Truckee Tahoe Airport District 2015 Greenhouse Gas Inventory

September 2017

Prepared for: Truckee Tahoe Airport District
10356 Truckee Airport Road
Truckee, California 06161

Prepared by: First Environment, Inc.
770 L Street, Suite 950
Sacramento, California 95814

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List of Acronyms

ACI - Airports Council International

ACERT - Airport Carbon and Emissions Reporting Tool

AEDT - Federal Aviation Administration Aviation Environmental Design Tool

APU – Auxiliary Power Unit

AR4 - Intergovernmental Panel on Climate Change's Fourth Assessment Report

CH_4 - methane

CO_2 – carbon dioxide

CO_2e - Carbon Dioxide Equivalents

eGRID – US EPA Emissions & Generation Resource Integrated Database

EPA – Environmental Protection Agency

FAA – Federal Aviation Administration

GHG – greenhouse gas

GWP – global warming potential

HFC - hydrofluorocarbon

IMP – Inventory Management Plan

IPCC - Intergovernmental Panel on Climate Change

LTO – landing and take-off

LPG – liquid petroleum gas (propane)

MT – metric tonnes

MSW – municipal solid waste

N_2O – nitrous oxide

PFC - perfluorocarbon

SAR - Intergovernmental Panel on Climate Change's Second Assessment Report

SF_6 – sulfur hexafluoride

TAR - Intergovernmental Panel on Climate Change's Third Assessment Report

TCR – The Climate Registry

TD PUD – Truckee Donner Public Utility District

TTAD – Truckee Tahoe Airport District

UNFCCC – United Nations Framework Convention on Climate Change

WARM - US EPA Waste Reduction Model

Executive Summary

First Environment, Inc. (First Environment) was retained by Truckee Tahoe Airport District (TTAD) to prepare a greenhouse gas (GHG) emissions inventory for airport activities in 2015. The GHG inventory assessed emissions of six greenhouse gases (GHGs):

- carbon dioxide (CO_2),
- methane (CH_4),
- nitrous oxide (N_2O),
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs), and
- sulfur hexafluoride (SF_6).

The scope of the inventory included all emissions sources under TTAD's operational control. This consisted of TTAD's Scope 1 "direct" emissions from stationary combustion, mobile combustion, and fugitive gas (e.g., refrigerant) releases, as well as Scope 2 "indirect" emissions from the purchase of electricity. The inventory also quantified TTAD Scope 3 emissions from airport tenants' activities including stationary and mobile combustion, fugitive emissions, and purchased electricity emissions as well as methane emissions resulting from the disposal of airport-generated waste at third-party landfills. Finally, the inventory also quantified TTAD Scope 3 emissions produced by aircraft operations at the airport.

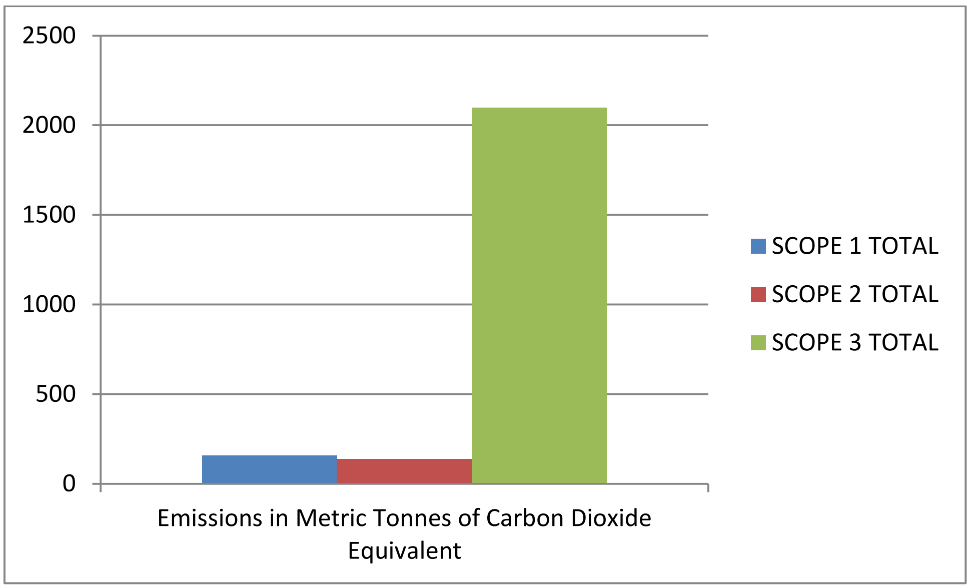
Emissions in the GHG Inventory are reported in Carbon Dioxide Equivalents (CO_2e). CO_2e is used to quantify total emissions because each GHG has a different Global Warming Potential (GWP). Using CO_2e equalizes all GHGs to one standard reference of metric tons of carbon dioxide equivalent. Unless otherwise noted in this report, GHG emissions were converted to CO_2e using Global Warming Potentials (GWPs), a standard conversion factor, from the Intergovernmental Panel on Climate Change's (IPCC) Second Assessment Report (SAR).

TTAD's total Scope 1 GHG emissions amounted to 158.60 metric tonnes carbon dioxide equivalents (MT CO_2e). These total emissions are divided almost evenly between stationary combustion, such as natural gas heating; and mobile combustion, such as gasoline consumption in airport fleet vehicles, with a small amount associated with refrigerant releases from refrigeration or air conditioning systems. As a point of reference, 158.60 MT CO_2e is approximately equivalent to the GHG emissions produced by 33.5 passenger vehicles driven for a year according to the US EPA's Greenhouse Gas Equivalencies Calculator.

TTAD's total Scope 2 GHG emissions amounted to 138.07 metric tons carbon dioxide equivalents (MT CO_2e). These emissions are associated with electricity usage by the airport and are roughly equivalent to the GHG produced from electricity use by 20.4 homes for one year.

TTAD's total Scope 3 GHG emissions amounted to 2099.22 metric tons carbon dioxide equivalents (MT CO_2e).

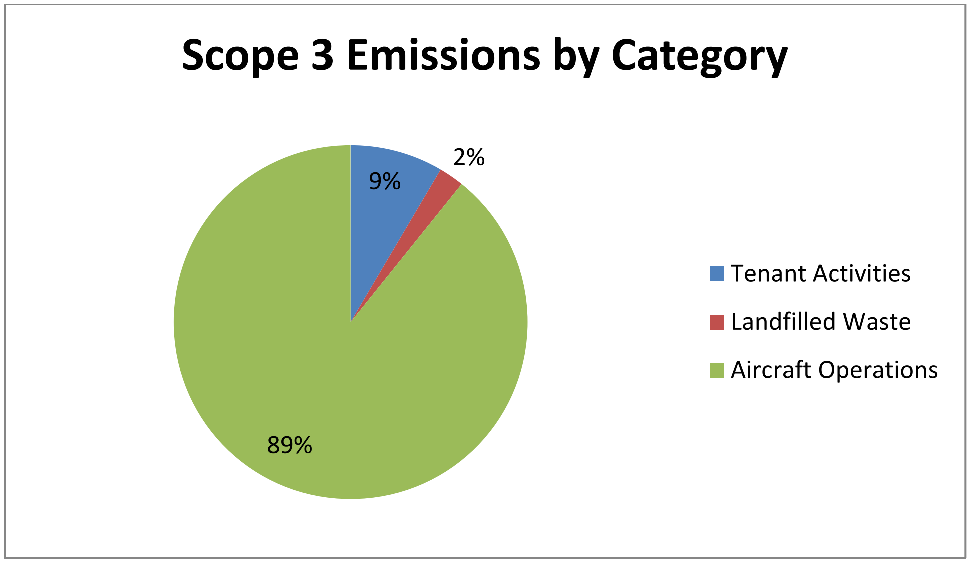
Figure 1: Total GHG Emissions by Scope



Scope 3 GHG emissions from aircraft operations, defined as landing and take-off (LTO) movements to an altitude of 3,000 feet, were calculated as 1873.26 metric tons carbon dioxide equivalents (CO_2e). These aircraft emissions are approximately equivalent to GHG emissions produced by 396 passenger vehicles driven for a year.

Scope 3 GHG emissions from tenant activities, mainly natural gas and electricity usage, totaled 178.09 metric tons carbon dioxide equivalents (CO_2e), though this value does not capture all tenant emissions at the airport due to unavailability of some tenant activity data.

Figure 2: Scope 3 Emissions by Category



Conducting this GHG inventory demonstrates TTAD's recognition of its relationship to both the local and global environment. It allows airport management to better understand and take responsibility for its activities and their climate impacts. Accordingly, this inventory provides a foundation and starting point for TTAD's efforts to reduce greenhouse gas emissions from its activities and demonstrate environmental stewardship. It also serves as a reference point to guide the development of policies, programs, and projects as TTAD pursues this environmental objective.

Introduction

A GHG emissions inventory identifies an organization's GHG emission sources and quantifies them according to a set of acknowledged conventions using established estimation methodologies.

The TTAD air emission inventory quantifies GHG from the "Kyoto six" greenhouse gases—carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). These six are the most recognized and common greenhouse gases from human-made sources and are designated as the Kyoto Six due to their identification in the United Nations Framework Convention on Climate Change Kyoto Protocol (UNFCCC).

Overview of the Airport

Truckee Tahoe Airport District is a regional general aviation airport serving the Town of Truckee, communities along the northern side of Lake Tahoe, and other nearby areas in the central Sierra Nevada mountain range of California.

The airport property occupies approximately 926 acres of land. Additionally, the District has interest in another 1,717 acres that was acquired to help preserve compatible land uses and enable aviation related services in other parts of the district.

Person Responsible

This GHG inventory was developed by First Environment under the direction of Kevin Smith, General Manager, Truckee Tahoe Airport District, and through consultation with TTAD staff including Hardy Bullock, Mike Cooke, Dave Hoffman, Stacey Justesen, Mike Ketron, Sally Lyon, Michelle Nicholas, Jill McClendon, and Phred Stoner.

Reporting Period

This GHG inventory report covers GHG emissions within TTAD boundaries described below during the period of:

- January 1 through December 31, 2015.

Organizational Boundaries

Organizational boundaries define the limits of a GHG inventory by identifying the activities that are owned and/or controlled by the entity and determining which emission sources should be included in its GHG inventory. The GHG emissions contained in this report were consolidated according to the operational control approach, where operational control is established for entities, facilities, activities, and sources over which the organization possesses the authority to implement operating policies such as financial, environmental, health, or safety directives.

This GHG inventory also identifies emissions that are a consequence of the activities of TTAD but result from facilities, activities, and sources owned by or under the operational control of other entities. For the TTAD GHG inventory, these other entities include airport tenants as well as the operators of aircraft which are served by the airport.

Activities excluded from the inventory's organizational boundaries include:

- Vehicles operated by the public, vendors, employees (including those of tenants and vendors), and public or private carriers used to provide transportation to and from the Airport.
- Construction and other contractor activity occurring on Airport property.

Operational Boundaries

Operational boundaries in GHG inventory refer to the specific types of emission sources that the TTAD, as defined by the inventory's organizational boundaries, possesses and includes in its GHG Inventory. A key distinction in setting operational boundaries is whether GHG emissions sources are categorized as direct emissions or indirect emissions.

- Direct emissions result from emission sources that are owned or operated by the organization.
- Indirect emissions are emissions that are due to an organization's activities but occur from sources owned or controlled by another organization.

The concept of emission "scopes" expands upon the distinction between direct and indirect emissions, splitting indirect emissions into two separate categories: one associated with indirect energy emissions and the other capturing all other types of indirect emissions. In addition, categories of common sources, such as stationary combustion, create a framework for the organization of the inventory. This framework facilitates the identification of appropriate quantification methodologies for emission sources, collection of data, as well as reporting of inventory results.

The general operational boundaries of the TTAD GHG inventory are as follows:

Scope 1: Direct GHG emissions from activities that are owned or controlled by the reporting entity.

TTAD Scope 1 GHG emission categories include the following:

- stationary combustion,
- mobile combustion,
- fugitive emissions.

Scope 2: Indirect GHG emissions from the generation of purchased or acquired energy, such as electricity, which is consumed by the reporting entity.

TTAD Scope 2 GHG emission categories include the following:

- purchased electricity.

Scope 3: All other indirect emissions not covered in Scope 2.

TTAD Scope 3 GHG emission categories include the following:

- tenant stationary combustion, mobile combustion, fugitive emissions, and consumption of purchased electricity;
- fugitive methane emissions resulting from airport waste disposed in third-party landfills;
- aircraft operations – specifically from the LTO cycle to an altitude of 3,000 feet.

Specific emission sources in the TTAD GHG inventory include the following:

Scope 1 - Direct Emissions

The following sources were identified as Scope 1 sources of GHG emissions:

- Stationary Combustion of Natural Gas in heaters, water heaters and similar units which produced CO_2, CH_4, and N_2O emissions.
- Stationary Combustion of Gasoline in a portable generator and portable welder which produced CO_2, CH_4, and N_2O emissions.
- Stationary Combustion of Diesel in airfield and maintenance generators which produced CO_2, CH_4, and N_2O emissions.
- Stationary Combustion of Acetylene by welding activities which produced CO_2, CH_4, and N_2O emissions.
- Mobile Combustion of Gasoline by ground support equipment and other airport vehicles which produced CO_2, CH_4, and N_2O emissions.
- Mobile Combustion of Diesel by ground support equipment and other airport vehicles which produced CO_2, CH_4, and N_2O emissions.
- Mobile Combustion of Propane by airport forklifts which produced CO_2, CH_4, and N_2O emissions.
- Fugitive Emissions of HFCs from Stationary Air Conditioning and Refrigeration Units releasing R-134a, R-404A, R-410A.
- Fugitive Emissions of HFCs from Mobile Air Conditioning Sources releasing R-134a
- Fugitive Emissions of CO_2 from Fire Extinguishers.

Scope 2 - Energy Indirect Emissions

The following sources were identified as Scope 2 sources of GHG emissions.

- Consumption of purchased electricity which indirectly resulted in CO_2, CH_4, and N_2O emissions.

Scope 3 - Other Indirect Emissions

The following sources were identified as Scope 3 sources of GHG emissions:

- Airport Tenant Activities -
  - Stationary Combustion of Natural Gas in heaters, water heaters, and similar units which produced CO_2, CH_4, and N_2O emissions.
  - Mobile Combustion of Gasoline by ground support equipment and other tenant vehicles which produced CO_2, CH_4, and N_2O emissions.
  - Mobile Combustion of Diesel by ground support equipment and other tenant vehicles which produced CO_2, CH_4, and N_2O emissions.
  - Mobile Combustion of Propane in tenant forklifts which produced CO_2, CH_4, and N_2O emissions.
  - Consumption of purchased electricity which indirectly resulted in CO_2, CH_4, and N_2O emissions.
  - Fugitive Emissions of HFCs from stationary air conditioning and refrigeration units releasing R-134a.
- Disposal of municipal solid waste generated by the airport in third-party landfills which resulted in CH_4 emissions.
- Emissions from Aircraft Operations at the Airport
  - LTO Cycle Emissions from Aircraft and Helicopters which produced CO_2, CH_4, and N_2O emissions.
  - Emissions from the Startup of Jet Engines which produced CO_2, CH_4, and N_2O emissions.
  - Emissions from Auxiliary Power Units (APUs) which produced CO_2, CH_4, and N_2O emissions.

This report also includes GHG emissions resulting from the combustion of aviation fuels sold at the airport as a further indicator of airport's impact on greenhouse gas emissions. The aviation fuels emissions were not aggregated with the above emissions since some of those emissions were already accounted for in LTO Cycle and engine start up emissions from aircraft operations and therefore would represent double-counting.

Source Exceptions

No sources of PFCs or SF_6 were identified in the TTAD inventory boundary.

In addition, some tenants did not provide data for emitting activities within the inventory boundary but these omissions are likely to be immaterial relative to the reported totals.

Quantification of Emissions

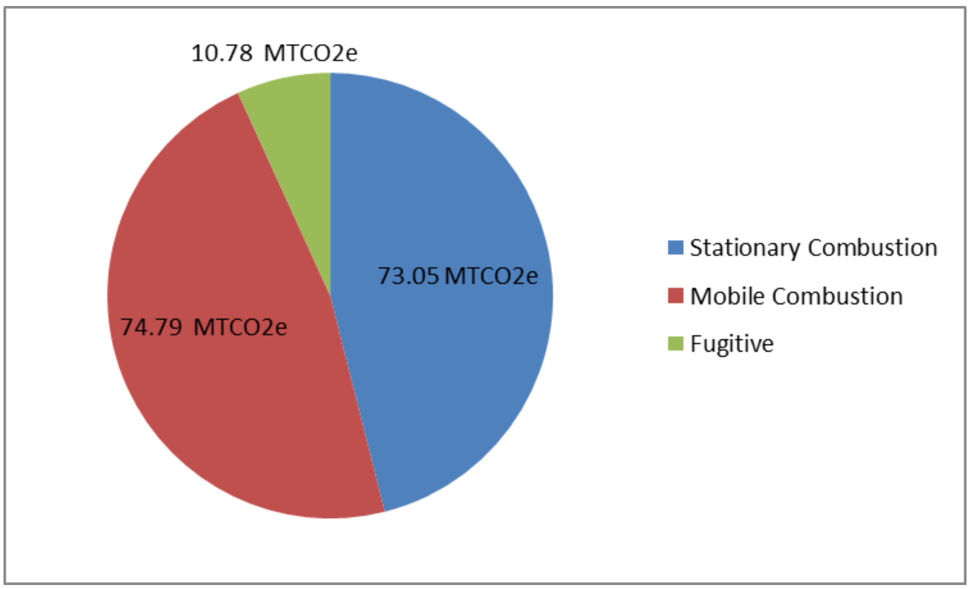
Scope 1 GHG Emissions

TTAD Total Scope 1 Emissions were quantified as 158.60 metric tonnes (MT) CO_2e. The quantity includes contributions of the following GHGs:

Table 1: Scope 1 GHG Emissions

	MT GHG	MT CO_2e
Carbon Dioxide (CO_2)	147.07	147.07
Methane (CH_4)	0.0056	0.12
Nitrous Oxide (N_2O)	0.002	0.63
Hydrofluorocarbons (HFCs)	0.007	10.78

Figure 3: Scope 1 Emissions by Source Type



Direct Stationary Combustion Emissions

TTAD direct stationary combustion emissions were quantified as 73.05 MT CO_2e. This stationary combustion quantity includes contributions from the following fuels:

Table 2: Direct Stationary Combustion by Fuel

Stationary Combustion Emissions	
Fuel	**MT CO_2e**
Natural Gas	70.09
Gasoline	0.50
Diesel	2.45
Acetylene	0.004

Direct Mobile Combustion Emissions

TTAD direct mobile combustion emissions were quantified as 74.78 MT CO_2e. This mobile combustion quantity includes contributions from the following fuels:

Table 3: Direct Mobile Combustion Emissions by Fuel

Mobile Combustion Emissions	
Fuel	**MT CO_2e**
Gasoline	32.55
Diesel	41.36
Propane	0.87

Direct Fugitive Emissions

TTAD direct fugitive emissions were quantified as 10.78 MT CO_2e. This fugitive emissions quantity includes contributions from the following sources:

Table 4: Direct Fugitive Emissions by Source Type

Mobile Combustion Emissions	
Fugitive Source Type	**MT CO_2e**
Chiller	7.98
Domestic Refrigeration	0.002
Stand Alone Commercial Application	0.58
Mobile Air Conditioning	2.21
CO_2 Fire Extinguishers	0.002

Scope 2 GHG Emissions

Total Scope 2 Emissions were quantified as 138.07 metric tonnes MT CO_2e. All Scope 2 emissions reported are from purchased electricity. The quantity includes contributions of the following GHGs:

Table 5: Scope 2 GHG Emissions

	MT GHG	MT CO_2e
Carbon Dioxide (CO_2)	137.53	137.53
Methane (CH_4)	0.002	0.05
Nitrous Oxide (N_2O)	0.002	0.49

TTAD's reported emissions from purchased electricity were calculated using a market-based method by applying a Truckee Donner Public Utility District-specific emission factor which considers the utility's contractual instruments for the environmental attributes of the power it purchases. An alternative approach to calculating emissions from purchased electricity is the location-based method, which relates the average emissions intensity of the larger electricity grid from which the electricity consumption occurs. TTAD's emission from electricity purchases were also calculated using the location-based method by applying the US EPA eGRID emission factor for the WECC Northwest subregion. The table below provides a comparison of the market-based and location-based method emission factors and the resulting GHG emissions from these different approaches:

Table 6: Market-based and Location-based EFs and GHG Emissions

Market-based Method			
TD PUD Emission Factors	lb CO_2 per MWh	lb CH_4 per GWh	lb N_2O per GWh
	606.8	9.55	7.02
Emissions	MT CO_2 - CO2e	MT CH_4 - CO_2e	MT N_2O - CO_2e
	137.53	0.05	0.49
Location-based Method			
eGRID subregion Emission Factors	lb CO_2 per MWh	lb CH_4 per GWh	lb N_2O per GWh
	907.0	97.8	14.2
Emissions	MT CO_2 - CO_2e	MT CH_4 - CO_2e	MT N_2O - CO_2e
	205.57	0.47	1.00

Scope 3 GHG Emissions

Total Scope 3 Emissions were quantified as 2099.22 MT CO_2e. The quantity includes contributions of the following GHGs:

Table 7: Scope 3 GHG Emissions

	MT GHG	**MT CO_2e**
Carbon Dioxide (CO_2)	2021.07	2021.07
Methane (CH_4)	2.60	54.54
Nitrous Oxide (N_2O)	0.06	17.10
Hydrofluorocarbons (HFCs)	0.005	6.50

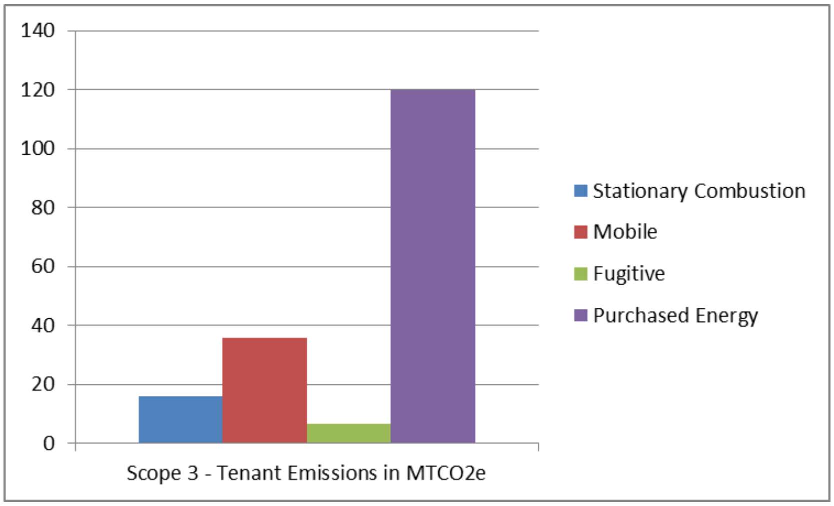
Scope 3 Tenant Activities

Indirect emissions from tenant activities were quantified as 178.09 MT CO_2e. This quantity includes contributions from the following tenant activities:

Table 8: Indirect Emissions from Tenant Activities

Tenant Activities	
Emission category	**MT CO_2e**
Stationary Combustion	15.98
Mobile Combustion	35.75
Fugitive Emissions	6.50
Purchased Electricity	119.85

Figure 4: Scope 3 Tenant Emissions by Source Type



Scope 3 Landfilled Waste

Indirect emissions from landfilled waste were quantified as 47.88 MT CO_2e. All reported Scope 3 Landfilled Waste emissions consist of methane (CH_4).

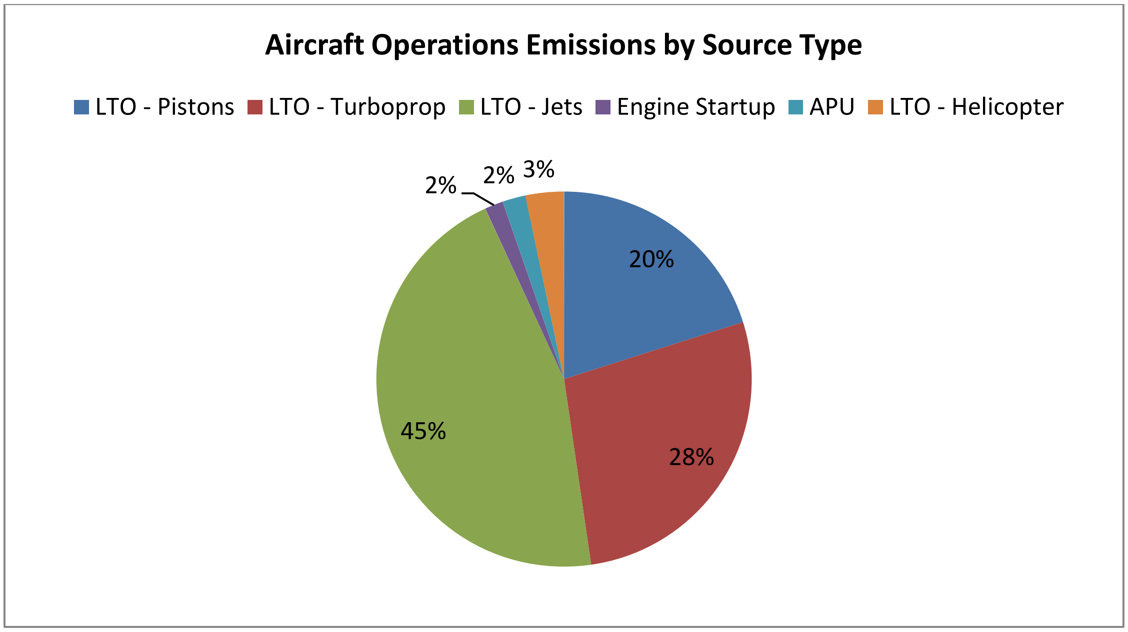
Scope 3 Aircraft Operations

Indirect emissions from aircraft operations were quantified as 1873.26 MT CO_2e. This quantity includes contributions from the following aircraft operation categories:

Table 9: Indirect Emissions from Aircraft Operations

Aircraft operations	
Aircraft operation category	**MT CO_2e**
LTO Cycle – Piston Aircraft	376.30
LTO Cycle - Turbo Prop Aircraft	517.07
LTO Cycle – Jet Aircraft	850.85
LTO Cycle - Helicopters	62.04
Jet Engine Startup	29.92
Auxiliary Power Units	37.07

Figure 5: Scope 3 Aircraft Emissions by Source Type



Though not included within Scope 3 to avoid double counting, emissions from total combustion of aviation fuels sold by TTAD were quantified as 3812.61 MT CO_2e. This quantity includes contributions from the following fuels:

Table 10: Emission from Fuel Sales

Aircraft operations	
Aircraft operation category	**MT CO_2e**
100LL Aviation Gasoline	678.80
Jet A Fuel	3133.81

EPA Reference Equivalents

To provide a point of reference for the TTAD emissions identified in this report, the following emission equivalencies were calculated using US EPA's Greenhouse Gas Equivalencies Calculator.

Table 11: TTAD GHG Emission Equivalencies

TTAD Emissions Category	$MTCO_2e$	These TTAD emissions are equivalent to the following:		
		Emissions from number of passenger vehicles driven for one year	Emissions from number of homes' electricity use for one year	Carbon sequestered by number of acres of forest in one year
Scope 1 – Stationary Combustion	73.05	15.4	10.8	69.1

TTAD Emissions Category	$MTCO_2e$	These TTAD emissions are equivalent to the following:		
		Emissions from number of passenger vehicles driven for one year	Emissions from number of homes' electricity use for one year	Carbon sequestered by number of acres of forest in one year
Scope 1 – Mobile Combustion	74.78	15.8	11.0	70.8
Scope 2 – Electricity Consumption	138.07	29.2	20.4	131.0
Scope 3 – Aircraft operations	1873.26	396	277	1773

2015 Weather Data

TTAD's location in the Sierra Nevada mountains makes its energy and fuel use, as well as its GHG emissions in a particular year, dependent upon the weather experienced during that year, both in terms of temperature and precipitation (especially snow). To provide a point of reference to the weather TTAD experienced during 2015, the following are the monthly heating degree days, cooling degree days, precipitation, and average temperature for 2015, as well as historical averages for these parameters for Truckee, California sourced from the Weather Underground, Western Regional Climate Center, and the National Climatic Data Center.

Table 12: Truckee, CA 2015 Weather Data

2015 Weather Data				
Month	**Total HDD**	**Total CDD**	**Precip (inches)**	**Avg. Temp (F)**
January	955	0	0.08	34.23
February	734	0	4.67	38.57
March	756	0	0.12	40.39
April	761	0	1.73	39.67
May	585	0	2.07	46.19
June	235	9	0.86	57.27
July	213	10	1.91	58.19
August	175	0	0.28	59.23
September	304	0	0	54.87
October	522	0	1.74	48.03
November	1068	0	3.27	29.27
December	1244	0	6.35	24.77

Table 13: Truckee, CA Climate Averages

Climate Averages				
Month	**Total HDD**	**Total CDD**	**Precip (inches)**	**Avg. Temp (F)**
January	1121	0	5.89	29.4
February	986	0	5.69	30.5
March	981	0	4.72	34.2
April	790	0	2.09	38.8
May	584	0	1.39	46.5
June	342	1	0.71	54
July	135	14	0.2	61.1
August	150	9	0.34	60.8
September	318	0	0.78	54.5
October	604	0	2.07	45.6
November	860	0	4.41	36.1
December	1067	0	5.97	29.9

GHG Inventory Base Year

A GHG inventory base year provides a standardized point of reference against which future inventories can be compared to identify changes, such as reductions, or track progress toward an emission goal or action plan. At this time, TTAD has not selected a GHG inventory base year.

Inventory Data Collection Methodologies

Data Collected for Each Source

Two primary methodologies were utilized to collect data.

- Data was provided by TTAD staff. In some cases when data were not available for a particular source, individuals with knowledge of the activities provided an estimate.
- Tenants were distributed customized questionnaires which requested various types of data from their activities such as electricity consumption, fuel consumption, and air conditioning/refrigeration systems.

The collection methodology for each source is summarized below.

Scope 1 Emissions

Stationary Combustion

Natural Gas

TTAD staff provided a summation of 2015 natural gas usage in therms in airport buildings compiled from utility invoices. Each building in the summary was designated as being under TTAD control or tenant operated and controlled. Total natural gas usage in airport-controlled buildings was summed and the quantification methodology was applied to this value.

Gasoline

TTAD staff provided a summation of 2015 gasoline usage in gallons consumed during airport activities, including both stationary and mobile equipment. TTAD staff also provided hourly fuel consumption rates for the gasoline-fueled generators and an estimate of weekly run times for 2015. These rates and estimates were used to estimate gasoline consumption by stationary sources and the quantification methodology was applied to this value.

Diesel

TTAD staff provided a summation of 2015 gasoline usage in gallons consumed during airport activities, including both stationary and mobile equipment. TTAD staff also provided hourly fuel consumption rates for the diesel-fueled generators and an estimate of weekly run times for 2015. These rates and estimates were used to estimate diesel consumption by stationary sources and the quantification methodology was applied to this value.

Acetylene

TTAD staff provided an estimate of 2015 acetylene usage in cubic feet and the quantification methodology was applied to this value.

Mobile Combustion

Gasoline

TTAD staff provided a summation of 2015 gasoline usage in gallons attributable to airport activities, including both stationary and mobile equipment. Gasoline usage by stationary sources was estimated using generator consumption rates and runtime estimates. This estimate of the stationary usage was subtracted from the total usage. The remaining quantity was assumed to be combusted by mobile sources and the quantification methodology was applied to this value.

Diesel

TTAD staff provided a summation of 2015 diesel usage in gallons attributable to airport activities, including both stationary and mobile equipment. Diesel usage by stationary sources was estimated using generator consumption rates and runtime estimates. This estimate of the stationary usage was subtracted from the total usage. The remaining quantity was assumed to be combusted by mobile sources and the quantification methodology was applied to this value.

Propane

TTAD staff provided a summation of 2016 propane purchases in gallons, which was assumed to be representative of 2015 usage, and the quantification methodology was applied to this value.

Fugitive Emissions

Stationary Air Conditioning and Refrigeration Units

TTAD staff provided an inventory of airport air conditioning and refrigeration units identifying refrigerant type and total unit charges in ounces. Unit information was aggregated by equipment types (e.g., domestic refrigeration) and refrigerant types and the quantification methodology was applied to this value.

Mobile Air Conditioning Sources

TTAD staff provided an inventory of airport ground services equipment and vehicles identifying which vehicles possessed air conditioning units. The number of vehicles with air conditioning units was multiplied by an assumed 0.5 kg charge of R-134A and the quantification methodology was applied to this value.

Fire Extinguishers

TTAD staff provided an inventory of airport fire extinguishers identifying extinguisher type and total charge in pounds. Carbon dioxide extinguisher information was extracted and totaled and the quantification methodology was applied to this value.

Scope 2 Emissions

Purchased Electricity

TTAD staff provided a summation of 2015 electricity consumption in kilowatt hours in airport buildings compiled from utility invoices. Each building in the summary was designated as being under TTAD control or tenant operated and controlled. Total electricity consumption in airport-controlled buildings was summed and the quantification methodology was applied to this value.

Scope 3 Emissions

Tenant Activities

Tenant Stationary Combustion of Natural Gas

TTAD staff provided a summation of 2015 natural gas usage in therms in airport buildings compiled from utility invoices. Each building in the summary was designated as being under TTAD control or tenant operated and controlled. Total natural gas usage in tenant-controlled buildings was summed. In addition, airport tenants possessing natural accounts directly with the gas utility reported an estimate of 2015 gas usage via the tenant questionnaire and these quantities were aggregated. The gas subtotals from the airport summation and the tenant questionnaires were summed and the quantification methodology was applied to this value.

Tenant Mobile Combustion of Gasoline

Airport tenants reported an estimate of 2015 gasoline usage in mobile sources via the tenant questionnaire. These quantities were aggregated and the quantification methodology was applied to this value.

Tenant Mobile Combustion of Diesel

Airport tenants reported an estimate of 2015 diesel usage in mobile sources via the tenant questionnaire. These quantities were aggregated and the quantification methodology was applied to this value.

Tenant Mobile Combustion of liquid petroleum gas (propane)

Airport tenants reported an estimate of 2015 liquid petroleum gas usage in mobile sources via the tenant questionnaire. These quantities were aggregated and the quantification methodology was applied to this value.

Tenant Air Conditioning and Refrigeration Units

Airport tenants reported air conditioning units and refrigerators via the tenant questionnaire. Reported unit counts were aggregated by equipment types (e.g., domestic refrigeration) multiplied by an average refrigerant charge for the types, and the quantification methodology was applied to this value.

Tenant Consumption of Electricity

TTAD staff provided a summation of 2015 electricity consumption in airport buildings compiled from utility invoices. Each building in the summary was designated as being under TTAD control or tenant operated and controlled. Total consumption in tenant-controlled buildings was summed. In addition, airport tenants possessing electricity accounts directly with the power utility reported an estimate of 2015 electricity usage via the tenant questionnaire and these quantities were aggregated. The electricity subtotals from the airport summation and the tenant questionnaires were summed and the quantification methodology was applied to this value.

Landfilled waste

TTAD staff provided an estimate of airport waste sent to the landfill of 21 cubic feet per week based on waste receptacle volume and an assumption of full weekly usage of this capacity. This weekly volume of waste was multiplied by 52 weeks and the quantification methodology was applied to this value.

Aircraft Operations

Aircraft LTO Cycle

Total aircraft operations allocated to general aircraft categories was determined from Truckee Tahoe Airport District Operations and Community Comment Report for 2015. In addition, TTAD staff provided “Model Report2015KTRK.xlsx” which identifies the number of arrival and departures for a particular aircraft type (e.g., AC109). These aircraft models were sorted according to three aircraft categories: piston, turbo prop, and jet. The aircraft in each category were ranked and model-specific arrival and departure totals were identified for the top 80 percent of the aircraft models. The 20 percent remainder of the operations from each aircraft category were assigned to a representative aircraft for that category identified by TTAD staff (e.g., Cessna Citation 560XL for jets) and assumed to be equally divided between arrivals and departures. These aircraft arrival and departure totals were summarized and the quantification methodology was applied to these values.

Helicopter LTO Cycle

Total helicopter operations were determined from Truckee Tahoe Airport District Operations and Community Comment Report for 2015. The operations were divided by two to identify helicopter LTOs and the quantification methodology was applied to this value.

Jet Engine Startup

Total turbo prop, jet and helicopter operations were determined from Truckee Tahoe Airport District Operations and Community Comment Report for 2015. These turbo prop, jet, and helicopter operations were divided by two to identify departure operations that would begin with a jet engine startup. Jet aircraft were assumed to have twin jet engines and helicopters were assumed to have single jet engines. Seventy percent of turbo prop aircraft were assumed to have single jet engines and the remaining 30 percent were assumed to have twin jet engines. Turbo prop, jet, and helicopter departure quantities were aggregated according to single engine aircraft and twin engine aircraft and the quantification methodology was applied to these values.

APU Emissions

Total operations for jets greater than 20,000 pounds were identified from Truckee Tahoe Airport District Operations and Community Comment Report for 2015. Sixty percent of these jet operations were assumed to have operated an APU and the quantification methodology was applied to this value.

Aviation Fuel Sales Emissions

TTAD staff provided 100LL aviation gasoline and Jet A fuel sales total in gallons as determined from the fuel dispensing system. The quantification methodology was applied to these values.

Emissions Quantification Methodologies

GHG emissions are calculated using methodologies from:

- United States Environmental Protection Agency Center for Corporate Climate Leadership Greenhouse Gas Inventory Guidance for:
  - Direct Emissions from Stationary Combustion Sources;
  - Direct Emissions from Mobile Combustion Sources;
  - Indirect Emissions from Purchased Electricity;
  - Direct Fugitive Emissions from Refrigeration, Air Conditioning, Fire Suppression, and Industrial Gases.
- The Climate Registry (TCR) General Reporting Protocol.
- Federal Aviation Administration Office of Environment and Energy Aviation Emissions and Air Quality Handbook.

In addition, GHG emissions are calculated using emission factors sourced from:

- United States Environmental Protection Agency Center for Corporate Climate Leadership Emission Factors for Greenhouse Gas Inventories.
- The Climate Registry Default Emission Factors.
- Truckee Donner Public Utility District 2012 Greenhouse Gas Emissions Re-Inventory.
- United States Environmental Protection Agency Emissions & Generation Resource Integrated Database (eGRID).
- Federal Aviation Administration Aviation Environmental Design Tool (AEDT).

The quantification methodology for each source is summarized in the following paragraphs.

Scope 1 Emissions

Stationary Combustion

Natural gas

Emissions were calculated by multiplying the mmBtu heat content of the total natural gas usage in airport-controlled buildings by natural gas emission factors for CO_2, CH_4, and N_2O sourced from the US EPA emission factors for GHG inventories. The results of these calculations were pounds of CO_2, CH_4 and N_2O emissions, which were converted to metric tonnes of CO_2, CH_4, and N_2O emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

Gasoline

Emissions were calculated by multiplying the total gallons of estimated gasoline usage by stationary sources by gasoline emission factors for CO_2, CH_4 and N_2O sourced from the US EPA emission factors for GHG inventories. The results of these calculations were pounds of CO_2, CH_4, and N_2O emissions, which were converted to metric tonnes of CO_2, CH_4, and N_2O emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

Diesel

Emissions were calculated by multiplying the total gallons of estimated diesel usage by stationary sources by diesel emission factors for CO_2, CH_4, and N_2O sourced from the US EPA emission factors for GHG inventories. The results of these calculations were pounds of CO_2, CH_4, and N_2O emissions, which were converted to metric tonnes of CO_2, CH_4, and N_2O emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

Acetylene

Emissions were calculated by multiplying the total cubic feet of estimated acetylene usage by CO_2 emission factor source from the TCR's GRP. The results of these calculations were pounds of CO_2 emissions that were converted to metric tonnes of CO_2 emissions. Emission factors for CH_4 and N_2O emissions from acetylene combustion were not available; emissions of these gases were assumed to be immaterial.

Mobile Combustion

Gasoline

Emissions were calculated by multiplying the total gallons of estimated gasoline usage by mobile sources by gasoline emission factors for CO_2, CH_4, and N_2O sourced from the US EPA emission factors for GHG inventories. The results of these calculations were pounds of CO_2, CH_4, and N_2O emissions that were converted to metric tonnes of CO_2, CH_4, and N_2O emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

Diesel

Emissions were calculated by multiplying the total gallons of estimated diesel usage by mobile sources by diesel emission factors for CO_2, CH_4, and N_2O sourced from the US EPA emission factors for GHG inventories. The results of these calculations were pounds of CO_2, CH_4, and N_2O emissions that were converted to metric tonnes of CO_2, CH_4, and N_2O emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

Propane

Emissions were calculated by multiplying the total gallons of estimated propane usage by mobile sources by liquid petroleum gas (LPG) emission factors for CO_2, CH_4, and N_2O sourced from the US EPA emission factors for GHG inventories, since propane emission factors for mobile sources were not available. The results of these calculations were pounds of CO_2, CH_4, and N_2O emissions that were converted to metric tonnes of CO_2, CH_4, and N_2O emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

Fugitive emissions

Refrigerants, stationary sources

Emissions were calculated by multiplying the total refrigerant charge in pounds for an equipment type (e.g., domestic refrigeration) by an equipment-specific “operating emission factor” reflecting a percent annual leakage of the equipment charge, sourced from TCR’s default emission factors. The results of these calculations were pounds of the specific refrigerant (e.g., R-134a) emissions, which were converted to metric tonnes of the refrigerant emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

Refrigerants, mobile sources

Emissions were calculated by multiplying the total estimated R-134a refrigerant charge in pounds for mobile air conditioning by an “operating emission factor” for mobile air conditioning systems, reflecting a percent annual leakage of the equipment charge, sourced from TCR’s default emission factors. The results of these calculations were pounds of R-134a emissions, which were converted to metric tonnes of the R-134a emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

CO_2 fire extinguishers

Emissions were calculated by multiplying the total CO_2 fire extinguisher capacity in pounds by an "operating emission factor" for portable fire suppression equipment, reflecting an annual leakage rate of the equipment, sourced from US EPA's guidance for direct fugitive emissions. The results of these calculations were pounds of CO_2 emissions, which were converted to metric tonnes CO_2e.

Scope 2 Emissions

Purchased Electricity

"Market-based electricity emissions" were calculated by multiplying the megawatt hours of total consumption in airport-controlled buildings by electricity emission factors for CO_2, CH_4, and N_2O sourced from the Truckee Donner PUD 2012 GHG Re-Inventory. The results of these calculations were pounds of CO_2, CH_4, and N_2O emissions that were converted to metric tonnes of CO_2, CH_4, and N_2O emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

An alternate calculation was performed to quantify "location-based electricity emissions" by multiplying the megawatt hours of total consumption in airport-controlled buildings by electricity emission factors for CO_2, CH_4, and N_2O sourced from the US EPA eGRID database. The results of these calculations were pounds of CO_2, CH_4, and N_2O emissions, which were converted to metric tonnes of CO_2, CH_4, and N_2O emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

Scope 3 Emissions

Tenant Activities

Tenant Stationary Combustion of Natural Gas

Emissions were calculated for total tenant natural gas usage using the same methodology as identified above for Scope 1 stationary combustion of natural gas.

Tenant Mobile Combustion of Gasoline

Emissions were calculated for total tenant gasoline usage using the same methodology as identified above for Scope 1 mobile combustion of gasoline.

Tenant Mobile Combustion of Diesel

Emissions were calculated for total tenant diesel usage using the same methodology as identified above for Scope 1 mobile combustion of diesel.

Tenant Mobile Combustion of liquefied petroleum gas

Emissions were calculated for total tenant LPG usage using the same methodology as identified above for Scope 1 mobile combustion of propane.

Tenant Air Conditioning and Refrigeration Units

Emissions were calculated for tenant air conditioning and refrigeration units using the same methodology as identified above for Scope 1 refrigerants, stationary sources.

Tenant Consumption of Electricity

Emissions were calculated for total tenant electricity consumption using the same methodology as identified above for Scope 2 purchased electricity.

Landfilled Waste

The estimate of annual cubic yards of airport waste was converted to short tons of waste landfilled assuming that it was a residential/institutional/commercial mixed municipal solid waste (MSW) stream and using a conservative waste density (i.e., volume to weight conversion factor) sourced from the US EPA Office of Resource Conservation and Recovery. This mixed MSW weight quantity was entered into the US EPA Waste Reduction Model (WARM) which calculated an emissions output in units of metric tonnes CO_2e, though calculated using IPCC GWPs from the fourth assessment report (AR4). For consistency with other CH_4 emission sources reported in the inventory, the AR4 GWP for CH_4 was used to convert the WARM output to metric tonnes of CH_4 emissions, which is the primary GHG released from landfills. This value was then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

Aircraft Operations

Aircraft LTO Cycle

Aircraft-specific arrival and departure totals were multiplied by aircraft-specific fuel burn quantities for landing and takeoff cycle modes (e.g., taxi-out, takeoff, climbout, etc.), which were modeled for Truckee Tahoe Airport conditions to an altitude of 3,000 feet using the FAA AEDT, to identify total aviation gasoline or jet fuel combusted for piston, turbo prop, and jet aircraft categories. The aircraft category fuel totals were multiplied by LTO-specific avgas and Jet A emission factors for CO_2, CH_4, and N_2O sourced from the FAA Aviation Emissions and Air Quality Handbook. The results of these calculations were pounds of CO_2, CH_4, and N_2O emissions that were converted to metric tonnes of CO_2, CH_4, and N_2O emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

Helicopter LTO Cycle

Total helicopter LTOs were multiplied by a fuel usage per LTO value for the Eurocopter AS350, as the helicopter model most representative of airport helicopter operations available, sourced from the Airports Council International (ACI) Airport Carbon and Emissions Reporting Tool (ACERT) to identify total jet fuel combusted for helicopter LTO. The helicopter Jet A total was multiplied by LTO-specific Jet A emission factors for CO_2, CH_4, and N_2O sourced from the FAA Aviation Emissions and Air Quality Handbook. The results of these calculations were pounds of CO_2, CH_4, and N_2O emissions that were converted to metric tonnes of CO_2, CH_4, and N_2O emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

Jet Engine Startup

Consistent with the jet engine startup fuel usage methodology from the FAA Aviation Emissions and Air Quality Handbook, single jet engine aircraft and twin engine aircraft departure totals were multiplied by an engine-specific “idle” fuel flow rate for the Pratt & Whitney JT15D-5, as an overall representative jet engine, sourced from FAA AEDT, adjusted to a 42-second startup period, to identify total jet fuel combusted for jet engine startups. The jet engine startup Jet A fuel total was multiplied by “startup mode”-specific Jet A emission factors for CO_2, CH_4, and N_2O sourced from the FAA Aviation Emissions and Air Quality Handbook. The results of these calculations were pounds of CO_2, CH_4, and N_2O emissions that were converted to metric tonnes of CO_2, CH_4, and N_2O emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

APU Emissions

Consistent with the APU fuel usage methodology from the FAA Aviation Emissions and Air Quality Handbook, the estimated APU usage total was multiplied by an APU-specific fuel flow rate for APU GTCP-36-100, as an overall representative APU, sourced from FAA AEDT. The

APU usage period was assumed to be 15 minutes. The calculation identified total jet fuel combusted for APU usage. The APU usage Jet A fuel total was multiplied by "startup mode"-specific Jet A emission factors for CO_2, CH_4, and N_2O sourced from the FAA Aviation Emissions and Air Quality Handbook. The results of these calculations were pounds of CO_2, CH_4, and N_2O emissions that were converted to metric tonnes of CO_2, CH_4, and N_2O emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

Aviation Fuel Sales Emissions

The 100LL and Jet A fuel sales total in gallons were multiplied by aviation gasoline and kerosene-type jet fuel emission factors for CO_2, CH_4, and N_2O sourced from the US EPA emission factors for GHG inventories. The results of these calculations were pounds of CO_2, CH_4, and N_2O emissions that were converted to metric tonnes of CO_2, CH_4, and N_2O emissions, and then multiplied by IPCC SAR GWPs to identify total emissions in units of metric tonnes CO_2e.

Global Warming Potentials

The Global Warming Potentials, identified in the Second Assessment Report of the Intergovernmental Panel on Climate Change, were used to convert the GHG emissions associated with Airport activities into carbon dioxide equivalents (CO_2e).

The Global Warming Potentials applied to the TTAD GHG inventory were the following:

Name	Chemical Formula	SAR GWP Value
Carbon Dioxide	CO_2	1
Methane	CH_4	21
Nitrous oxide	N_2O	310
Hydrofluorocarbons (HFCs), HFC blends and refrigerant blends		
R-410A		1725
R-134A		1300
R-404A		3260

Uncertainty Assessment and Quality Assurance

With regard to a GHG Inventory, quality refers to the general accuracy and consistency between an organization's actual emissions and quantified emissions. The difference between actual and quantified emissions results from uncertainty and error introduced by activities such as data collection, data management, calculations, and reporting. Inventory quality is impacted as data progresses from individual sources to the final report.

The inventory contains reporting uncertainty resulting from the potential for errors to be introduced in certain activities. Overall uncertainties are as follows:

- Not all data was received from primary sources (i.e., invoices) and backup data was not provided with the information recorded on the tenant forms. Thus, errors present in the initial data will be transferred to errors in the emission calculations.
- Default emission factors, though used as a best practice, may present a level of uncertainty from the actual emissions.

Verification of this Report

This report, the information it contains, and the data it is based upon have not been verified by an external third party.