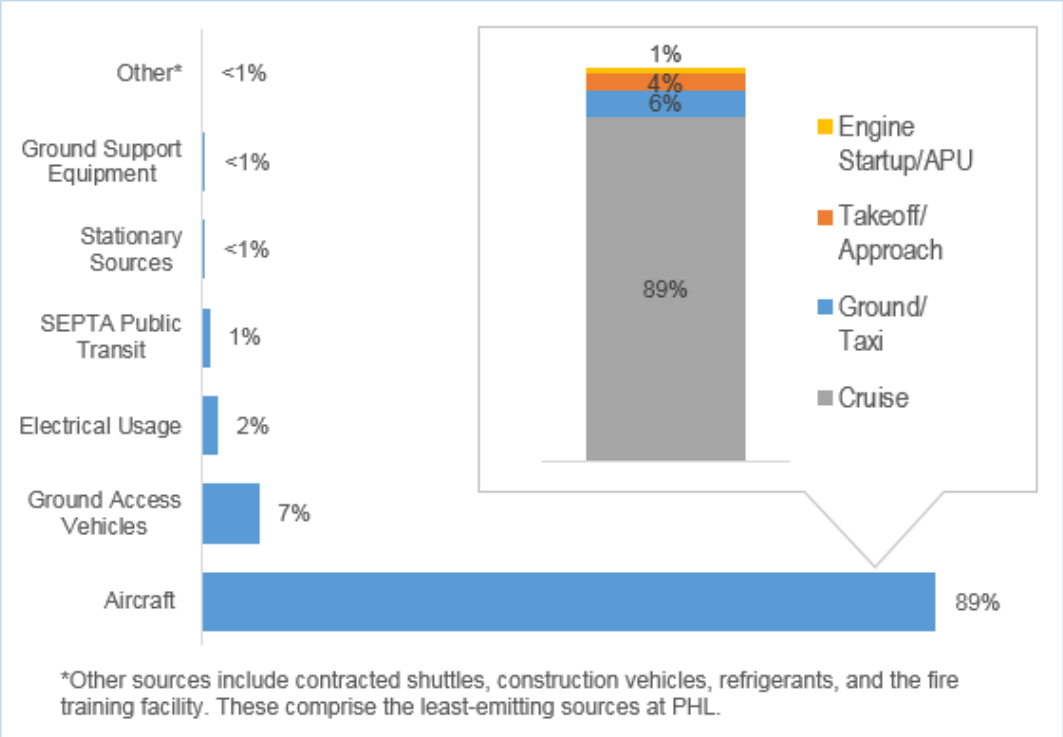


7 Conclusion

This GHG emissions inventory was completed for PHL for the year 2016. The main objective of the inventory was to assist PHL with identifying, quantifying, and managing the Airport's emissions of GHGs in accordance with its commitment to environmental stewardship.

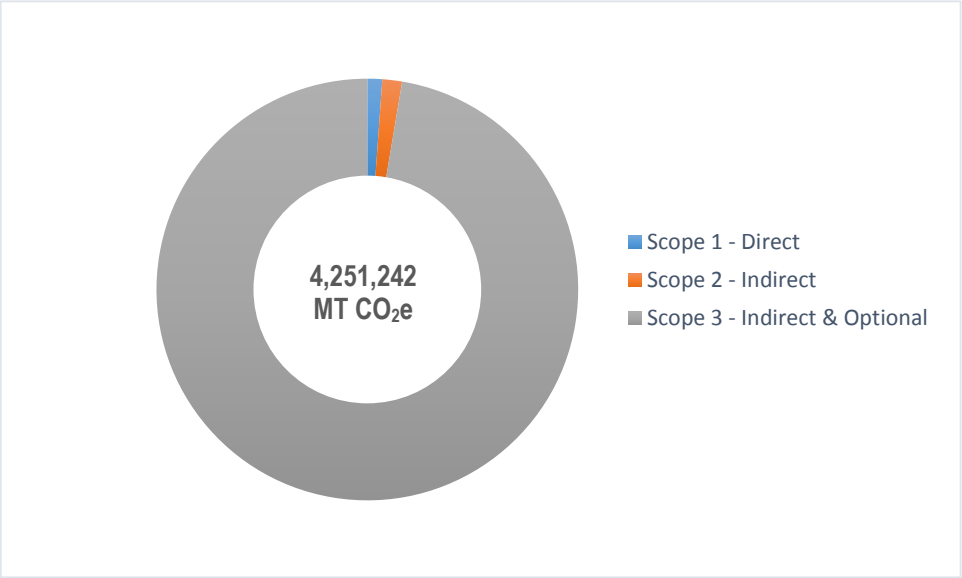
Overall, the majority of the GHG emissions were attributed to aircraft operations, which amounted to 89 percent of the total GHG emissions. Of special importance, approximately 89 percent of these aircraft emissions occur at cruise mode, representing a segment of the aircraft flight that occurs beyond the local environs of PHL. Ground access vehicles were the second-highest emitting sources in the inventory. **Figure 6** illustrates the contributors of GHG emissions at PHL.

Figure 6. Contributors of GHG Emissions



Airport owned and controlled sources (i.e., Scope 1) comprised only one percent of the total GHG emissions. **Figure 7** presents the percentage breakdown for the three scopes.

Figure 7. GHG Emissions by Scope



In 2016, compared to baseline conditions PHL reduced its GHG emissions by 4,700 MT CO_2e as a result of waste management practices by diverting materials from the landfill through recycling initiatives by the tenants and Airport.[18,19]

Compared to the 2013 GHG emission inventory, the 2016 inventory showed a reduction of approximately five percent. This is due in part to the Airport's emissions reduction initiatives as well as a decrease in passenger activity and aircraft operations over this timeframe. From 2013 to 2016, passengers decreased by 1% and aircraft operations decreased by 13%. The difference in emissions is also due to slight differences in methodology, assumptions, and available data between the two analysis years. GHG emissions associated with Airport, tenant and public sources all decreased from 2013 and 2016.

Compared to other large commercial hub airports in the northeastern United States, PHL's GHG emissions are quite similar in that Scope 1 emissions typically range between 1 to 2 percent of the total inventory, Scope 2 emissions approximately 1 percent, and Category 3 emissions typically range between 97 to 98 percent.[20] **Figure 8** illustrates these findings.

[18] The baseline condition assumes all waste would be landfilled. See **Appendix C** for further details on waste management reduction emission calculations.

[19] Emissions estimates based on data available from the City of Philadelphia's Division of Aviation (DOA), US Airways, and Marketplace Philadelphia. Recycling quantities are not inclusive of all tenants at PHL.

[20] PHL's GHG emissions were compared to recently-prepared airport GHG emissions inventories for two large hub commercial airports located in the northeast of the United States (i.e., Airport A and B). Airport A had 361,343 operations and 14,531,990 enplanements and Airport B had 260,201 operations and 10,970,190 enplanements during the inventory year. It should be noted that the data presented in Figure 11 are approximations as it is difficult to compare precisely GHG emissions between airports because there are several factors (e.g., airport size, types of emissions sources, variations between emissions source activity levels, geographic location, and geographic extent of the GHG inventory boundary) that vary considerably between airports and that have a large bearing on a GHG emission inventory.

Figure 8. PHL GHG Emissions Compared to Other Airports