

Technical Support Document
Non-road
Sulfur Dioxide (SO₂) Annual Inventory:
2023 & 2040

February 2026
Utah Division of Air Quality
Emissions Inventory Section

Table of Contents

1.0 Overview.....	2
2.0 Nonroad Equipment.....	3
3.0 Airport Sector.....	4
3.1 2023 & 2040 Airport Inventory.....	6
4.0 Rail Sector.....	6
4.1 2023 Rail Inventory.....	7
4.2 2040 Projection Rail Inventory.....	7
5.0 References.....	8
6.0 Appendix.....	9

1.0 Overview

The purpose of this technical support document is to explain which emissions modeling assumptions were used to develop the non-road mobile source inventories for the Sulfur Dioxide (SO₂) SIP. Annual SO₂ inventories were developed for the years 2023 and 2040, covering Salt Lake and Tooele counties within the Utah (UT), Sulfur Dioxide (SO₂) Non-Attainment Area (NA).

Non-road mobile inventories meet the Clean Air Act requirements of 172(c)(3), requiring State Implementation Plan inventories to be comprehensive, accurate, and current. Emission estimates are confined to the Environmental Protection Agency (EPA) approved Motor Vehicle Emissions Simulator (MOVES5 5.0.1-movesdb20241112) and various EPA National Emissions Inventories (NEI) covering the state of Utah.

The non-road mobile inventory sources include: non-road engines and motorized equipment (MOVES5), aircraft and airport ground support equipment (EPA NEI), and locomotives (EPA NEI).

2.0 Nonroad Equipment

Nonroad equipment includes all mobile sources that are not on-highway excluding locomotives, aircraft, or commercial marine vessels. Locomotive emissions from railyards, aircraft and associated ground support equipment are described in Section 3 and 4.

EPA's MOVES5-Nonroad model was used to obtain emission inventories for nonroad mobile vehicles and equipment that operate on unpaved roads or other areas but not on paved roads. The inventory includes nonroad engines and equipment, such as lawn and garden equipment, construction equipment, engines used in recreational activities, portable industrial, commercial, and agricultural engines.

MOVES-Nonroad estimates emissions result from a diverse collection of equipment from lawn mowers to locomotive support using a variety of fuel types, as shown in Table 1.

Table 1. MOVES-Nonroad Equipment and Fuel Types	
Equipment Types	Fuel Types
Agriculture	Gasoline Diesel Compressed Natural Gas (CNG) Liquified Petroleum Gas (LPG)
Commercial	
Construction	
Industrial	
Lawn and Garden	
Logging	
Oil Field	
Pleasure Craft (recreational marine; excludes commercial marine vessels)	
Railroad (excludes locomotives)	
Recreational	
Underground Mining	

The nonroad runs were executed using MOVES5, the most current publicly-released version of EPA's Motor Vehicle Emissions Simulator (MOVES) Model. The default database is movesdb20241112. However, EPA's 2016 Platform Inventory Collaborative developed specific agriculture and construction spatial allocations specifically for the nonroad equipment for the MOVES model. These updated allocations are not included in the default MOVES database. The nonroad sector of EPA's 2022v1 modeling platform, as well as the 2023 NEI, used a modified MOVES default database built from the publicly released version, movesdb20241112_nrupdates [1]. This modified database was used for this MOVES based nonroad inventory.

Nonroad emissions were computed for each month of the year (January-December), utilizing daily outputs covering weekday and weekend days. Output units were grams per weekday/weekend day. Emissions were converted from daily to monthly to annual tons per year using the number of grams/day and then converting to tons per year.

MOVES5 organizes data inputs into databases called County Data Manager (CDM) tables. For the default setting that was utilized, CDMs were developed only for local monthly metrological profiles for Salt Lake and Tooele counties for the year 2023.

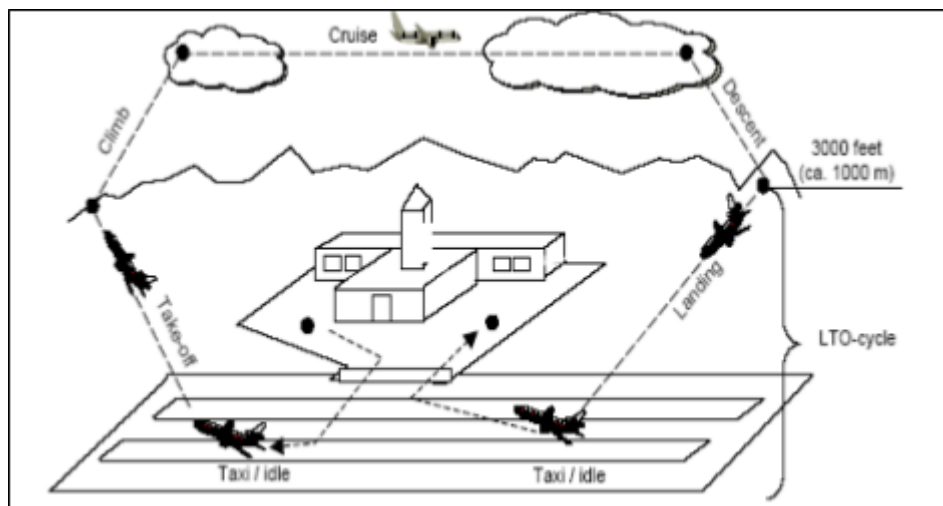
The UDAQ Technical Analysis Section provided meteorological conditions from the MesoWest archives. MesoWest (mesowest.utah.edu) is a database of current and archived meteorological data from weather stations in the United States maintained by the University of Utah. Meteorological data was identified by locating the largest population center for each county. Then the nearest weather station was acquired from the MesoWest data archives: Salt Lake QHW Hawthorne and Tooele QED Erda. Hourly temperature and relative humidity profiles were averaged to generate an averaged diurnal profile for each of the 12 months within 2023.

3.0 Airport Sector

The airport sector contains emissions from aircraft, categorized by their itinerant class (i.e., commercial, air taxi, military, or general), as well as emissions from aircraft auxiliary power units (APUs), and ground support equipment (GSE) from all known U.S. airports. Although the MOVES-Nonroad model has the ability to estimate emissions from Airport GSE, the airport sector emissions are taken from the national emissions inventory (NEI) which include GSE.

Aircraft exhaust, GSE, and APU emissions estimates are associated with aircrafts' landing and takeoff (LTO) cycle. GSEs are typically found at airports, such as aircraft refueling vehicles, baggage handling vehicles and equipment, aircraft towing vehicles, and passenger buses. Figure 1 shows six specific operating modes in an LTO cycle: Approach, Taxi/idle-in, Taxi/idle-out, Idling, Takeoff, Climb out.

Figure 1. LTO cycle



For airports where the available LTO included detailed aircraft-specific make and model information, EPA's NEI used the Federal Aviation Administration's (FAA) Aviation Environmental Design Tool (AEDT) to estimate emissions. For airports where FAA databases do not include such detail, the EPA used assumptions regarding the percent of LTOs that were associated with piston-driven (using aviation gas) versus turbine-driven (using jet fuel) aircraft. Then, the EPA estimated emissions based on the percent of each aircraft type, LTOs, and EFs. [2]

Table 2 shows the associated SCCs that the emissions associated with airport activities are attributed to.

Table 2. Airport Sector SCCs	
SCC	Description
2265008005	Airport Ground Support Equipment (Gasoline-fueled)
2270008005	Airport Ground Support Equipment (Diesel-fueled)
2275001000	Military Aircraft
2275020000	Commercial Aircraft
2275050011	General Aviation, Piston driven (aviation gas)
2275050012	General Aviation, Turbine driven (jet fuel)
2275060011	Air Taxi, Piston driven (aviation gas)
2275060012	Air Taxi, Turbine driven (jet fuel)
2275070000	Aircraft Auxiliary Power Units

3.1 2023 & 2040 Airport Inventory

As of the preparation of this technical support document, the airport sector of the 2023 NEI has not been released for use. Instead, the 2017 airport sector inventory was accessed from EPA's Emissions Inventory System (EIS) that details emissions totals by facility. This report data was then filtered for facilities in Tooele and Salt Lake Counties. This was the inventory used to project the 2023 base year inventory and the projected 2040 inventory for airports. Note, the 2020 NEI data for the airport sector was not used because the COVID pandemic in 2020 was not a representative year for airplane emissions.

Utilizing the method in the 2022v1 modeling platform technical support document[1], airport emissions were projected based on factors derived from the 2023 terminal area forecast (TAF)

data available from the FAA[3]. This data contains operational data from active airports in the National Plan of Integrated Airport Systems. Projection factors were computed using the ratio of the itinerant data from the airport operation table between the base and projection year, in this case 2017 to 2023. All inventory facilities in Tooele and Salt Lake county were matched to specific airport codes from the TAF report.

The same method to project the 2017 NEI to the year 2023 was applied to project the 2023 airport emissions further to 2040.

4.0 Rail Sector

The rail sector consists of emissions from EPA's point, nonpoint, and nonroad sources. The NEI estimates yard locomotive emissions in the point source inventory, and are associated with the operation of switcher engines at identified rail yards. In the nonpoint inventory, the emissions from diesel-electric locomotives are divided up into 4 categories: Class I line-haul operations, Class II and III operations, Passenger Trains (Amtrak) and Commuter railroads. Railway maintenance emissions (SCC 2285002015) are included in the nonroad emissions inventory, and modeled by MOVES and therefore are not included within the rail sector inventory. The SCC used for each of these emissions sources and the inventory they are found in are detailed in Table 3 below.

Table 3. Rail Sector SCC and Inventory Type		
SCC	Rail SCC Description	EPA Inventory Type
28500201	Internal Combustion Engines; Railroad Equipment; Diesel; Yard Locomotives	Point
2285002006	Mobile Sources; Railroad Equipment; Diesel; Line Haul Locomotives: Class I Operations	Nonpoint
2285002007	Mobile Sources; Railroad Equipment; Diesel; Line Haul Locomotives: Class II / III Operations	Nonpoint
2285002008	Mobile Sources; Railroad Equipment; Diesel; Line Haul Locomotives: Passenger Trains (Amtrak)	Nonpoint
2285002009	Mobile Sources; Railroad Equipment; Diesel; Line Haul Locomotives: Commuter Lines	Nonpoint
2285002015	Mobile Sources; Railroad Equipment; Diesel; Railway Maintenance	Nonroad

4.1 2023 Rail Inventory

The 2023 NEI rail yard inventory and nonpoint inventory from EIS were utilized for this SIP. Details on how these inventories are compiled can be found within EPA's NEI technical support

documentation for the point source rail yard-related emissions and rail emissions in the nonpoint data category [2][5].

4.2 2040 Projection Rail Inventory

Projected rail sector emissions for the 2040 inventory were calculated based on the methods outlined in the EPA's 2016v3 modeling platform technical support document [4] . Projection factors were based on future year fuel use values based on the Energy Information Administration's 2023 Annual Energy Outlook (AEO) rail energy use growth rates¹. AEO data for total rail freight was used for the Class I/II/III haul lines, and total passenger rail data was used for the passenger and commuter rail lines. The resulting projection factor was applied to the 2023 NEI rail emissions data based on the category of rail operation, seen in Table 4, below.

Table 4. Rail SCC and AEO Energy Use Projection Factor by Mode Category			
SCC	SCC Description	AEO Category	AEO Projection Factor
28500201	Internal Combustion Engines; Railroad Equipment; Diesel; Yard Locomotives	Total Freight	0.9648415251
2285002006	Mobile Sources; Railroad Equipment; Diesel; Line Haul Locomotives: Class I Operations	Total Freight	0.9648415251
2285002007	Mobile Sources; Railroad Equipment; Diesel; Line Haul Locomotives: Class II / III Operations	Total Freight	0.9648415251
2285002008	Mobile Sources; Railroad Equipment; Diesel; Line Haul Locomotives: Passenger Trains (Amtrak)	Total Passenger	1.220845353
2285002009	Mobile Sources; Railroad Equipment; Diesel; Line Haul Locomotives: Commuter Lines	Total Passenger	1.220845353

¹ Annual Energy Outlook 2023 Table: Table 35. Transportation Sector Energy Use by Mode and Type, Rail .

5.0 References

[1] U.S. Environmental Protection Agency, “Technical Support Document (TSD) Preparation of Emissions Inventories for the 2022v1 North American Emissions Modeling Platform”, 2025. Available:

https://www.epa.gov/system/files/documents/2025-12/2022v1_emismod_tsd_base_and_2026_may2025_508.pdf

[2] U.S. Environmental Protection Agency, “2020 National Emissions Inventory Technical Support Document: Point Sources”, 2023. Available:

https://www.epa.gov/system/files/documents/2023-01/NEI2020_TSD_Section3_Point.pdf

[3] Federal Aviation Administration, “Forecast Process 2024 TAF”, 2025. Available:

<https://taf.faa.gov/Downloads/FinalForecastProcessfor2024TAF.pdf>

[4] U.S. Environmental Protection Agency, “Technical Support Document (TSD): Preparation of Emissions Inventories for the 2016v3 North American Emissions Modeling Platform”, 2023.

Available:

https://www.epa.gov/system/files/documents/2023-03/2016v3_EmisMod_TSD_January2023_1.pdf

[5] U.S. Environmental Protection Agency, “2020 National Emissions Inventory Technical Support Document: Locomotives”, 2023. Available:

https://www.epa.gov/system/files/documents/2023-03/NEI2020_TSD_Section12_Locomotives.pdf

6.0 Appendix

List of Appendix Tables

Table A-1. Non-road equipment 2023 & 2040 Annual SO₂ Dioxide emissions for Salt Lake and Tooele Counties

Table A-2. Airport Sector 2023 & 2040 Annual SO₂ emissions for Salt Lake and Tooele Counties

Table A-3. Rail Sector 2023 & 2040 Annual SO₂ emissions for Salt Lake and Tooele Counties

Table A-1. Non-road equipment 2023 & 2040 Annual SO2 Dioxide emissions for Salt Lake and Tooele Counties		
County	Year	Total Tons per Year
Salt Lake	2023	2.99
	2040	4.19
Tooele	2023	0.17
	2040	0.20

Table A-2. Airport Sector 2023 & 2040 Annual SO2 emissions for Salt Lake and Tooele Counties		
County	Year	Total Tons per Year
Salt Lake	2023	144.56
	2040	201.54
Tooele	2023	20.20
	2040	20.16

Table A-3. Rail Sector 2023 & 2040 Annual SO2 emissions for Salt Lake and Tooele Counties		
County	Year	Total Tons per Year
Salt Lake	2023	0.43
	2040	0.44
Tooele	2023	0.38
	2040	0.38