November 2023

2019 Greenhouse Gas Emissions Inventory

Burlington International Airport

PREPARED FOR

Burlington International Airport
1200 Airport Drive
South Burlington, VT 05403

PREPARED BY

101 Walnut Street
PO Box 9151
Watertown, MA 02471

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Introduction

Burlington International Airport (BTV, or "the Airport") is developing a Sustainability Management Plan (SMP) to understand its existing performance and set ambitious goals towards improving the Airport's sustainability. As a critical component of the SMP, BTV has committed to reducing its greenhouse gas (GHG) emissions by embracing clean, renewable, and efficient energy systems and improving airport operations that otherwise contribute to climate change. This 2019 Greenhouse Gas Emissions Inventory provides BTV with a necessary baseline that enables the Airport to track its progress towards absolute emissions reduction. It also helps the Airport to engage its airlines, tenants, and partners in actions to reduce emissions.

Purpose

BTV wishes to better understand the GHG emissions generated at the Airport. Preparing a GHG emissions inventory presents an opportunity to identify and analyze the sources of emissions generated by the Airport and to target mitigation strategies that have the greatest reduction potential. Conducting and regularly updating GHG emissions inventories can be useful in understanding how to best design policies and programs that reduce GHG emissions, as well as for tracking their effectiveness.

The purpose of this 2019 Greenhouse Gas Emissions Inventory is to quantity GHG emissions from Airport activities and establish a baseline to which future inventories can be compared to demonstrate performance improvements over time. The results of the inventory will be used to advance sustainability planning efforts at the Airport, including the development of decarbonization goals and the identification of GHG reduction strategies.

This document provides an overview of the findings of the 2019 GHG Emissions Inventory and describes the approach and methodology used to conduct the analysis. It also includes business-as-usual projections for 2030, which take existing emissions and apply facility-specific growth/change factors to show the general direction of GHG emissions if no significant action were to be taken by BTV to reduce those emissions. The document concludes with a summary of current actions being taken to reduce GHG emissions at the Airport.

BTV intends to use the contents of this report to support Level 1 (Mapping) certification under the Airports Council International (ACI) Airport Carbon Accreditation (ACA) Program. The ACA Program is the only global carbon management certification program for airports. It relies on internationally recognized methodologies to provide airports with a common framework for active GHG emissions management. In order to achieve the first level of accreditation (Level 1 – Mapping), BTV is required to measure and inventory its annual Scope 1 and Scope 2 emissions.

Inventory Year

Calendar year 2019 was chosen as the reporting year for this GHG inventory. The selection of this year was based on the availability of data, determined through discussions with BTV. Calendar years 2020 and 2021 were considered, though it was determined that these were less viable options due to the COVID-19 pandemic disrupting normal Airport activities during the period.

BTV completed an initial inventory of GHG emissions in 2010 as part of the City of Burlington Climate Action Plan (2012). However, the 2010 inventory was limited to the Airport's vehicle fleet and natural gas and electricity consumption. Going forward, the 2010 GHG emissions baseline will be replaced with the baseline established in this 2019 Greenhouse Gas Emissions Inventory.

Organizational Boundary

The 2019 GHG Emissions Inventory follows the control approach as described in the *Greenhouse Gas Protocol: A Corporate and Reporting Standard*. Under the control approach, an organization (i.e., BTV) accounts for 100 percent of the GHG emissions from operations over which it has control. The section below describes the Airport's operational boundary by categorizing emissions as either direct or indirect as well as identifying the applicable scopes for GHG accounting purposes.

Sources of Emissions

GHG emissions inventories are categorized by emission scopes and sources. Scopes define the categories of ownership and level of control that an entity has over emissions generation, while sources are the operations or activities generating the emissions. General descriptions of scope categories are provided below.

- **Scope 1** includes direct emissions from sources that are owned and controlled by BTV, such as fuel used to power Airport-owned vehicles and energy used to power Airport facilities (i.e., natural gas, fuel oil, etc.).
- **Scope 2** refers to indirect emissions associated with purchased electricity for heating, cooling, and powering facilities.
- **Scope 3** refers to indirect emissions generated by others at the Airport or due to activities taking place at the Airport, including by tenants and the traveling public. Example Scope 3 emissions include aircraft activity, emissions from tenant-based stationary sources and facility power, as well as emissions from off-airport ground transportation.

This inventory primarily addresses BTV's Scope 1 and Scope 2 emissions, with select Scope 3 categories included based on data availability. The GHGs evaluated as part of the inventory include the following:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)

These gases are consistent with those regulated under the Kyoto Protocol. The three gases regulated under the Kyoto Protocol missing from this list are sulfur hexafluoride (SF_6), hydrofluorocarbons (HFC), and perfluorocarbons (PFC). For aviation operations, emissions of the fluorinated compounds (including HFC and PFC) are less significant because these compounds are generally emitted from industrial activities. They can be emitted from airport activities associated with the use of refrigerants and fire extinguishers; however, refrigerants and fire extinguishers were excluded from this inventory since refrigerant data was not available and there are no fire extinguishers owned by BTV. SF_6 sources relevant to airports are typically connected to electrical transmission and distribution equipment. SF_6 was not evaluated for this inventory due to the complexity of measuring SF_6 emissions.

Table 1 below summarizes emission scopes and sources associated with typical airport activities.

Table 1. Scopes and Sources for Airport Activities

Owning or Controlling Entity	**Source**	**Scope**	**Inventory Reporting Status**
Airport Operator	Buildings (e.g., natural gas, oil, propane)	Scope 1	Reported
	Fossil Fuel Power Generation (e.g., CHP)	Scope 1	N/A to BTV – No on-site power generation
	Vehicles, Equipment, and GSE	Scope 1	Reported
	Emergency Generators	Scope 1	Reported
	Fire Training	Scope 1	N/A to BTV – Conducted by third party
	De-Icing/Glycol	Scope 1	N/A to BTV – Conducted by third party
	On-Site Waste Treatment	Scope 1	N/A to BTV
	Refrigerants	Scope 1	Excluded due to data availability
	Electricity Consumption	Scope 2	Reported
	Off-Site Waste Processing	Scope 3	Reported
	Off-Site Wastewater Treatment	Scope 3	Scope 3 source not included for 2019
	Power Distribution Losses	Scope 3	Reported
	Construction	Scope 3 (or Scope 1)	Scope 3 source not included for 2019
	Employee Commuting	Scope 3	Scope 3 source not included for 2019
	Business Travel	Scope 3	Scope 3 source not included for 2019

Tenant (i.e., airlines, concessionaires, FBOs, etc.)	Aircraft	Scope 3	Reported
	APU	Scope 3	Reported
	Vehicles, Equipment, and GSE	Scope 3	Reported for VTANG.
	Buildings (e.g., natural gas, oil, propane)	Scope 3	Reported for VTANG.
	Electricity Consumption	Scope 3	Reported for VTANG.
	Emergency Generators	Scope 3	Reported for VTANG.
	Fire Training	Scope 3	Reported for VTANG.
	De-Icing/Glycol	Scope 3	Reported.
	Employee Commuting	Scope 3	Scope 3 source not included for 2019
Public	Ground Transportation	Scope 3	Scope 3 source not included for 2019

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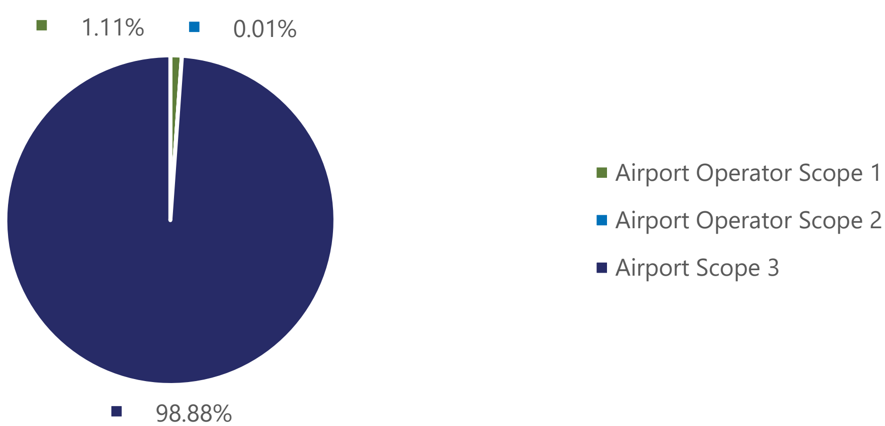
GHG Emissions Inventory Results

Total GHG emissions for calendar year 2019 were estimated to be 118,674 metric tons of carbon dioxide equivalent (MT CO_2e). Of this total, 1.1 percent can be directly attributed to BTV as Scope 1 and Scope 2 emissions, while 98.9 percent of emissions were associated with Scope 3 activities.

Summary of 2019 GHG Emissions

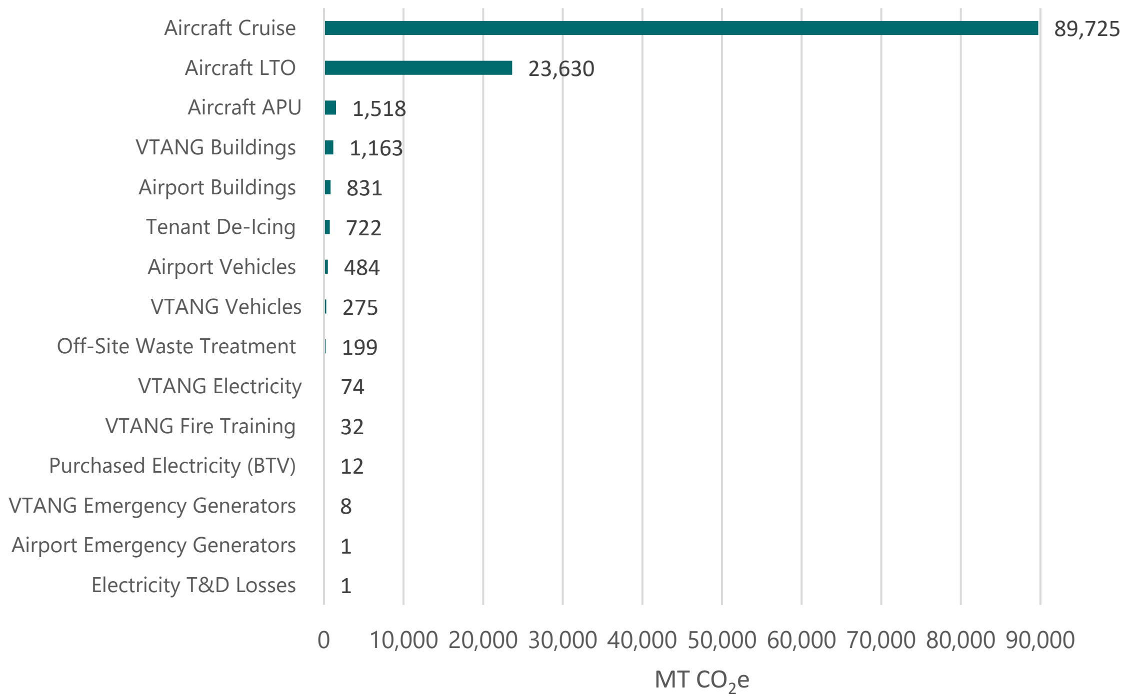
This GHG emissions inventory reports an estimated **118,674 MT CO_2e** were emitted at BTV in calendar year 2019. Airport Operator emissions (i.e., Scope 1 and Scope 2) were responsible for 1.1 percent of this total. The remaining 98.9 percent of emissions can be attributed to tenant operations and other business activities associated with the Airport (i.e., Scope 3). It is important to note that this inventory does not include the full gamut of applicable Scope 3 categories at BTV due to data availability, and therefore likely undercounts total Scope 3 emissions. **Figure 1** shows the inventory results by scope.

Figure 1. 2019 GHG Emissions Inventory Results by Scope



Including Scope 3 sources, the largest source of emissions was Aircraft Cruise (i.e., full flight) emissions, based on aircraft fuel uploaded at BTV. Aircraft Cruise GHG emissions were estimated to be 89,725 MT CO_2e in 2019, comprising 75.6 percent of total emissions. This does not include Aircraft landing and takeoff (LTO) emissions (i.e., takeoff, climb out, and approach up to 3,000 ft), which is the next largest source of emissions. Looking only at Scope 1 and Scope 2 emissions for which the Airport is directly responsible, the largest source of emissions was diesel and gasoline consumption in Airport-owned vehicles and equipment (484.2 MT CO_2e). **Figure 2** shows the inventory results by source.

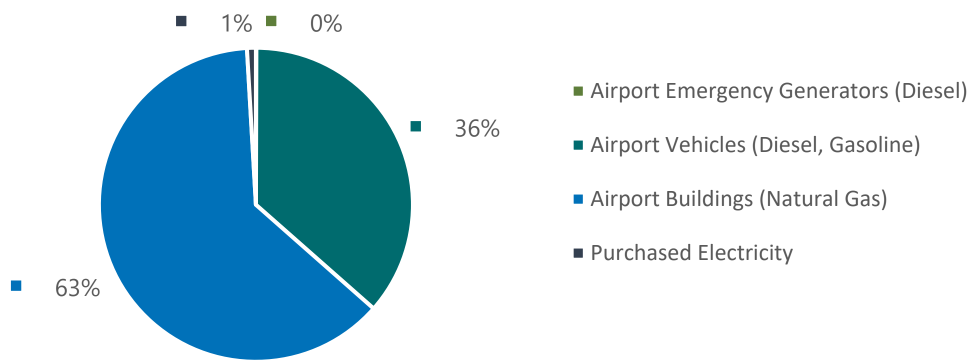
Figure 2. 2019 GHG Emissions Inventory Results by Source (MT CO_2e)



Scope 1 and Scope 2 Emissions

Total Scope 1 and Scope 2 emissions were estimated to be 1,328 MT CO_2e. Scope 1 sources, including natural gas used for heating and diesel and gasoline consumed in Airport-operated vehicles and generators, accounted for 99.1 percent of Airport Operator emissions (1,315.9 MT CO_2e). Scope 2 emissions from purchased electricity accounted for 0.9 percent of Airport Operator emissions (12.2 MT CO_2e). As described in **Chapter 3**, BTV emissions from purchased electricity are minimal due to the renewable energy supply of its utilities – Burlington Electric Department (BED) and Green Mountain Power (GMP). **Figure 3** summarizes Scope 1 and Scope 2 emissions sources for 2019.

Figure 3. 2019 GHG Emissions Inventory Results – Scope 1 and Scope 2 (MT CO_2e)



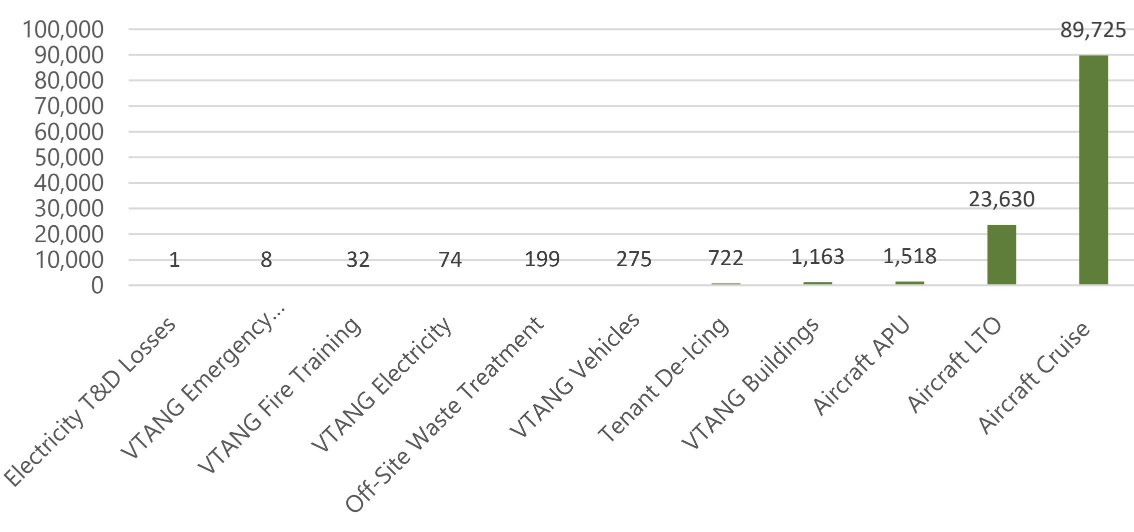
Scope 3 Emissions

Total Scope 3 emissions were estimated to be 117,346 MT CO_2e in 2019. The vast majority of these emissions (97.9 percent) were associated with aircraft operations from LTO, flight, and APU time. Additional Scope 3 categories analyzed as part of this inventory include solid waste processing, electricity transmission and distribution (T&D) losses, airline de-icing activity, and VTANG operations. Refer to **Table 1** and **Chapter 3** for those Scope 3 categories that were omitted from this inventory, either due to lacking applicability or data deficiency.

It should be noted that the Vermont Air National Guard (VTANG), a primary tenant at BTV, is the only tenant that provided activity data for this inventory. Accordingly, Scope 3 emissions are further undercounted in this inventory since the full range of activity data associated with tenant operations at the Airport was not estimated.

Figure 4 summarizes the Scope 3 emissions categories that were included as part of this inventory.

Figure 4. 2019 GHG Emissions Inventory Results – Scope 3 (MT CO_2e)



Military Operations

To understand the impact of military operations on the Airport's Scope 3 emissions, the section below describes the LTO and cruise emissions specific to military aircraft. The methodology for calculating GHG emissions from aircraft is detailed in **Chapter 3**. **Table 2** below presents LTO emissions for based and transient military aircraft, as well as cruise (i.e., full flight) emissions for all aircraft fueled by VTANG. LTO emissions are based on aircraft movement data by aircraft type.

Table 2. GHG Emissions Specific to Military Operations at BTV

Source	GHG Emissions (MT CO_2e)	Percent of Total BTV Aircraft Emissions
Based Military LTO	325.8	1.4% of LTO Emissions
Transient Military LTO	418.2	1.8% of LTO Emissions
Total Military LTO	744.1	3.1% of LTO Emissions
Cruise (i.e., full flight)	26,235.2	29.2% of Cruise Emissions

LTO = landing and takeoff emissions (i.e., takeoff, climb out, and approach up to 3,000 ft)
Cruise emissions are based on Jet A fuel uploaded by VTANG

Business-As-Usual (BAU) Forecast

BAU projections take baseline emissions and apply facility-specific growth and other relevant change factors to show the general direction of GHG emissions if no significant action were to be taken by BTV to reduce those emissions. It is important to note that BAU projections are heavily dependent on assumptions that contribute to the development of the change factors, and therefore, any variances or additional influences (e.g., new regulations or governmental policy) can result in significant changes to the projections.

Under the BAU scenario, BTV's GHG emissions are expected to fall from 118,674 MT CO_2e to 112,579 MT CO_2e, a decline of 5.1 percent. The projected decline is the result of improvements occurring outside of BTV's control. These improvements include, for example:

› A 2 percent annual efficiency gain from improved aircraft design.[1]

› A 10 percent replacement of jet fuel with sustainable aviation fuel (SAF) by 2030.[2, 3]

› A vehicle efficiency improvement of 25.7 percent, based on the expected change in average MPG between 2019 and 2030.[4]

› GMP fully transitioning to a renewable energy supply.[5]

[1] IEA Aviation (July 2023). Tracking Aviation. Retrieved from https://www.iea.org/energy-system/transport/aviation

[2] Hillyer, M. (September 22, 2021). Clean Skies for Tomorrow Leaders: 10% Sustainable Aviation Fuel by 2030. World Economic Forum. Retrieved from https://www.weforum.org/press/2021/09/clean-skies-for-tomorrow-leaders-commit-to-10-sustainable-aviation-fuel-by-2030/

[3] This is an assumption based on an industry average; actual reductions at BTV will be dependent on the Airport supporting the advancement of local SAF supplies.

[4] U.S. Energy Information Administration, AEO2023 National Energy Modeling System run ref2023.d020623a. Retrieved from https://www.eia.gov/outlooks/aeo/data/browser/#/?id=50-AEO2023&cases=ref2023&sourcekey=0

[5] GMP energy supply is currently 100 percent carbon free.

In some cases, such improvements are offset by expected increases in passenger activity and aircraft operations.

Table 3 provides the results of the 2030 BAU forecast.

Table 3. Business as Usual GHG Emissions Projections

	2019 Baseline ($MT\ CO_2e$)	**2030 ($MT\ CO_2e$)**	**Baseline – 2030 (% Change)**
Scope 1	1,315.9	1,425.8	+8.4%
Scope 2	12.2	0	-100%
Scope 3	117,346.3	111,152.9	-5.3%
Total Emissions	**118,674.4**	**112,578.7**	**-5.1**

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Approach and Methodology

The Airports Council International (ACI) Airport Carbon and Emissions Reporting Tool (ACERT) was used to quantify BTV's GHG emissions for 2019 based on activity data provided or otherwise collected by the Airport. This chapter documents the approach and methodology used to prepare the 2019 GHG Emissions Inventory using ACERT and other guiding resources.

Guiding Resources

The 2019 GHG Emissions Inventory utilizes ACI's Airport Carbon and Emissions Reporting Tool v6.0 (ACERT). The methodologies used in ACERT are consistent with the ACI's Guidance Manual: Airport Greenhouse Gas Emissions Management (2009)[6] and the Greenhouse Gas Protocol.[7] The data analyzed using ACERT is directly transferrable to the Airport Carbon Accreditation (ACA) Online Application Portal and can be customized for each Level of ACA (e.g., Level 1 – Mapping).

This inventory also follows the guidance presented in the Airport Cooperative Research Program's (ACRP) Report 11: Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories (2009).[8] ACRP Report 11 provides a framework for identifying and quantifying specific components of airport contributions to GHG emissions. Following this methodology allows for consistency in developing GHG inventories and improves comparability among airports.

Estimating GHG Emissions

All GHG emissions estimated in this 2019 GHG emissions inventory were quantified using formula-based methodologies, which calculate emissions using activity data from each source and emission factors. The basic equation is:

$$\textit{Activity Data (unit)} \times \textit{Emission Factor } (MTCO_2e / \textit{unit}) = \textit{Emissions } (MTCO_2e).$$

[6] Airport Council International (November 2009). Guidance Manual: Airport Greenhouse Gas Emissions Management. Available at https://www.verifavia.com/bases/ressource_pdf/148/ACI-Guidance-Manual-Airport-Greenhouse-Gas-Emissions-Management.pdf

[7] World Resources Institute and World Business Council for Sustainable Development (March 2004). The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard. Available at https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

[8] Brian Kim (Wyle Laboratories, Inc.), Ian Waitz (Consultant), Mary Vigilante (Synergy Consultants, Inc.), Royce Bassarab (Wyle Laboratories, Inc.) (2009). ACRP Report 11: Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories. Transportation Research Board/Airport Cooperative Research Program. Available at https://crp.trb.org/acrpwebresource4/acrp-report-11-guidebook-on-preparing-airport-ghg-inventories/

The exact equation may vary due to the activity data and emissions factors available for the activity. Activity data refer to the relevant measurement of energy use or other GHG emissions-generating processes, such as fuel consumption by fuel type, metered annual electricity consumption, annual vehicle miles traveled (VMT), and tons of waste generated.

Known emission factors are used to convert energy usage or other activity data into quantities of emissions generated by the activity. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g., MT CO_2 per kilowatt [kWh] of electricity).

The six GHGs regulated under the Kyoto Protocol and evaluated as part of ACERT include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). For most activities, this 2019 GHG emissions inventory only reports on CO_2, CH_4, and N_2O. This is mainly due to the fact that HFCs and PFCs are generally emitted from industrial activities and are therefore less relevant to aviation operations. The exception is airport activities associated with the use of refrigerants and fire extinguishers. However, as previously noted, refrigerants and fire extinguishers were excluded from this inventory.

Due to their scale, emissions are reported using the unit of metric tons of carbon dioxide equivalent (MT CO_2e). The base unit CO_2e is used to compare the atmospheric impact of different GHGs. Global warming potential (GWP) values are used to convert GHGs – CH_4 and N_2O in the case of this 2019 inventory – to amounts of CO_2 that have a comparable impact. This is because CH_4 and N_2O are emitted in smaller amounts than CO_2, but have a much larger greenhouse effect on the atmosphere per unit emitted. To achieve the equivalency, the calculated emission of each gas is multiplied by the GWP values for each gas. The GWP values applied in the 2019 inventory were sourced from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report, 2014 (AR5): 1 (CO_2), 28 (CH_4), and 265 (N_2O).

Data Sources

The data collection effort for the 2019 GHG emissions inventory was led by BTV staff, particularly the Director of Aviation and the Director of Engineering & Environmental Compliance. BTV staff were responsible for internal coordination to retrieve data from applicable individuals or departments. Key data holders included the Chief Financial Officer, Office Manager, and Director of Ground Transportation. BTV staff were also responsible for coordinating with the Vermont Air National Guard (VTANG), a primary tenant at BTV.

Scope 1 Emissions

Scope 1 emissions are the direct emissions from sources that are owned and controlled by BTV. At BTV, natural gas is the only fuel commodity that is purchased for on-site combustion in heaters and boilers. Diesel fuel is consumed in the Airport's emergency generator units and is also considered a stationary source of emissions. There are no power generation systems at the Airport, with the exception of a solar PV system owned by the utility that is described under *Scope 2 Emissions* below. The combustion of gasoline and diesel in Airport-owned vehicles and equipment is considered a mobile source of emissions under Scope 1.

Additional processes and activities that could be included under Scope 1 in an airport's GHG inventory, such as refrigerant use, fire training, de-icing, and wastewater treatment were omitted from this inventory. This was because either the data was not available (in the case of refrigerant use), BTV does not control the activity (in the case of aircraft and surface de-icing), or they were found to be not applicable to the Airport (in the case of wastewater treatment).

Table 4 below details the Scope 1 sources that were included in the inventory and the associated activity data for each source that was analyzed. It also describes the assumptions made for each source, where relevant.

Table 4. Scope 1 Data Sources

Emissions Source	**ACERT Step**	**Source Description and Assumptions**	**Activity Data**
Airport Fleet Vehicles	2.1	Vehicles and equipment owned and operated by BTV consume fuel in the form of gasoline and diesel. Fuel data for CY2019 was provided by BTV using the "Daily Inventory of USTs at Maintenance Shop" tracking spreadsheet. The spreadsheet tracks the daily reading on BTV's diesel and gasoline underground storage tanks (USTs). To obtain the total fuel dispensed to BTV vehicles, the "Total Pumped" columns were summed for both for Tank 1 (Diesel) and Tank 2 (Gasoline).	Gasoline 2,580 gallons Diesel 45,044 gallons
Emergency Generator Fuel Consumption	2.3	BTV has six emergency generators at the Airport. Diesel fuel consumption for generators was provided by BTV for 2019. Fuel was associated with either the Electrical Vault (43 gallons) or Maintenance Shop (15 gallons). Total diesel consumption was assumed to encompass all six generators.	Diesel 58 gallons
Stationary Source Fuel Consumption – Buildings	3.1	BTV facilities are heated using natural gas supplied by Vermont Gas Systems (VGS). VGS usage data was provided by BTV for 2019 in the form of a "Gas Report Usage and Cost" spreadsheet. The spreadsheet contained invoice data by month for accounts and meters paid for by BTV.	Natural Gas 155,248 CCF

Scope 2 Emissions

Scope 2 emissions are indirect emissions associated with electricity that is purchased for heating, cooling, and powering facilities. GHG emissions are calculated based on the electricity consumed during the inventory year and an emission factor. BTV purchases electricity from BED and GMP to power the Airport. As described in the table below, BTV emissions from purchased electricity are minimal due to the renewable energy supply of both utilities. BED was 100 percent renewable in 2019, including line losses. GMP was 94 percent renewable in 2019. Accordingly, the Airport's GHG emissions from purchased electricity are based solely on the remaining six percent of GMP's fuel mix that was not renewable in 2019.

Following ACRP and ACA guidance, the location-based method was used to estimate electricity emissions from GMP's non-renewable supply. The location-based method uses emission factors from the U.S. EPA's Emissions & Generation Resource Integrated Database (eGRID) system to calculate GHG emissions from purchased electricity. eGRID provides emission factors for CO_2, CH_4, and N_2O by subregion of the U.S., which are determined from the fuel mix of the electric grid (i.e., amount of natural gas, coal, hydropower, etc.) in that particular subregion. BTV is located in the NEWE eGRID subregion (NPCC, New England).

Table 5 below details the Scope 2 sources that were included in the inventory and the associated activity data for each source that was analyzed. It also describes the assumptions made for each source, where relevant.

Table 5. Scope 2 Data Sources

Emissions Source	**ACERT Step**	**Source Description and Assumptions**	**Activity Data**
Electricity Consumption	4.1a	Electricity data from BED and GMP was provided by BTV for 2019 in spreadsheet form. Data was also provided directly from BED based on the two GMP substations that are present at the Airport. In 2019, the substation load was 4,922,638 kWh, representing the total grid energy coming into the Airport from BED. BED also owns the renewable energy credits (RECs) for a grid-connected solar PV array on top of the Parking Garage, which produced 586,151 kWh in 2019. Together, the gross load from BED amounted to 5,508,789 kWh. However, the actual metered usage from BTV-owned accounts and other accounts was 5,371,221, meaning that there were 137,568 kWh in distribution losses. Of the total metered usage, the 26 meters owned by BTV comprised 4,134,523 kWh. There are 29 other accounts that make up the remaining 1,236,697 kWh that would not be accounted for under Scope 2, since tenants own them. These totals do not include the 618,339 kWh of metered usage from BTV-associated GMP accounts in 2019. Note that the 618,339 kWh is likely an overestimate for BTV's electricity consumption since some of this usage is attributed to tenant operations but could not be parsed out due to data availability. Importantly, BED was 100 percent renewable in 2019; electricity supplied by BED was therefore excluded from the inventory since no emissions were produced. GMP was 94 percent renewable in 2019, including nuclear. GMP electricity emissions were therefore discounted by 94 percent (i.e., only six percent of the 618,339-kWh total was analyzed).	4,134,523 kWh (BED) 586,151 kWh (BED Solar) 618,339 kWh (GMP) *Only 37,100 kWh analyzed for the inventory, due to renewable energy supplies from BED and GMP*

Scope 3 Emissions

Scope 3 emissions are indirect emissions generated by others at the Airport or due to activities taking place at the Airport, including by tenants and the traveling public. Scope 3 emissions sources can include transportation by employees and passengers, aircraft operations, waste disposal, and tenant operations. Since Scope 3 sources consist of aircraft operations, as well as passenger vehicles traveling to and from an airport, these sources typically comprise the majority of GHG emissions at an airport. Such is true at BTV.

For the 2019 GHG emissions inventory, only select Scope 3 emissions sources were analyzed. Importantly, much of the data below represents the activities of VTANG. Utility data from other tenants was not analyzed as part of this GHG inventory. Due to VTANG data availability, 2022 is often used as a proxy for the inventory year (2019). GHG emissions from VTANG operations in 2022 are included to inform BTV of the relative contribution of VTANG to the Airport's overall carbon footprint, since VTANG activity specific to non-aircraft sources (e.g., vehicle fleet, buildings, etc.) is not expected to change much year over year. However, these estimates are not meant to be exact due to the variation in reporting years. For improved accuracy relative to aircraft emissions, VTANG's aircraft fuel consumption was adjusted based on the difference in their aircraft operations between 2019 and 2022.

Table 6 below details the Scope 3 sources that were included in the inventory and the associated activity data for each source that was analyzed. It also describes the assumptions made for each source, where relevant.

Table 6. Scope 3 Data Sources

Emissions Source	**ACERT Step**	**Source Description and Assumptions**	**Activity Data**
Fleet Vehicles – VTANG	2.1	Vehicles and equipment owned and operated by VTANG consume fuel in the form of gasoline and diesel. Fuel data for CY2022 was provided as part of BTV's request for information to VTANG.	Gasoline 11,998 gallons Diesel 16,447 gallons
Fire Training – VTANG	2.2	The VTANG fire department consumed diesel fuel for fire training activities at the ARFF station in 2019. Fuel data was provided by the Deputy Direction of Aviation – Operations at BTV.	Diesel 3,118 gallons
Emergency Generator Fuel Consumption – VTANG	2.3	VTANG uses diesel and gasoline fuel in its emergency generator power units. Fuel data for CY2022 was provided as part of BTV's request for information to VTANG.	Gasoline 49 gallons Diesel 679 gallons
Stationary Source Fuel Consumption – VTANG	3.1	VTANG facilities are heated using natural gas. VTANG natural gas consumption data was provided for 2022 as part of BTV's request for information to VTANG.	217,248 CCF

Emissions Source	ACERT Step	Source Description and Assumptions	Activity Data
Electricity Consumption – VTANG	4.1a	VTANG purchased 3,784,878 kWh from GMP in 2022. GMP was 94 percent renewable in 2019; GMP electricity emissions were therefore discounted by 94 percent (i.e., only six percent of 3,784,878 kWh was analyzed). GMP's renewable status in 2019 was used for consistency with the Scope 2 analysis as described above. Utility data from other tenants was not analyzed as part of this GHG inventory.	3,784,878 kWh (GMP)
Electricity Transmission & Distribution Losses	4.1c	The country default factor was used to calculate electricity T&D losses based on the Airport's non-renewable electricity consumption in 2019. The default factor was taken from a 2011 technical paper on electricity-specific emission factors for grid electricity. The United States factor is found on page 18 of the paper.	4 g CO_2e/kWh
Solid Waste Processing	6.1	Casella is the solid waste and recycling hauler for the Airport. BTV provided annual tonnages of trash, recycling, and compost for 2019. Trash hauled from the Airport is taken to the landfill in the Town of Coventry, VT, which has a gas-to-energy facility operated by Washington Electric Co-op. This facility converts landfill gas (i.e., methane) into electricity and has a generating capacity of 8 MW. Landfill gas-to-energy projects are estimated to capture 60 to 90 percent of the methane emitted from the landfill.[9] Therefore, the GHG emissions calculated from BTV's trash tonnage data were reduced by 60 percent. Recycling was excluded due to its assumed negligible impact on GHG emissions.	Trash 132.24 tons Compost 31.32 tons Recycling 38.97 tons
De-Icing	6.3	Heritage Aviation conducts de-icing for the Airport. De-icing activity data was provided by BTV by way of a "BTV De-Icing Fluid Calculations" document, which contained gallons of de-icing fluid applied at BTV between January and May 2019. BTV supplemented these data via email for the remaining applicable months of October through December. The type of fluid was not specified for within "BTV De-Icing Fluid Calculations;" however, fluid types for the data covering October through December were classified as various blends of glycol. Therefore, this inventory assumes that all fluid used for de-icing at the Airport contained glycol. The data did not specify whether the de-	219,760 gallons of de-icing chemicals containing glycol

[9] U.S. EPA Landfill Methane Outreach Program (LMOP). Benefits of Landfill Gas Energy Projects. Retrieved from https://19january2017snapshot.epa.gov/lmop/benefits-landfill-gas-energy-projects_.html

Emissions Source	ACERT Step	Source Description and Assumptions	Activity Data
		icing fluid was used for surface or aircraft applications; aircraft application was assumed.	
Aircraft Operations	7.1b	Detailed aircraft movements were used to calculate landing and takeoff (LTO) emissions below 3,000 ft. Aircraft movements were provided by BTV within the Burlington International Airport 14 CRF Part 150 Update: 2018 and 2023 Noise Exposure Maps report. Table 9 of this report contains modeled 2018 annual aircraft operations by category, engine type, and ICAO code. The total movement data for each aircraft type (by ICAO code) was aligned with ACERT group categories based on equipment type, engine type, and engine count. This 2018 data was adjusted to reflect 2019 operations based on data retrieved from the FAA[10]. Specifically, adjustment factors were developed and applied for each aircraft category to develop proxies for 2019 operations. Total aircraft LTO emissions and LTO emissions specific to military operations are provided in **Chapter 2**.	See detailed aircraft movement data in Appendix A.
Aircraft Taxi Times	7.1c	Average aircraft taxi time (in + out) was determined using the ASPM Taxi Times: Standard Report for BTV based on CY2019. The average taxi out time was added to the average taxi in time for a total taxi time. This total time was assumed to be the same for each aircraft group (i.e., general aviation/business aviation aircraft, regional/small aircraft, medium/large aircraft).	Average taxi out time 18.66 min Average taxi in time 5.59 min Total taxi time 24.25 min/LTO
Aircraft Auxiliary Power Unit (APU) Usage	7.2	A value of 15 min/LTO was used for aircraft APU time for each aircraft group (i.e., small/medium aircraft, large aircraft). This value was based on the findings of 2018 study on "Emissions from auxiliary power units and ground power units during intraday aircraft turnarounds at European airports" (https://doi.org/10.1016/j.trd.2018.06.015).	15 min/LTO

[10] Federal Aviation Administration. Terminal Area Forecast. Retrieved from https://taf.faa.gov/

Emissions Source	ACERT Step	Source Description and Assumptions	Activity Data
Aircraft Cruise	7.3	Fuel (e.g., AvGas, Jet-A1) dispensed during the study year is used to calculate aircraft cruise emissions in ACERT. Total fuel dispensed to aircraft by BTV was provided by month for 2019, including jet fuel and 100 octane low lead (100LL), which is a common type of AvGas. Jet A fuel data was also provided by VTANG, but for 2022. VTANG fuel use in 2019 was estimated using 2022 fuel use and the ratio of military operations at BTV between 2019 and 2022. Operations data was taken from the Air Traffic Activity System (ATADS) Standard Report for Airport Operations. Airport operations data showed a 22.4 percent increase in military flights from 2019 to 2022; therefore, fuel usage provided for 2022 was reduced by 22.4 percent to reflect 2019 fuel consumption. Fuel dispensed by BTV was added to fuel dispensed by VTANG to calculate total Airport fuel used for aircraft. Total aircraft cruise emissions and cruise emissions specific to military operations are provided in **Chapter 2**.	BTV – Jet A 8,874,027 gallons BTV – AvGas 129,459 gallons VTANG – Jet A 2,811,673 gallons

Excluded Emissions Sources

Following discussions with BTV, certain GHG emissions sources were excluded from this 2019 GHG Emissions Inventory. For Scope 1 and Scope 2, an emissions source was excluded if the data was not available for 2019, or if that particular emissions source was not applicable to BTV operations. For Scope 3, only select emissions sources were analyzed as part of this inventory, since the focus was on the Airport's direct emissions. Additionally, only Scope 1 and Scope 2 emissions are required to be analyzed for ACA Level 1 – Mapping accreditation. As subsequent GHG inventories are performed in future years, the number of Scope 3 categories analyzed is expected to grow. **Table 7** below lists the emissions sources that were excluded from this inventory.

Table 7. Excluded Emissions Sources

Source	Scope	ACERT Step	Reason for Exclusion
Fire Training	1	2.2	Fire training was conducted by VTANG in 2019 but not BTV. There are no CO_2 extinguishers used by BTV.
On-site Renewable Heat Energy (e.g., geothermal)	1	3.2	Not applicable to BTV.

Source	Scope	ACERT Step	Reason for Exclusion
Fossil Fuel Generated Electricity Produced On-Site (e.g., CHP)	1	4.2	Not applicable to BTV.
On-site Solid Waste Processing	1	6.1	Not applicable to BTV.
On-site Wastewater Processing	1	6.2	Not applicable to BTV.
Surface De-Icing	1	6.3	De-icing data provided by BTV did not differentiate between surface and aircraft applications, but it was assumed that the data provided was used for aircraft de-icing. Future inventories will discern between the two application types.
Refrigerants	1	6.5	Airport-owned refrigerant use was excluded from the inventory due to data availability.
Purchased Heat or Steam	2	5.1	Not applicable to BTV.
Airside/Tenant Vehicles and Equipment	3	2.1	VTANG vehicle fuel data was approximated for this inventory. Additional tenant data will be analyzed in future inventories with expanded outreach to airlines and tenants.
Tenant Stationary Source Fuel Consumption	3	3.1	VTANG natural gas data was approximated for this inventory. Additional tenant data will be analyzed in future inventories with expanded outreach to tenants.
Tenant Electricity Consumption	3	4.1	VTANG electricity data was approximated for this inventory. Additional tenant data will be analyzed in future inventories with expanded outreach to tenants.
Wastewater Processing by Third-Party	3	6.2	Not included for 2019. To be pursued in future inventories.
Aircraft Maintenance – Number of Run-ups	3	7.4	Not included for 2019. To be pursued in future inventories.
Corporate Travel	3	8	Not included for 2019. To be pursued in future inventories.

Source	Scope	ACERT Step	Reason for Exclusion
Ground Access Transportation	3	9	Not included for 2019. To be pursued in future inventories.
On-Site Construction Activities	3		Not included for 2019. To be pursued in future inventories.

Considerations for Future Inventories

The value of GHG emissions inventories grow significantly when the inventories are conducted on a regular basis. Increasing the frequency of inventories allows for more accurate conclusions to be drawn from observed trends, and makes it easier to track the effectiveness of GHG reduction strategies.

The effectiveness of a GHG inventory is a direct result of the activity data that is used to conduct the analysis. The availability and accuracy of data determine the ability of an inventory to provide truly meaningful findings, particularly when it comes to informing policy decisions. Therefore, it is important to continue to improve data collection and tracking efforts, and to engage professionals with in-depth planning, policy, and engineering knowledge to interpret the results and provide relevant mitigation recommendations that are implementable.

GHG Accounting Efficiency, Consistency, and Accuracy

1. Aim to conduct a GHG inventory on a regular basis (i.e., annually or every five years at minimum), with particular attention given to ensuring consistency in reporting and scope categorization. More frequent inventories may be necessitated upon significant changes to operating conditions.
2. Expand the number of Scope 3 emissions sources included in future inventories, to the extent practicable. This will require coordination and outreach to tenants.
3. Ensure that electricity and fuel purchased by tenants is metered and tracked separately so that it can be accounted for under Scope 3.
4. Institute a centralized data management system to more efficiently track GHG inventory inputs. This management system could be built during the next reporting year to document the source, contact, or other information related to each data input. This would improve the accuracy and traceability of BTV's GHG reporting.

Carbon Disclosure and Third-Party Review

1. Utilize ongoing annual reporting efforts to achieve certification through the Airport Carbon Accreditation (ACA) Program, the only institutionally endorsed global carbon management certification program for airports. ACA allows airports to apply for certification at six different stages, depending on the maturity of their carbon management program. To apply for certification, airports must complete a GHG inventory and have it independently verified in accordance with ISO14064 (Greenhouse Gas Accounting) by one of the verifiers approved by

the ACA program administrator. ACA certification would allow for peer benchmarking, confirmation of data and process accuracy through third-party review, and community outreach opportunities. It would also be an opportunity to demonstrate the Airport's commitment to GHG reduction.

4

Climate Mitigation at BTV

BTV recognizes its role as a leader and collaborator in advancing climate action within its own operations as well as in the larger region. GHG emissions reduction at the Airport supports relevant local and state goals, such as Vermont's pledge to reduce GHG emissions by 80 percent below 2005 levels by 2050[11]. At the local level, the City of Burlington is following its Net Zero Roadmap in partnership with BED to eliminate GHG emissions. The City of South Burlington has set a goal to reduce total 2019 emissions by 60 percent by 2030. BTV is in the process of developing a Sustainability Management Plan, which will include climate goals and targets specific to the Airport.

Current Actions Supporting GHG Emissions Reduction

BTV actively seeks to reduce the GHG emissions generated at the Airport, through energy efficiency measures and other means, even as its operations continue to expand. Though not an exhaustive list, the following represents climate mitigation projects and initiatives that BTV or its partners have recently implemented at the Airport.

› Energy Efficiency:
  - Partnered with BED to replace fluorescent and incandescent light bulbs with energy-efficient LEDs in the parking garage.
  - Completed LED lighting retrofits at the terminal, and at all roadways, taxiways, and parking lots.
  - Pursued daylight harvesting and energy efficient window glazing for BTV buildings.
  - Upgraded the terminal's 50-year-old heating and cooling system.
  - Applied white roofing materials and surfacing to select Airport facilities, reducing the cooling demand and mitigating heat island effects.

› On-Site Renewable Energy Production:
  - 500 kW roof-mounted solar array at the Parking Garage (owned by BED)
  - 24 kW roof-mounted solar array at the FBO Facility (owned by Heritage Aviation)
  - 100 kW wind turbine at the FBO Facility (owned by Heritage Aviation)

[11] Climate Change in Vermont. Global Warming Solutions Act. Retrieved from https://climatechange.vermont.gov/about

    - 1.5 MW ground- and roof-mounted solar arrays at the VTANG base (owned by VTANG)
- Additional Climate Mitigation:
    - Has a solid waste plan that addresses operations Airport-wide, as well as programs in place for recycling and composting to reduce the amount of waste being sent to Coventry facility.
    - Installed bike racks and walkways onsite to promote active, fossil fuel-free forms of transportation.
    - Coordinated the installation of 15 electric vehicle (EV) charging stations at the Parking Garage to support EV adoption among passengers, employees, and visitors.
    - Incentivizes rideshare and public transportation to reduce Scope 3 emissions from Airport ground access, offering free Green Mountain Transit bus passes to all of its direct employees. The Airport is also a member of the Chittenden Area Transportation Management Association (CATMA), which provides sustainable transportation options for its members' employees. CATMA programs include Carpool/Vanpool Support, a Guaranteed Ride Home Program, and a Bike/Walk Rewards Program.

Next Steps

As mentioned, BTV is in the process of developing a Sustainability Management Plan (SMP). The SMP will focus on multiple sustainability impact areas, including energy and GHG emissions, and identify ambitious goals and targets to increase the Airport's sustainability performance. The plan will then recommend strategies to achieve these goals and targets, prioritizing those with the greatest potential to reduce BTV's GHG emissions.

A

Appendix A – Detailed Aircraft Data

Category	Engine Type	ICAO Code	AEDT Equip. ID	ANP Type	Arrivals		Departures		Local (Touch and Go)			
					Day	Night	Day	Night	Day	Night	Total	2019 Adjusted
Air Carrier	Jet	A319	4930	A319-131	142	80	133	89	-	-	445	476
		A320	4900	A320-232	91	132	147	76	-	-	447	478
		B712	88	717200	52	137	39	150	-	-	377	403
		B737	4861	737700	11	69	20	60	-	-	160	171
		B738	5294	737800	87	86	119	53	-	-	345	369
		B739	2502	737800	5	47	8	44	-	-	104	111
		B752	2512	757PW	243	-	238	5	-	-	487	521
		CRJ7	4211	CRJ9-ER	708	132	718	122	-	-	1681	1798
		CRJ9	2548	CRJ9-ER	773	566	882	457	-	-	2679	2865
		E170	3070	EMB170	128	16	139	6	-	-	289	309
		E190	4288	EMB190	968	438	1,005	400	-	-	2811	3007
		E75L	3071	EMB175	484	225	469	240	-	-	1417	1516
		E75S	3816	EMB175	487	120	395	212	-	-	1213	1297
		MD88	2074	MD83	13	38	6	46	-	-	104	111
	Turbine Propeller	DH8D	4778	DHC830	27	-	27	-	-	-	55	59
Air Taxi	Jet	BE40	5296	MU3001	110	-	110	-	-	-	220	205
		C560	4929	CNA560U	28	-	26	1	-	-	56	52
		C56X	4794	CNA560XL	154	6	156	4	-	-	321	300
		C680	5184	CNA680	39	1	38	3	-	-	81	76
		C68A	5347	CNA680	74	5	77	3	-	-	159	148
		C750	1314	CNA750	73	-	73	-	-	-	146	136
		CL30	4856	CL600	98	3	101	-	-	-	202	189
		CL35	5345	CL600	105	6	111	-	-	-	222	207
		CL60	4805	CL601	23	-	23	-	-	-	45	42
		CRJ2	1250	CL600	2,669	212	2,555	326	-	-	5,761	5,377
		E145	2557	EMB14L	1,362	112	1,413	62	-	-	2,949	2,752
		E45X	4874	EMB145	1,337	82	1,276	143	-	-	2,838	2,649
		E55P	4917	CNA55B	96	3	96	3	-	-	197	184
		F2TH	4804	CNA750	19	1	20	-	-	-	40	37
		F900	4034	CNA750	45	6	49	3	-	-	104	97
		GLEX	3734	BD-700-	24	-	24	-	-	-	48	45
	Turbine Propeller	B350	1539	DHC6	114	1	110	5	-	-	230	215
		BE99	4918	DHC6	78	-	78	-	-	-	157	147
		BE9L	4918	DHC6	21	-	21	-	-	-	43	40
		E110	1498	DHC6	605	-	605	-	-	-	1,209	1,128
		PC12	3122	CNA208	329	37	328	38	-	-	732	683
General Aviation	Jet	BE40	5296	MU3001	53	5	50	8	-	-	116	124
		C25A	3974	CNA525C	131	10	125	16	-	-	281	301
		C25B	3974	CNA525C	407	5	330	82	-	-	824	884
		C25C	4276	CNA525C	100	3	103	-	-	-	206	221
		C525	3974	CNA525C	75	3	78	-	-	-	156	167
		C550	4327	CNA55B	148	5	146	8	-	-	306	328
		C560	4929	CNA560U	53	-	50	3	-	-	105	113
		C56X	4794	CNA560XL	332	23	340	15	-	-	708	760
		C680	5184	CNA680	181	18	193	5	-	-	397	426
		C750	1314	CNA750	43	3	40	5	-	-	90	97
		CL30	4856	CL600	48	-	48	-	-	-	95	102
		CL60	4805	CL601	60	3	63	-	-	-	126	135
		E35L	5351	CNA55B	40	-	40	-	-	-	80	86
		E50P	4902	CNA510	95	3	95	3	-	-	196	210
		E55P	4917	CNA55B	53	-	53	-	-	-	105	113
		F2TH	4804	CNA750	50	3	47	5	-	-	105	113
		F900	4034	CNA750	65	-	65	-	-	-	131	141
		G280	4198	IA1125	105	-	98	8	-	-	211	226
		GL5T	3732	BD-700-	108	13	118	3	-	-	241	259
		GLF4	5267	GIV	63	5	68	-	-	-	136	146
		GLF5	4858	GV	116	5	115	5	-	-	241	259
		H25B	2014	LEAR35	70	18	83	5	-	-	176	189
		H25C	4758	LEAR35	50	3	53	-	-	-	105	113
		LJ45	4843	LEAR35	40	3	40	3	-	-	85	91
		LJ60	2033	LEAR35	241	5	224	22	-	-	492	528
		WW24	1973	IA1125	95	13	92	16	-	-	216	232
		AA5	1532	GASEPF	50	-	50	-	-	-	100	107
		B350	1539	DHC6	88	-	88	-	-	-	176	189

	Turbine Propeller	BE20	3790	DHC6	216	8	215	9	-	-	447	480
		BE9L	4918	DHC6	153	8	155	5	-	-	322	345
		C441	1287	CNA441	163	-	155	9	-	-	327	351
		P46T	1465	GASEPF	70	-	65	5	-	-	141	151
		PC12	3122	CNA208	285	71	266	90	-	-	713	765
		TBM7	1533	CNA208	85	-	85	-	-	-	171	183
		TBM8	2580	CNA441	68	-	68	-	-	-	136	146
		TBM9	4677	CNA208	45	3	48	-	-	-	95	102
General Aviation	Piston Propeller	BE33	1271	GASEPV	60	-	60	-	-	-	121	130
		BE35	1271	GASEPV	75	-	73	3	-	-	151	162
		BE36	1276	CNA208	264	3	258	8	-	-	533	572
		BE58	1196	BEC58P	279	-	274	5	-	-	558	599
		C150	1882	GASEPF	40	-	40	-	-	-	80	86
		C172	1267	CNA172	3,414	88	3,409	92	10,187	137	17,327	18,589
		C180	1271	GASEPV	53	-	53	-	-	-	105	113
		C182	1262	CNA182	234	-	234	-	-	-	467	501
		C206	3172	CNA206	72	4	70	5	-	-	151	162
		C340	2116	BEC58P	98	5	103	-	-	-	206	221
		C414	2119	BEC58P	58	3	58	3	-	-	121	130
		DA40	1271	GASEPV	63	-	63	-	-	-	126	135
		M20P	1271	GASEPV	146	-	146	-	-	-	291	312
		P28A	3178	PA28	217	4	219	3	-	-	442	474
		P28R	1271	GASEPV	352	5	357	-	728	4	1,446	1,551
		P32R	1271	GASEPV	40	3	43	-	-	-	85	91
		PA24	1901	GASEPV	55	-	55	-	81	-	191	205
		PA27	1194	BEC58P	35	5	35	5	-	-	80	86
		PA28	2102	GASEPF	103	-	103	-	-	-	206	221
		PA31	779	BEC58P	216	28	224	20	-	-	487	522
		PA32	1271	GASEPV	40	-	40	-	-	-	80	86
		PA34	2103	BEC58P	47	6	48	5	-	-	105	113
		PA46	1271	GASEPV	88	-	88	-	-	-	176	189
		S22T	1325	COMSEP	98	-	98	-	-	-	196	210
		SR22	1325	COMSEP	650	13	643	20	-	-	1,326	1,423
Based Military	Jet	F16	N/A	N/A	1,535	-	1,535	-	307	-	3,377	3,087
	Helicopter	H72	N/A	N/A	211	18	229	-	-	-	458	419
		H60	N/A	N/A	324	133	361	96	-	-	914	835
Transient Military	Jet	B752	2512	757PW	16	-	16	-	96	-	128	134
		C17	1401	C17	11	-	11	-	72	-	94	98
		K35R	1981	KC135R	11	-	11	-	72	-	94	98
		DC10	1349	DC1030	5	-	5	-	30	-	40	42
		C560	4929	CNA560U	19	1	19	1	125	7	172	180
		GLF5	4858	GV	18	1	19	-	120	4	162	169
	Turbine Propeller	BE20	3790	DHC6	10	-	10	-	66	-	86	90
		C130	1203	C130	27	-	25	2	176	8	238	249
		CN35	42	SF340	11	-	11	-	72	-	94	98
		DH8C	4778	DHC830	10	-	10	-	66	-	86	90
		C208	4677	CNA208	3	-	3	-	20	-	26	27
	Piston Propeller	C206	3172	CNA206	9	-	9	-	58	-	76	79
		C421	1287	CNA441	1	-	1	-	6	-	8	8