Updates to Air Emissions Trends Methodology, 2002-2024: February 2025

Background and Updates

Each year, the EPA updates data for air emissions trends for Criteria Air Pollutants (CAPs) except for Lead from 1970 the latest available year (usually one year before the current calendar year). For example, the version published in the spring of 2023 included data for the years 1970-2022. These data include carbon monoxide (CO), ammonia (NH_3), nitrogen oxides (NO_X), particulate matter 10 microns or less in diameter (PM_{10}), particulate matter 2.5 microns or less in diameter ($PM_{2.5}$), sulfur dioxide (SO_2), and volatile organic compounds (VOC). EPA provides these emissions trends data as aggregated sectors (called Tier 1 categories) for both state and national trends. This document describes the spring 2025 trends data release, including the improvements that EPA has made in the emission trends estimation process for the years 2002-2024. In a prior release (spring 2023), EPA implemented these changes for years 2002 through 2020 to minimize the effects of emissions estimation methodological changes during this period, so that the data are more reflective of actual emission changes that occurred. Compared to the spring 2024 release, the spring 2025 release adds year 2024 and updates years 2020 through 2023 estimates; with some minor exceptions for year 2018, all estimates prior to 2020 are unchanged from the February 2024 release.

These data rely on the National Emissions Inventory (NEI) and year-specific data. For the interim years and years after the latest NEI year, EPA includes data from its emissions modeling platforms, provided on EPA's [Air Emissions Modeling website](#), which includes extensive Technical Support Documents. In many cases, EPA has created year-specific emissions estimates that can be included from these platforms. For years after the latest NEI year, EPA uses available data collections from continuous monitoring for electricity generating units. For mobile source emissions in years after the latest NEI year (i.e., 2020 for the current release), EPA uses a mix of year-specific model runs projected emissions from emissions modeling platforms and submitted data to estimate emissions for interim years after the latest NEI year. Otherwise, for years after the latest (2020) NEI year, EPA holds emissions constant from the latest (2020) NEI, year-specific-emissions modeling platform values, or (primarily for 2023 and 2024) interpolations to future year emissions modeling platform values.

For the trends data released in the February 2025, EPA has added the year 2024 as the most recent year provided, and where emissions modeling platform (such as fires, mobile and point sources, and many nonpoint sources) or [Clean Air Markets Program Data](#) are not available, have incorporated data from the 2020 NEI estimates for the years 2021 through 2024. For years 2002 through 2019, we have also incorporated data from the published methodology called EPA's Air QUAlity TimE Series project (EQUATES), as discussed below.

Another enhancement in trends data, first introduced for the spring 2023 release, is for years 2002 through 2024, the availability of elemental carbon (abbreviated "EC" and synonymous with "black carbon") and organic carbon (abbreviated "OC") components of $PM_{2.5}$ and data for the 60 EIS sectors in addition to the traditional Tier 1 categories. We also provide trends data by both EIS sector and Tier 1 category together to highlight the overlap between EIS sectors and Tier 1 categories. EIS sectors (listed in Table 2 below) provide additional details

on the types of sources that contribute to each Tier 1 category; however, an EIS sector can contribute emissions to multiple Tier 1 categories.[1]

The methods and data prior to the year 2002 remain unchanged from prior trends data releases. Please refer to documentation on how air emission trends are computed for the years 1900-2001 ("Trends Procedural Documentation" on the Air Pollutant Emissions Trends Data web site).

Table 1 provides the pollutant coverage used in EPA's trends data (both National and by State), and whether these are available by Tier 1 categories and EIS sectors, for the different time periods from the older methods to the updates we have made as part of the spring 2023 air emissions trends data release.

Table 1: Sectors and Pollutants covered in EPA's Air Emissions Trends Data

Year(s)	Pollutant Coverage	Tier 1 / Sector Coverage	Methodology
1970-1989	NOx, SO_2, VOC, PM_{10}, CO	Tier 1 category	Old methods
1990-2001	NOx, SO_2, NH_3, $PM_{2.5}$, PM_{10}, VOC	Tier 1 category	Old methods
2002-2019	NOx, SO_2, NH_3, $PM_{2.5}$, PM_{10}, VOC, EC, OC	Tier 1 category and EIS sector	New methods based on EQUATES and plus 2016 based on the 2016v3 emissions modeling platform
2020	NOx, SO_2, VOC, $PM_{2.5}$, PM_{10}, NH_3, EC, OC	Tier 1 category and EIS sector	2020 NEI data
2021-2024	NOx, SO_2, VOC, $PM_{2.5}$, PM_{10}, NH_3, EC, OC	Tier 1 category and EIS sector	2021 - 2022: 2021 and 2022v1 emissions modeling platform data. 2023 - 2024: interpolation of 2022 to 2026 for mobile sources, draft 2023-EGU data, with 2023 and 2024 EGU NOX and SO2 data from Continuous Emissions Monitoring Systems (CEMS), where available; draft 2023 wildfires; all other data carried forward from 2022 values.

Methods used in the updates made for 2002-2024

The improvements EPA has made to estimating the emission trends can be split into two parts. The first part covers the years 2002 through 2019, and the second part covers years 2020 through 2024. For the first part, EPA based these improvements on a recently published methodology called EPA's Air QUAlity TimE Series project (EQUATES). This has been published in the "Data in Brief" journal in 2023 and includes annual emissions estimates for years 2002 through 2017. An EPA website also provides information about the project. The EQUATES emissions data were developed using to the extent possible, consistent input data and methods across all years for as many sectors as possible based on the 2017 NEI (which was the most recent publicly available national inventory at the time of the EQUATES work). This approach was taken in EQUATES to avoid artificial step-changes in emissions estimates due to changes in methodology that evolved over the sixteen-year period that do not reflect real-world activity data and processes that describe emissions for a given source. The actual

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[1] Both Tier1 categories and EIS sectors are derived through source classification code (SCC) assignments, which is the most detailed process-level available in NEI and the Emissions Modeling Platforms. More information on SCCs is available at https://www.epa.gov/scc, which includes a complete download of the latest SCC table with associated mapping to Tier1 categories and EIS Sectors. Note: the SCC table is periodically updated and can result in quality assurance issues with changing tier or sector assignments over time.

data used reflect "version 1.1" of the EQUATES data, which has adjustments to emissions from livestock, fugitive dust, and solvents as compared to the original EQUATES. More information can be found here: https://www.epa.gov/cmaq/data-download-step-2#equates-emissions-trends

While the EQUATES paper cited above provides detailed information on how these methods were incorporated across sectors, a summary is provided here. With a couple of exceptions listed below, in general, the EQUATES methodology starts with the most recent NEI data available at the time of the research (the 2017 NEI) as the baseline for methods and back-casts 2017 data to the year 2002 while holding those methods constant and accounting for year-to-year changes in activity data and emission factors. In summary, for each sector/source category, one of the following four general approaches was used to estimate emissions for the years 2002 through 2016:

- New methods for creating consistent emissions for all years
- Scale 2016 or 2017 emissions with scaling factors based on activity data and/or control information
- Use existing modeling platform data
- Leave flat at 2017 NEI levels

Table 2 (based on the EQUATES paper) provides a broad overview of how some of the source categories were handled based on the four general approaches listed above. More details can be found in the EQUATES paper.

Table 2: Brief description of the method used to develop years 2002-2017 emissions for each source category

Source Category (and EIS data categories)	EIS Sector Name(s)	Brief Method Description
Agriculture (nonpoint)	Agriculture - Livestock Waste Agriculture - Fertilizer Application	Livestock emissions based on scaling 2017 NEI values using animal head count data. Fertilizer emissions derived from bidirectional runs of CMAQ.
Fuel combustion - Electric Generation (point)	Fuel Comb - Electric Generation – Biomass Fuel Comb - Electric Generation - Coal Fuel Comb - Electric Generation - Natural Gas Fuel Comb - Electric Generation - Oil Fuel Comb - Electric Generation – Other	Based on existing hourly data (from multiple NEIs) for all years but processed using the most recent tools/methods.
Fires (point, nonpoint)	Fires - Agricultural Field Burning Fires - Prescribed Fires Fires – Wildfires	Based on new methods (see Section 2.1.3 of the EQUATES paper) to produce day-specific estimates.
Fugitive Dust (nonpoint)	Agriculture - Crops & Livestock Dust Dust - Construction Dust Dust - Paved Road Dust Dust - Unpaved Road Dust	For agricultural dust, unpaved road dust, and paved road dust, used 2017 NEI data and scaling factors based on activity surrogates. All other sources used 2017 NEI data for all years.
Aircraft (point)	Mobile – Aircraft	Based on 2017 NEI data and scaling factors based on Federal Aviation Administration Terminal Area Forecast data.

Source Category (and EIS data categories)	EIS Sector Name(s)	Brief Method Description
Commercial Marine Vessels (nonpoint)	Mobile – Commercial Marine Vessels	Based on 2017 NEI data and scaling factors based on regional fuel consumption as an activity surrogate with additional pollutant-specific adjustments for fuel standards.
Nonroad equipment (nonroad)	Mobile - Non-Road Equipment – Diesel Mobile - Non-Road Equipment - Gasoline Mobile - Non-Road Equipment – Other	Estimated using EPA's Motor Vehicle Emission Simulator (MOVES) version 2014b supplemented with data for California and Texas.
Onroad vehicles (onroad)	Mobile - On-Road Diesel Heavy Duty Vehicles Mobile - On-Road Diesel Light Duty Vehicles Mobile - On-Road non-Diesel Heavy Duty Vehicles Mobile - On-Road non-Diesel Light Duty Vehicles	Emissions computed using emission rates from MOVES version 3, activity data back cast from 2017 NEI, and EQUATES meteorological data; supplemented with emissions data from California.
Locomotives (nonpoint)	Mobile – Locomotives	Based on 2017 NEI data and scaling factors based on fuel sales data as an activity surrogate with additional adjustment for specific pollutants to account for regulations and sulfur technology.
Oil and Gas (point, nonpoint)	Industrial Processes - Oil & Gas Production	Point used year-specific modeling platform data (based on multiple NEIs). Nonpoint used Oil and Gas Tool for 2002, 2005, 2008, 2011, 2014, 2016, 2017 and adjustment factors for all other years.
Commercial Cooking (nonpoint)	Commercial Cooking	Used year-specific modeling platform data (based on multiple NEIs).
Fuel Combustion – Commercial / Institutional, Industrial, and residential other than wood (point, nonpoint)	Fuel Comb - Comm/Institutional – Biomass Fuel Comb - Comm/Institutional - Coal Fuel Comb - Comm/Institutional - Natural Gas Fuel Comb - Comm/Institutional - Oil Fuel Comb - Comm/Institutional - Other Fuel Comb - Industrial Boilers, ICEs - Biomass Fuel Comb - Industrial Boilers, ICEs - Coal Fuel Comb - Industrial Boilers, ICEs - Natural Gas Fuel Comb - Industrial Boilers, ICEs - Oil Fuel Comb - Industrial Boilers, ICEs - Other Fuel Comb - Residential - Natural Gas Fuel Comb - Residential - Oil Fuel Comb - Residential - Other	Commercial and industrial biomass used 2017 NEI data and scaling factors based on national-level consumption data. For all other emissions used year-specific modeling platform data (based on multiple NEIs).
Gas Stations (point, nonpoint)	Gas Stations	Linear interpolation between 2002 NEI and 2017 NEI data.

Source Category (and EIS data categories)	EIS Sector Name(s)	Brief Method Description
Industrial Processes other than oil and gas production (nonpoint, point)	Industrial Processes - Cement Manuf Industrial Processes - Chemical Manuf Industrial Processes - Ferrous Metals Industrial Processes - Mining Industrial Processes - NEC Industrial Processes - Non-ferrous Metals Industrial Processes - Petroleum Refineries Industrial Processes - Pulp & Paper Industrial Processes - Storage and Transfer	Used year-specific modeling platform data (based on multiple NEIs).
Other Nonpoint Sources - Miscellaneous	Miscellaneous Non-Industrial NEC Bulk Gasoline Terminals	Used 2017 NEI data for all years.
Waste Disposal (point, nonpoint)	Waste Disposal	Used 2017 NEI data for all years, except composting. For composting, scaled 2017 NEI values based on activity surrogate.
Residential Wood Combustion (nonpoint)	Fuel Comb - Residential – Wood	Scaled 2017 NEI values based on national-level consumption data.
Volatile Chemical Products including Solvents (nonpoint)	Solvent - Consumer & Commercial Solvent Use Solvent - Degreasing Solvent - Dry Cleaning Solvent - Graphic Arts Solvent - Industrial Surface Coating & Solvent Use Solvent - Non-Industrial Surface Coating	Based on new VCPy method (see section 2.1.14 of the EQUATES paper).

For the year 2016, EPA did not use the EQUATES data for the emissions trends. Instead, EPA made use of the 2016 version 3 modeling platform data, which was developed for regulatory modeling efforts. Comparisons between these modeling platform data and EQUATES data for 2016 yielded limited differences, but the 2016v3 modeling platform data represents EPA's best available 2016 estimates and therefore were selected for inclusion in the trends release. The 2016v3 platform incorporates emissions based on the MOtor Vehicle Emissions Simulator, version 3 (MOVES3), the 2017 NEI nonpoint inventory, the Western Regional Air Partnership oil and gas inventory, and inventories for Canada and Mexico. The 2016v3 platform supports a variety of regulatory projects at EPA including interstate transport analyses related to the 2015 Ozone NAAQS. More information on the 2016v3 Platform data is available on our Air Emissions Modeling website.

In addition to the EQUATES-based emissions data available for the years 2002 through 2017, EPA used a combination of methods to create "EQUATES-like" data for 2018 and 2019. EPA estimated 2018 and 2019 emissions using the emissions modeling platform data for 2018 and 2019, with some minor modifications to some sectors that made the estimation methods more consistent with the 2002 through 2017 data from EQUATES. The 2018 and 2019 modeling platform data are based on the 2017 NEI (published in January 2021 along with other data specific to the year 2019, adjusted for EQUATES (for some sectors) as shown in Table 3). The 2018 Emissions Modeling Platform Technical Support Document and the 2019 Emissions Modeling Platform Technical Support Document provide more information on how 2018 and 2019 emissions were estimated.

The year 2017 in all cases is represented to the extent possible by 2017 NEI data, and the year 2020 is represented by 2020 NEI data. In contrast, years 2021 through 2024 estimates are based on the 2020 NEI with year-specific estimates for point sources, many nonpoint sources, onroad and nonroad mobile sources, and fires as shown in Table 3.

Table 3: Year-by-year methods/approach used to estimate emissions

Trends Year(s)	Methods Used, Comments
1970-2001	Old methods for all pollutants. Please see "Trends Procedural Documentation" on the Air Pollutant Emissions Trends Data site for more details on the methods used during this time frame. In addition, the spreadsheets of data posted at the above website should be consulted ("read me" and "development of data" spreadsheets, that describes specifics of how the emissions were estimated for the years during this timeframe. All emissions included at the national level including PR, VI, AK, and HI. PR, VI not included in state totals. Offshore and biogenic (soil and vegetation) emissions data are not included in any of the totals.
2002 through 2015	As discussed in the EQUATES paper, PR, VI, AK, and HI are included in all estimates. Offshore and biogenic (soil and vegetation) emissions data are not included in any of the totals.
2016	The 2016v3 Platform.
2017	2017 NEI data, as discussed in the EQUATES paper.
2018	The year 2018 data were developed by using 2018 Emissions Modeling Platform data in various ways, including: 2018-specific point source data, a 2018-specific run of the oil and gas tool, use of EQUATES meteorological data for dust and onroad emissions calculations, extrapolation of 2017 data for some sectors, and use of EQUATES methods for some sectors (e.g., fires).
2019	As with the year 2018, the year 2019 was developed by using the 2019 Emissions Modeling Platform data in various ways, including: 2019-specific point source data, a 2019-specific run using the oil and gas tool, use of EQUATES meteorological data for dust and on-road emissions computations, extrapolation of 2017 data for some sectors, and use of EQUATES methods for some sectors (e.g., fires).
2020	2020 NEI data, with data pulled from EIS state/SCC summary reports in February 2025

Trends Year(s)	Methods Used, Comments
2021	The 2021 Emissions Modeling Platform (2021hb), published in October 2024, is used for most estimates. The 2021 emissions modeling platform is based on the 2020 NEI but utilizes year-2021 estimates for all major source categories including EGUs, industrial point sources, mobile sources, fires, and most significant nonpoint sources. For comprehensive documentation on the 2021 platform, see the referenced web site. Specifics include: • Point sources are from the 2021 point inventory released in May 2024, except that rail yard emissions were increased by 5% from 2020 levels and aircraft were projected to 2021 based on available Terminal Area Forecast (TAF) data. EGU emissions use NOx and SO2 from Clean Air Markets Program Data. • Agricultural livestock waste computed using a similar method as 2020 but with 2021 animal populations and meteorological data. • Dust, nonpoint oil and gas, rail, and agricultural fertilizer estimates adjusted using 2021 activity data. • Agricultural burns: 2021 emissions developed by EPA with very limited activity data provided by states. • Wildfires: emissions estimates for 2021 incorporated activity data from National Interagency Fire Center (NIFC) and other federal agency sources. Updated emissions factors compared to those used in 2020NEI were used. • Prescribed burns emissions estimates for 2021 incorporated activity data from the US Forest Service, Department of Interior, and very limited state activity data. Updated emissions factors compared to those used in 2020NEI were used • Commercial marine vessel emissions were developed using 2021 activity data and methods slightly refined from those used for 2020 NEI for all 50 states and D.C. • Residential wood combustion emissions were based on 2020 NEI values adjusted to 2021 based on data from the State Energy Data System (SEDS). • MOVES4 was used to develop emissions for onroad mobile sources and includes increased emission rates for ammonia. Onroad emissions in non-CONUS areas were backcast from 2022hc using national 2022->2021 adjustment factors by SCC and pollutant. • MOVES4 was used to develop nonroad emissions except for California which used an interpolation of their 2020 and 2023 emissions submittals. • Some data for Alaska, Hawaii, Puerto Rico, and U.S. Virgin Islands are carried forward from the 2020 NEI as year 2021 meteorology data for non-continental U.S. areas were not available.

Trends Year(s)	Methods Used, Comments
2022	Version 1 of the 2022 platform, 2022v1 Emissions Modeling Platform (2022hc), is used. Specifics include: • Nonroad mobile: 2022 MOVES run labelled "20240111". For California, an interpolation of their submitted 2020 and 2023 emissions was used. • Onroad mobile: Derived from MOVES4 using 2022 VMT data, some of which was provided directly by state and local agencies. For California, data 2022-specific data from CARB were used. • Commercial Marine Vessels: Computed for all 50 states and D.C. using methods slightly refined from 2020 in conjunction with 2022 activity with some substitution of year 2021 data where there were quality assurance issues • Rail: updated from 2020 NEI values based on 2023 fleet mix and 2022 fuel use data • Agricultural burns: developed by EPA in June 2024 including activity data provided by some states. • Wildfires: emissions are from the 2022v1 emissions modeling platform and incorporated activity data from National Interagency Fire Center (NIFC), other federal agency sources and some states. • Prescribed burns emissions are from the 2022v1 emissions modeling platform and incorporated activity data from the US Forest Service, Department of Interior, and a substantial amount of state activity data; pile burning estimates are also introduced. • Point sources: based on the 2022 point inventory following incorporation of comments (EIS dataset from June 2024). • Airports: 2022-specific emissions computed for the Top 50 commercial airports using a method similar to the 2020 NEI process, with state-provided emissions for ATL. All other airport emissions were projected from 2020 to 2022 using factors derived from the 2023 Terminal Area Forecast (TAF) using airport-specific factors where available and state-level factors elsewhere. • EGUs: based on year June 2024 point inventory including 2022 Clean Air Markets Program Data for NOx and SO_2 downloaded in January 2024. • Oil and gas: Point sources rely on 2022 NEI or projected from 2020 or 2021 using EIA state-level factors. Nonpoint emissions created using the 2020 oil and gas tool with 2022 EPA and state activity or direct 2022 state emissions data; OK and WY production emissions projected from 2020NEI data. • Residential wood combustion: state-level projections to year 2021 using EIA SEDS data. • Most other nonpoint sources either held at 2020 NEI values or projected to 2022 where activity data was available for projections.

Trends Year(s)	Methods Used, Comments
2023 & 2024	• EGUs: the most recently available year-2023 or year-2024 EGU CEMS data for NOx and SO2 were downloaded ([Clean Air Markets Program Data)](#) using the API on February 3, 2025 and overlaid onto the EGU emissions from the draft 2023 point flat file dated January 31, 2025. • For onroad and nonroad, the emissions for 2023 and 2024 are interpolated between the year 2022 emissions in the 2022v1 emissions modeling platform (2022hc) and the year-2026 projection from that platform (2026hc), with extrapolations for non-CONUS areas based on total CONUS emissions. • The draft 2023 wildfire and agricultural fire inventories were used for 2023 and 2024, but 2022 prescribed fires were pulled forward into both 2023 and 2024. • For all sectors other than EGUs, onroad, nonroad, and fires, the emissions are pulled forward from 2022 to both 2023 and 2024.