Documentation of 2022v1 Emissions Released in October 2024

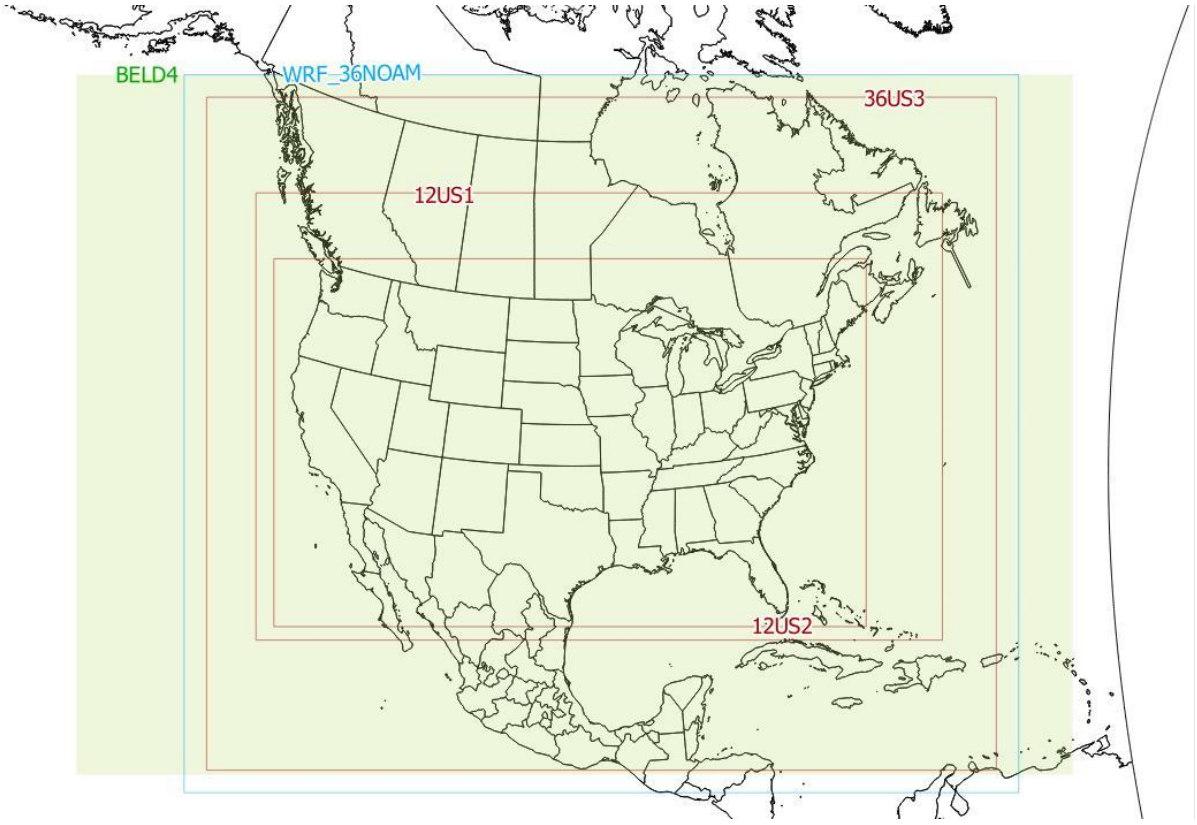
Version: 10/21/2024

1. Introduction

The 2022v1 base year and analytic year emissions for each sector for 2026, 2032, and 2038 were developed according to the below details. Figure 1-1 shows the 36US3, 12US1, and 12US2 grids for which emissions were developed.

For more information on this mechanism and recent emissions modeling techniques see Technical Support Document: Preparation of Emissions Inventories for the 2020 Emissions Modeling Platform (EPA, 2023) for the base year and for the analytic years the Technical Support Document: Preparation of Emissions Inventories for the 2018v2 Emissions Modeling Platform (EPA, 2023). The corresponding technical support document for the 2022v1 emissions modeling platform will be developed in 2024.

Figure 1-1. Air Quality Modeling Domains



2. Base Year Emissions Development

Development of Base Year Emissions for each 2022v1 Emissions Modeling Platform Sector

A summary of how the emissions for each sector of base year emissions were developed follows. **Note that base year emissions data for CMAQ and CAMx are available on AWS through the 2022 Platform Open Data page.** The CAMx emissions were made available a few days before October 21, 2024.

afdust (area fugitive dust):

- Paved roads were projected from 2020 to 2022 by applying factors to 2020 NEI emissions based on county total VMT trends, 2022 versus 2020. Posted numbers are fully adjusted with both meteorological and transport fractions.
- Animal dust, a.k.a. "dust kicked up by hooves" were projected from 2020->2022 using factors based on county and animal type based on animal count census data from the 2020 NEI versus the 2022 USDA Census of Agriculture. Emissions were held at 2020 levels for counties/animal types with zero or missing data in either 2020 or 2022. Projection factors limited to range of +/- 20%.
- Unpaved roads and all other sources in afdust (i.e., construction, agricultural tilling, mining) were head at 2020NEI levels. Adjustments were made to New Jersey unpaved road emissions in response to comments.
- To prepare air quality model-ready emissions, emissions were adjusted based on 2022 meteorology and transportable fraction.
- Some temporal profile changes were incorporated into the processing for this sector in response to comments. See below for more information.

airports:

- Emissions for Top 50 commercial airports other than ATL computed by running the Aviation Environmental Design Tool (AEDT) using a method similar to the 2020 NEI process. See Documentation on the development of 2022 aviation emissions for top 50 airports for more information.
- Emissions for Hartsfield-Jackson (ATL) airport were provided by Georgia EPD.
- All other airport emissions were projected from 2020 to 2022 using factors derived from the 2023 Terminal Area Forecast (TAF) with airport-specific values derived where available and state-level factors were used elsewhere.
- 2022-specific temporal profiles are used for emissions at airports.

beis:

- Biogenic Emissions Inventory System (BEIS) version 4, was run using the Biogenic Emissions Landuse Database (BELD) version 6 and year 2022 meteorology. This is consistent with how the biogenic emissions were developed for the 2020 NEI.

cmv_c1c2 (Category 1 and 2 Commercial Marine Vessels):

- Emissions for Category 1 and 2 commercial marine vessels (CMV) were computed using 2020 NEI methods using year 2022 Automatic Identification System (AIS) data. For more information see this document on the development of the Category 1 and 2 Commercial Marine Vessel 2022 Emissions Inventory.
- During the acquisition of the 2022 AIS data from the U.S. Coast Guard, EPA was made aware of a data quality issue that started in late March and continued through late June of 2022. To address this, emissions were substituted in from the 2021 CMV C1C2 inventory for this period.
- An additional enhancement for the 2022 C1C2 CMV inventory was the development and application of a mask that was applied to remove any emissions over land due to stray AIS signals.

cmv_c3 (Category 3 Commercial Marine Vessels):

- The Category 3 CMV emissions were computed by EPA using 2020 NEI methods using 2022 Automatic Identification System (AIS) data. For more information see this document on the development of the Category 3 Commercial Marine Vessel 2022 Emissions Inventory.
- During the acquisition of the 2022 AIS data from the U.S. Coast Guard, EPA was made aware of a data quality issue that started in late March and continued through late June of 2022. To address this, emissions were substituted in from the 2021 CMV C3 inventory for this period.
- An additional enhancement for the 2022 C3 CMV inventory was the development and application of a mask that was applied to remove any emissions over land due to stray AIS signals and interpolated values.

fertilizer

- Fertilizer emissions will be computed in the late summer of 2024 using a bi-directional CMAQ run with 2022 emissions. Fertilizer emissions will then be extracted from the CMAQ run outputs and can be used to drive other air quality models.

livestock:

- Emissions for beef and dairy cattle, broilers, layers, and swine derived from the Farm Emissions Model (FEM). Includes 2022 census animal counts and input from Idaho and other animal counts from the 2022 Census of Agriculture and run using 2022 meteorology.
- The livestock counts for North Carolina were adjusted in response to comments.
- Emissions for turkeys, horses, sheep, and goats were projected from 2020NEI based on factors derived from 2020 and 2022 census animal counts. Emissions were held at 2020 levels for counties/animal types with zero or missing data in either 2020 or 2022. Projection factors were limited to a range of +/- 20%.
- A new aspect of emissions modeling was the use of daily emissions totals instead of month-to-day temporal profiles.

nonpt (nonpoint sources not included in other sectors):

- Most emissions are from 2020 NEI unless otherwise noted (see Table 2-1 for more information).
- Bulk terminals/plants and pipeline gasoline: Projected from 2020 to 2022 using national factors derived from the State Energy Data System (SEDS) from the U.S. Energy Information Administration (EIA). We note that the use of national factors is not consistent with the task force request to use regional factors.
- All other fuel types: Emissions were projected from 2020 to 2022 using statewide factors based on the SEDS consumption dataset (see Table 2-1 and *2022_nonpt_projection_SCC_xref_MSN_codes.xlsx* for more details).
- Human cremation: Emissions were projected from 2020 to 2022 using factors based on county-level death counts and statewide cremation rates.
- Projection factors from 2020 to 2022 were limited to a range of +/- 30%.
- Some emissions in Indiana were removed from this sector in response to comments.
- Emissions from open burning have been split out into a separate sector.
- Some temporal profile updates were implemented for this sector. See below for details.

nonroad:

- MOVES4 was run for 2022 using 2022 meteorological data.
- In California, 2020 and 2023 emissions provided by California Air Resources Board (CARB) were interpolated to 2022.
- Some temporal profiles were updated for this sector. See below for details.

np_oilgas:

- Most emissions from a run of the 2020 NEI oil and gas tool updated with 2022 activity data.
- Abandoned wells and blowdown and pigging emissions were included and derived separately for 2022.
- This second uses some state-provided factors and emissions data.
- Activity data feedback was received from NY, UT and WY and incorporated prior to computing the emissions.
- Colorado submitted their own nonpoint Oil and Gas inventory.
    - Several edits have occurred in the last week; those edits are not included in Data Retrieval Tool at this time
    - Colorado included exploration-related sources
    - These emissions were augmented with HAPs based on their VOC emission and NH3, PM, SO2 and metals were added based on Oil and Gas Tool emissions.
- Oklahoma used 2020NEI emissions for production-related sources and applied state projection factors for oil, natural gas and condensate to get to year 2022 estimated emissions.
- Wyoming used 2020NEI emissions for production-related sources and applied county projection factors to get to year 2022 estimated emissions
- Pennsylvania submitted nonpoint emission for unconventional wells
    - These emissions were subtracted out of the Oil and Gas Tool emissions to generate conventional well emissions.

- The Oil and Gas Tool emissions are used for EXPLORATION-related sources except for Colorado.
- The Point source subtraction process was used for New Mexico and Kansas within the 2022 Oil and Gas Tool emissions.
- Some updates to emissions in Texas were implemented in response to comments.
- 2022-specific monthly temporal profiles and spatial surrogates are used.

np_solvents:

- All emissions, except asphalt paving, are projected from the 2020NEI, including state-submitted emissions. Using 2021 data, a SCC-specific ratio derived and applied to 2020NEI emissions. This ensures state-submitted emissions magnitudes are preserved. For asphalt paving, 2020NEI emissions are carried forward.
- Some updates were made to emissions in New Jersey in response to comments.
- Some temporal profile updates were made for this sector. See below for details.

onroad:

- MOVES4 was run for 2022 in rates mode to derive emission factors and SMOKE-MOVES was run for each type of activity data and emission rates to compute emissions.
- Vehicle Miles Traveled (VMT) were based on Federal Highway Administration (FHWA) VMT data for 2022, with state-submitted data incorporated where provided. (VMT state submissions: AK CO CT DE GA KS ME MD MA MI NH NJ NY NC OR PA SC TN TX UT VA WA WV WI, and Jefferson County, KY.)
- In the final base year data, VMT for Colorado are based on EPA default data, and other activity based on VMT was adjusted as a result of this change.
- Vehicle Population (VPOP) data were carried forward from 2020NEI, with state-submitted data used where provided. (VPOP state submissions: DE, GA, NY, and WI) Vehicles were added in some areas to resolve discrepancies between VMT and VPOP.
- STARTS data were carried forward from 2020NEI, except where the VPOP changed (either via state submissions or VMT/VPOP discrepancy resolution), in which case STARTS activity was changed in proportion to the VPOP. (e.g. where VPOP increased, STARTS was increased proportionally, and vice versa.)
- HOTELING hours were calculated from 2022 VMT using the standard hours/mile factor applied to restricted road VMT for combination long-haul trucks.
- Off-network idling (ONI) hours were computed based on the year 2022 county databases and VMT.
- In California, emissions data provided by CARB in 2024 for 2020 and 2023 were interpolated to 2022.
- Speeds are based on data for January 2021 and temporal profiles are 2022-specific.

openburn (open burning):

- This new sector for 2022v1 platform was split out from the nonpt sector and includes emissions from yard waste, land clearing, and residential household waste burning (SCCs starting with 261).

ptagfire (agricultural fires):

- Use HMS detects that intersect with the USDA Crop Data Layer shapefile
- Used activity from GA, FL, ID, and WA
- Received some activity data from a few other states but determined that it would not improve the quality of the emissions dataset
- Generated emissions using a prototype Crop burn Module for Bluesky Pipeline authored by EPA-ORD.
- Several adjustments were made to this sector in response to comments.

ptfire-rx (prescribed fires):

- Activity data were developed based on the python SmartFire2 software maintained at USEPA to take activity data from various federal and state agencies to generate daily acres burned at specific latitude and longitude
    - Federal activity sources included US Forest Service, Dept of Interior, National Interagency Fire Center, and ICS209
- Used US Forest Service's BlueSky Pipeline tool to generate emissions
- Flint Hills prescribed grassland burns are processed outside of Bluesky Pipeline using activity received from Kansas
    - About 2M acres burned from mid-February through April
    - Counties in eastern Kansas and Includes 4 counties in Oklahoma
- A new pile burn methodology was implemented for this inventory.
- See this technical memo on the development of the "beta" fire emissions for more information: https://gaftp.epa.gov/Air/emismod/2022/v1/draft/fires/2022EMP_beta_version_fires_tech_memo.2024Apr12.pdf
- Several adjustments were made to the final emissions for this sector in response to comments.

ptfire-wild (wild fires):

- Used python SmartFire2 software maintained at USEPA to take activity data from various federal and state agencies to generate daily acres burned at specific latitude and longitude
    - Federal activity sources included US Forest Service, National Interagency Fire Center, and ICS209
- Used US Forest Service's BlueSky Pipeline tool to generate emissions
- See this technical memo on the development of the "beta" fire emissions for more information: https://gaftp.epa.gov/Air/emismod/2022/v1/draft/fires/2022EMP_beta_version_fires_tech_memo.2024Apr12.pdf
- Several adjustments were made to the final emissions for this sector in response to comments.

ptegu (Electric Generating Units):

- Emissions are based on 2022 NEI point source dataset from June 2024, with NO_x and SO_2 from Continuous Emissions Monitoring System (CEMS) data downloaded in January, 2024 inserted using the CEMConvert program for units matched to the NEI.
- Several adjustments were made to the emissions in this sector including latitude-longitude updates in response to comments and adjustments to stack parameters that were defaulted and outside of a reasonable range for specific processes.

ptnonipm (Point sources not in other point source sectors):

- All sources except rail yards are based on the 2022 NEI point source dataset from June 2024.
- Several adjustments were made to the emissions in this sector including latitude-longitude updates in response to comments and adjustments to stack parameters that were defaulted and outside of a reasonable range for specific processes.
- Some adjustments to sources in New Jersey, New Hampshire, and Texas were made in response to comments. Some additional states may have made their own adjustments directly in EIS.
- Railyards are included in this sector. For information on their development see this document on the Development of 2022 locomotive emissions. Some rail yards from this data set were adjusted as a result of comments and detailed review of 2021 emissions data.
- Some temporal profile updates were implemented for this sector. See below for details.

pt_oilgas (oil and gas-related point sources):

- Emissions for this sector are based on the 2022 NEI point dataset from June 2024.
- Sources in the 2022 point dataset in which emissions are from 2020 or 2021 were projected to 2022 using EIA-based state projection factors.
    - These state projection factors were applied to production-related NAICS codes in the inventory

rail:

- Line haul locomotive emissions updated from 2020 NEI based on 2023 fleet mix and 2022 fuel use data. See Development of 2022 locomotive emissions for more information.
- HAP augmentation was updated using corrected factors.

rwc (Residential Wood Combustion):

- 2020 NEI RWC emissions projected to 2021 using state-wide factors based on SEDS.
- Emissions provided by Idaho were incorporated. In California, emissions from SCC 2104008700 were replaced with EPA estimates per their request, and emissions from SCCs 21040082x0 were removed (except for NH3).

Emissions in Canada were mostly interpolated to 2021 based on the inventories ECCC provided for 2020 and 2023. Fires in Canada are based on a new method that uses tools similar to those used to develop the U.S. inventory.

Emissions in Mexico were pulled forward from the 2019 platform for many sectors (see https://www.epa.gov/air-emissions-modeling/2019-emissions-modeling-platform-technical-support-document for more information). Emissions in border states were updated based on the SEMARNAT 2018 inventory that was reviewed and edited in collaboration with EPA. Onroad emissions were based on MOVES-Mexico outputs interpolated to 2021. Fires in Mexico are based on Fire INventory from NCAR (FINN). A new set of spatial surrogates for Mexico were developed for this platform.

Table 2-1. Methods to Prepare the Year 2022 Nonpoint Sector Emissions

Sector	Source Category	Task Force Identified 2020-2022 Projection Method
Solvents	Solvents	EPA to develop growth factors representing the projected change in emissions from 2020 (to 2021 for v1 and to 2022 for v2) based on implementing the 2020 NEI emissions estimation methodology. The factors are to be applied to 2020 NEI emissions to address situations where 2020 NEI emissions were supplied by state/local agencies
Fugitive Dust (note that meteorological and transport fraction adjustments are separately applied in modeling process)	Paved Roads	Apply VMT-based growth rates to 2020 NEI emissions (i.e., 2022 VMT/2020 VMT); EPA will use state-supplied 2022 state-supplied VMT data where provided
	Agricultural Production – Livestock	Apply 2022/2020 livestock counts used to estimate 2022 ammonia emissions for the Ag. Livestock category (see row 26 below)
	Unpaved Roads	Hold constant
	Construction	Hold constant
	Agricultural Production – Crops	Hold constant
	Mining and Quarrying	Hold constant
Livestock	Agricultural Livestock	2021 livestock emission estimates available now; EPA excepts to be able to develop 2022 estimates before April
Fertilizer	Agricultural Fertilizer	EPA will be newly running CMAQ/EPIC to estimate these emissions this summer (EPA needs to wait to get updated data output from an early CMAQ run)
Residential Wood	All subcategories	Apply EIA State Energy Data System residential wood consumption ratios (2021 SEDS currently available; 2022 available in May-perhaps update to 2022 SEDS for v2?)

All Other Nonpoint	All Other Nonpoint Source Fuel Combustion	Apply EIA State Energy Data System energy consumption ratios (2021 SEDS available for all fuels; 2022 data available for some fuels; perhaps update to 2022 SEDS for v2?)
	Stage 1 Gasoline Unloading at Service Stations	Apply EIA State Energy Data System Transportation Sector/Motor Gasoline consumption ratios
	Stage 1 Gasoline Unloading at Bulk Terminals/Plants	Apply EIA State Energy Data System Total Motor Gasoline consumption ratios
	Aviation Gasoline Stage I and II	Apply EIA State Energy Data System Aviation Gasoline consumption ratios
	Pipeline Gasoline	Apply EIA State Energy Data System Total Motor Gasoline consumption ratios
	Human Cremation	Estimate 2022 county-level number of cremations from 2022 actual county-level deaths from CDC's Wonder Database and 2022 state-level (projected) cremation rates from National Funeral Directors Association's "Cremation and Burial Report" and apply 2022/2020 county-level cremation ratios to 2020 NEI cremation emissions
	Commercial Cooking	Hold constant
	Portable Fuel Containers	Hold constant
	Asphalt Paving	Hold constant
	Open Burning	Hold constant
	Landfills/POTWs	Hold constant
	Charcoal Grilling	Hold constant

3. Emissions Modeling Data and Settings

Temporal profile changes in 2022v1 platform

We created new general TREF and TPRO datasets for 2022 platform, rather than continue to build off of datasets from older platforms. As part of this, the separate “ptagfire” PTREF was combined with the general cross reference so that ptagfire and ptfire_othna no longer need a separate PTREF.

Changes made to temporal profiles for the 2022v1 base year:

- **afdust**: New temporal profiles (monthly, weekly, hourly) were created to use for paved and unpaved roads. The monthly profile is based on monthly emissions from 2022hc onroad PM2.5 brake and tire wear, since that has less temperature dependence. Weekly and hourly profiles are based on averages of the TMAS profiles used in SMOKE-MOVES. Unpaved uses averages of passenger trucks only; paved uses weighted averages (3/4 LD excluding motorcycles, 1/4 HD excluding buses). There are separate hourly profiles for weekdays vs weekends.

- **afdust**: For ag tilling, flat day-of-week profiles are now being used along with new monthly profiles mostly based on nonroad ag emissions which are based on LADCO-provided MOVES data and more accurately reflect tilling activities, peaking in spring and fall.
- **afdust**: For dust from livestock, the monthly profiles for 2805100010 and 2805100050 (beef cattle and swine) were updated to the 2022 data from https://u.osu.edu/beef/2023/10/25/more-heifers-supporting-feedlot-inventory/. Profiles for other livestock dust not changed from the 2020 platform.
- **airports:** For airports, 2022-specific temporal profiles based on the Aviation System Performance Metrics (ASPM) data which provides specific monthly/daily/hourly for 77 airports were used. For other airports, use state average for monthly/daily and (new for 2022) national average for hourly. Georgia provided monthly temporal profiles for ATL for commercial (one profile), and general+military (another profile).
- **nonpt** Evaporative SCCs (all active SCCs starting with 250105- and 250106-) now use a profile based on monthly total VOC emissions from 2022hc onroad evaporative off-network processes (RPP and RPV), based on the final 2022 onroad run.
- **nonpt**: Residential natural gas (2104006000) is using new monthly profiles by state based on Energy Information Administration (EIA) data. The data source is https://www.eia.gov/dnav/ng/hist/n3010us2m.htm.
- **nonroad**: Residential and commercial snowblowers were changed to flat day-of-week, since snow falls when it falls regardless of weekday/weekend.
- **np_solvents**: All asphalt SCCs (paving and roofing) are using new EIA-based monthly profiles for "asphalt and road oil" by PADD region. The data source is https://www.eia.gov/dnav/pet/PET_CONS_PSUP_A_EPPA_VPP_MBBL_A.htm.
- **np_solvents**: For interior painting, a.k.a. architectural coating (2401001000): created a new monthly profile PAINT22 based on 2022 data from https://fred.stlouisfed.org/series/MRTSSM44412USN/.
- **np_solvents**: For pesticides (scc in ('2461850000','2461800001','2460800000')), monthly profiles were changed as follows: AZ/CA/FL/HI/TX (the warmest states) are flat annual. Other moderately warm southeast states from North Carolina south and west to Oklahoma are flat from March through October. All other states are flat from April through September. This is based on a comment and follow discussions.
- **ptnonipm**: The profiles for 40202501 (surface coating for metals) was changed to hourly profile 11, which operates from 7am to 5pm.

In addition to the above updates, as has been done in recent modeling platforms, 2022-specific temporal profiles were used for oil and gas emissions (monthly); onroad activity data including vehicle miles-traveled, hoteling hours, and starts; residential wood combustion; livestock and fertilizer emissions.

4. Development of Analytic Year Emissions

The draft analytic year emissions for 2026, 2032, and 2038 for each sector were developed as described in Table 4-1. More details by sector are available in the later subsections. Closure and control data were provided by state and local agencies and are described in Sections 4.3.1 and 4.3.2.

Table 4-1. Summary of Methods Used to Prepare Analytic Year U.S. Emissions

Sector	Method/ Inventory files
afdust	Adjustment factors for paved roads and other SCCs were applied as described in Section 4.2.1.
airports	Airport emissions were projected by multiplying base year emissions by ratios of the TAF activity in the analytic year divided by the TAF activity in the base year. Georgia DNR provided data for Hartsfield-Jackson (ATL) airport. Factors outside of a specific range were set to state average factors. See Section 4.2.2 for more details.
beis	Hold constant at base year 2022 levels.
cmv_c1c2	CMV C1C2 emissions were projected by multiplying base year emissions by factors derived from the Freight Analysis Framework Version 5 for corresponding ship types and for six different regions. See Section 4.2.3 for more details.
cmv_c3	CMV C3 emissions were projected by multiplying base year emissions by factors derived from the Freight Analysis Framework Version 5 for corresponding ship types and for six different regions. An additional adjustment to NOx was made to account for the penetration of cleaner engines over time based on an extrapolation of trends from recent ship registry data sets. See Section 4.2.4 for more details.
fertilizer	Hold constant at base year 2022 levels.
livestock	Livestock emissions were projected by multiplying base year emissions by factors based on ratios of emissions from the GHG tool by livestock type. See Section 4.2.5 for more details.
nonpt	Nonpoint emissions were projected by multiplying base year emissions by factors based on the ratio of the 'growth surrogate' for the analytic year divided by the value for the base year. Controls were applied to reflect various national rules. See Section 4.2.6 for more details.
openburn	Hold constant at base year 2022 levels.
nonroad	Analytic year emissions are based on runs of MOVES4 for each year using inputs consistent with the base year. For California, CARB-provided inventories were used for 2026 and 2032, with 2038 emissions derived from an interpolation between 2032 and 2050 emissions. See Section 4.4.1 for more details.
np_oilgas	The oil and gas task force devised separate approaches for projecting SCC related to production vs those related to exploration. See Section 4.2.7 for more details.
np_solvents	Nonpoint emissions were projected by multiplying base year emissions by factors based on the ratio of the 'growth surrogate' for the analytic year divided by the value for the base year. Controls were applied to reflect various national rules. See Section

Sector	Method/ Inventory files
	4.2.6 for more details.
onroad	Onroad emissions were developed using year-specific activity data and emission factors. Some states provided VMT. Adjustment factors to reflect regulations not included in MOVES4 were applied. For California, CARB-provided emissions were used after adjustment factors were applied. See Section 4.4.2 for more details.
ptagfire	Hold constant at base year 2022 levels.
ptfire-rx	Hold constant at base year 2022 levels.
ptfire-wild	Hold constant at base year 2022 levels.
ptfire_othna	Hold constant at base year 2022 levels.
ptegu	2026 EGU emissions were based on engineering analysis for units more than 25MW with year 2022 emissions carried forward for smaller units. For 2032 and 2038, outputs from IPM were used. See Section 4.1 for more details including a specific disclaimer about the 2038 emissions.
ptnonipm	Non-EGU point source emissions were projected by multiplying base year emissions by factors derived from analytic year surrogates specific to each SCC and NAICS. Rail yards were projected by multiplying base year emissions by factors based on analytic year to base year AEO locomotive fuel use ratios. Refinery adjustment factors for 2032 and 2038 to reflect the impact of recent rules were applied. Closures were reflected. Controls were applied to reflect various national and state rules. See Section 4.2.8 for more details.
pt_oilgas	Followed oil and gas task force recommendations. See Section 4.2.7 for more details.
rail	Rail emissions were projected by multiplying base year emissions by factors based on analytic year to base year AEO locomotive fuel use ratios. See Section 4.x for more details.
rwc	Hold constant at base year 2022 levels.

Many summaries and graphics are provided to support the data review. Descriptions of these and their locations are as follows:

1. County-SCC summaries and facility total summaries are available in the 2022v1 Emissions Data Retrieval Tool. These include 2022 fertilizer emissions, held constant across the analytic years. Onroad emissions have been mapped to use the NEI SCCs.
2. The county-SCC summaries in the data retrieval tool have been updated to include SCCs for point sources as well as other sources as of October 21, 2024. As a result, emissions for all emissions sectors can now be retrieved at the county-SCC level.

3. A state + modeling platform sector summary for the 2022v1 cases including EC, OC, and other broad PM species. On October 21, 2024 another version that includes columns for the 2016v3 platform cases has been added to this folder.
4. Facility and unit-level comparison summaries for point sources including similar emissions for 2016v3 cases are available for EGUs and non-EGU point sources (including ptnonipm and pt_oilgas) in the reports / point folder. The unit-level non-EGU summaries are restricted to sources with at least 1 tpy of emissions. An airport-level comparison is available in the reports / mobile / airports folder.
5. A county x modeling platform sector summary of CAPs is available.
6. A state+SCC summary of CAP emissions from the 2022v1 cases is available. A state-SCC summary including draft 2022v1 and 2016v3 platform cases has been added as of October 21, 2024.
7. County and State + SCC summaries of VMT, VPOP, and onroad mobile emissions for 2022v1 cases with appropriate breakdowns of SCCs are available in the reports / mobile / onroad folder.
8. Consolidated growth and control packet spreadsheet files for each sector that uses CoST are available in the reports / projection_controls / draft_analytic / CoST_packets folder. Note that control packets representing rules typically include the rule name. A file including the onroad factors applied to approximate the rules not included in MOVES4 is also included. The raw CoST packets are also available in a subfolder of this directory.
9. Summaries of the CoST detailed results at a couple levels of details are available and include control program, state, pollutant and the impact of applied projection factors and controls. The full detailed results are also available in the detailed_results_full folder.
10. Base and difference maps of emissions and related data mostly at the county level are available as follows:
    a. County maps are various resolutions are also included in the reports / mobile / onroad folder.
    b. Nonroad maps and summary are in the reports / mobile / nonroad folder.
    c. Airport maps and summaries of projection factors and emissions are in the reports / mobile/ airports folder.
    d. Rail locomotive maps are in the reports / mobile / rail folder.
    e. County maps of nonpoint sector emissions for afdust, livestock, np_oilgas, np_solvents, and nonpt are available in the reports / nonpoint folder along with gridded maps of fertilizer emissions.
    f. County maps of point source emissions of pt_oilgas, ptegu, and ptnonipm are available in the reports / point / maps folder.
    g. Gridded emissions maps are available for the CMV sectors in the reports / mobile / CMV folder, along with some CMV-specific summaries and documentation on how the emissions were developed.

4.1 Development of EGU Emissions for the 2022v1 Emissions Modeling Platform

The analytic year EGU emissions inventories relied on Engineering Analysis for 2026, and EPA's Power Sector Modeling Platform using Integrated Planning Model (IPM) 2023 Reference Case, with additional updates for the fleet and on-the-books rules, for 2032 and 2038.

Regarding the 2038 EGU emissions: In March of 2024, EPA opened a non-regulatory docket (EPA-HQ-OAR-2023-0262) to solicit public comment on regional haze-related topics in advance of proposing revisions to the Regional Haze Rule. Given the Agency's intent to undertake a notice-and-comment rulemaking process that would affect the third planning period and possibly later state implementation plans, we encourage parties to consider forthcoming rule revisions prior to conducting modeling for regional haze purposes. However, to work towards development of data inputs that can be used to support regional haze modeling, we encourage interested parties to provide feedback to help improve the content and accuracy of the 2022v1 emissions modeling platform, including the draft 2038 analytic year emissions projections.

Details on the development of the analytic year EGU emissions are as follows:

- EPA's 2026 Engineering Analysis emissions developed with the most recent data available as of summer 2024:
    - The starting point was 2023 NOx,SO2, and Hg emissions reported to Clean Air and Power Division (CAPD): https://campd.epa.gov/
    - Known unit retirements, coal to gas conversions, control retrofits, unit specific rate adjustments due to BART or state RACT rules, and new unit construction from the January 2024 NEEDS (which is equivalent to the data in the June 2024 NEEDS database).
    - PM, VOC, NH3, and CO emissions were calculated using NEI 2022 and Energy Information Administration (EIA) 860/923 emissions factors and CAPD generation data.
    - No additional Good Neighbor Plan (GNP) related changes reflected in 2026 inventory. All but 2 states were in compliance in 2023; these 2 states were under assurance levels in 2023.
    - The 2026 engineering analysis data included emissions according to ORIS and CAPD IDs. The Engineering Analysis units were matched to EIS facility and unit IDs using existing CAPD-EIS matches from the 2022 base year point inventory and NEEDS database. For units with a CAPD -EIS match, units from 2022 were retained, with emissions adjusted to match the engineering analysis. All units from 2022 which were not matched in the engineering analysis were carried forward to 2026 with the same emissions, except for units listed as retired in the 2026 analysis. For all units in the 2026 analysis which were not matched to a unit in the 2022 base year inventory, new units were created with new point source IDs, SCCs for natural gas EGUs, and default stack parameters.
- EPA's 2032 and 2038 EGU emissions projections uses EPA's 2023 Reference Case with additional updates:
    - Reflecting IRA provisions, Final GNP (impact is minor in 2032 and beyond), Final OTAQ GHG Vehicle Rules (see Section Onroad Mobile Sources (onroad)4.4.2), Final Mercury and Air

Toxics Standards (MATS) risk and technology review (RTR), Final Greenhouse Gas Standards and Guidelines for Fossil Fuel-Fired Power Plants, Final effluent limit guidelines (ELG) and coal combustion residuals (CCR).

- Standard IPM outputs are for 2028, 2030, 2035, 2040, 2045, 2050. A specific IPM run was conducted reflecting known retirements for analytic years 2032 and 2038.
- Emissions factors for post processing (PM, VOC, NH3, CO) are calculated using NEI 2022 and EIA 860/923 generation data (same as 2026 post-processing).

Data files and summaries related to the analytic year EGU emissions are posted in the point reports section of the FTP site.

IPM is a linear programming model that accounts for variables and information such as energy demand, planned unit retirements, and planned rules to forecast unit-level energy production and configurations. EPA's 2023 Reference case using IPM reflects current and existing state regulations, Renewable Portfolio Standards and Clean Energy Standards as of end of 2023.

Some of the key parameters used in the IPM run are:

- Demand: AEO 2023 non-EV demand + on-the-books OTAQ GHG LMDV and HDV Rules
- Gas and Coal Market assumptions: Gas market assumptions as of end of 2021 (with LNG export assumptions from AEO 2023) and coal market assumptions as of end of 2021 with adjustments for historic consumption
- Cost and performance of fossil generation technologies: AEO 2023
- Cost and performance of renewable energy generation technologies: NREL ATB 2023 (mid-case)
- Fleet: NEEDS rev 06-06-2024 (xlsx)

Note that units identified to have a primary fuel of landfill gas, fossil waste, non-fossil waste, residual fuel oil, or distillate fuel oil may be missing emissions values for certain pollutants in the generated inventory flat file for 2032 and 2038. Units with missing emissions values **were not** gapfilled using projected base year values as is sometimes done for IPM output files. When performed, these projections are calculated using the ratio of the analytic year seasonal generation in the IPM parsed file and the base year seasonal generation at each unit for each fuel type in the unit as derived from EIA-923 tables and the 2022 NEI. This type of gapfilling will be considered for the final 2022v1 analytic year emissions.

Once IPM has been run, a process is performed to first parse the results to unit level and then to generate a flat file in a format that SMOKE can read. To accomplish this, a cross reference file is needed to map the NEEDS IDs to NEI IDs for facility and unit and for stack parameters. The cross reference file used for the IPM outputs was "NEEDS_NEI_xref_2022_16apr2024.xlsx " and incorporates information about unit and stack configurations from the 2022 NEI Point source inventory. The flat file that results from this process includes emissions for five summer months (May to September), four "shoulder" months (March, April, October, November) and three winter months (January, February, and December). The emissions from each of these "seasons" were placed into separate flat files so that SMOKE can preserve the total emissions within each season to the extent possible within rounding errors

Combined cycle units produce some of their energy from process steam that turns a steam turbine. The IPM model assigns a fraction of the total combined cycle production to the steam turbine. When the emissions are calculated these steam units are assigned emissions values that come from the combustion portion of the process. In the base year NEI steam turbines are usually implicit to the total combined cycle unit. To achieve the proper plume rise for the total combined cycle emissions, the stack parameters for the steam turbine units were updated with the parameters from the combustion release point. Additionally, some units, such as landfill gas, may not be assigned a valid SCC in the initial flat file. The SCCs for these units were updated based on the base year SCC for the unit-fuel type.

The EGU sector NO_x emissions by state are listed in Table 4-2 for the cases that comprise this platform. The state total emissions in this table may not exactly match the sum of the emissions for each state in the flat files for each season due to the process of apportioning seasonal total emissions to hours for input to SMOKE followed by summing the daily emissions back up to annual. However, any difference should be well within one percent of the state total emissions.

Table 4-2. EGU sector NOx emissions by State for the 2022v1 cases

state	2022hc	2026hc	2032hc	2038hc
Alabama	16,510	13,773	11,523	10,257
Alaska	6,195	6,195	6,195	6,195
Arizona	15,668	9,637	4,864	4,437
Arkansas	17,015	14,550	1,600	555
California	5,816	5,757	11,214	7,050
Colorado	17,778	12,496	6,745	1,363
Connecticut	3,076	2,892	2,279	0
Delaware	911	462	300	185
District of Columbia	0	0	37	36
Florida	38,816	33,010	26,348	21,493
Georgia	20,636	19,122	3,539	2,339
Hawaii	13,581	13,581	13,571	12,669
Idaho	1,420	1,680	844	775
Illinois	20,575	10,239	5,419	4,773
Indiana	41,679	25,883	4,031	3,265
Iowa	16,966	14,182	1,041	179
Kansas	13,554	9,477	2,253	2,092
Kentucky	31,989	28,582	11,879	11,114
Louisiana	31,107	21,147	7,027	3,598
Maine	3,594	3,406	1,670	1,326
Maryland	4,405	3,584	2,598	2,348
Massachusetts	5,584	5,314	5,109	5,065
Michigan	29,158	18,696	8,991	5,388
Minnesota	14,491	11,183	1,076	632
Mississippi	16,333	12,262	4,448	3,677

state	2022hc	2026hc	2032hc	2038hc
Missouri	48,204	34,976	4,708	4,475
Montana	10,459	10,382	855	356
Nebraska	20,178	18,453	2,530	1,821
Nevada	4,488	2,101	1,905	1,506
New Hampshire	1,504	1,167	504	490
New Jersey	4,835	4,332	3,646	3,168
New Mexico	6,604	2,913	810	659
New York	13,762	11,931	8,616	6,459
North Carolina	26,865	24,036	3,561	3,366
North Dakota	28,897	28,549	5,251	5,239
Ohio	31,933	22,299	4,243	2,975
Oklahoma	18,700	18,150	2,185	1,272
Oregon	2,775	2,207	464	0
Pennsylvania	27,252	16,826	12,014	9,541
Puerto Rico	21,425	21,425	21,425	21,425
Rhode Island	302	619	158	129
South Carolina	14,016	13,900	8,095	7,823
South Dakota	1,144	1,085	56	9
Tennessee	8,262	6,834	1,023	610
Texas	93,611	86,224	14,891	9,934
Tribal Data	8,412	7,616	52	51
Utah	23,396	9,442	1,507	1,155
Vermont	194	109	37	41
Virginia	12,598	11,482	6,135	4,566
Washington	7,659	3,766	2,827	2,142
West Virginia	30,156	22,916	15,210	15,181
Wisconsin	10,985	7,932	1,970	1,204
Wyoming	26,411	19,591	7,644	7,481

4.2 Projected Emissions Computed using CoST

To project U.S. emissions for sectors other than EGUs, facility/unit closures information, growth (projection) factors and/or controls were applied to certain categories within those sectors. Some facility or sub-facility-level closure information was applied to the point sources. There are also a handful of situations where new inventories were generated for sources that did not exist in the NEI (e.g., biodiesel and cellulosic plants, yet-to-be constructed cement kilns). This subsection provides details on the data and projection methods used to develop analytic year emissions for sectors other than EGUs that were developed using the Control Strategy Tool.

Because the projection and control data are developed mostly independently from how the emissions modeling sectors are defined, this section is organized primarily by the type of projections data, with

secondary consideration given to the emissions modeling sector (e.g., industrial source growth factors are applicable to multiple emissions modeling sectors). The rest of this section is organized in the order that the EPA uses the Control Strategy Tool (CoST) in combination with other methods to produce analytic year inventories: 1) for point sources, apply facility or sub-facility-level closure information via CoST; 2) apply all PROJECTION packets via CoST (these contain multiplicative factors that could cause increases or decreases); 3) apply all percent reduction-based CONTROL packets via CoST; and 4) append any other analytic-year inventories not generated via CoST. This organization allows consolidation of the discussion of the emissions categories that are contained in multiple sectors, because the data and approaches used across the sectors are consistent and do not need to be repeated. Sector names associated with the CoST packets are provided in parentheses following the subsection titles.

The impacts of the projection and control factors on the emissions for each sector are shown in tables in this section. In addition, the actual projection and control factors used to develop the analytic year emissions are shown when they are general enough to fit into a table of reasonable length, although in some cases, there are hundreds or thousands of factors used and the tables would be too large. To see these factors, visit the spreadsheets see the spreadsheets in the reports / projection_controls / draft_analytic / CoST_packets folder on the FTP site for this platform.

4.2.1 Fugitive dust growth (afdust)

Packets:

afdust_nonpoint_projection_packet_version2_2022hc_to_2026_csv_12sep2024_v0
afdust_nonpoint_projection_packet_version2_2022hc_to_2032_csv_12sep2024_v0
afdust_nonpoint_projection_packet_version2_2022hc_to_2038_csv_12sep2024_v0

For paved roads (SCC 2294000000), the afdust emissions were projected to analytic years based on differences in county total VMT as follows:

Analytic year afdust paved roads = 2022 afdust paved roads * (Analytic year county total VMT) / (2022 county total VMT)

The VMT projections are described in the onroad section.

Other sources used the average of AEO2023 census region specific employment and value of shipments data to derive growth surrogates.

SCCs in the afdust sector used surrogates shown in Table 4-3 to derive projection factors in similar ways as shown above for the paved roads.

Table 4-3. Growth Indicators used to grow SCCs in the afdust Sector

SCC	Sector	Growth Indicator	Source	Geography
2294000000	Dust - Paved Road Dust	Total VMT	MOVES 4.0.1 or State-supplied	County
2296000000	Dust - Unpaved Road Dust	No Growth		

SCC	Sector	Growth Indicator	Source	Geography
2311010000	Dust - Construction Dust	EMPIND25-27 (Construction: Building, Heavy/ Civil Engineering, Specialty Trade); REVIND48	AEO2023	Regional (Census Division)
2311020000	Dust - Construction Dust	EMPIND25-27 (Construction: Building, Heavy/Civil Engineering, Specialty Trade); REVIND48	AEO2023	Regional (Census Division)
2311030000	Dust - Construction Dust	Total VMT	2022v1 VMT	County
2325000000	Industrial Processes – Mining	EMPIND24 (Other Mining and Quarrying); REVIND47	AEO2023	Regional (Census Division)
2325020000	Industrial Processes – Mining	EMPIND24 (Other Mining and Quarrying); REVIND47	AEO2023	Regional (Census Division)
2325030000	Industrial Processes – Mining	EMPIND24 (Other Mining and Quarrying); REVIND47	AEO2023	Regional (Census Division)
2325060000	Industrial Processes - Mining	EMPIND24 (Other Mining and Quarrying); REVIND47	AEO2023	Regional (Census Division)
2801000000	Agriculture - Crops & Livestock Dust	EMPIND20 (Crop Production); REVIND42	AEO2023	Regional (Census Division)
2801000003	Agriculture - Crops & Livestock Dust	EMPIND20 (Crop Production); REVIND42	AEO2023	Regional (Census Division)
2801000005	Agriculture - Crops & Livestock Dust	EMPIND20 (Crop Production); REVIND42	AEO2023	Regional (Census Division)
2801000008	Agriculture - Crops & Livestock Dust	EMPIND20 (Crop Production); REVIND42	AEO2023	Regional (Census Division)
2801530000	Agriculture - Crops & Livestock Dust	EMPIND21 (Other Agriculture); REVIND44	AEO2023	Regional (Census Division)
2805100010	Agriculture - Crops & Livestock Dust	Beef Cattle surrogate	EPA State GHG Projections Tool	State
2805100020	Agriculture - Crops & Livestock Dust	Dairy Cattle surrogate	EPA State GHG Projections Tool	State
2805100030	Agriculture - Crops & Livestock Dust	Young Chickens surrogate	EPA State GHG Projections Tool	State
2805100040	Agriculture - Crops & Livestock Dust	Young Chickens surrogate	EPA State GHG Projections Tool	State
2805100050	Agriculture - Crops & Livestock Dust	Hog surrogate	EPA State GHG Projections Tool	State
2805100060	Agriculture - Crops & Livestock Dust	Turkey surrogate	EPA State GHG Projections Tool	State

4.2.2 Airport Sources (airports)

Packets:

airport_projections_itn_taf2023_2022_2026_for_2022v1_platform_09aug2024_v0
airport_projections_itn_taf2023_2022_2032_for_2022v1_platform_09aug2024_v0
airport_projections_itn_taf2023_2022_2038_for_2022v1_platform_09aug2024_v0

Airport emissions were projected based on factors derived from the 2023 Terminal Area Forecast (TAF) data available from the Federal Aviation Administration (see https://www.faa.gov/data_research/aviation/taf/).

Projection factors were computed using the ratio of the itinerant (ITN) data from the Airport Operations table between the base and projection year. Where possible, airport-specific projection factors were used. For airports that could not be matched to a unit in the TAF data, state default growth factors by itinerant class (i.e., commercial, air taxi, and general) were created from the set of unmatched airports. Emission growth factors for facilities from 2022 to each analytic year were limited to a range of 0.2 (80% reduction) to 5.0 (400% growth), and the state default projection factors were limited to a range of 0.5 (50% reduction) to 2.0 (100% growth). Military state default projection values were kept flat (i.e., equal to 1.0) to reflect uncertainly in the data regarding these sources.

For Alabama, North Carolina, Nevada, and Utah, we used the 2026 state-average projection factors for 2032 and 2038 as well, due to large differences in the underlying data at smaller airports beyond 2026. For similar reasons, the 2032 state-average projection factors for Colorado were used for all analytic years in that state.

4.2.3 Category 1 and Category 2 Commercial Marine Vessels (cmv_c1c2)

Packets:

projection_packet_CMV_C1C2_2022_2026_csv_19aug2024_v0
projection_packet_CMV_C1C2_2022_2032_csv_19aug2024_v0
projection_packet_CMV_C1C2_2022_2038_csv_19aug2024_v0

Category 1 and category 2 (C1C2) CMV emissions were projected based on factors derived from the Freight Analysis Framework version 5. See the Category 3 CMV documentation for more details on the development of the projection factors for both C1C2 and C3 CMV vessels.

4.2.4 Category 3 Commercial Marine Vessels (cmv_c3)

Packets:

projection_packet_CMV_C3_2022_2026_csv_19aug2024_v0
projection_packet_CMV_C3_2022_2032_csv_19aug2024_v0
projection_packet_CMV_C3_2022_2038_csv_19aug2024_v0

Category 3 (C3) CMV emissions were projected based on factors derived from the Freight Analysis Framework version 5. An additional adjustment was applied to NOx emissions. See the Category 3 CMV documentation for more details on the development of the factors.

4.2.5 Livestock (livestock)

Packets:

livestock_nonpoint_projection_packet_version2_2022hc_to_2026_csv_12sep2024_v0
livestock_nonpoint_projection_packet_version2_2022hc_to_2032_csv_12sep2024_v0
livestock_nonpoint_projection_packet_version2_2022hc_to_2038_csv_12sep2024_v0

Livestock emissions were projected based on factors derived the Greenhouse Gas Inventory Tool. National factors were used to project emissions from beef and dairy cows, and state-level factors were used to project emissions from swine. Other livestock categories were held flat.

4.2.6 Other nonpoint and Nonpoint Solvents (nonpt, np_solvents)

Packets:

nonpoint_projection_packet_version2_2022hc_to_2026_csv_12sep2024_v0
nonpoint_projection_packet_version2_2022hc_to_2032_csv_12sep2024_v0
nonpoint_projection_packet_version2_2022hc_to_2038_csv_12sep2024_v0

Other nonpoint emissions were projected based on factors derived from specific surrogates for each SCC as identified by the Nonpoint task force in a similar way to how emissions in the afdust sector were projected. One of the surrogates used was population. The county-specific population dataset used to derive changes between the baes and analytic years was the Woods and Poole dataset used by BenMAP. The AEO used for many growth surrogates was AEO 2023. Any VMT-based projections are based on the final county-level VMT data developed for each of the years of the 2022v1 platform. For a complete list of nonpoint growth surrogates by SCC, see the NP_AnalyticYr_Crosswalk spreadsheet in the reports / nonpoint folder on the FTP site.

4.2.7 Oil and gas sources (np_oilgas, pt_oilgas)

Packets:

np_oilgas_projection_packet_2026hc_csv_20aug2024_v0
np_oilgas_projection_packet_2032hc_csv_20aug2024_v0
np_oilgas_projection_packet_2038hc_csv_20aug2024_v0

pt_oilgas_projection_packet_2026hc_csv_22aug2024_v0
pt_oilgas_projection_packet_2032hc_csv_22aug2024_v0
pt_oilgas_projection_packet_2038hc_csv_22aug2024_v0

Projection factors were generated using state historical production data from EIA for 2022 and 2023 plus the AEO2023 production forecast data. These factors were applied only to production-related non-point and point sources and consisted mainly of state-specific factor with Texas and New Mexico factors being the exception where factors applied down to the county-level to better estimate the different supply regions in those two states. Projections factors for transmission-related point sources used the AEO2023 production forecast data only to create a national factor each for the transmission of oil and for the transmission of natural gas.

Exploration-related non-point sources did not use projection factors at all instead a three year average of exploration activity (e.g. feet drilled) was compiled using years 2018, 2019 and 2022. The averaged activity was then input into the EPA Oil and Gas Tool to generate an averaged-activity-emissions dataset to be used as a starting point for each analytic year. Controls were applied to each of these source categories (production, transmission, and exploration); please see info in later sections about controls.

4.2.8 Non-EGU Point sources (ptnonpim)

Packets:

ptnonipm_projection_packet_2022hc_to_2026_csv_18sep2024_v0
ptnonipm_projection_packet_2022hc_to_2032_csv_18sep2024_v0
ptnonipm_projection_packet_2022hc_to_2038_csv_18sep2024_v0
ptnonipm_Projection_rail_2022hc_to_2026_future_year_16aug2024_v0
ptnonipm_Projection_rail_2022hc_to_2032_future_year_16aug2024_v0
ptnonipm_Projection_rail_2022hc_to_2038_future_year_16aug2024_v0
Projection_2022v1platform_refinery_adjustments_2032_25sep2024_v0
Projection_2022v1platform_refinery_adjustments_2038_25sep2024_v0

The methods used to develop growth factors for non-EGU point sources in ptnonipm were developed by the industrial point task force. Non-EGU, non-rail sources were split into two main categories: fuel-use (including combustion or storage) and non-fuel use. Data centers were treated separately from the two categories. For fuel-use sources, using the 2023 Annual Energy Outlook, national energy use, national value of shipments (VOS) and regional VOS data was used to derive projection factors. For these sources, national factors of energy use by fuel, industry, and year per VOS were scaled to regional VOS by industry and year. A few sources occurred in regions where AEO regional VOS data were zeroed out. For these few cases, only national VOS data was used. Non-fuel use categories, determined by NAICS code, used the average of regional EIA employment and VOS projections to develop growth factors. Data centers assumed linear growth rate to 2050 of 67% using EIA projection information from AEO2022. All growth factors for non-EGU, non-rail sources were capped to a growth rate of +/- 2% year over year: 8% for 2026, 22% for 2032, and 37% for 2038. The tables used to project the ptnonipm emissions for the draft analytic year emissions are described in Table 4-4 and were added here on October 21, 2024.

Railyards were treated independently using AEO2023 growth without RFCI adjustments, the same data sources described for rail switchers and class 2/3.

Table 4-4. Ptnonipm Source Growth Surrogate Assignments

Category	Sources	Method
Fuel-Use	SCC3 1XX, 2XX, 403, 404, excluding 28500201	National fuel consumption, national VOS and regional VOS data to develop regional growth factors. AEO2023 Tables 24-34 was used for fuel consumption and national VOS data. Regional VOS data was made available through special request only.

		For cases in which source SCCs in the NEI could not be mapped to AEO industrial sectors (Tables 24-34), regional fuel use data for the applicable macro-level category was used. These sources used data found in AEO2023 Table 2.
Non-Fuel Use	All other SCC3s (NOT 1XX, 2XX, 403, 404, excluding 28500201)	For the NEI sources that do not map to energy-use categories, use the average of regional EIA employment and VOS projections to develop growth surrogates.
Data Centers	NAICS 518, 519, 924-928	From AEO2022 publication, assume growth of 67% through 2050.
Railyards	SCC 28500201	AEO2023 growth without RFCI adjustments. Same method as switcher and class 2/3 rail, described in rail section.

4.2.9 Railroads (rail)

Packets:

Projection_rail_2022hc_to_2026_future_year_16aug2024_v0
Projection_rail_2022hc_to_2032_future_year_16aug2024_v0
Projection_rail_2022hc_to_2038_future_year_16aug2024_v0

Rail projection factors are relatively flat. Rail emissions were projected based on factors derived for categories of locomotives based on AEO (fuel use) growth rates including some adjustments. Table 4-5 shows the projection factors used for the various locomotive categories.

Table 4-5 Projection factors for Rail SCCs from the 2022 Base Year

R-1 Fuel Use Data Trends	Passenger Rail SCCs: 2285002008, 2285002009	2022 Switcher & class 2/3 SCCs: 28500201, 2285002007	Line Haul SCC: 2285002006
2022	1.000	1.000	1.000
2023	1.038	0.986	0.986
2024	1.060	1.026	1.045
2025	1.075	1.002	1.027
2026	1.091	0.959	0.991
2027	1.106	0.926	0.964
2028	1.119	0.913	0.957
2029	1.132	0.923	0.975
2030	1.142	0.918	0.976
2031	1.152	0.921	0.986
2032	1.165	0.929	1.003
2033	1.178	0.936	1.017
2034	1.193	0.940	1.029
2035	1.205	0.946	1.043
2036	1.217	0.947	1.052
2037	1.229	0.949	1.062
2038	1.241	0.952	1.073
2039	1.253	0.950	1.079
2040	1.267	0.951	1.088

4.3 Closures and Controls Applied Using CoST

The final step in the projection of emissions to each analytic year is the application of any control technologies or programs. For analytic-year New Source Performance Standards (NSPS) controls (e.g., oil and gas, Reciprocating Internal Combustion Engines (RICE), Natural Gas Turbines, and Process Heaters), we attempted to control only new sources/equipment using the following equation to account for growth and retirement of existing sources and the differences between the new and existing source emission rates.

$$Qn = Qo \{ [(1 + Pf)^{t} - 1] Fn + (1 - Ri)^{t} Fe + [1 - (1 - Ri)^{t}] Fn] \}$$

Equation 4-1

where:

Qn = emissions in projection year
Qo = emissions in base year
Pf = growth rate expressed as ratio (e.g., 1.5=50 percent cumulative growth)
t = number of years between base and analytic years
Fn = emission factor ratio for new sources
Ri = retirement rate, expressed as whole number (e.g., 3.3 percent=0.033)
Fe = emission factor ratio for existing sources

The first term in Equation 4-1 represents new source growth and controls, the second term accounts for retirement and controls for existing sources, and the third term accounts for replacement source controls. The parameters used in Equation 4-1 for various rules are shown in Table 4-6.

Table 4-6. Assumed retirement rates and new source emission factor ratios for NSPS rules

NSPS Rule	Sector(s)	Retirement Rate years (%/year)	Pollutant Impacted	Applied where?	New Source Emission Factor (Fn)
RICE	np_oilgas, pt_oilgas, nonpt, ptnonipm	40, (2.5%)	NO_X	Lean burn: PA, all other states	0.25, 0.606
				Rich Burn: PA, all other states	0.1, 0.069
				Combined (average) LB/RB: PA, other states	0.175, 0.338
			CO	Lean burn: PA, all other states	1.0 (n/a), 0.889
				Rich Burn: PA, all other states	0.15, 0.25
				Combined (average) LB/RB: PA, other states	0.575, 0.569
			VOC	Lean burn: PA, all other states	0.125, n/a
				Rich Burn: PA, all other states	0.1, n/a
				Combined (average) LB/RB: PA, other states	0.1125, n/a
Gas Turbines	pt_oilgas, ptnonipm	45 (2.2%)	NO_X	California and NO_X SIP Call states	0.595
				All other states	0.238
Process Heaters	pt_oilgas, ptnonipm	30 (3.3%)	NO_X	Nationally to Process Heater SCCs	0.41

The rules listed in Table 4-6 have CoST packets implemented to reflect them as shown in Table 4-7.

Table 4-7. Rules with CoST packets implemented

Rule	Pollutant Controlled	Compliance Date
HON (F, G, H, I)	VOC	2027
Natural Gas Turbines NSPS (KKKK)	NOx	2005 or newer
Organic Liquids Distribution (EEE) NESHAP	VOC	July 2023
Process Heaters NOx NSPS (DDDDD)	NOx	2013 or newer
RICE NSPS (IIII, JJJJ)	NOx, CO, VOC (PA only)	2006 or newer
Taconite (RRRRR) NESHAP	PM	2027
Gasoline Distribution	VOC	2027
Oil & Gas NSPS		

4.3.1 Closures

Packets:

closures_2022v1_platform_fromEIS_16sep2024_v1
closures_2022v1_platform_fromSLT_16sep2024_v0

Closures following the year 2022 were extracted from the Emissions Inventory System (EIS) in August of 2024. State and local agencies representing the following jurisdictions supplied closure information: Allegheny County (PA), Georgia, Hawaii, Iowa, Illinois, Montana, North Carolina, North Dakota, New Hampshire, Oklahoma, South Carolina, Tennessee, Texas, Utah, Virginia, Washington, and Wisconsin.

4.3.2 State-submitted Control information

Packets:

Control_2022_20XX_2022v1_point_nonpoint_SLT_controls_07oct2024_v1

Control information was provided by agencies representing the following jurisdictions: Delaware, Hawaii, Iowa, New Hampshire, Oklahoma, Tennessee, Texas, Utah, Virginia, and Washington.

4.3.3 Hazardous Organic National Emission Standards for Hazardous Air Pollutants (HON, 40 CFR Part 63 subparts F, G, H, I)

Packets:

Control_2022_203X_Hazardous_Organic_NESHAP_2022v1platform_07oct2024_v1

EIS facility IDs were retrieved from Appendix A of the regulatory docket document Lists of Facilities Subject to the HON, Group I and Group II Polymers and Resins NESHAPs, and NSPS subparts VV, VVa, III, NNN, and RRR. The IDs were run through a report in EIS to gather additional facility information. An 3.37% emissions reduction of VOC was applied to matching EIS facilities with no existing VOC controls.

4.3.4 Natural Gas Turbines New Source Performance Standards (NSPS, 40 CFR Part 60 subpart KKKK)

Packets:

Control_2022_2026_NG_Turbines_pt_oilgas_2022v1platform_05sep2024_v0
Control_2022_2032_NG_Turbines_pt_oilgas_2022v1platform_05sep2024_v0
Control_2022_2038_NG_Turbines_pt_oilgas_2022v1platform_05sep2024_v0
Control_2022_2026_NG_Turbines_NSPS_ptnonipm_2022v1platform_30sep2024_v0
Control_2022_2032_NG_Turbines_NSPS_ptnonipm_2022v1platform_30sep2024_v0
Control_2022_2038_NG_Turbines_NSPS_ptnonipm_2022v1platform_30sep2024_v0

4.3.5 Organic Liquids Distribution National Emission Standards for Hazardous Air Pollutants (NESHAP, 40 CFR Part 63 subpart EEEE)

Packets:

Control_2022_2026_Organic_Liquids_Distribution_NESHAP_2022v1platform_02oct2024_v1
Control_2022_203X_Organic_Liquids_Distribution_NESHAP_2022v1platform_02oct2024_nf_v3

Affected facilities were listed in Appendix A of the Review of the RACT/BACT/LAER Clearinghouse Database for the Organic Liquids Distribution Source Category memo found in the regulatory docket. Facility information was pulled from EIS to check control information. If no VOC controls existed at a facility, an 8% VOC emissions reduction was applied.

4.3.6 National Emission Standards for Hazardous Air Pollutants (NESHAP) for Major Sources: Process Heaters (40 CFR Part 63 subpart DDDDD)

Packets:

Control_2022_2026_Process_Heaters_pt_oilgas_2022v1platform_06sep2024_v0
Control_2022_2032_Process_Heaters_pt_oilgas_2022v1platform_06sep2024_v0
Control_2022_2038_Process_Heaters_pt_oilgas_2022v1platform_06sep2024_v0
Control_2022_2026_Process_Heaters_NSPS_ptnonipm_2022v1platform_30sep2024_v0
Control_2022_2032_Process_Heaters_NSPS_ptnonipm_2022v1platform_30sep2024_v0
Control_2022_2038_Process_Heaters_NSPS_ptnonipm_2022v1platform_30sep2024_v0

4.3.7 Reciprocating Internal Combustion Engines (RICE) New Source Performance Standards (NSPS, 40 CFR Part 60 subparts IIII & JJJJ)

Packets:

Control_2022_2026_RICE_NSPS_nonpt_ptnonipm_2022v1platform_07oct2024_v1
Control_2022_2032_RICE_NSPS_nonpt_ptnonipm_2022v1platform_07oct2024_v1
Control_2022_2038_RICE_NSPS_nonpt_ptnonipm_2022v1platform_07oct2024_v1
Control_2022_2026_RICE_NSPS_np_oilgas_2022v1platform_09sep2024_v0
Control_2022_2032_RICE_NSPS_np_oilgas_2022v1platform_09sep2024_v0
Control_2022_2038_RICE_NSPS_np_oilgas_2022v1platform_09sep2024_v0
Control_2022_2026_RICE_NSPS_pt_oilgas_2022v1platform_09sep2024_v0
Control_2022_2032_RICE_NSPS_pt_oilgas_2022v1platform_09sep2024_v0
Control_2022_2038_RICE_NSPS_pt_oilgas_2022v1platform_09sep2024_v0

4.3.8 National Emission Standards for Hazardous Air Pollutants: Taconite Iron Ore Processing (40 CFR Part 63 subpart RRRRR)

Packets:

Control_2022_203X_Taconite_NESHAP_2022v1platform_07oct2024_v1

4.3.9 National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Gasoline Distribution (40 CFR 63 subparts R and BBBBB)

Packets:

Control_2022_203X_Gasoline_Distribution_NESHAP_nonpt_ptnonipm_2022v1platform_30sep2024_v0

Area source SCCs were located by running an EIS report for VOC emissions by county for the sectors Gas Stations and Bulk Gasoline Terminals. The percent of emissions reductions was calculated by

4.3.10 Oil & Gas New Source Performance Standards

Packets:

Control_2022_2026_OilGas_NSPS_np_oilgas_2022v1platform_25sep2024_v0
Control_2022_2032_OilGas_NSPS_np_oilgas_2022v1platform_25sep2024_v0
Control_2022_2038_OilGas_NSPS_np_oilgas_2022v1platform_25sep2024_v0
Control_2022_2026_OilGas_NSPS_pt_oilgas_2022v1platform_25sep2024_v0
Control_2022_2032_OilGas_NSPS_pt_oilgas_2022v1platform_25sep2024_v0
Control_2022_2038_OilGas_NSPS_pt_oilgas_2022v1platform_25sep2024_v0

For more information on NSPS Oil and Gas rule(s), see https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-operations/new-source-performance-standards-and

4.4 Sectors with Projected Emissions Computed Outside of CoST

Projections for sectors not calculated using CoST are discussed in this section.

4.4.1 Nonroad

Outside of California and Texas, the MOVES4 was run for the analytic years. The fuels used are specific to the analytic year, but the meteorological data represented the year 2018. The 2032 nonroad emissions include all nonroad control programs finalized as of the date of the MOVES3.0.3 release, including most recently:

- Emissions Standards for New Nonroad Spark-Ignition Engines, Equipment, and Vessels: October 2008 (https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-control-emissions-nonroad-spark-ignition);
- Growth and control from Locomotives and Marine Compression-Ignition Engines Less than 30 Liters per Cylinder: March 2008 (https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-control-emissions-air-pollution-locomotive); and
- Clean Air Nonroad Diesel Final Rule – Tier 4: May 2004 (https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-control-emissions-air-pollution-nonroad-diesel).

The resulting analytic year inventories were processed into the format needed by SMOKE in the same way as the base year emissions. Inside California, CARB provided data for various analytic years. VOC and $PM_{2.5}$ by speciation profile, and VOC HAPs, were added to all analytic year California nonroad inventories based on analytic year MOVES runs.

4.4.2 Onroad Mobile Sources (onroad)

For 2022v1, MOVES4 was run to obtain onroad emission factors that account for the impact of on-the-books rules that are implemented into MOVES4. These include regulations such as:

- Safer Affordable Fuel Efficient (SAFE) Vehicles Final Rule for Model Years 2021-2026 (March 2020);
- Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2 (October 2016);

- Tier 3 Vehicle Emission and Fuel Standards Program (March 2014) (https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-control-air-pollution-motor-vehicles-tier-3);
- 2017 and Later Model Year Light-Duty Vehicle GHG Emissions and Corporate Average Fuel Economy Standards (October 2012);
- Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles (September 2011);
- Regulation of Fuels and Fuel Additives: Modifications to Renewable Fuel Standard Program (RFS2) (December 2010);
- Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards Final Rule for Model-Year 2012-2016 (May 2010); and
- Revised 2023 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions Standards, 86 FR 74434 (December 30, 2021).

In addition, projection factors were developed and applied to estimate the impact of these rules that are on the books but were not included in MOVES4:

- *Light- and Medium-Duty Multi-Pollutant Rule* (LMDV) with higher projected electric vehicle (EV) fractions and more stringent standards for carbon dioxide (CO_2), particulate matter (PM), non-methane organic gases (NMOG) and oxides of nitrogen (NO_X). See: https://www.govinfo.gov/content/pkg/FR-2021-12-30/pdf/2021-27854.pdf.
- *Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles,* 89 Fed. Reg. 27842, April 18, 2024.
- *EPA's Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles—Phase 3 (HDP3*) with higher projected fractions for zero emission vehicles and updated energy consumption estimates for heavy-duty vehicles (both ICE and ZEV), 89 Fed. Reg. 29440., April 22, 2024.

Local inspection and maintenance (I/M) and other onroad mobile programs are included such as: California LEVIII, the National Low Emissions Vehicle (LEV) and Ozone Transport Commission (OTC); LEV regulations, local fuel programs, and Stage II refueling control programs. Note that MOVES3 emission rates for model years 2017 and beyond are equivalent to CA LEVIII rates for NOx and VOC. Therefore, it was not necessary to update the rates used for states that have adopted the rules in 2020 or later years. The most recent California rules passed after 2020 are not reflected in this platform.

Onroad emissions in California were based on emissions provided by CARB for 2026, 2032, and 2050. The 2038 emissions were derived by interpolating the emissions values between 2032 and 2050. In a similar fashion to the adjustments applied in other states to reflect rules not included in MOVES4, adjustment factors were also developed and applied to California emissions to estimate the impact of the federal rules not reflected in CARB's EMFAC2017 model. No attempt was made to account for any of the recent California regulations.

VMT was projected from 2022 to each analytic year using projection factors based on AEO2023 projections, and applied nationally by fuel type and broad vehicle type (light duty, medium duty for

buses and single unit trucks, and heavy duty for combination trucks). Diesel light duty cars were held flat in projections, but diesel light duty trucks were projected using the AEO. Light duty VMT projections also incorporated a county-level adjustment based on projected human population trends, so that counties expected to grow more than the national average in population receive a corresponding increase in VMT for those counties, and vice versa. The AEO2023-based VMT projection factors are shown in Table 4-8. Four states (NJ, NY, NC, and WI) provided VMT for each analytic year.

Table 4-8. Projection factors for VMT by Fuel and Vehicle Class

	2022-to-2026	2022-to-2032	2022-to-2038
Gas light duty	1.036	1.054	1.059
Gas medium duty	1.108	1.303	1.500
Gas heavy duty	1.103	1.508	1.788
Diesel light duty cars	1.000	1.000	1.000
Diesel light duty trucks	1.252	1.611	1.862
Diesel medium duty	1.008	1.050	1.091
Diesel heavy duty	1.018	1.050	1.067
CNG medium duty	1.073	1.027	1.148
CNG heavy duty	1.080	1.040	1.169
E-85 light duty	0.900	0.688	0.555
Electric light duty	3.339	10.370	17.986

In addition, a small, negligible amount of VMT was created for CNG combination long haul trucks, and for all electric heavy duty vehicle types, for the analytic years. These fuel and source type combinations are newly supported in MOVES4, and activity for these SCCs was created to support future considerations. For the moment, activity for these new MOVES4 SCCs is very small and does not impact the results.

Vehicle population is computed as: analytic year VPOP = base year VPOP * (analytic year VMT / base year VMT) by county and SCC6 (fuel + vehicle type). Wisconsin provided VPOP for each analytic year.

Vehicle starts for analytic years are computed as: analytic year starts = base year starts * (analytic year VPOP / base year VPOP).

Long haul hoteling hours are computed at the county level using the formula:

analytic year hoteling = base year hoteling * (analytic year VMT / base year VMT)

where only the VMT from combination long haul trucks on restricted roads are considered. Where hoteling exists in counties with zero combo-long-haul-restricted-road VMT, hoteling from the base year was projected using the national diesel heavy duty projection factors for VMT from AEO2023. Year-specific APU fractions were used to split county-level hoteling to individual SCCs as follows: 17.0% for 2026, 25.1% for 2032, and 29.3% for 2038.

On-network idling hours (ONI) activity data were calculated based on VMT. For each representative county, the ratio of ONI hours to onroad VMT (on all road types) was calculated using the MOVES ONI

Tool by source type, fuel type, and month. These ratios were then multiplied by each county's total VMT (aggregated by source type, fuel type, and month) to get hours of ONI activity.