2022 National Emissions Inventory: Aviation Component

Prepared for:

Office of Air Quality Planning and Standards

Air Quality Assessment Division (C339-02)

Research Triangle Park, NC 22771

Prepared by:

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2022 National Emissions Inventory: Aviation Component

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1.0 Introduction

Eastern Research Group (ERG) developed the 2022 aviation inventory for the US EPA. The US EPA requested that ERG develop an inventory for 51 major US airports. The list of airports is available in Table 1-1.

Table 1-1. 51 Major Airports

Airport Code	Airport Name
ANC	Ted Stevens Anchorage
ATL	Hartsfield-Jackson Atlanta
AUS	Austin-Bergstrom
BNA	Nashville
BOS	General Edward Lawrence Logan
BUR	Bob Hope
BWI	Baltimore-Washington
CLE	Cleveland Hopkins
CLT	Charlotte Douglas
CVG	Cincinnati/Northern Kentucky
DAL	Dallas Love Field
DCA	Ronald Reagan Washington National
DEN	Denver
DFW	Dallas Fort Worth
DTW	Detroit Metropolitan Wayne County
EWR	Newark Liberty
FLL	Fort Lauderdale-Hollywood
HOU	William P. Hobby
IAD	Washington Dulles
IAH	George Bush Intercontinental
IND	Indianapolis
JFK	John F. Kennedy
LAS	Harry Reid
LAX	Los Angeles
LGA	LaGuardia
LGB	Long Beach
MCO	Orlando
MDW	Chicago Midway
MEM	Memphis
MIA	Miami
MKE	Milwaukee Mitchell
MSP	Minneapolis-Saint Paul
MSY	Louis Armstrong New Orleans
OAK	Oakland
ONT	Ontario
ORD	Chicago O'Hare
PDX	Portland
PHL	Philadelphia
PHX	Phoenix Sky Harbor
PIT	Pittsburgh
RDU	Raleigh-Durham
SAN	San Diego
SAT	San Antonio
SDF	Louisville Muhammad Ali
SEA	Seattle-Tacoma
SFO	San Francisco
SJC	San José Mineta
SLC	Salt Lake City
SMF	Sacramento
SNA	John Wayne
STL	St. Louis Lambert

ERG developed the aviation component of the 2022 Platform for criteria air pollutants. The compiled data will be used to support modeling activities, help with regulatory initiatives, state implementation programs to address concerns in nonattainment areas and address airport-related emission inquiries.

The emissions associated with airport activities are attributed to the following sources with associated source classification codes (SCC):

- Commercial aviation (SCC: 2275020000)
- Air taxis
    - Piston driven (SCC: 2275060011)
    - Turbine driven (SCC: 2275060012)
- General aviation
    - Piston driven (SCC: 2275050011)
    - Turbine driven (SCC: 2275050012)
- Military (SCC: 2275001000)
- Auxiliary Power Units (SCC: 2275070000)
- Ground Support Equipment
    - Diesel-fueled (SCC: 2270008005)
    - Gasoline-fueled (SCC: 2265008005)

Commercial air carriers (AC) transport passengers, freight, or both and tend to be larger aircraft that are driven with jet engines. Air taxis (AT), which are also considered to be commercial aircraft, are usually smaller aircraft (less than 60 passengers) that operate on a limited basis compared to larger commercial aircraft that carry between 60 and 800 passengers. General aviation (GA) includes most other aircraft used for recreational flying and personal transportation. Smaller aircraft that support business travel, usually on an unscheduled basis, are also included in the GA category.

2.0 Background

Aircraft tend to emit significant amounts of air pollutants. The national AT and GA fleet includes both jet and propeller-driven aircraft. Most of the AT and GA fleet are comprised of piston- (or propeller-) driven aircraft, though these aircraft types also include smaller business jets and turboprops and helicopters equipped with piston or turboshaft engines. The piston-driven aircraft tend to have higher VOC emissions and lower NO_x emissions than turbine-powered aircraft. For this inventory it is assumed that propeller-driven aircraft and turbine-driven aircraft account for 72.1% and 27.9%, respectively, of all generic GA emissions.[1] Propeller-driven aircraft and turbine-driven aircraft account for 21.8% and 78.2%, respectively, of all generic AT emissions.[1] These values were used as a national-scale default value obtained from published studies used to investigate lead emissions from aviation sources.

Military aircraft (MIL) comprise a wide range of aircraft types such as training aircraft, fighter jets, helicopters, and jet- and propeller-driven cargo planes of varying sizes. Because of limited

[1] U.S. EPA, *Calculating Piston-Engine Aircraft Activity for the Draft 2011 National Emissions Inventory*. June 2012.

information concerning the make-up of the military aircraft fleet, for this inventory it was assumed that most military aircraft are jet-powered.

Aircraft emissions considered for this study are limited to an aircraft's landing and takeoff (LTO) cycle. The cycle begins when the aircraft approaches the airport on its descent from cruising altitude, then lands and taxis to the gate, where it idles during passenger deplaning. The cycle continues as the aircraft idles during passenger boarding, taxis back onto the runway, takes off, and ascends (or climbs out) to cruising altitude. Figure 2-1 illustrates the six specific operating modes in an LTO cycle:

- Approach
- Taxi/idle-in
- Taxi/idle-out
- Idling
- Takeoff
- Climb out.

The LTO cycle provides a basis for calculating aircraft emissions associated with airports. During each mode of operation, an aircraft engine operates at a specific power setting and fuel consumption rate for a given aircraft make and model. Emissions for one complete cycle are calculated by multiplying emission factors for each operating mode for each specific aircraft engine and the typical period of time the aircraft is operating. It should be noted that FAA's aircraft emissions model, Aviation Environmental Design Tool (AEDT) estimates emissions based on a specified flight path. The flight path for this study is based on a single runway that represents the airports activities.

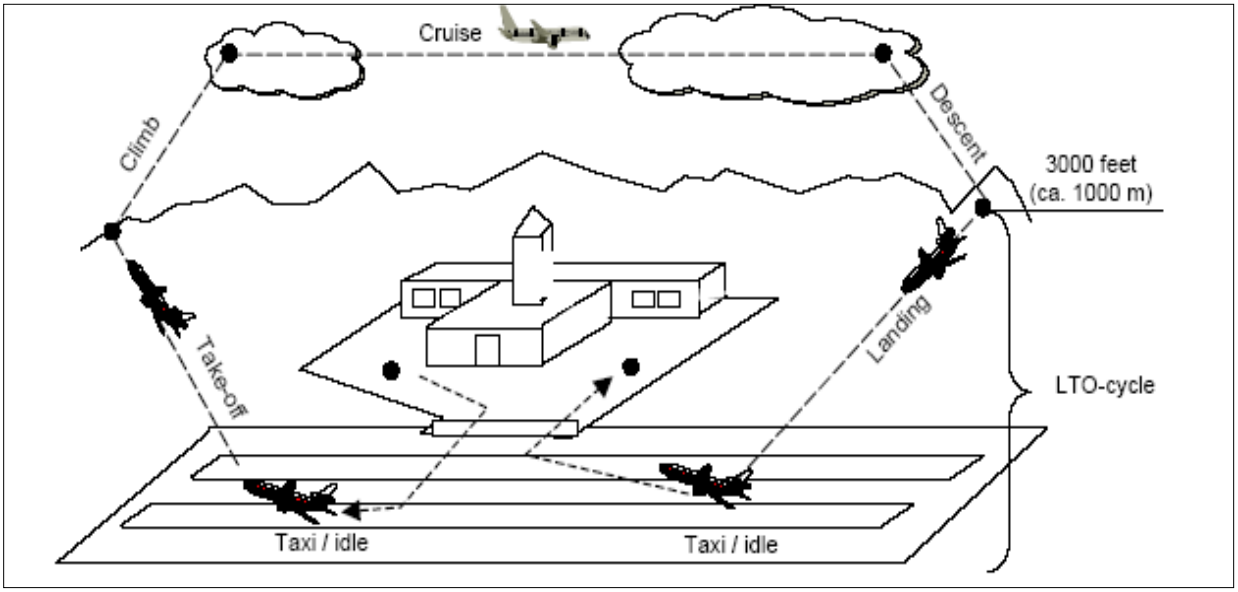

Figure 2-1. Landing and Takeoff Cycle

3.0 Activity Data Sources

To implement this project, ERG obtained aircraft activity data from various sources. There are two general sources of airport data; the preferred sources are local data from the states themselves. The other are publicly available national data sources from the Federal Aviation Administration's (FAA). Section 3.1 discusses the national data sources and Section 3.2 discusses the state provided data.

3.1 National Data Sources Airport Activities

ERG compiled aircraft LTO data from several FAA data sources including the following: 2022 T-100 dataset,[2] 2022 (TAF, 2022 OPSNET,[3] and 2022 5010 data).[4]

The T-100 data is derived from commercial aviation operations, reported directly by the airlines and specifically includes very detailed information about large commercial air carriers and air taxis. Because the T-100 aircraft data are provided for individual aircraft specifying manufacturer and aircraft model, they can be matched to specific aircraft in the FAA's AEDT, a SQL-based software tool used to estimate emissions.

Because of the details provided in T-100, it is also possible to identify which aircraft are typically used for air taxi services based on typical passenger capacity. All non-air taxi data in the T-100 data are assumed to be larger commercial aircraft.

The FAA's Terminal Area Forecast (TAF) and Operations Network (OPSNET) datasets do not provide operations data at the aircraft manufacturer and model level of detail that the T-100 data does; instead, operations are provided for general aircraft types (i.e., AC, AT, GA and MIL). OPSNET includes actual operations at FAA controlled facilities, while TAF includes the OPSNET data and also modeled operations for other non-FAA control facilities. Note that the TAF and OPSNET data are provided as operations (separate operation counts for each landing and takeoff leg), such that the TAF and OPSNET operations need to be divided by 2 to get LTOs.

The TAF/ OPSNET data were adjusted because both the T-100 data and the TAF/ OPSNET data include AC and AT; these data needed to be adjusted to avoid issues of double counting when the two datasets were combined.

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[2] Title 14 - Code of Federal Regulations - Part 241 Uniform System of Accounts and Reports for Large Certificated Air Carriers. T-100 Segment (All Carriers) - Published Online by Bureau of Transportation Statistics. http://www. https://www.transtats.bts.gov/Fields.asp?gnoyr_VQ=GEE. Accessed August 11, 2023.

[3] Federal Aviation Administration. The Operations Network (OPSNET). http://aspm.faa.gov/opsnet/sys/Airport.asp. Accessed October 12, 2023.

[4] Federal Aviation Administration. 2020. *Airport Master Record Form 5010*. Published by Civix. https://www.airportiq5010.com/5010Web/advancedSearch. Accessed November 1, 2023.

The FAA 5010 Airport Master Records are used for airport infrastructure planning and include a variety of information about airport operations and characteristics. Such information is particularly important for smaller public facilities where data sources are sparse. The ERG reviewed the data reported in the 5010 submittals to estimate LTO activity for general aviation and air taxis. Because the 51 airports were all larger airports, no 5010 data were needed to gap fill missing activity data.

3.2 State Provided Airport Activity Data

As the data was being compiled, only data for ATL was submitted by the Georgia Environmental Protection Division for inclusion into the dataset.

Appendix A includes the detailed LTO data submitted by GA and incorporated into the dataset.

3.3 Comparison of LTO Data

The final LTO database with state data incorporated was then compared to the LTO data for the 51 target airports included in the 2022 Platform. Table 3-1 summarizes the LTO comparison. The significant increase in commercial, GA, and AT is expected as 2020 aviation activities were strongly impacted by the pandemic, except for GA turbine powered aircraft which saw a raise in activity in 2020; for example, 76.5 percent of piston powered GA were operating in 2022 compared to 93.9 percent for turbine powered aircraft.[5]

Table 3-1. 2022 and 2020 LTO Comparison for 51 Airports

SCC	SCC Description	2020 LTOs	2022 LTOs	Percent
2275001000	Aircraft/Military	34,777	36,986	6%
2275020000	Aircraft/Commercial	3,997,410	6,062,387	52%
2275050011	Aircraft /General Aviation /Piston	383,397	583,165	52%
2275050012	Aircraft /General Aviation /Turbine	279,387	237,260	-15%
2275060011	Aircraft /Air Taxi /Piston	95,260	188,244	98%
2275060012	Aircraft /Air Taxi /Turbine	640,475	706,577	10%
	Total	**5,430,706**	**7,814,619**	**44%**

4.0 Development of 2022 Emissions Estimation Methodology

To develop the most accurate aircraft emission inventory possible, ERG took two different approaches. If aircraft-specific data were available, ERG used the FAA's AEDT model version 3e in conjunction with detailed aircraft activity data from T-100. If such detailed data were not available, then ERG applied a more general approach for different aircraft types (i.e., air taxis,

[5] FAA General Aviation and Part 135 Activity Surveys – CY 2020 https://www.faa.gov/data_research/aviation_data_statistics/general_aviation/cy2020.

general aviation, and military aircraft) using available generic emission estimating procedures. Using these two complementary approaches provides the most accurate emission estimates for the larger commercial jets, which tends to be the most significant aircraft emission source, while still providing estimates for smaller aircraft.

4.1 Aircraft Specific Estimation Methodology (AEDT)

AEDT was used for the aircraft-specific activity data. To pull the data into AEDT, ERG manually entered the data as operations.

After confirming all operations had been successfully entered into AEDT, the model was run and exported into two .csv files, one file for aircraft operations, and criteria emissions, and one file for the summary of the model runs. In this most recent version 3e of AEDT HAP emissions were aggregated to the airport level and were not detailed enough. Therefore only criteria emissions were estimated using AEDT. HAP speciation profiles used in the generic methodology were then used to calculate the HAP emissions for the AEDT data. Due to how the AEDT model is designed, multiple individual files must be exported and combined to build a complete inventory. These files were exported and formatted for the flight path below mixing height, APU operations, and GSE operations. The emissions were converted from grams to short tons and additional IDs were added to each file, including state facility identifiers, SCC codes, and aircraft engine type codes. The emissions data were exported as emission factors and were then multiplied by the various operations to estimate total emissions by aircraft type and airport.

4.2 Generic Emissions Estimating Procedures

AEDT can provide emission estimates if the aircraft make and model are known. Often this is not the case for air taxis, general aviation, and military aircraft activity from the TAF and OPSNET datasets which do not include aircraft make data. They only include aircraft type, requiring the use of the following equation:[6, 7, 8]

$$E_{ixj} = LTO_i \times FR_x \times EF_{ij}$$

Where:

E_{ixj} = Emission estimate for aircraft type i equipped with engine type x and pollutant j (lbs/year)

LTO_i = Annual count of LTO cycles for aircraft type i

[6] U.S. EPA. *Documentation for Aircraft, Commercial Marine Vessel, Locomotive, and Other Nonroad Components of the National Emissions Inventory, Volume I Methodology*. February 10, 2005.

[7] U.S. EPA/ FAA. *Recommended Best Practice for Quantifying Speciated Gas-Phase Organic Gas Emissions from Aircraft Equipped with Turbofan, Turbojet, and Turboprop Engines.* February 2009.

[8] U.S. EPA. *2020 National Emissions Inventory: Aviation Component* https://gaftp.epa.gov/air/nei/2017/doc/supporting_data/point/2017Aircraft_main_19aug2019.pdf Accessed August 10, 2021.

FR_x = Fraction of LTOs equipped with engine type x

EF_{ij} = Generic emission factor for aircraft type i equipped with engine type x and pollutant j (lbs/LTO)

i = Aircraft type (i.e., air taxi, general aviation, and military)

x = Engine type (i.e., jet or turboprop, and piston engine)

j = Criteria pollutant j

Critical to the calculation is the application of representative emission factors that account for the different aircraft in the national fleet. Table 4-1 lists all of the criteria pollutant emission factors used for the generic approach. Appendix B lists all of the generic criteria and HAP emission factors by SCC.

As discussed above, when the GA and AT breakout is unknown, EPA assumed that 72.1% of all generic GA activity are powered by propeller-driven aircraft and 27.9% are jet- (or turbine) driven; and 21.8% of all generic AT activity are powered by propeller-driven aircraft and 78.2% are jet- (or turbine) driven. The T-100 data had the piston and jet engines already disaggregated.

Table 4-1. Emission Factors for Aircraft Types (pounds per LTO)

Aircraft Type	Pollutant					
	CO	NO_X	PM_{10}-PRI	$PM_{2.5}$-PRI	SO_X	VOC
Commercial	22.38	18.58	1.08	1.05	1.78	6.16
Air Taxi (turbine)	3.61	0.78	0.60	0.59	0.16	1.01
Air Taxi (propeller)	28.13	0.16	0.60	0.42	0.02	0.17
General Aviation (turbine)	9.58	0.32	0.24	0.23	0.07	0.69
General Aviation (propeller)	12.01	0.07	0.24	0.16	0.01	0.15
Military	25.96	22.33	1.39	1.36	2.11	10.87

5.0 Summary of Airport Emissions

Table 5-1 summarizes the total annual emissions from airports; emissions disaggregated by SCCs, are provided in Appendix C. Figures 5-1 and 5-2 summarize the VOC and NO_X emissions as a pie chart by SCC descriptions. Military operations are relatively stable relative to the other aircraft operations, the fraction of total emissions attributed to them increased in 2022. Most of the military emissions are derived from the generic approach, which is a less accurate method, especially considering the range of aircraft types used by the military.

Table 5-1. Total Annual 2022 Emissions from 51 Airports

Pollutant Name	Pollutant Code	Emissions (Ton)
Carbon Dioxide	CO_2	16,956,688.40
Carbon Monoxide	CO	91,671.50

Pollutant Name	Pollutant Code	Emissions (Ton)
Nitrogen Oxides	NO_X	65,729.62
PM_{10} Primary (Filt + Cond)	PM_{10}-PRI	1,240.01
$PM_{2.5}$ Primary (Filt + Cond)	PM_{25}-PRI	1,193.06
Sulfur Dioxide	SO_2	6,525.60
Volatile Organic Compounds	VOC	11,002.63
1,3-Butadiene	106990	173.75
1-Methylnaphthalene	90120	21.13
2,2,4-Trimethylpentane	540841	4.72
Acenaphthene	83329	0.13
Acenaphthylene	208968	0.73
Acetaldehyde	75070	438.65
Acrolein	107028	251.25
Anthracene	120127	0.15
Benz[a]Anthracene	56553	0.02
Benzene	71432	175.36
Benzo[a]Pyrene	50328	0.02
Benzo[b]Fluoranthene	205992	0.03
Benzo[g,h,i,]Perylene	191242	0.05
Benzo[k]Fluoranthene	207089	0.03
Chrysene	218019	0.02
Cumene	98828	0.31
Dibenzo[a,h]Anthracene	53703	0.01
Ethyl Benzene	100414	18.91
Fluoranthene	206440	0.17
Fluorene	86737	0.27
Formaldehyde	50000	1,264.63
Hexane	110543	0.51
Indeno[1,2,3-c,d]Pyrene	193395	0.02
Lead	7439921	5.93
Methanol	67561	185.15
m-Xylene	108383	28.93
Naphthalene	91203	71.79
o-Xylene	95476	17.03
Phenanthrene	85018	0.48
Phenol	108952	74.47
Propionaldehyde	123386	74.61
Styrene	100425	31.94
Toluene	108883	73.39
Xylenes (Mixed Isomers)	1330207	4.25

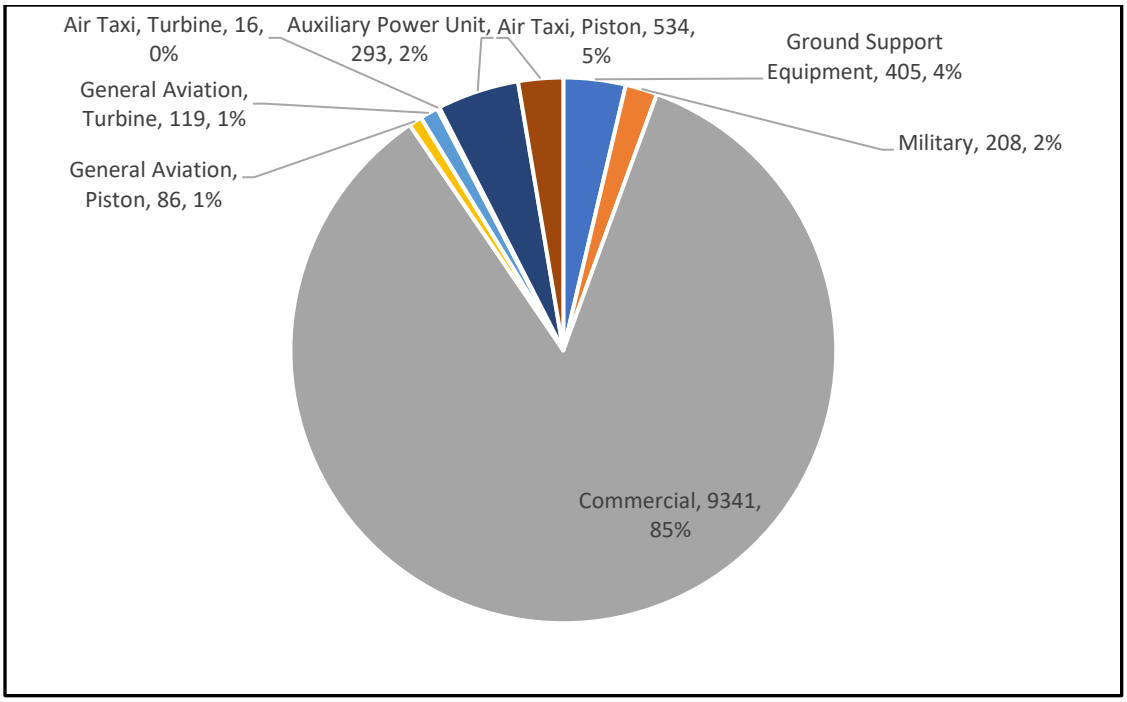

Figure 5-1. Total 2022 Annual VOC Emissions from 51 Airports (tons) by SCC Description

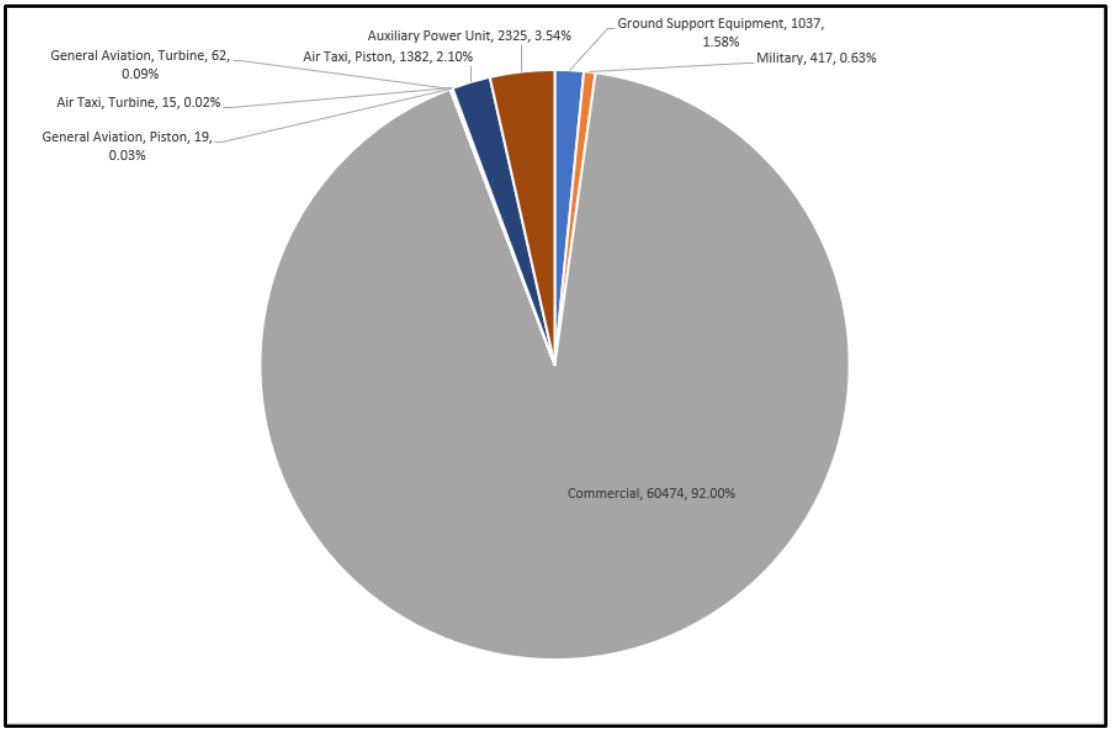

Figure 5-2. Total 2022 Annual NO_x Emissions from 51 Airports (tons) by SCC Description

As part of our data quality checks for this project, a variety of alternative data sources were evaluated to ensure that the 2022 data for the 51 airports were reasonable and accurate, including comparison with the 2020 NEI. As a special request, the FAA provided their 2022 radar data of actual aircraft movements to ensure that our aircraft counts for each airport were reasonable. Additionally data were also evaluated from Cirium's fleet analyzer[9] which includes the fleet mix of in-service aircraft for commercial, general aviation, and business aircraft (excludes military aircraft) Noting the engines these aircraft used. Appendix D summarizes the QA checks performed for this project.

6.0 References

Title 14 - Code of Federal Regulations - Part 241 Uniform System of Accounts and Reports for Large Certificated Air Carriers. T-100 Segment (All Carriers) - Published Online by Bureau of Transportation Statistics. https://www.transtats.bts.gov/Fields.asp?gnoyr_VQ=GEE. Accessed August 11, 2023.

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U.S. EPA/ FAA. *Recommended Best Practice for Quantifying Speciated Gas-Phase Organic Gas Emissions from Aircraft Equipped with Turbofan, Turbojet, and Turboprop Engines.* February 2009.

[9] Cirium Fleet Analyzer https://www.cirium.com/solutions/fleets-analyzer/

Appendix A
Georgia Environmental Protection Division 2022 Aviation Submittal: Atlanta

Data submitted by GA EPA

FacilitySiteIdentifier	EISFacilitySiteIdentifier	SourceClassificationCode	ProcessDescription	AircraftEngineTypeCode	2022 LTO
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	202390	1095
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	203816	6022.5
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	202564	730
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	202559	2920
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	202547	16,425
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	202503	37,047
ATL	9748811	2275050012	General Aviation, Turbine	202105	730
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	202089	0
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	206394	365
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	200176	18615
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	200704	1095
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	200665	730
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	200083	44712
ATL	9748811	2275050012	General Aviation, Turbine	201489	547.5
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	200991	31572
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	200962	11497
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	205314	9490
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	202456	55845
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	201111	1277
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	201074	4197
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	206200	3285
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	202499	31572
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	200374	3832

FacilitySiteIdentifier	EISFacilitySiteIdentifier	SourceClassificationCode	ProcessDescription	AircraftEngineTypeCode	2022 LTO
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	200553	365
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	202539	2372
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	204366	365
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	206227	730
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	201237	182.5
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	204211	2920
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	205274	182
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	200393	40332
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	202054	547
ATL	9748811	2275050011	General Aviation, Piston	202024	0
ATL	9748811	2275060012	Air Taxi, Turbine	201250	15877.5
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	204006	547
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	200481	7482
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	204257	365
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	205308	365
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	204129	3102
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	200332	730
ATL	9748811	2275050012	General Aviation, Turbine	203044	365
ATL	9748811	2275050012	General Aviation, Turbine	201298	365
ATL	9748811	2275050012	General Aviation, Turbine	200031	730
ATL	9748811	2275050012	General Aviation, Turbine	201503	182.5
ATL	9748811	2275020000	Commercial Aircraft, Total: All Types	206383	365

Appendix B
Generic Aircraft Type Emission Factors

SCC	Process Description	CAS No.	Pollutant	Emission factors (tons/LTO)
2275060011	Aircraft /Air Taxi /Piston	100425	Styrene	3.221E-07
2275060011	Aircraft /Air Taxi /Piston	108883	Toluene	9.853E-06
2275060011	Aircraft /Air Taxi /Piston	540841	2,2,4-Trimethylpentane	3.394E-08
2275060011	Aircraft /Air Taxi /Piston	1330207	Xylene	5.552E-06
2275050011	Aircraft /General Aviation /Piston	VOC	VOC	7.524E-05
2275050011	Aircraft /General Aviation /Piston	NO_X	Nitrogen Oxides	3.250E-05
2275050011	Aircraft /General Aviation /Piston	CO	Carbon Monoxide	6.007E-03
2275050011	Aircraft /General Aviation /Piston	SO_2	Sulfur Dioxide	5.000E-06
2275050011	Aircraft /General Aviation /Piston	PM_{10}-PRI	PM_{10} Primary (Filt + Cond)	1.184E-04
2275050011	Aircraft /General Aviation /Piston	$PM_{2.5}$-PRI	$PM_{2.5}$ Primary (Filt + Cond)	8.166E-05
2275050011	Aircraft /General Aviation /Piston	83329	Acenaphthene	8.640E-08
2275050011	Aircraft /General Aviation /Piston	208968	Acenaphthylene	4.876E-07
2275050011	Aircraft /General Aviation /Piston	75070	Acetaldehyde	5.874E-07
2275050011	Aircraft /General Aviation /Piston	107028	Acrolein	5.684E-08
2275050011	Aircraft /General Aviation /Piston	120127	Anthracene	1.006E-07
2275050011	Aircraft /General Aviation /Piston	71432	Benzene	3.837E-06
2275050011	Aircraft /General Aviation /Piston	56553	Benzo(a)anthracene	1.184E-08
2275050011	Aircraft /General Aviation /Piston	50328	Benzo(a)pyrene	1.184E-08
2275050011	Aircraft /General Aviation /Piston	205992	Benzo(b)fluoranthene	1.420E-08
2275050011	Aircraft /General Aviation /Piston	191242	Benzo(ghi)perylene	3.077E-08
2275050011	Aircraft /General Aviation /Piston	207089	Benzo(k)fluoranthene	1.420E-08
2275050011	Aircraft /General Aviation /Piston	106990	1,3-Butadiene	9.285E-07
2275050011	Aircraft /General Aviation /Piston	218019	Chrysene	1.184E-08
2275050011	Aircraft /General Aviation /Piston	53703	Dibenzo(ah)anthracene	0.000E+00
2275050011	Aircraft /General Aviation /Piston	100414	Ethylbenzene	1.393E-06
2275050011	Aircraft /General Aviation /Piston	206440	Fluoranthene	1.077E-07
2275050011	Aircraft /General Aviation /Piston	86737	Fluorene	1.787E-07
2275050011	Aircraft /General Aviation /Piston	50000	Formaldehyde	2.549E-06
2275050011	Aircraft /General Aviation /Piston	193395	Indeno(1,2,3-cd)pyrene	9.468E-09
2275050011	Aircraft /General Aviation /Piston	98828	Isopropylbenzene	0.000E+00
2275050011	Aircraft /General Aviation /Piston	67561	Methanol	0.000E+00
2275050011	Aircraft /General Aviation /Piston	91576	2-Methyl Naphthalene	0.000E+00
2275050011	Aircraft /General Aviation /Piston	91203	Naphthalene (gas phase)	4.327E-07
2275050011	Aircraft /General Aviation /Piston	91203	Naphthalene (solid phase)	1.073E-05
2275050011	Aircraft /General Aviation /Piston	110543	N-Hexane	6.632E-07
2275050011	Aircraft /General Aviation /Piston	85018	Phenanthrene	3.006E-07
2275050011	Aircraft /General Aviation /Piston	108952	Phenol	0.000E+00

SCC	Process Description	CAS No.	Pollutant	Emission factors (tons/LTO)
2275050011	Aircraft /General Aviation /Piston	123386	Propionaldehyde	5.684E-08
2275050011	Aircraft /General Aviation /Piston	100425	Styrene	3.221E-07
2275050011	Aircraft /General Aviation /Piston	108883	Toluene	9.853E-06
2275050011	Aircraft /General Aviation /Piston	540841	2,2,4-Trimethylpentane	3.394E-08
2275050011	Aircraft /General Aviation /Piston	1330207	Xylene	5.552E-06
2275001000	Aircraft/Military	VOC	VOC	5.433E-03
2275001000	Aircraft/Military	NO_X	Nitrogen Oxides	1.117E-02
2275001000	Aircraft/Military	CO	Carbon Monoxide	1.298E-02
2275001000	Aircraft/Military	SO_2	Sulfur Dioxide	1.055E-03
2275001000	Aircraft/Military	PM_{10}-PRI	PM_{10} Primary (Filt + Cond)	6.965E-04
2275001000	Aircraft/Military	$PM_{2.5}$-PRI	$PM_{2.5}$ Primary (Filt + Cond)	6.798E-04
2275001000	Aircraft/Military	83329	Acenaphthene	0.000E+00
2275001000	Aircraft/Military	208968	Acenaphthylene	0.000E+00
2275001000	Aircraft/Military	75070	Acetaldehyde	2.333E-04
2275001000	Aircraft/Military	107028	Acrolein	1.337E-04
2275001000	Aircraft/Military	120127	Anthracene	0.000E+00
2275001000	Aircraft/Military	71432	Benzene	9.180E-05
2275001000	Aircraft/Military	56553	Benzo(a)anthracene	0.000E+00
2275001000	Aircraft/Military	50328	Benzo(a)pyrene	0.000E+00
2275001000	Aircraft/Military	205992	Benzo(b)fluoranthene	0.000E+00
2275001000	Aircraft/Military	191242	Benzo(ghi)perylene	0.000E+00
2275001000	Aircraft/Military	207089	Benzo(k)fluoranthene	0.000E+00
2275001000	Aircraft/Military	106990	1,3-Butadiene	9.213E-05
2275001000	Aircraft/Military	218019	Chrysene	0.000E+00
2275001000	Aircraft/Military	53703	Dibenzo(ah)anthracene	0.000E+00
2275001000	Aircraft/Military	100414	Ethylbenzene	9.503E-06
2275001000	Aircraft/Military	206440	Fluoranthene	0.000E+00
2275001000	Aircraft/Military	86737	Fluorene	0.000E+00
2275001000	Aircraft/Military	50000	Formaldehyde	6.723E-04
2275001000	Aircraft/Military	193395	Indeno(1,2,3-cd)pyrene	0.000E+00
2275001000	Aircraft/Military	98828	Isopropylbenzene	1.638E-07
2275001000	Aircraft/Military	67561	Methanol	9.858E-05
2275001000	Aircraft/Military	91576	2-Methyl Naphthalene	1.125E-05
2275001000	Aircraft/Military	108383	M-Xylene And P-Xylene	1.540E-05
2275001000	Aircraft/Military	91203	Naphthalene	2.955E-05
2275001000	Aircraft/Military	110543	N-Hexane	0.000E+00
2275001000	Aircraft/Military	95476	O-Xylene	9.066E-06
2275001000	Aircraft/Military	85018	Phenanthrene	0.000E+00
2275001000	Aircraft/Military	108952	Phenol	3.965E-05

SCC	Process Description	CAS No.	Pollutant	Emission factors (tons/LTO)
2275001000	Aircraft/Military	123386	Propionaldehyde	3.970E-05
2275001000	Aircraft/Military	100425	Styrene	1.688E-05
2275001000	Aircraft/Military	108883	Toluene	3.506E-05
2275001000	Aircraft/Military	540841	2,2,4-Trimethylpentane	0.000E+00
2275050011	Aircraft /General Aviation /Piston	7439921	Lead	7.686E-06
2275060011	Aircraft /Air Taxi /Piston	7439921	Lead	7.686E-06
2275020000	Aircraft/Commercial	VOC	VOC	3.082E-03
2275020000	Aircraft/Commercial	NO_X	Nitrogen Oxides	9.288E-03
2275020000	Aircraft/Commercial	CO	Carbon Monoxide	1.119E-02
2275020000	Aircraft/Commercial	SO_2	Sulfur Dioxide	8.910E-04
2275020000	Aircraft/Commercial	PM_{10}-PRI	PM_{10} Primary (Filt + Cond)	5.385E-04
2275020000	Aircraft/Commercial	$PM_{2.5}$-PRI	$PM_{2.5}$ Primary (Filt + Cond)	5.256E-04
2275020000	Aircraft/Commercial	83329	Acenaphthene	0.000E+00
2275020000	Aircraft/Commercial	208968	Acenaphthylene	0.000E+00
2275020000	Aircraft/Commercial	75070	Acetaldehyde	1.328E-04
2275020000	Aircraft/Commercial	107028	Acrolein	7.613E-05
2275020000	Aircraft/Commercial	120127	Anthracene	0.000E+00
2275020000	Aircraft/Commercial	71432	Benzene	5.226E-05
2275020000	Aircraft/Commercial	56553	Benzo(a)anthracene	1.297E-09
2275020000	Aircraft/Commercial	50328	Benzo(a)pyrene	9.621E-10
2275020000	Aircraft/Commercial	205992	Benzo(b)fluoranthene	1.892E-09
2275020000	Aircraft/Commercial	191242	Benzo(ghi)perylene	1.726E-11
2275020000	Aircraft/Commercial	207089	Benzo(k)fluoranthene	1.892E-09
2275020000	Aircraft/Commercial	106990	1,3-Butadiene	5.245E-05
2275020000	Aircraft/Commercial	218019	Chrysene	1.313E-09
2275020000	Aircraft/Commercial	53703	Dibenzo(ah)anthracene	2.551E-09
2275020000	Aircraft/Commercial	100414	Ethylbenzene	5.409E-06
2275020000	Aircraft/Commercial	206440	Fluoranthene	2.492E-09
2275020000	Aircraft/Commercial	86737	Fluorene	0.000E+00
2275020000	Aircraft/Commercial	50000	Formaldehyde	3.827E-04
2275020000	Aircraft/Commercial	193395	Indeno(1,2,3-cd)pyrene	2.050E-09
2275020000	Aircraft/Commercial	98828	Isopropylbenzene	9.326E-08
2275020000	Aircraft/Commercial	67561	Methanol	5.611E-05
2275020000	Aircraft/Commercial	91576	2-Methyl Naphthalene	6.404E-06
2275020000	Aircraft/Commercial	108383	M-Xylene And P-Xylene	8.767E-06
2275020000	Aircraft/Commercial	91203	Naphthalene	1.682E-05
2275020000	Aircraft/Commercial	110543	N-Hexane	0.000E+00
2275020000	Aircraft/Commercial	95476	O-Xylene	5.161E-06
2275020000	Aircraft/Commercial	85018	Phenanthrene	1.112E-08

SCC	Process Description	CAS No.	Pollutant	Emission factors (tons/LTO)
2275020000	Aircraft/Commercial	108952	Phenol	2.257E-05
2275020000	Aircraft/Commercial	123386	Propionaldehyde	2.260E-05
2275020000	Aircraft/Commercial	100425	Styrene	9.606E-06
2275020000	Aircraft/Commercial	108883	Toluene	1.996E-05
2275020000	Aircraft/Commercial	540841	2,2,4-Trimethylpentane	1.466E-06
2275060012	Aircraft /Air Taxi /Turbine	VOC	VOC	5.029E-04
2275060012	Aircraft /Air Taxi /Turbine	NO_X	Nitrogen Oxides	3.877E-04
2275060012	Aircraft /Air Taxi /Turbine	CO	Carbon Monoxide	1.806E-03
2275060012	Aircraft /Air Taxi /Turbine	SO_2	Sulfur Dioxide	8.124E-05
2275060012	Aircraft /Air Taxi /Turbine	PM_{10}-PRI	PM_{10} Primary (Filt + Cond)	3.017E-04
2275060012	Aircraft /Air Taxi /Turbine	$PM_{2.5}$-PRI	$PM_{2.5}$ Primary (Filt + Cond)	2.944E-04
2275060012	Aircraft /Air Taxi /Turbine	83329	Acenaphthene	0.000E+00
2275060012	Aircraft /Air Taxi /Turbine	208968	Acenaphthylene	0.000E+00
2275060012	Aircraft /Air Taxi /Turbine	75070	Acetaldehyde	2.167E-05
2275060012	Aircraft /Air Taxi /Turbine	107028	Acrolein	1.242E-05
2275060012	Aircraft /Air Taxi /Turbine	120127	Anthracene	1.331E-10
2275060012	Aircraft /Air Taxi /Turbine	71432	Benzene	8.528E-06
2275060012	Aircraft /Air Taxi /Turbine	56553	Benzo(a)anthracene	2.014E-11
2275060012	Aircraft /Air Taxi /Turbine	50328	Benzo(a)pyrene	1.103E-11
2275060012	Aircraft /Air Taxi /Turbine	205992	Benzo(b)fluoranthene	0.000E+00
2275060012	Aircraft /Air Taxi /Turbine	191242	Benzo(ghi)perylene	1.829E-12
2275060012	Aircraft /Air Taxi /Turbine	207089	Benzo(k)fluoranthene	0.000E+00
2275060012	Aircraft /Air Taxi /Turbine	106990	1,3-Butadiene	8.558E-06
2275060012	Aircraft /Air Taxi /Turbine	218019	Chrysene	1.876E-11
2275060012	Aircraft /Air Taxi /Turbine	53703	Dibenzo(ah)anthracene	0.000E+00
2275060012	Aircraft /Air Taxi /Turbine	100414	Ethylbenzene	8.827E-07
2275060012	Aircraft /Air Taxi /Turbine	206440	Fluoranthene	2.784E-10
2275060012	Aircraft /Air Taxi /Turbine	86737	Fluorene	0.000E+00
2275060012	Aircraft /Air Taxi /Turbine	50000	Formaldehyde	6.245E-05
2275060012	Aircraft /Air Taxi /Turbine	193395	Indeno(1,2,3-cd)pyrene	0.000E+00
2275060012	Aircraft /Air Taxi /Turbine	98828	Isopropylbenzene	1.522E-08
2275060012	Aircraft /Air Taxi /Turbine	67561	Methanol	9.157E-06
2275060012	Aircraft /Air Taxi /Turbine	91576	2-Methyl Naphthalene	1.045E-06
2275060012	Aircraft /Air Taxi /Turbine	108383	M-Xylene And P-Xylene	1.431E-06
2275060012	Aircraft /Air Taxi /Turbine	91203	Naphthalene	2.745E-06
2275060012	Aircraft /Air Taxi /Turbine	110543	N-Hexane	0.000E+00
2275060012	Aircraft /Air Taxi /Turbine	95476	O-Xylene	8.421E-07
2275060012	Aircraft /Air Taxi /Turbine	85018	Phenanthrene	1.238E-09
2275060012	Aircraft /Air Taxi /Turbine	108952	Phenol	3.683E-06

SCC	Process Description	CAS No.	Pollutant	Emission factors (tons/LTO)
2275060012	Aircraft /Air Taxi /Turbine	123386	Propionaldehyde	3.688E-06
2275060012	Aircraft /Air Taxi /Turbine	100425	Styrene	1.568E-06
2275060012	Aircraft /Air Taxi /Turbine	108883	Toluene	3.257E-06
2275060012	Aircraft /Air Taxi /Turbine	540841	2,2,4-Trimethylpentane	1.915E-07
2275050012	Aircraft /General Aviation /Turbine	VOC	VOC	3.447E-04
2275050012	Aircraft /General Aviation /Turbine	NO_X	Nitrogen Oxides	1.619E-04
2275050012	Aircraft /General Aviation /Turbine	CO	Carbon Monoxide	4.789E-03
2275050012	Aircraft /General Aviation /Turbine	SO_2	Sulfur Dioxide	3.679E-05
2275050012	Aircraft /General Aviation /Turbine	PM_{10}-PRI	PM_{10} Primary (Filt + Cond)	1.184E-04
2275050012	Aircraft /General Aviation /Turbine	$PM_{2.5}$-PRI	$PM_{2.5}$ Primary (Filt + Cond)	1.155E-04
2275050012	Aircraft /General Aviation /Turbine	83329	Acenaphthene	0.000E+00
2275050012	Aircraft /General Aviation /Turbine	208968	Acenaphthylene	0.000E+00
2275050012	Aircraft /General Aviation /Turbine	75070	Acetaldehyde	1.486E-05
2275050012	Aircraft /General Aviation /Turbine	107028	Acrolein	8.516E-06
2275050012	Aircraft /General Aviation /Turbine	120127	Anthracene	5.221E-11
2275050012	Aircraft /General Aviation /Turbine	71432	Benzene	5.846E-06
2275050012	Aircraft /General Aviation /Turbine	56553	Benzo(a)anthracene	7.903E-12
2275050012	Aircraft /General Aviation /Turbine	50328	Benzo(a)pyrene	4.327E-12
2275050012	Aircraft /General Aviation /Turbine	205992	Benzo(b)fluoranthene	0.000E+00
2275050012	Aircraft /General Aviation /Turbine	191242	Benzo(ghi)perylene	7.178E-13
2275050012	Aircraft /General Aviation /Turbine	207089	Benzo(k)fluoranthene	0.000E+00
2275050012	Aircraft /General Aviation /Turbine	106990	1,3-Butadiene	5.866E-06
2275050012	Aircraft /General Aviation /Turbine	218019	Chrysene	7.359E-12
2275050012	Aircraft /General Aviation /Turbine	53703	Dibenzo(ah)anthracene	0.000E+00
2275050012	Aircraft /General Aviation /Turbine	100414	Ethylbenzene	6.051E-07
2275050012	Aircraft /General Aviation /Turbine	206440	Fluoranthene	1.092E-10
2275050012	Aircraft /General Aviation /Turbine	86737	Fluorene	0.000E+00
2275050012	Aircraft /General Aviation /Turbine	50000	Formaldehyde	4.281E-05
2275050012	Aircraft /General Aviation /Turbine	193395	Indeno(1,2,3-cd)pyrene	0.000E+00
2275050012	Aircraft /General Aviation /Turbine	98828	Isopropylbenzene	1.043E-08
2275050012	Aircraft /General Aviation /Turbine	67561	Methanol	6.277E-06
2275050012	Aircraft /General Aviation /Turbine	91576	2-Methyl Naphthalene	7.163E-07
2275050012	Aircraft /General Aviation /Turbine	108383	M-Xylene And P-Xylene	9.806E-07
2275050012	Aircraft /General Aviation /Turbine	91203	Naphthalene	1.881E-06
2275050012	Aircraft /General Aviation /Turbine	110543	N-Hexane	0.000E+00
2275050012	Aircraft /General Aviation /Turbine	95476	O-Xylene	5.773E-07
2275050012	Aircraft /General Aviation /Turbine	85018	Phenanthrene	4.858E-10
2275050012	Aircraft /General Aviation /Turbine	108952	Phenol	2.525E-06
2275050012	Aircraft /General Aviation /Turbine	123386	Propionaldehyde	2.528E-06

SCC	Process Description	CAS No.	Pollutant	Emission factors (tons/LTO)
2275050012	Aircraft /General Aviation /Turbine	100425	Styrene	1.075E-06
2275050012	Aircraft /General Aviation /Turbine	108883	Toluene	2.233E-06
2275050012	Aircraft /General Aviation /Turbine	540841	2,2,4-Trimethylpentane	1.313E-07
2275060011	Aircraft /Air Taxi /Piston	VOC	VOC	8.484E-05
2275060011	Aircraft /Air Taxi /Piston	NO_X	Nitrogen Oxides	7.900E-05
2275060011	Aircraft /Air Taxi /Piston	CO	Carbon Monoxide	1.407E-02
2275060011	Aircraft /Air Taxi /Piston	SO_2	Sulfur Dioxide	7.500E-06
2275060011	Aircraft /Air Taxi /Piston	PM_{10}-PRI	PM_{10} Primary (Filt + Cond)	3.017E-04
2275060011	Aircraft /Air Taxi /Piston	$PM_{2.5}$-PRI	$PM_{2.5}$ Primary (Filt + Cond)	2.081E-04
2275060011	Aircraft /Air Taxi /Piston	83329	Acenaphthene	2.202E-07
2275060011	Aircraft /Air Taxi /Piston	208968	Acenaphthylene	1.243E-06
2275060011	Aircraft /Air Taxi /Piston	75070	Acetaldehyde	5.874E-07
2275060011	Aircraft /Air Taxi /Piston	107028	Acrolein	5.684E-08
2275060011	Aircraft /Air Taxi /Piston	120127	Anthracene	2.564E-07
2275060011	Aircraft /Air Taxi /Piston	71432	Benzene	3.837E-06
2275060011	Aircraft /Air Taxi /Piston	56553	Benzo(a)anthracene	3.017E-08
2275060011	Aircraft /Air Taxi /Piston	50328	Benzo(a)pyrene	3.017E-08
2275060011	Aircraft /Air Taxi /Piston	205992	Benzo(b)fluoranthene	3.620E-08
2275060011	Aircraft /Air Taxi /Piston	191242	Benzo(ghi)perylene	7.843E-08
2275060011	Aircraft /Air Taxi /Piston	207089	Benzo(k)fluoranthene	3.620E-08
2275060011	Aircraft /Air Taxi /Piston	106990	1,3-Butadiene	9.285E-07
2275060011	Aircraft /Air Taxi /Piston	218019	Chrysene	3.017E-08
2275060011	Aircraft /Air Taxi /Piston	53703	Dibenzo(ah)anthracene	0.000E+00
2275060011	Aircraft /Air Taxi /Piston	100414	Ethylbenzene	1.393E-06
2275060011	Aircraft /Air Taxi /Piston	206440	Fluoranthene	2.745E-07
2275060011	Aircraft /Air Taxi /Piston	86737	Fluorene	4.555E-07
2275060011	Aircraft /Air Taxi /Piston	50000	Formaldehyde	2.549E-06
2275060011	Aircraft /Air Taxi /Piston	193395	Indeno(1,2,3-cd)pyrene	2.413E-08
2275060011	Aircraft /Air Taxi /Piston	98828	Isopropylbenzene	0.000E+00
2275060011	Aircraft /Air Taxi /Piston	67561	Methanol	0.000E+00
2275060011	Aircraft /Air Taxi /Piston	91576	2-Methyl Naphthalene	0.000E+00
2275060011	Aircraft /Air Taxi /Piston	91203	Naphthalene (gas phase)	4.327E-07
2275060011	Aircraft /Air Taxi /Piston	91203	Naphthalene (solid phase)	2.736E-05
2275060011	Aircraft /Air Taxi /Piston	110543	N-Hexane	6.632E-07
2275060011	Aircraft /Air Taxi /Piston	85018	Phenanthrene	7.662E-07
2275060011	Aircraft /Air Taxi /Piston	108952	Phenol	0.000E+00
2275060011	Aircraft /Air Taxi /Piston	123386	Propionaldehyde	5.684E-08

Appendix C
Total 2022 Annual Emissions for 51 Airports by SCC

SCC	Process Description	Pollutant	Pollutant CAS	2022 Emissions (tons)
2265008005	GSE-4stroke gas	Carbon Monoxide	CO	11,110.78
2265008005	GSE-4stroke gas	Nitrogen Oxides	NO_X	674.53
2265008005	GSE-4stroke gas	PM_{10} Primary (Filt + Cond)	PM_{10}-PRI	45.52
2265008005	GSE-4stroke gas	$PM_{2.5}$ Primary (Filt + Cond)	PM_{25}-PRI	41.88
2265008005	GSE-4stroke gas	Sulfur Dioxide	SO_2	6.66
2265008005	GSE-4stroke gas	Volatile Organic Compounds	VOC	287.75
2270008005	GSE-Diesel	Carbon Monoxide	CO	157.74
2270008005	GSE-Diesel	Nitrogen Oxides	NO_X	362.15
2270008005	GSE-Diesel	PM_{10} Primary (Filt + Cond)	PM_{10}-PRI	18.35
2270008005	GSE-Diesel	$PM_{2.5}$ Primary (Filt + Cond)	PM_{25}-PRI	17.80
2270008005	GSE-Diesel	Sulfur Dioxide	SO_2	1.14
2270008005	GSE-Diesel	Volatile Organic Compounds	VOC	117.52
2275001000	MIL	1,3-Butadiene	106990	3.53
2275001000	MIL	1-Methylnaphthalene	90120	0.43
2275001000	MIL	Acetaldehyde	75070	8.95
2275001000	MIL	Acrolein	107028	5.13
2275001000	MIL	Benzene	71432	3.52
2275001000	MIL	Carbon Dioxide	CO_2	50,538.39
2275001000	MIL	Carbon Monoxide	CO	491.17
2275001000	MIL	Cumene	98828	0.01
2275001000	MIL	Ethyl Benzene	100414	0.36
2275001000	MIL	Formaldehyde	50000	25.78
2275001000	MIL	Methanol	67561	3.78
2275001000	MIL	m-Xylene	108383	0.59
2275001000	MIL	Naphthalene	91203	1.13
2275001000	MIL	Nitrogen Oxides	NO_X	416.56
2275001000	MIL	o-Xylene	95476	0.35
2275001000	MIL	Phenol	108952	1.52
2275001000	MIL	PM_{10} Primary (Filt + Cond)	PM_{10}-PRI	25.81
2275001000	MIL	$PM_{2.5}$ Primary (Filt + Cond)	PM_{25}-PRI	25.19
2275001000	MIL	Propionaldehyde	123386	1.52
2275001000	MIL	Styrene	100425	0.65
2275001000	MIL	Sulfur Dioxide	SO_2	39.61
2275001000	MIL	Toluene	108883	1.34
2275001000	MIL	Volatile Organic Compounds	VOC	208.36
2275020000	COM	1,3-Butadiene	106990	158.42
2275020000	COM	1-Methylnaphthalene	90120	19.34

SCC	Process Description	Pollutant	Pollutant CAS	2022 Emissions (tons)
2275020000	COM	2,2,4-Trimethylpentane	540841	4.44
2275020000	COM	Acetaldehyde	75070	401.17
2275020000	COM	Acrolein	107028	229.98
2275020000	COM	Benz[a]Anthracene	56553	0.00
2275020000	COM	Benzene	71432	157.86
2275020000	COM	Benzo[a]Pyrene	50328	0.00
2275020000	COM	Benzo[b]Fluoranthene	205992	0.01
2275020000	COM	Benzo[g,h,i,]Perylene	191242	0.00
2275020000	COM	Benzo[k]Fluoranthene	207089	0.01
2275020000	COM	Carbon Dioxide	CO_2	16,020,119.66
2275020000	COM	Carbon Monoxide	CO	66,517.15
2275020000	COM	Chrysene	218019	0.00
2275020000	COM	Cumene	98828	0.28
2275020000	COM	Dibenzo[a,h]Anthracene	53703	0.01
2275020000	COM	Ethyl Benzene	100414	16.34
2275020000	COM	Fluoranthene	206440	0.01
2275020000	COM	Formaldehyde	50000	1,155.98
2275020000	COM	Indeno[1,2,3-c,d]Pyrene	193395	0.01
2275020000	COM	Methanol	67561	169.50
2275020000	COM	m-Xylene	108383	26.48
2275020000	COM	Naphthalene	91203	50.80
2275020000	COM	Nitrogen Oxides	NO_X	60,474.11
2275020000	COM	o-Xylene	95476	15.59
2275020000	COM	Phenanthrene	85018	0.03
2275020000	COM	Phenol	108952	68.18
2275020000	COM	PM_{10} Primary (Filt + Cond)	PM_{10}-PRI	563.69
2275020000	COM	$PM_{2.5}$ Primary (Filt + Cond)	PM_{25}-PRI	562.68
2275020000	COM	Propionaldehyde	123386	68.27
2275020000	COM	Styrene	100425	29.02
2275020000	COM	Sulfur Dioxide	SO_2	5,946.45
2275020000	COM	Toluene	108883	60.29
2275020000	COM	Volatile Organic Compounds	VOC	9,340.80
2275050011	GA-Piston	1,3-Butadiene	106990	0.54
2275050011	GA-Piston	2,2,4-Trimethylpentane	540841	0.02
2275050011	GA-Piston	Acenaphthene	83329	0.09
2275050011	GA-Piston	Acenaphthylene	208968	0.49
2275050011	GA-Piston	Acetaldehyde	75070	0.34
2275050011	GA-Piston	Acrolein	107028	0.03
2275050011	GA-Piston	Anthracene	120127	0.10

SCC	Process Description	Pollutant	Pollutant CAS	2022 Emissions (tons)
2275050011	GA-Piston	Benz[a]Anthracene	56553	0.01
2275050011	GA-Piston	Benzene	71432	2.21
2275050011	GA-Piston	Benzo[a]Pyrene	50328	0.01
2275050011	GA-Piston	Benzo[b]Fluoranthene	205992	0.01
2275050011	GA-Piston	Benzo[g,h,i,]Perylene	191242	0.03
2275050011	GA-Piston	Benzo[k]Fluoranthene	207089	0.01
2275050011	GA-Piston	Carbon Dioxide	CO_2	57,071.99
2275050011	GA-Piston	Carbon Monoxide	CO	4,549.83
2275050011	GA-Piston	Chrysene	218019	0.01
2275050011	GA-Piston	Ethyl Benzene	100414	0.80
2275050011	GA-Piston	Fluoranthene	206440	0.11
2275050011	GA-Piston	Fluorene	86737	0.18
2275050011	GA-Piston	Formaldehyde	50000	1.47
2275050011	GA-Piston	Hexane	110543	0.38
2275050011	GA-Piston	Indeno[1,2,3-c,d]Pyrene	193395	0.01
2275050011	GA-Piston	Lead	7439921	4.48
2275050011	GA-Piston	Naphthalene	91203	11.07
2275050011	GA-Piston	Nitrogen Oxides	NO_X	18.58
2275050011	GA-Piston	Phenanthrene	85018	0.30
2275050011	GA-Piston	PM_{10} Primary (Filt + Cond)	PM_{10}-PRI	67.43
2275050011	GA-Piston	$PM_{2.5}$ Primary (Filt + Cond)	PM_{25}-PRI	47.02
2275050011	GA-Piston	Propionaldehyde	123386	0.03
2275050011	GA-Piston	Styrene	100425	0.19
2275050011	GA-Piston	Sulfur Dioxide	SO_2	4.13
2275050011	GA-Piston	Toluene	108883	5.68
2275050011	GA-Piston	Volatile Organic Compounds	VOC	86.49
2275050011	GA-Piston	Xylenes (Mixed Isomers)	1330207	3.20
2275050012	GA-Turbine	1,3-Butadiene	106990	2.03
2275050012	GA-Turbine	1-Methylnaphthalene	90120	0.25
2275050012	GA-Turbine	2,2,4-Trimethylpentane	540841	0.05
2275050012	GA-Turbine	Acetaldehyde	75070	5.14
2275050012	GA-Turbine	Acrolein	107028	2.95
2275050012	GA-Turbine	Anthracene	120127	0.00
2275050012	GA-Turbine	Benz[a]Anthracene	56553	0.00
2275050012	GA-Turbine	Benzene	71432	2.02
2275050012	GA-Turbine	Benzo[a]Pyrene	50328	0.00
2275050012	GA-Turbine	Benzo[g,h,i,]Perylene	191242	0.00
2275050012	GA-Turbine	Carbon Dioxide	CO_2	103,336.90
2275050012	GA-Turbine	Carbon Monoxide	CO	1,027.41

SCC	Process Description	Pollutant	Pollutant CAS	2022 Emissions (tons)
2275050012	GA-Turbine	Chrysene	218019	0.00
2275050012	GA-Turbine	Cumene	98828	0.00
2275050012	GA-Turbine	Ethyl Benzene	100414	0.21
2275050012	GA-Turbine	Fluoranthene	206440	0.00
2275050012	GA-Turbine	Formaldehyde	50000	14.81
2275050012	GA-Turbine	Methanol	67561	2.17
2275050012	GA-Turbine	m-Xylene	108383	0.34
2275050012	GA-Turbine	Naphthalene	91203	0.65
2275050012	GA-Turbine	Nitrogen Oxides	NO_X	61.83
2275050012	GA-Turbine	o-Xylene	95476	0.20
2275050012	GA-Turbine	Phenanthrene	85018	0.00
2275050012	GA-Turbine	Phenol	108952	0.87
2275050012	GA-Turbine	PM_{10} Primary (Filt + Cond)	PM_{10}-PRI	20.99
2275050012	GA-Turbine	$PM_{2.5}$ Primary (Filt + Cond)	PM_{25}-PRI	20.52
2275050012	GA-Turbine	Propionaldehyde	123386	0.87
2275050012	GA-Turbine	Styrene	100425	0.37
2275050012	GA-Turbine	Sulfur Dioxide	SO_2	13.64
2275050012	GA-Turbine	Toluene	108883	0.77
2275050012	GA-Turbine	Volatile Organic Compounds	VOC	119.48
2275060011	AT- Piston	1,3-Butadiene	106990	0.17
2275060011	AT- Piston	2,2,4-Trimethylpentane	540841	0.01
2275060011	AT- Piston	Acenaphthene	83329	0.04
2275060011	AT- Piston	Acenaphthylene	208968	0.23
2275060011	AT- Piston	Acetaldehyde	75070	0.11
2275060011	AT- Piston	Acrolein	107028	0.01
2275060011	AT- Piston	Anthracene	120127	0.05
2275060011	AT- Piston	Benz[a]Anthracene	56553	0.01
2275060011	AT- Piston	Benzene	71432	0.72
2275060011	AT- Piston	Benzo[a]Pyrene	50328	0.01
2275060011	AT- Piston	Benzo[b]Fluoranthene	205992	0.01
2275060011	AT- Piston	Benzo[g,h,i,]Perylene	191242	0.01
2275060011	AT- Piston	Benzo[k]Fluoranthene	207089	0.01
2275060011	AT- Piston	Carbon Dioxide	CO_2	50,533.56
2275060011	AT- Piston	Carbon Monoxide	CO	2,647.65
2275060011	AT- Piston	Chrysene	218019	0.01
2275060011	AT- Piston	Ethyl Benzene	100414	0.26
2275060011	AT- Piston	Fluoranthene	206440	0.05
2275060011	AT- Piston	Fluorene	86737	0.09
2275060011	AT- Piston	Formaldehyde	50000	0.48

SCC	Process Description	Pollutant	Pollutant CAS	2022 Emissions (tons)
2275060011	AT- Piston	Hexane	110543	0.12
2275060011	AT- Piston	Indeno[1,2,3-c,d]Pyrene	193395	0.00
2275060011	AT- Piston	Lead	7439921	1.45
2275060011	AT- Piston	Naphthalene	91203	5.23
2275060011	AT- Piston	Nitrogen Oxides	NO_X	14.87
2275060011	AT- Piston	Phenanthrene	85018	0.14
2275060011	AT- Piston	PM_{10} Primary (Filt + Cond)	PM_{10}-PRI	56.79
2275060011	AT- Piston	$PM_{2.5}$ Primary (Filt + Cond)	PM_{25}-PRI	39.18
2275060011	AT- Piston	Propionaldehyde	123386	0.01
2275060011	AT- Piston	Styrene	100425	0.06
2275060011	AT- Piston	Sulfur Dioxide	SO_2	1.41
2275060011	AT- Piston	Toluene	108883	1.85
2275060011	AT- Piston	Volatile Organic Compounds	VOC	15.97
2275060011	AT- Piston	Xylenes (Mixed Isomers)	1330207	1.05
2275060012	AT-Piston	1,3-Butadiene	106990	9.06
2275060012	AT-Piston	1-Methylnaphthalene	90120	1.11
2275060012	AT-Piston	2,2,4-Trimethylpentane	540841	0.20
2275060012	AT-Piston	Acetaldehyde	75070	22.94
2275060012	AT-Piston	Acrolein	107028	13.15
2275060012	AT-Piston	Anthracene	120127	0.00
2275060012	AT-Piston	Benz[a]Anthracene	56553	0.00
2275060012	AT-Piston	Benzene	71432	9.03
2275060012	AT-Piston	Benzo[a]Pyrene	50328	0.00
2275060012	AT-Piston	Benzo[g,h,i,]Perylene	191242	0.00
2275060012	AT-Piston	Carbon Dioxide	CO_2	675,087.89
2275060012	AT-Piston	Carbon Monoxide	CO	2,585.81
2275060012	AT-Piston	Chrysene	218019	0.00
2275060012	AT-Piston	Cumene	98828	0.02
2275060012	AT-Piston	Ethyl Benzene	100414	0.93
2275060012	AT-Piston	Fluoranthene	206440	0.00
2275060012	AT-Piston	Formaldehyde	50000	66.11
2275060012	AT-Piston	Methanol	67561	9.69
2275060012	AT-Piston	m-Xylene	108383	1.51
2275060012	AT-Piston	Naphthalene	91203	2.91
2275060012	AT-Piston	Nitrogen Oxides	NO_X	1,381.67
2275060012	AT-Piston	o-Xylene	95476	0.89
2275060012	AT-Piston	Phenanthrene	85018	0.00
2275060012	AT-Piston	Phenol	108952	3.90
2275060012	AT-Piston	PM_{10} Primary (Filt + Cond)	PM_{10}-PRI	123.48

SCC	Process Description	Pollutant	Pollutant CAS	2022 Emissions (tons)
2275060012	AT-Piston	$PM_{2.5}$ Primary (Filt + Cond)	PM_{25}-PRI	120.85
2275060012	AT-Piston	Propionaldehyde	123386	3.90
2275060012	AT-Piston	Styrene	100425	1.66
2275060012	AT-Piston	Sulfur Dioxide	SO_2	187.48
2275060012	AT-Piston	Toluene	108883	3.45
2275060012	AT-Piston	Volatile Organic Compounds	VOC	533.60
2275070000	APU	Carbon Monoxide	CO	2,583.96
2275070000	APU	Nitrogen Oxides	NO_X	2,325.33
2275070000	APU	PM_{10} Primary (Filt + Cond)	PM_{10}-PRI	317.94
2275070000	APU	$PM_{2.5}$ Primary (Filt + Cond)	PM_{25}-PRI	317.94
2275070000	APU	Sulfur Dioxide	SO_2	325.09
2275070000	APU	Volatile Organic Compounds	VOC	292.66

Appendix D
2022 Platform Aviation QA

Task	Check	Checked by	Date	Comment
Aircraft matching to Cirium data	Noted 21 aircraft for which the match was uncertain	Roger Chang Richard Billings	11/8/2023	Removed Helicopters Suggested matches for 2 aircraft models
Check matching to AEDT	Flagged 15 engines to be checked	Richard Billings	11/11/2023	Recommended 1 change; there were other aircraft engine combinations but not in AEDT
Checked airport matching of radar data to AEDT airport data (note the Radar data was provided as a special request)	Queries were linking to the right data field. Non matching airports are smaller facilities not considered for the 2022 platform	Richard Billings	11/28	KRDU and KLAX were not matched.
Checked OPSNET clean up	int_ga and loc_ga and int_mil and loc_mil appear to be combined correctly and match totals in the ranking spreadsheet.	Richard Billings	11/29	Las Vegas was high on the list, Checked – they have a lot of AT and Mil. Not surprising that Long Beach and John Wayne are at the top for GA The big air carriers are as expected.
Checked T-100 to SCC matching	Checked DB queries	Richard Billings	12/1	Queries look good, summed by SCC and compared to ATL – everything matched
Checked T-100 to OPSNET operations	Military and Air Carriers looked good	Richard Billings	12/1	Need to split out piston and turbine in OBSNET using ratios from Section 2.0.
Check AEDT manual inputs	Match records entered in AEDT to the original Excel file	Roger Chang	2/13	Fixed a few records in MIA, SFO, MSP, DTW, FLL
Check AEDT manual inputs	Match records entered in AEDT to the original Excel file	Roger Chang	2/18	Fixed a few records in SLC
Check Access queries	Makes sure all queries were run and record counts make sense and add up	Roger Chang	2/27	Record counts made sense and added up. Final LTO's matched original LTO's

Task	Check	Checked by	Date	Comment
Compare 2022 with 2020	Check to see if emissions made sense relative to previous inventory	Roger Chang	2/28-2/29	Differences made sense given the changes in LTO and a quick confirmation in AEDT.
Check Naphthalene emissions	Naphthalene seemed higher than it should be	Roger Chang	3/8	Confirmed that one query grew the Naphthalene by x3 accidently in the reformatting because Naphthalene was in the look up table three times with difference names.