



Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations

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Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National
Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations

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Acronyms and Abbreviations Used in this Guidance

AEO	Annual Energy Outlook
AERR	Air Emissions Reporting Rule
APU	Auxiliary power unit
BEIS	Biogenic Emissions Inventory System
BELD3	Biogenic Emissions Land Use Database, version 3
AT	Air Taxes
C1	Category 1 (marine vessel)
C2	Category 2 (marine vessel)
C3	Category 3 (marine vessel)
CAA	Clean Air Act
CAMD	Clean Air Markets Division
CAP	Criteria air pollutant
CAS	Chemical Abstracts Service
CEMS	Continuous Emissions Monitoring System(s)
CMV	Commercial marine vessel
CNG	Compressed natural gas
CO	Carbon monoxide
CO2	Carbon dioxide
DARS	Data Attribute Rating System
DOE	Department of Energy
ECA-IMO	Emissions Control Area-International Maritime Organization
EDD	Effective date of designation
EDMS	Emissions and Dispersion Modeling System
EE	Energy efficiency
EGU	Electric Generating Unit
EIA	Energy Information Administration
EIIP	Emissions Inventory Improvement Program
EIS	Emissions Inventory System
EMCH	Emissions Modeling Clearinghouse
EPA	Environmental Protection Agency
EPMM	Electric Power Market Model
ERTAC	Eastern Regional Technical Advisory Committee
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FIPS	Federal Information Processing Standards
FRS	Federal Registry Service
GA	General Aviation
GHG	Greenhouse gas
GIS	Geographic Information Systems
GSE	Ground support equipment

HAP	Hazardous air pollutant
HEDD	High electricity demand day
Hg	Mercury
HCl	Hydrochloric acid
IPM	Integrated Planning Model
IPP	Inventory Preparation Plan
LPG	Liquified petroleum gas
LTO	Landing and takeoff
MARKAL	Market Allocation (model)
MEGAN	Model of Emissions of Gases and Aerosols from Nature
MIMS	Multimedia Integrated Modeling System
MOVES	Motor Vehicle Emissions System
NAAQS	National Ambient Air Quality Standards
NAA	Nonattainment area
NAD	North American Datum
NAICS	North American Industry Classification System
NATA	National Air Toxics Assessment
NEEDS	National Electric Energy Data
NEI	National Emissions Inventory
NEMS	National Energy Modeling System
NESHAP	National Emission Standard for Hazardous Air Pollutants
NH ₃	Ammonia
NLDN	National Lightning Detection Network
NMIM	National Mobile Inventory Model
NONROAD	Nonroad emissions model
NMHC	Non-methane hydrocarbon
NO _x	Nitrogen Oxides
O ₃	Ozone
OAP	Office of Atmospheric Programs
OAQPS	Office of Air Quality Planning and Standards
OAR	Office of Air and Radiation
OECA	Office of Enforcement and Compliance Assurance
ORIS	Office of Regulatory Information Systems
OTAQ	Office of Transportation Air Quality
OTR	Ozone Transport Region
PM	Particulate matter
PM _{2.5}	Particulate matter with diameter 2.5 microns and less
PM ₁₀	Particulate matter with diameter 10 microns and less
QAPP	Quality Assurance Project Plan
RE	Renewable energy
RICE	Reciprocating Internal Combustion Engines
RFP	Reasonable Further Progress

ROP	Rate of Progress
SCC	Source classification code
SIP	State implementation plan
SMOKE	Sparse Matrix Operator Kernel Emissions
SO ₂	Sulfur Dioxide
SSM	Startup, Shutdown, and Malfunction
STEEM	Ship Traffic, Energy and Environmental Model
TAF	Terminal Area Forecast
TCA	1,1,1-trichloroethane
TDM	Travel demand model
TIP	Tribal Implementation Plan
TOG	Total organic gases
TRI	Toxics Release Inventory
U.S.	United States
USDA	U.S. Department of Agriculture
VMT	Vehicle miles traveled
WFU	Wildland fire use
WGS	World Geodetic System
WLF	Wildland fire
WRF	Weather Research and Forecasting
VOC	Volatile organic compounds

1 Introduction

1.1 Purpose

This document provides guidance on how to develop emissions inventories to meet state implementation plan (SIP) requirements for complying with the 8-hour ozone national ambient air quality standard (NAAQS), the 24-hour and annual fine particulate matter (PM_{2.5}) NAAQS, and the regional haze regulations. It is intended for use by the United States (U.S.) Environmental Protection Agency (EPA) Regional offices; state, local, and tribal air quality management authorities; and the general public. This guidance is designed to implement national policy on these emissions inventories as embodied in the Clean Air Act (CAA), the Ozone SIP Requirements Rule for the 2008 ozone NAAQS (also called the Ozone Implementation Rule)¹, the PM_{2.5} SIP Requirements Rule², and the Regional Haze Regulations (RHR).³

This document does not substitute for provisions or regulations of the CAA enumerated above, nor is it a regulation itself. As the term “guidance” suggests, it provides recommendations on how to implement the inventory requirements. Thus, it does not impose binding, enforceable requirements on any party, nor does it assure that the EPA will approve all instances of its application, as the guidance may not apply to a particular situation based upon the specific circumstances.

The EPA and state, local, and tribal decision makers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate. Final decisions by the EPA regarding a particular SIP demonstration will only be made based on the statute and regulations, and will only be made following a final submission and after notice and opportunity for public review and comment. Interested parties are free to raise questions and objections about the appropriateness of the application of this guidance to a particular situation; the EPA will, and state, local, and tribal air agencies should, consider whether or not the recommendations in this guidance are appropriate in that situation.

Through the provisions of the Tribal Authority Rule, tribes are not required to develop emissions inventories. If tribes choose to develop an emissions inventory that may become part of a SIP or Tribal Implementation Plan (TIP) inventory covered by this guidance, the tribes are encouraged to follow the provisions of this guidance. Notwithstanding the possible inventory development by local and tribal air agencies, the remainder of this document will refer to inventories prepared for “SIPs” for compliance with NAAQS.

¹ Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements; (40 CFR part 51 Subpart AA; see also <https://www.epa.gov/ozone-pollution/implementation-2008-national-ambient-air-quality-standards-naaqs-ozone-state>).

² Fine Particulate Matter National Ambient Air Quality Standards: State Implementation Plan Requirements, (40 CFR part 51 Subpart Z; see also <https://www.epa.gov/pm-pollution/implementation-national-ambient-air-quality-standards-naaqs-fine-particulate-matter>).

³ Regional Haze Regulations (40 CFR part 51 Subpart P) See also <https://www.epa.gov/visibility/visibility-regulatory-actions>.

1.2 Other Inventory Guidance and Resources

This document is a guide for state, local, and tribal air agencies (called “air agencies” in this guidance) for preparing and submitting their emissions inventories for the 8-hour ozone NAAQS, 24-hour and annual PM_{2.5} NAAQS, and for the regional haze program. It is not a procedures document that comprehensively covers the methods for compiling and documenting emissions inventories. Furthermore, the predecessors to this guidance have historically relied on separate guidance documents to add information for various specific purposes. In Section 2.3, we list the various inventory components needed for 8-hour ozone, PM_{2.5}, and regional haze implementation and identify the associated sections of this guidance and other relevant guidance materials.

In addition to this guidance, the “Guidance on the Use of Models and Other Analyses for Demonstrating Attainment for Air Quality Goals for Ozone, PM_{2.5}, and Regional Haze” (http://www3.epa.gov/ttn/scram/guidance_sip.htm), or “Modeling Guidance,” covers the creation of emissions inventories for use in air quality modeling. These modeling inventories differ from the inventories covered in this document in that they usually have a larger spatial extent (i.e., a multi-state area as opposed to just the nonattainment area or individual state) and require extra processing steps to obtain the spatial and temporal resolution of the air quality model input species. To the extent the Modeling Guidance covers future-year emissions, efforts have been made to harmonize the future-year guidance in that Guidance with the information included in Section 5 of this document.

In accordance with 40 CFR 51.5(b), states are urged to use applicable, state-of-the art techniques for estimating emissions. Types of emissions inventories are discussed in Section 3 and include base year and projected inventories. A number of inventory development resources are available from the EPA for use by air agencies for estimating base year emissions inventories. Table 1 provides these references and a brief description of how they can be used. More information on how these resources can be applied is provided in Sections 4 and 5.

Table 1: List of EPA estimation resources for emissions inventories

Resource and website	Description
National Emissions Inventory (NEI)	Summaries of the latest NEI data and documentation are available from links provided at this website. More detailed data are available to air agencies from the Emissions Inventory System (EIS).
Emission Factors used for the National Emissions Inventory (NEI)^λ	The National Emissions Inventory (NEI) program provides emissions estimation tools (that include emission factors) and point-source emission factors based on EPA rule development efforts. In many cases, these factors are more recent than those in WebFire and AP-42, and agencies are encouraged to rely on these where available.
Emissions Inventory System	The EIS allows for summaries and extraction of detailed data for use by air agencies. The EIS allows both state-submitted as well as the composite EPA-

Resource and website	Description
	state data used for the NEI to be queried and downloaded. Training on reports is also available, and Appendix A provides an EIS quick reference for county and facility reports.
Local-scale emissions inventory development	In 2010, the EPA completed a project to assess the building of multi-pollutant inventories at the scale of nonattainment areas. A project description and the final report are available; the latter documents the recommended actions for state and local agencies that want to develop local-scale emissions inventories, including SIP planning inventories.
Electric Generating Unit emissions data from Continuous Emissions Monitoring Systems (CEMS)^Δ	Carbon dioxide (CO ₂), nitrogen oxides (NO _x), sulfur dioxide (SO ₂), and heat input data from Electric Generating Units (EGUs) collected by the EPA. Heat input data can be used to estimate hourly emissions of other pollutants using emission factors.
Emissions Inventory Improvement Program (EIIP) Documentation, Volumes 1-9	Emissions estimation procedures for point, area (nonpoint) and mobile sources. While much of the information included in these reports is still relevant, the EIIP documentation for point and nonpoint sources has some outdated parts, and the sections below indicate some of those limitations and alternative resources. The EIIP documentation for mobile sources (volume 4) is out of date because it refers to previous versions of EPA emissions models. <i>Use more current resources, listed below for mobile sources and fires.</i> While EIIP is also out of date for biogenic sources, these sources are relevant only for modeling inventories and not for the inventories covered by this guidance.
Emission Factors – WebFire and AP-42	Emission factors are used to estimate emissions, generally by multiplying by some activity value for that emissions activity, where no better method of emissions quantification or estimation is available. <i>AP-42 is not an appropriate source of emission factors for mobile sources other than road dust.</i>
General Principles for the 5-Year Regional Haze Progress Reports for the Initial Regional Haze State Implementation Plans	This document has been developed by the EPA for the EPA Regional offices and states in preparing and reviewing the 5-year progress reports for the initial Regional Haze SIPs. This document summarizes and clarifies the requirements for the first 5-year reports, including emissions inventory aspects.

Resource and website	Description
Motor Vehicle Emissions System (MOVES)	The model, technical documentation, and guidance on the use and application of the MOVES model for on-road and nonroad mobile sources.
State and Local Transportation Policy and Guidance	Webpage that provides state and local agencies with direction on how to implement strategies for controlling emissions from mobile sources. Includes links to guidance documents that describe process for securing SIP air quality credits for voluntary and innovative emission reduction programs. See also link to nonroad documentation now available from the MOVES page.
Transportation Conformity	General information, policy and technical guidance about transportation conformity.

λ From this main web page, obtain factors using the link to the latest available NEI or NEI Plan.

Δ Select “Data Sets and Published Reports”.

Many other resources from other organizations exist. Where specific methods or tools from non-EPA organizations are included in this documentation, this document includes relevant references for those materials to help readers find these additional sources of information.

In addition to base year emissions, emissions projections are needed for a variety of reasons, including redesignation maintenance plans, the attainment projected inventory for a nonattainment area (NAA), air quality modeling for attainment plans, and projecting reasonable progress goals for visibility improvement as part of Regional Haze SIPs. In Section 5, this guidance provides information on methods for emissions projections. The EPA provides emissions projections data and documentation as part of its modeling platforms that are available at the Emissions Modeling Clearinghouse (<https://www.epa.gov/air-emissions-modeling>). On-road and nonroad mobile source projections are covered in the mobile regulatory documentation associated with [MOVES](#). Additional nonroad mobile projections information (for aircraft, commercial marine vessels, and locomotives) are included as part of this documentation in the nonroad mobile sources part of Section 5.

1.3 Summary of Relevant Statutory Provisions

Numerous sections of the CAA apply to the implementation of emissions inventory requirements. This section provides a brief synopsis of some of those sections that may be relevant for reference in later sections of this guidance. All of the sections below are a part of CAA Title I – Programs and Activities.

- **Section 110(a)** describes the basic requirements for SIPs, which provide for implementation, maintenance, and enforcement of the NAAQS.
 - **Section 110(a)(1)** specifies parameters for “infrastructure SIPs.”
 - **Section 110(a)(2)** specifies a “notice and public hearing”⁴ process is needed.

General

General

⁴ Public hearings are explained at 40 CFR 51.102(a).

- **Section 110(a)(2)(F)** specifies that infrastructure SIPs shall require, as may be prescribed by the EPA Administrator, “periodic reports on the nature and amounts of emissions and emissions-related data” from stationary sources.
- **Section 110(a)(2)(K)** requires infrastructure SIPs to provide for air quality modeling as determined necessary by the Administrator and allows the EPA to require the submission upon request of data related to that air quality modeling.
- **Section 110(a)(2)(J)** addresses requirements related to Part C of the CAA, related to prevention of significant deterioration and visibility protection.

Readers should refer to the [“Guidance on Infrastructure State Implementation Plan \(SIP\) Elements under Clean Air Act Sections 110\(a\)\(1\) and 110\(a\)\(2\)”](#); September 2013.

- **Section 110(p)** requires states to submit “reports” according to the Administrator’s schedule, “relating to emissions reductions, vehicle miles traveled, congestion levels, or any other information the Administrator may deem necessary to assess the development effectiveness, need for revision, or implementation of any plan or plan revision” for a SIP.
- **Sections 169A and 169B** focus on visibility protection for Federal class I areas and require the EPA to promulgate regulations establishing requirements for implementation plans to assure reasonable progress towards improving visibility. To do this, the EPA has codified the regional haze program requirements in 40 CFR 51.308 and 51.309, with associated definitions in 51.301.
- **Section 172(c)(3)** in Part D, Subpart 1 describes NAA SIP requirements for all criteria air pollutants (CAPs) – carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO₂), ozone, particulate matter (PM), and SO₂ – that, unless superseded by subsequent NAAQS-specific subparts, apply to SIPs for NAAs submitted to the EPA. This section includes a requirement that such SIPs include a current inventory of actual emissions in a NAA. It allows the EPA Administrator to require periodic updates needed to determine if the general requirements of nonattainment SIPs (i.e., Subpart 1) are met.
- **Section 175A** describes maintenance plans, which are SIP revisions that provide for the maintenance for 10 years of any primary NAAQS for which an area has been redesignated to attainment and may include additional control measures necessary to ensure this maintenance. Updated emissions inventories are to be included in a maintenance plan.

General

Regional
Haze

General

General

- **Section 182(a)-(f)** provide SIP inventory requirements for all areas designated as nonattainment for the ozone NAAQS.
 - **Section 182(a)** includes SIP requirements for ozone NAAs classified as Marginal and above.
 - **Section 182(a)(1)** requires a current and comprehensive inventory of actual emissions of all sources of ozone precursors to be included in a SIP.
 - **Section 182(a)(3)(A)** requires periodic inventories to be provided by a state to EPA, until an area is redesignated to attainment, no later than the end of each 3-year period after the submission of the inventory for 182(a)(1).
 - **Section 182(a)(3)(B)** requires areas to include in their SIP a requirement for stationary sources of NO_x and volatile organic compounds (VOC) to provide the state with an annual statement showing actual emissions of NO_x and VOC.
 - **Section 182(b)** includes SIP requirements for ozone NAAs classified as Moderate and above.
 - **Section 182(b)(1)(A)** requires a rate of progress (ROP) demonstration, and describes requirements for annual reductions in VOC and NO_x emissions as necessary to attain the ozone NAAQS.
 - **Section 182(b)(1)(B)** requires a baseline emissions inventory for NO_x and VOC from all anthropogenic sources in the NAA to be included in ozone SIPs for purposes of rate of progress/reasonable further progress (RFP) demonstrations.
 - **Section 182(c)** includes SIP requirements for ozone NAAs classified as Serious and above. This section defines major sources for areas classified as Serious as sources that emit or have the potential to emit at least 50 tons of VOC per year.
 - **Section 182(c)(2)(A)** requires an attainment demonstration based on photochemical modeling. A modeling inventory is needed for the attainment demonstration analysis.
 - **Section 182(c)(2)(B)** requires a RFP demonstration, and describes requirements for a timeline of VOC emissions reductions. RFP demonstrations must include baseline emissions for comparison against the emissions reductions.
 - **Section 182(d)** defines major sources for areas classified as Severe as sources that emit or have the potential to emit at least 25 tons of VOC per year.
 - **Section 182(e)** defines major sources for areas classified as Extreme as sources that emit or have the potential to emit at least 10 tons of VOC per year.

Ozone

Ozone

- **Section 182(f)** provides that all major source CAA requirements for VOC also apply for NO_x unless a waiver is received.
- **Section 182(j)(1)** requires states in a multi-state ozone NAA to take all reasonable steps to coordinate, substantively and procedurally, the revisions and implementation of SIPs for a multi-state ozone NAA.
- **Section 184(b)(2)** defines major sources for areas within the ozone transport region (OTR) as any stationary source that emits, or has the potential to emit, 50 tons per year of VOC. Per the requirement for Section 182(f), this definition also applies to sources of NO_x.
- **Section 189(a)(2)** in Part D, Subpart 4 provides a different and earlier schedule (18 months rather than 3 years) for PM SIPs than provided for in the general provision in Part D, Subpart 1.
- **Section 189(b)(3)** (also Part D, Subpart 4) defines major sources in Serious PM NAAs as sources that emit 70 tons per year of PM₁₀. Inventories for PM SIPs for Serious NAAs should establish the inventory of major point sources using the lower threshold. This section of the CAA has been determined through the courts to be the appropriate governing section for PM_{2.5} implementation as well as PM₁₀.

PM _{2.5}
PM _{2.5}

It is important to note the distinction between a requirement in the CAA that an inventory be a SIP submission or included in a SIP submission, a requirement that a state's SIP provide for the preparation and submission to EPA of an inventory or other emissions information, and a requirement that a SIP demonstrate some fact (such that a NAAQS will be attained by a future date) that can only be established by using sound emission inventory information in an appropriate manner. This distinction is important because if an inventory is a required SIP submission, then certain procedural requirements apply. Inventories that are SIP submissions, or included in SIP submissions, must comply with all procedural requirements that are applicable to any other SIP submission including but not necessarily limited to those specified CAA section 110 and 40 CFR 51.102, 103 and Appendix V. This document clarifies which emission inventories are required SIP submissions and which are not.

1.4 Summary of Guidance Contents

This guidance document will define parts of and considerations for emissions inventories to meet SIP requirements for complying with the 8-hour ozone NAAQS, the PM_{2.5} NAAQS (24-hour and annual), and the regional haze regulations. Section 2 provides an overview of the creation, documentation, and submission of the planning inventories. Section 3 has subsections for each of the separate inventory requirements or recommendations, with details provided for all requirements except the base year and projected emissions inventories. Sections 4 and 5 provide the detailed guidance on developing base year emissions inventories and projected emissions inventories, respectively.

2 SIP Inventory Overview

There are two categories of emissions inventories associated with SIP development: *planning* inventories and *modeling* inventories. Modeling inventories are used for modeled attainment demonstrations and setting reasonable progress goals for visibility protection. Planning inventories are needed for ozone and PM_{2.5} SIPs to quantify nonattainment area emissions, and they are used as a part of RFP analysis and transportation conformity. The primary focus of this guidance is the *planning* inventories, whereas the modeling inventories are primarily addressed in the modeling guidance that is provided separately in the Modeling Guidance document (see Section 1.2). Unless otherwise noted, all inventories discussed in this guidance are planning inventories.

Generally, the EPA recommends that the planning inventories and modeling inventories be consistent, though there are exceptions. The exceptions are noted where they arise throughout this guidance and the Modeling Guidance; however, the EPA generally encourages air agencies to minimize inconsistencies where possible.

The many aspects of planning inventories are covered more thoroughly in Section 3. These aspects include the timing for submitting the various inventory components, the inventory preparation plan (IPP), the base year NAA inventory, the RFP baseline inventory, the ozone periodic inventory, the ozone emissions statement requirement for SIPs, the maintenance inventories, the attainment projected inventory for the NAA, public hearings, and inventory approval by the EPA.

In this section, we provide an overview of the creation, documentation, and submission of the planning inventories. Section 2.1 lists the various steps associated with building the planning inventory parts of a SIP and identifies the relevant sections of this document that address those steps. The discussions between air agencies and the EPA regarding the inventory approval process is described in Section 2.2. In Section 2.3, we list all of the required inventory components, including modeling inventories that are needed for ozone, PM_{2.5}, or regional haze, but otherwise defer to the Modeling Guidance for the factors for air agencies to consider in building those inventories. In Sections 2.4 and 2.5, we describe other federal emissions reporting requirements that are relevant to NAAQS implementation and provide definitions of key terms needed to understand, develop, and submit emissions inventories for SIPs.

2.1 Recommended Steps for Building the Inventory Parts of a SIP

Throughout this document, we describe many technical components that could be included in inventories in a SIP for ozone, PM_{2.5}, or regional haze implementation. Before air agencies start to create those components, it is important to recognize that there is a process associated with building them. This section describes the process agencies should undertake for a successful inventory development and submittal effort.

The inventory development process involves both required and optional steps. Some optional steps may be taken by the air agency if it believes it is in its best interest to do so, and optional steps can also become critical to a particular SIP development process and identified as such by an EPA Regional office. Thus, a fundamental part of the process is establishing and maintaining open lines of communication between the air agency and the respective Regional office. The Regional office should be viewed by the

air agency as the typical starting point for questions related to planning and modeling inventory development, and the Regional office staff will direct questions needing EPA headquarters input as they arise.

A key aspect of this guidance is identifying opportunities for states to leverage existing work to help them meet the implementation requirements. This starts in Section 2.4 with a description of how work done in support of the NEI can be helpful for the SIP inventory work.

Table 2 provides a list of steps for completing the planning inventory and related parts of a SIP. The list is provided in groups of steps that occur in phases presented roughly in chronological order. The second column of the table indicates the section(s) of this document that give more information on the particular step. States and Regional offices should look for opportunities to be efficient where possible to reduce workload. For example:

- an Inventory Preparation Plan for an air agency that has prepared emission inventory SIPs for a given NAAQS may not be needed, could reference a past plan, or could need fewer details;
- combining documentation from separate steps into a single document where that makes sense; and
- referencing externally provided inventory documentation where externally prepared emissions data have been used in the SIP inventory is acceptable (in this case, the air agency would just explain why the externally prepared data are applicable for the SIP inventory).

Table 2: Steps for building the inventory parts of a SIP

Inventory-related SIP development step	Document section
Planning	
• Review this guidance.	All
• Become familiar with inventory development resources.	1.1 1.2
• During development of the Inventory Preparation Plan, clarify and discuss the inventory approval process that your Regional office will use, including all requirements, reporting formats and elements to be included, timing, and technical documentation contents.	2.2 (general) 3.1 (timing)
• Understand required and potentially required inventory components for the SIP. Determine which inventories must be created for your SIP.	2.3
• Understand inventory definitions and data requirements.	2.5
• Understand timing requirements of submitted components.	3.1
• Prepare and finalize the Inventory Preparation Plan.	3.2
• Prepare a quality assurance project plan (QAPP)	3.2
• Understand requirements and choose key inventory features, including inventory year(s), the pollutants and precursors to be included, and priority emissions sources.	4
Creating Inventories	
• Assess what inventories already exist that can be used as a starting point.	2.4 3.3

Inventory-related SIP development step	Document section
<ul style="list-style-type: none"> • Create base-year (planning) inventories. 	4
<ul style="list-style-type: none"> • Quality assure and refine base year inventory data in accordance with the IPP and QAPP. 	0
<ul style="list-style-type: none"> • Create projected (planning) emission inventories. 	5
<ul style="list-style-type: none"> • Quality assure and refine projected planning emission inventories in accordance with the IPP and QAPP. 	5.5
Preparing Documentation	
<ul style="list-style-type: none"> • Review requirements with respective Regional office in light of the particular challenges associated with a given SIP development process, such a first nonattainment SIP development for a state, area, or air agency staff. 	2.2
<ul style="list-style-type: none"> • Prepare documentation. 	3.10
Public Hearings	3.9
Submit to the EPA for Approval	3.10

2.2 Discuss the Inventory Approval Process with EPA

Early in the SIP planning process, air agencies should discuss the emissions inventory approval process for that specific SIP with their respective EPA Regional office. These discussions should address the tangible items (e.g., reports, data files, summary spreadsheets) that will be delivered to the EPA as necessary to support the EPA's review and approval.

A common source of confusion is whether inventories must undergo public review. Inventories that are SIP submissions, or are included in SIP submissions, must comply with all procedural requirements that are applicable to any other SIP submission including but not necessarily limited to those specified in CAA section 110 and 40 CFR 51.102, 103 and Appendix V. Details on the public review issue are addressed in more detail in Section 3.9.

As new issues arise during the SIP development process, air agencies or the EPA Regional offices may need to reassess the previously discussed inventory approval process. Both agencies should be aware of possible changes that are needed as the inventory development process occurs, and either party should raise concerns about the need for discussion and possible revision of the process. Details of the process and documentation can be modified through additional discussions as the need arises. As the inventory development process works far better when lines of communication remain open, the EPA encourages periodic coordination meetings or check-ins during the inventory development periods.

Table 3 provides a list of tangible reports, summaries, and data files that could be included as part of the inventory efforts for SIPs. Some of these items are needed to meet statutory and/or regulatory requirements, and these are listed in Tables 4 through 6 below. The form of reports, summaries, and data files to be included should be clarified with the Regional office at the start of the inventory development process for SIPs. States should discuss and confirm with the EPA Regional office the items to be included in the SIP to avoid inadvertent omission of items required for approval of the inventory parts of the SIP. While certain recommended items in Table 3 are not specifically required by the

regulations, the EPA review of the required elements should include supporting documentation so that the EPA can assess whether the approaches used for developing inventories are technically sufficient and meet the requirements to use appropriate methods and current, accurate information.

One notable and important difference between regional haze and the other two programs (ozone attainment SIPs and PM_{2.5} attainment SIPs) is that there is no requirement to submit detailed emissions inventory data as an element of a required Regional Haze SIP. While the regional haze program expects that inventories will be used to accomplish the required elements of the Regional Haze SIP and the regional haze regulations require the SIP to provide for the preparation of emission inventories for particular timeframes,⁵ the detailed emissions inventory data are not submitted as a SIP element (or SIP revision) like the data must be for ozone and PM_{2.5}. The recommended items in Table 3, however, will allow the EPA to make a determination whether the emissions information used in Regional Haze analysis is sufficient for the purposes of the SIP.

Following receipt of an emissions inventory from air agencies, the EPA will determine if it is part of a SIP submission or not. If an emissions inventory is provided to the EPA as a component of a SIP submittal, then EPA will process that SIP submittal, including the emissions inventory component, in accordance with applicable laws and regulations (FN: CAA section 110 and 40 CFR 51.102, 103 and Appendix V). As an example, emissions inventories required by CAA section 182(a)(1) are to be provided to EPA as a SIP submission (FN: See 80 FR 12264,12291). Conversely, if an emissions inventory is provided to the EPA outside of a SIP submittal, then EPA will review and process that inventory as necessary.

⁵ See 40 CFR 51.308(d)(4)(v) Regional Haze SIPs must “provide for” statewide emissions inventories of pollutants that are reasonably anticipated to cause or contribute to visibility impairment in any mandatory Class I Federal area. The Regional Haze Rule similarly requires state’s Regional Haze SIPs for the second and subsequent implementation periods to provide for such emissions inventories (40 CFR 51.308(f)(6)(v)).

Table 3: Recommended items to include in inventory information provided to the EPA

	Inventory Item	Ozone	PM_{2.5}	Regional Haze
Planning Inventories	Inventory Preparation Plan	X	X	X
	Emissions Inventory Report, with explanations of methods, quality assurance and emissions summaries. All inventories can be included in such a report, including base year and projected inventories. The inventories to be included depend on the NAAQS, the nonattainment classification, and the stage of implementation (initial SIP, redesignation, etc.).	X	X	
	Emissions Inventory Report, with explanations of methods, quality assurance and emissions summaries. All inventories can be included in such a report, including base year (applicable only for the SIP due on July 31, 2007), most recent year, and projected inventories.			X
	Tables or spreadsheets of emissions summaries included in the inventory report	X	X	X
	Detailed emissions inventory files, databases, or spreadsheets	X	X	
Modeling Inventories	Modeling Demonstration Report – The emissions information can be a section in a larger report or could have its own report. The content should include methods, quality assurance, and emissions summaries for the modeling inventories, including projected inventories. A statewide emissions summary is needed, and this can be included in the planning inventory SIP for convenience.	X	X	X
	Tables or spreadsheet summaries of emissions inventory used for modeling	X	X	X
	Detailed emissions inventory files, databases, or spreadsheets	X	X	
	Detailed data about emissions controls used to model	X	X	
Other	Emission Statement SIP showing the state’s program to require sources to submit emissions statements annually	X		

2.3 Planning and Modeling Inventory Components

The ozone, PM_{2.5}, or regional haze implementation rules have specific inventory requirements for SIPs to support attainment, maintenance, and/or reasonable progress demonstrations. Additionally, there are possible inventory details that could be required or advisable for various reasons. One major distinction between the inventory requirements of the ozone and PM_{2.5} rules versus the RHR is that the former two rules require inventories for NAAs, while the latter expects that states develop statewide inventories. This section provides a list for each of the three rules for the required and possible inventory components of SIPs, with additional details for the types of planning inventories.

2.3.1 Ozone SIP Inventory Components

The Ozone Implementation Rule (40 CFR part 51, Subpart AA) provides the regulatory requirements for inventories of actual emissions that support ozone NAAQS implementation by air agencies. Table 4 below is a list of components that could be part of preparing an ozone SIP. The governing portion of the CAA, and/or rule citation and deadline are listed where applicable, as well as sections in this guidance document or other guidance where they are addressed. The deadlines are expressed in months after the effective date of designation (EDD) of the area. Note that not all components are required in every case. Individual SIP requirements may be different depending on attainment designation, year of designation, and other factors specified in the rules. These details should be discussed with the relevant EPA Regional office.

States and other air agencies that perform modeled attainment demonstrations should also refer to the Modeling Guidance (http://www3.epa.gov/ttn/scram/guidance_sip.htm), which includes a section on emissions inventories for modeling. As part of that guidance, emissions inventory summaries are described for inclusion in technical documentation about the modeled attainment demonstration. To assist the public when it comments on the SIP submittal and to facilitate EPA review of the SIP submissions, these summaries of modeling inventories can be submitted as part of the documentation provided with the emissions inventory SIP, but are not required SIP elements.

Table 4: References for Ozone SIP emissions inventory components

Inventory Component	Required by CAA? (CAA Section)	Regulatory Citation (Due Date)	Guidance Sections and/or Document(s)
Inventory Preparation Plan			Section 3.2
Base year inventory for the NAA	182(a)(1)	40 CFR 51.1115(a) (24 months after EDD)	Section 3.3 and Section 4
ROP/RFP baseline NAA inventory (part of the ROP/RFP plan(s); for Moderate and above areas)	Moderate & above: 182(b)(1)(B) Serious & above: 182(c)(2)(B)	40 CFR 51.915 40 CFR 51.1110(b) (36 months after EDD)	Section 3.4 and Section 4
Periodic NAA inventory	182(a)(3)	40 CFR 51.915 40 CFR 51.1115(b) (No later than the end of each 3-year period after required base year submission)	Section 3.5 and Section 4
Attainment projected inventory for the NAA ⁺		Summary required by 40 CFR 51.114 (b) (with plan)	Section 3.8 and Section 5
Maintenance NAA inventory	175A(a) [†]		Section 3.7 and Section 4
Source Emission Statements requirement for SIPs	182(a)(3)(B)	40 CFR 51.915 (24 months after EDD)	Section 3.6
Inventories for modeled attainment demonstrations (base and	182(c)(2)(A) ^Δ	40 CFR 51.908 40 CFR 51.1108 (Timing depends on	See the Modeling Guidance . Summaries of inventories (base and projected

Inventory Component	Required by CAA? (CAA Section)	Regulatory Citation (Due Date)	Guidance Sections and/or Document(s)
projected attainment year modeling inventories)		nonattainment classification)	attainment year) are encouraged to be included in technical documentation.
Public hearing requirement for SIP inventories	110(a)(2)	40 CFR 51.102	Section 3.9
Planning inventory documentation			Section 3.10

+ If this inventory is the mechanism by which the ROP/RFP plan requirements will show the emissions reductions required for ROP/RFP, then this inventory or its summary would necessarily become part of the ROP/RFP plan(s). Motor vehicle emissions budgets for purposes of transportation conformity are the on-road portion of the projected emissions associated with the ROP/RFP plan.

‡ Maintenance NAA inventories are only associated with maintenance SIPs rather than attainment demonstration SIPs.

Δ While modeling inventories are not an explicit requirement of the CAA, it is presumed here that states would not be able to perform credible modeled attainment demonstrations without modeling inventories.

2.3.2 Annual and 24-Hour PM_{2.5} SIP Inventory Components

The PM_{2.5} SIP Requirements Rule (40 CFR part 51, Subpart Z) provides the regulatory requirements for inventories of actual emissions that support PM_{2.5} NAAQS implementation by state, local, and tribal agencies. In Table 5 below, we list the inventory components that could be part of a PM_{2.5} SIP and provide a map to the governing portion of the CAA, regulations, and the applicable guidance.

For areas that perform modeled attainment demonstrations, please also refer to the [Modeling Guidance](#), which includes a section on emissions inventories for modeling. As part of that guidance, summaries are described for statewide inventories. For convenience, these summaries can be included in the emissions inventory SIP. Areas that do not perform modeled attainment demonstrations would not need to provide the statewide inventories for PM_{2.5}.

Table 5: References for PM_{2.5} SIP emissions inventory components

Inventory Component	Required by CAA? (CAA Section)	Regulatory Citation (Due Date)	Guidance Sections and/or Document(s)
Inventory Preparation Plan			Section 3.2
Base year inventory for the NAA	172(c)(3)	Moderate 40 CFR 51.1008(a)(1) ^α (18 months after EDD)	Section 3.3 and Section 4
Attainment projected inventory for the NAA		Moderate: 40 CFR 51.1008(a)(2) ^α (18 months after EDD)	Section 3.8 and Section 5
Maintenance NAA inventory	175A(a) [‡]		This document, Section 3.7 and Section 4
Inventories for modeled attainment demonstrations (base year and projected)	189(a)(1) for Moderate areas and	40 CFR 51.1001 and Appendix W (18 months after EDD)	Modeling Guidance . Summaries of statewide inventories (base and projected attainment

Inventory Component	Required by CAA? (CAA Section)	Regulatory Citation (Due Date)	Guidance Sections and/or Document(s)
attainment year modeling inventories)	189(b)(1) for Serious areas ^Δ		year) are encouraged to be included in technical documentation.
Public hearing requirement for SIP inventories	110(a)(2)	40 CFR 51.102	Section 3.9
Planning inventory documentation			Section 3.10

^α If an area is reclassified as Serious, the applicable requirements refer back to this subsection from 40 CFR 51.1008(b). If a Serious area has failed to meet the PM_{2.5} NAAQS by the Serious area attainment date, then see 40 CFR 51.1008(c), which still refers back to the Moderate area requirements and has a 12 month deadline.

⁺ Maintenance NAA inventories are only associated with maintenance SIPs rather than attainment demonstration SIPs.

^Δ While modeling inventories are not an explicit requirement of the CAA, it is presumed here that states would not be able to perform credible modeling attainment demonstrations without modeling inventories.

2.3.3 Regional Haze SIP Inventory Components

The RHR (40 CFR part 51, Subpart P) has significantly different inventory requirements from ozone and PM_{2.5} implementation rules. One reason for this difference is the time horizon of the regional haze program. The program consists of implementation periods that are referred to as the first planning period, second planning period and so forth. There are parts of regional haze implementation plans that have been completed via the SIP for the first implementation period (ending in 2018) and may not need to be revisited in SIPs for later implementation periods, but for completeness we also explain these here. Another difference is that the RHR requires the use of statewide planning inventories rather than inventories for only a smaller NAA. Finally, the most important difference is that there is no requirement that emission inventories be submitted as a SIP revision. While the inventories are needed to support the SIP, and the SIP must provide for the specified emission inventory information, the detailed statewide inventories need not be submitted. This section briefly discusses the existing requirements related to emission inventories for the first planning period, and then goes on to address the same requirements as proposed for the second and subsequent planning periods.

For the first planning period, the RHR in 40 CFR 51.308(d)(3)(iii) required a SIP submission to include the technical basis on which the State was relying to determine its apportionment of emission reduction obligations necessary to achieve reasonable progress towards natural visibility conditions, including identification of the “baseline emissions inventory” used for such technical analysis. The rule indicated that the baseline emissions inventory year for the first planning period is presumed to be the most recent year of the consolidated periodic emissions inventory (as defined in Subpart A and commonly called the NEI). As a result, this “baseline” inventory used in the SIPs reflects a year from the 2000-2004 period, for which the 2002 was the applicable NEI year. For the first planning period, most states also used a year from this period as the base year for their regional air quality modeling (states that were members of the Lake Michigan Air Directors Consortium (LADCO) also used 2005 in their air quality modeling).

In addition, 40 CFR 51.308(d)(4)(v) required that the plan provide for a statewide inventory of emissions for a “baseline” year, for the most recent year in which data are available (“recent year”), and estimates of future projected emissions. This section made it clear that the inventories associated with the planning effort needed to be “statewide.” This guidance document does not explain in detail the emission inventory requirements for SIPs for the first implementation period, most of which have already been submitted and acted upon by the EPA.

The regional haze rule required a first progress report 5 years after submission of the first periodic comprehensive SIP revisions in 40 CFR 51.308(g). Because many of the first of these required 5-year progress report SIP revisions have already been submitted and the remaining progress reports should be far along in preparation as of the date of this document, this guidance document does not address the first-required progress reports. For guidance on these first required 5-year progress reports, readers should use the separate guidance document [“General Principles for the 5-Year Regional Haze Progress Reports for the Initial Regional Haze State Implementation Plans.”](#)

Periodic SIP revisions for the second and subsequent planning periods are due on or before July 31, 2021, July 31, 2028, and every 10 years thereafter. 40 CFR 51.308(f) of the RHR outlines the requirements for these comprehensive, 10-year SIP revisions. Section 51.308(f)(2) specifies that the SIP revision include a long-term strategy, and section 51.308(f)(2)(iii) requires that the state document the technical basis for its determinations of the emission reductions from anthropogenic sources that are necessary for achieving reasonable progress towards natural visibility conditions. The wording in this section requires that the state’s emission information must, at a minimum, include “information on emissions in a year at least as recent as the most recent year for which the State has submitted emission inventory information to the Administrator in compliance with the triennial reporting requirements of subpart A of this part.” Additionally, the rule provides a 12-month grace period after the submission of emissions inventory information before states are required to use that information in a regional haze SIP submission.

Periodic progress reports for the second and subsequent planning periods are due on January 31, 2025, July 31, 2033, and every 10 years thereafter (40 CFR 51.308(g)). Progress reports are scheduled to be submitted midway between the most recent SIP revision and the subsequent “10-year” SIP revisions (section 51.308(g)). Section 51.308(g)(4) requires states to analyze the change in emissions over the period since the previous plan revision (i.e., the SIP revisions due in 2021, 2028, and every 10 years thereafter). Per the rule, emissions changes should be identified by type of source or activity, and this guidance provides recommendations for what emissions summaries these reports should include to accomplish that objective. In addition, the rule specifies that the analysis of historical emissions must extend at least through the most recent year for which the state has submitted emission inventory information to the EPA in compliance with the triennial reporting requirement of the Air Emissions Reporting Rule (AERR), 40 CFR part 51, Subpart A. For data (such as EGU data) that are submitted directly via a centralized EPA emissions data system and then made available by EPA, the data used must be the most recent year for which the EPA has provided state-level summary data or an internet-based tool by which the State may obtain such a summary as of a date 6 months before the required date of the progress report. Further, section 51.308(g)(5) requires an assessment of any significant

changes in anthropogenic emissions within or outside the state that have occurred since the previous SIP revision.

In the RHR, section 51.308(f)(6)(v) mirrors a part of section 51.308(d)(4)(v) by specifying that SIP revisions for the second and subsequent planning periods must provide for a statewide inventory of emissions for the most recent year in which data are available (“recent year”) and estimates of projected emissions. Therefore, in its SIP revision for the second and subsequent implementation periods, a state will need to describe its process for preparing, or providing essential information for the collective preparation of, a statewide emission inventory for the latest “recent year” and a projection inventory for the last year of the implementation period. Table 6 summarizes a list of the Regional Haze SIP emissions inventory components, including the appropriate references to the CAA, the regulations, and the relevant sections of this guidance.

Table 6: References for regional haze SIP emissions inventory components

Inventory Component	Required? (CAA Section)	Regulatory Citation (Due Date)	Guidance Sections and/or Document(s)
Inventory Preparation Plan			Section 3.2
Baseline statewide inventory Recent year statewide inventory Projected statewide inventory (For the first planning period)	169A(b) ⁺	40 CFR 51.308(d)(4)(v) (completed)	Previously completed as part of initial Regional Haze SIP for the first planning period.
Periodic progress report, recent year statewide inventory	169A(b) ⁺	40 CFR 51.308(g)(4) and (5) (see guidance noted above)	Section 3.5.2 and Section 3.10.3
10-year SIP revisions, recent year statewide inventory ^Δ	169A(b) ⁺	40 CFR 51.308(f)(6)(v) (varied dates)	Section 3.5.2 and Section 4
10-year SIP revisions, projected statewide inventory ^Δ	169A(b) ⁺	40 CFR 51.308(f)(6)(v) (varied dates)	Section 3.8 and Section 5
Documentation			Section 3.10

⁺ CAA 169A(b) provides the authority to provide guidelines to the states on appropriate techniques and methods to implement the visibility protection goals in the CAA. This has been done through regulations as codified in 40 CFR 51.308 and 51.309.

^Δ If modeling is done to support the 10-year SIP revision, these are modeling inventories.

2.4 Other Relevant Federal Emissions Reporting Requirements

The Air Emissions Reporting Rule (AERR), 40 CFR part 51, Subpart A, requires states to provide to the EPA annual statewide emissions inventory data, regardless of whether that state has nonattainment areas. This regulation requires reporting of actual emissions of CO, NO_x, VOC, SO₂, PM_{2.5}, particulate matter with diameter ten microns and less (PM₁₀), and ammonia (NH₃). For PM_{2.5}, the AERR requires states to report primary (i.e., “direct”) PM_{2.5}, which is defined as the sum of filterable PM_{2.5} and condensable PM. The agencies are required to report the filterable PM_{2.5} and condensable PM separately where they are present from the source (see Section 4.2.1). States may delegate the reporting requirements to local air agencies. Tribes can also submit these data to the NEI, but are not

required to do so. These data are used by the EPA's Office of Air and Radiation's (OAR) Office of Air Quality Planning and Standards (OAQPS) to build the NEI, and a complete version that includes all sources of emissions (with minor exceptions) is released every 3 years.

The AERR includes both triennial and annual statewide reporting requirements, with more extensive reporting requirements for triennial inventory years. Triennial years for the NEI include 2011, 2014, and every 3rd year thereafter. For the interim annual inventories, reporting is limited to emissions data from only the larger point sources (Type "A" sources), as defined by [Appendix A of 40 CFR part 51, Subpart A](#). For the triennial inventories, lower point source thresholds are given in Appendix A, consistent with the definition of major sources in 40 CFR part 70. All other sources of emissions must be reported as nonpoint or mobile sources on a county basis in the triennial submissions. Additionally, lower point source thresholds may apply to ozone, PM_{2.5}, PM₁₀, and CO NAAs, depending on the area's nonattainment classification.

The AERR requirements are relevant for SIP planning inventory purposes in several ways. First, the AERR and its associated EIS (data system) provide the appropriate data elements (fields to be reported) for inventories for electronic transfer to the EPA. Second, AERR-based inventories are often used as a starting point for SIP inventories. Third, in some cases, AERR submissions can meet some of the inventory requirements described in this document. Finally, the resources provided by the EPA for states to meet their AERR reporting obligations, such as emissions inventory tools and models, associated documentation, emission factors, new emissions methods, and quality assurance approaches, can assist inventory developers when making inventories for SIP planning and modeling purposes.

As a point of clarification, air agencies must meet all relevant planning inventory SIP requirements regardless of the availability or use of the EPA data associated with the AERR/NEI process. While the EPA resources can be helpful to states in meeting those requirements, the SIP requirements and the associated public review and Regional office approval process are independent requirements that must be met. It would not be sufficient to merely point to the EPA's publication of the NEI as having met the SIP emissions inventory requirements. However, it may be sufficient for a state to submit as a SIP revision an inventory that contains some or all of the same data as in the NEI, with sufficient justification and using the applicable public comment process.

2.5 Emissions Inventory Definitions

Emissions inventory work requires knowledge of many terms and codes. In this section, we define the terms relevant to inventories that are used throughout this document. This section also references external materials needed for obtaining definitions of all valid fields that can be used for building inventories, which are based on the tables used to submit data to the EPA for the AERR. Many definitions relevant for emissions inventories are defined in the CAA or codified in the AERR and the implementation rules. These are included here for a convenient reference in a single location since these terms are used throughout this document. Without these definitions, the meaning of the subsequent sections would be less clear. The sample below is not intended to represent a comprehensive list of inventory related definitions.

2.5.1 Source Category/Data Category

Traditionally, the term “source category” has been used to identify the major types of emissions inventory groupings: stationary point sources, stationary area (or nonpoint) sources⁶, on-road mobile sources, nonroad mobile sources. In addition, fires and biogenic sources are sometimes included as additional source categories.

In practice, some inventories have started including large moveable facilities, such as asphalt plants, in the point sources inventory without associating them with a specific county. Additionally, some mobile sources such as locomotives and commercial marine vessels (CMVs) are treated as nonpoint data (i.e., the formatting of it) for the purpose of reporting these data to the EPA via the EIS (see also Section 4.8.5 as well as the EIS information referenced in Table 1). Similarly, because of the data format and their physical nature (i.e., a discrete geographic location), rail yards and airports are treated as point data in the EIS.

With the advent of the EIS, the preferred term for indicating subsets of inventory data has become “data category” rather than “source category” because the groupings have much more to do with how the data are created and the data structure than the features of the actual emissions sources included in the category. For example, locomotives and commercial marine vessels are included in the nonpoint data category for inventories in the EIS, but in fact are nonroad mobile sources. Additionally, the EIS ushered in a new data category called “events,” which are typically wildfires or prescribed fires (agricultural fires are part of the nonpoint data category), but in principle could include other significant, short-duration, emissions events.⁷

2.5.2 Types of Emissions: Annual, Seasonal, Actual, Potential, and Allowable

Various terms are used in this and other documents to reference various types of emissions. Here, we provide a brief list of definitions associated with various emissions types.

Actual emissions means the emissions of a pollutant from an affected source determined by taking into account actual emission rates associated with normal source operation and actual or representative production rates (i.e., capacity utilization and hours of operation) (40 CFR 51.491). This is in contrast with potential emissions or allowable emissions. These actual emissions should include emissions of a pollutant that occur during periods of startup, shutdown, and malfunction (see Section 4.8.1). In addition, please see Section 4.1 for a description of selecting a year for creating actual emissions estimates.

Allowable emissions means the emissions of a pollutant from an affected source determined by taking into account the most stringent of all applicable SIP emissions limits and the level of emissions

⁶ Over time, stationary area sources have been renamed “nonpoint” sources to avoid confusion with the air toxics regulatory term “area sources,” which are often sources that meet the criteria pollutant definition of point sources. Likewise, the term “stationary” is often ignored in common use for both the point source and nonpoint labels.

⁷ While the EIS is not currently configured to accept event data other than for fires, this means that the idea of an “event” could be expanded to other types of events that are not currently inventoried because of the difficult nature and non-routine nature of these types of emissions.

consistent with source compliance with all federal requirements related to attainment and maintenance of the NAAQS and the production rate associated with the maximum rated capacity and hours of operation (unless the source is subject to federally enforceable limits that restrict the operating rate, or hours of operation, or both) (40 CFR 51.491).

Annual emissions are defined in the AERR (40 CFR 51.50) as actual emissions for a plant, point, or process that are measured or calculated to represent a calendar year. This means that annual emissions should include all emissions of the relevant sources at a facility or from a nonpoint or mobile process occurring during a calendar year. In general, unless otherwise specified, annual emissions means actual emissions, as defined above.

Average season day emissions means the sum of all emissions during the applicable season divided by the number of days in that season. This definition is used in the context of inventories developed for SIPs associated with the 24-hour PM_{2.5} NAAQS.

Potential to emit means the maximum capacity of a stationary source to emit a pollutant under its physical and operational design (40 CFR 51.301). Also called “potential emissions,” 40 CFR 51.301 also defines this term to specify that any physical or operational limitation on the capacity of the source to emit a pollutant including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation or the effect it would have on emissions is federally enforceable. Secondary emissions do not count in determining the potential to emit of a stationary source.

As described in “Potential to Emit: A Guide for Small Businesses” (EPA-456/B-98-003), potential to emit considers the equipment design and can also consider certain controls and limitations on the operation of the equipment. Potential emissions can be expressed as *potential controlled emissions*, which are the pollutant emissions while a source is operating at the maximum design capacity, a schedule of 8,760 hours per year, and considering the efficiency of the control equipment. In contrast, *potential uncontrolled emissions* are simply the pollutant emissions while the source is operating at the maximum design capacity and a schedule of 8,760 hours per year without factoring in controls.

Startup, Shutdown, and Malfunction (SSM) emissions are emissions that occur during startup, shutdown, or malfunctions at industrial facilities. As a factual matter, the emissions rate during periods of SSM can be much larger than the emissions rates during periods of normal operating procedure (that is, not during periods of SSM). However, applicable emissions limitations apply at all times, including during periods of SSM.⁸ More information about the startup and shutdown emissions in the SIP inventory context is described in Sections 4.3 and 4.8.1.

Ozone season day emissions means an average day’s emissions for a typical ozone season work weekday. The state shall select, subject to EPA approval, the particular month(s) in the ozone season

⁸ On May 22, 2015, the EPA issued a final action to ensure that states have plans in place that are fully consistent with CAA and court decisions concerning SSM operations. This action included a “SIP call” that directs 36 states to correct specific SSM provisions in their SIPs. The SIP submission deadline for the states subject to this action is November 22, 2016. See the [rule website](#) for more information.

and the day(s) in the work week to be represented, considering the conditions assumed in the development of RFP plans and/or emissions budgets for transportation conformity.

2.5.3 Duration and Timing of Emissions

Inventory start date means the first day of the inventory period. This can be used for compiling and reporting monthly or other shorter period emissions, including events.

Inventory end date means the last day of the inventory period. This can be used for compiling and reporting monthly or other shorter period emissions, including events.

Inventory year or Emissions year means the year for which emissions estimates are reported (40 CFR 51.50).

See also “Emission Type” in codes Section 2.5.14.

2.5.4 Data Elements

The term “data elements” means parts of a data file that contain individual items of data. These are also called fields or variables. Examples of key data elements associated with emissions inventories include emissions; activity; emission factors; state/county identifiers; facility, unit, and process identifiers; plant names; control measure codes; and process codes. This list is just a sample and is not intended to represent a comprehensive list of required codes (see also Section 2.5.5).

Note that emissions data categories (Section 2.5.1) are not a data element per se, but rather emissions inventory submissions usually are broken out into separate datasets for each data category.

2.5.5 Emissions Reporting Data Elements

The Ozone Implementation Rule and PM_{2.5} SIP Requirements Rule refer to the AERR and this guidance for information on reporting data elements. Since the AERR is focused on emissions submitted for the annual NEI inventory, it only includes definitions for those data and fields that are *required* by the NEI program. For ozone SIP inventories, ozone season day emissions are required, but are optional for reporting in accordance with the AERR. For PM SIP inventories, either or both annual or average season day emissions can be included (depending on the circumstances), but the average season day emissions are optional for reporting for AERR purposes.

The many required and optional data elements for emissions inventories are described in Excel files called Staging Requirements. These files are comprehensive for all of the required and optional fields that can be submitted to the EPA for SIP inventories, not only the submissions for the NEI. The shared field list for NEI and SIP inventories helps air agencies by promoting clarity and familiarity through common data element definitions across multiple inventory requirements. The descriptions provided in those Excel files are very limited, so this document provides additional information for the most important of these fields. These spreadsheets are available at the Emissions Inventory Training website at <https://www.epa.gov/air-emissions-inventories/air-emissions-inventory-training> using the links for “Training Materials” listed for each training on the page. Within the Zip file provided for the “Training Materials” links, an Excel file is available that includes “staging requirements” and lists the data elements and their definitions.

Although many fields in the Staging Requirements are optional for AERR reporting purposes, some of these fields can be critical for inventory development for SIPs and even the NEI. By “optional,” we mean those fields that are not explicitly required by the AERR or that are not enforced during electronic reporting as needing to be provided to successfully submit the data to the EPA. The list below identifies fields that are “optional” but that are strongly recommended to be included in all emissions inventories, documentation, and reporting as applicable for the sources in the state or NAA. For example, control parameters are optional only because emissions controls do not exist on every unit and process in an inventory, thus the EPA cannot enforce this during electronic reporting as a required field. However, the control information is required by the AERR when it exists at the emissions source and should be provided for SIP inventories.

Unit Description: This field describes the unit in words. It can be invaluable in pairing the unit and corresponding processes to correct source classification codes (SCCs).

Unit design capacity: Unit design capacity means a measure of the size of a point source, based on the reported maximum continuous throughput or output capacity of the unit (40 CFR 51.50). Useful for boilers, this field is needed when trying to understand the cost per ton of pollutant emissions reduced associated with controls on boilers. The cost per ton is generally higher for smaller boilers. The design capacity can be critical in SIP planning for ensuring that good decisions are made about controls on stationary boilers and other units. While required by the AERR, the EIS does not enforce this field as many states do not have this information available. By including these data in SIP inventory development, states can help to further improve the data available to them for decision making as well as for consideration by the EPA.

Control measure: This field is a unique code for the type of control device or operational measure (e.g., wet scrubber, flaring, process change, and ban) used to reduce emissions (see 40 CFR 51.50). When assessing whether an emissions source can be further controlled to contribute emissions reductions needed for attainment, it is imperative to know whether there is a control measure included on a unit or process. The type of measure is also needed to understand whether other controls can be added. The associated data elements such as control efficiency, capture efficiency, rule effectiveness, and rule penetration are all useful as well for the same reasons. These latter control parameters are also needed when calculating potential controlled emissions.

Alternative facility names or identifiers: This field can be very useful in matching the facility with other databases, such as the Toxics Release Inventory (TRI), the Federal Registry System, or the National Electric Energy Data System (NEEDS) database. If air agencies change their agency IDs (facility, unit, process, and release point) from one year to the next, this table can help prevent creating duplicates in the EIS and other databases.

EIS IDs: While the EIS Facility ID, Unit ID, Process ID, and Release Point ID (see Section 2.5.15) are not required by the AERR or for SIP inventories, it is the standard by which the EPA compiles and reports all point source inventories. The EPA reports and modeling all use these EIS IDs, and so to the extent air

agency databases can use these IDs in their data systems, it helps facilitate matching across the many purposes for inventories.

Release Point Geographic Coordinates: As described in Section 2.5.17, the EIS and inventories generally can have location coordinates (i.e., latitude/longitude) for a facility or at individual release point locations.

2.5.6 Throughput and Activity

Throughput means a measurable factor or parameter that relates directly or indirectly to the emissions of an air pollution source during the period for which emissions are reported (40 CFR 51.50). Throughput is also called activity. Depending on the source category, activity information may refer to the amount of fuel combusted, raw material processed, product manufactured, or material handled or processed. It may also refer to population, employment, miles travelled, or number of existing units. Activity throughput is typically the value that is multiplied against an emission factor to generate an emissions estimate. Consequently, it is important to coordinate activity used for a given emissions source with the available emission factors for that source.⁹

There are some special types of activities always used for certain categories. Examples for mobile sources include:

Vehicle Miles Traveled (VMT): The number of miles travelled within a year or as an average daily value for all vehicles within a group (e.g., vehicle type, fuel type, and county). See also MOVES Technical Guidance (<http://www.epa.gov/otaq/models/moves/index.htm#sip>).

Vehicle population: The number of vehicles of a certain type and fuel usage within a group (such as a county).

Equipment population: The number of nonroad equipment units of a certain type and fuel usage within a group (such as a county).

2.5.7 Emission Factors

An emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per megagram of coal burned). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in the source category (i.e., a population average). Emission factors have long been the fundamental key to developing emissions inventories for air quality

⁹ Some air agencies have raised the concern that throughput at industrial facilities is considered confidential business information (CBI), however, this field is required by the AERR. Since this field is “emission data” required by the AERR, it cannot be protected as CBI under CAA section 114(c).

NAAQS implementation. More information on emission factors is available from the Clearinghouse for Inventories and Emissions Factors (<https://www.epa.gov/chief/>) on the EPA website.

The general equation for emissions estimation is:

$$EE = AA \times EEEE \times (1 - EEEE/100)$$

where:

E = emissions,

A = activity total,

EF = emission factor, and

ER = overall emission reduction efficiency percent.

The ER term is the combination of the relevant percentages related to emissions controls and rules that reduce emissions, as listed in Section 2.5.18.

Emission factors are not limited to factors that only represent broad national industry averages published by the EPA. Emission factors can also be stack-, process-, unit-, or facility-specific, depending on the basis of the source test information. Whether for a single facility or a group of facilities of the same type, it is still considered an emission factor for the purposes of this guidance.

2.5.8 Point Sources

As defined by the AERR in 40 CFR 51.50, point sources are large, stationary (non-mobile), identifiable sources of emissions that release pollutants into the atmosphere. A point source is a facility that is a major source under 40 CFR part 70 for one or more of the pollutants for which reporting is required by 40 CFR 51.15 (a)(1). This does not include the emissions of hazardous air pollutants, which are not considered in determining whether a source is a point source for ozone, $PM_{2.5}$, and regional haze emissions inventory development and reporting. These point sources can be associated with a single point or group of points in space. Examples of important point source emissions categories include power plants, industrial boilers, petroleum refineries, cement plants, and other industrial plants.

According to the ozone and $PM_{2.5}$ Implementation Rules, the AERR governs the emissions level above which sources are inventoried as point sources. While the AERR also requires data from state agencies for use in the NEI, the AERR emissions point source thresholds have been coordinated with the various SIP implementation rules and definitions of major sources and, therefore, they apply to all inventories provided to the EPA. The AERR bases the emissions level on a potential to emit emissions size threshold. Table 7 provides the potential to emit point source reporting thresholds included in the AERR. For evaluating the potential to emit threshold, it is appropriate to use potential *controlled* emissions for controlled sources. As shown in Table 7, special requirements apply to NAA sources, where even lower thresholds may apply depending upon the severity of the NAA classification.

Air agencies may include point sources at even lower levels in their NEI or SIP planning and modeling inventories. The AERR thresholds simply provide a minimum requirement. Depending on the nature of the nonattainment problem and the need to characterize smaller sources as point sources, a state may

want to consider and the EPA Regional offices may encourage lower thresholds so air agencies can produce effective SIPs.

Type A source means a large point source with potential annual emissions of any CAP or CAP precursor greater than or equal to the corresponding emission threshold listed in the AERR. These sources must be reported by states every year and have higher reporting thresholds. The thresholds are not repeated in the table below because they are not relevant for the definition of point sources for SIP inventory purposes, which follow the Type B thresholds for triennial reporting as shown below. See [Appendix A of 40 CFR part 51, Subpart A](#) for the Type A source thresholds.

Type B source means a point source smaller than a Type A source with potential annual emissions of any CAP or CAP precursor greater than or equal to the relevant Type B emission threshold listed in the AERR and in this section. Type B point sources are required by the AERR to be included in a state or local inventory submission for point sources in the triennial years and are applicable to SIP planning and modeling inventories as well.

Table 7: Point source triennial reporting thresholds (potential to emit) for criteria pollutants in the Air Emissions Reporting Rule

Pollutant	Triennial NEI thresholds: potential to emit (tons/yr)	
	Type B sources (default)	NAA sources
1 SO ₂	≥ 100	≥ 100
2 SO ₂		PM _{2.5} (Serious) ≥ 70
3 VOC or NO _x	≥ 100	≥ 100
4 VOC or NO _x....	.....	O ₃ (Moderate within OTR) ≥ 50 ⁺
5 VOC or NO _x....	.....	O ₃ (Serious) ≥ 50
6 VOC or NO _x....	.....	O ₃ (Severe) ≥ 25
7 VOC or NO _x....	.....	O ₃ (Extreme) ≥ 10
8 VOC or NO _x....	.....	PM _{2.5} (Serious) ≥ 70
9 VOC .....	.....	O ₃ (within OTR) ≥ 50 ⁺
10 CO	≥ 1000	≥ 1000 ⁺
11 CO .....	.....	CO (all areas) ≥ 100
12 Pb	≥ 0.5 [*]	≥ 0.5
13 PM ₁₀	≥ 100	≥ 100
14 PM ₁₀ .....	.....	PM ₁₀ (Serious) ≥ 70
15 PM _{2.5}	≥ 100	≥ 100
16 PM _{2.5} .....	.....	PM _{2.5} (Serious) ≥ 70
17 NH ₃	≥ 100	≥ 100
18 NH ₃ .....	.....	PM _{2.5} (Serious) ≥ 70

⁺ This threshold for ozone nonattainment areas is incorrectly listed in the AERR as 100 tpy. This is not consistent with other regulations. The EPA is working to make this correction in the AERR.

^{*} The lead threshold is in actual emissions rather than potential to emit to be consistent with the lead monitoring rule requirements.

2.5.9 Nonpoint Sources

Nonpoint sources are also called “area sources”.¹⁰ These sources collectively represent individual sources of emissions that have not been inventoried as specific point or mobile sources. These individual sources treated collectively as nonpoint sources are typically too small, numerous, or difficult to inventory using the methods for the other classes of sources. Examples of key nonpoint sources include residential combustion, institutional and commercial boilers, agricultural burning, industrial and non-industrial solvents and graphic arts, degreasing, most agricultural sources, consumer products, architectural coatings, and sources of dust including roads and construction.

2.5.10 On-road Mobile Sources

On-road mobile sources are also called “highway mobile sources.” These sources are the motor vehicles (e.g., automobiles, buses, trucks) traveling on local and highway roads. A motor vehicle is any self-propelled vehicle used to carry people or property on a street or highway (40 CFR 51.50). On-road mobile sources should be estimated by the latest recommended on-road mobile source models. Currently, that means the [MOVES model](#) for all states but California, and the [EMFAC¹¹ model](#) for California.

2.5.11 Nonroad Mobile Sources

Nonroad mobile sources are also called “off-highway” mobile sources. These are defined as a nonroad engine or nonroad vehicle. As per 40 CFR 51.50, a nonroad engine is an internal combustion engine (including the fuel system) that is not used in a [on-road] motor vehicle or a vehicle used solely for competition, or that is not affected by sections 111 or 202 of the CAA. Also defined by 40 CFR 51.50, a nonroad *vehicle* (rather than engine) is a vehicle that is run by a nonroad engine and that is not a [on-road] motor vehicle or a vehicle used solely for competition. Examples of nonroad mobile sources include aircraft, airport ground support equipment, locomotives, CMVs, construction equipment powered by an internal combustion engine, agricultural equipment powered by an internal combustion engine, and lawn and garden engines and equipment.

There are a variety of tools for estimating emissions from nonroad mobile sources. The EPA develops and maintains approaches for aircraft, locomotives, and CMVs, which are documented as part of the NEI program (for the latest approaches, refer to the [latest NEI documentation](#)).

Starting with the MOVES2014a version of MOVES, the MOVES model should be used for nonroad source emissions. MOVES2014a includes features not previously available in MOVES that simplify processing of emissions output and includes updated fuel input files that result in small changes in emission results. In addition, the prior tools available for nonroad emissions estimations (NONROAD2008 and NMIM2008) may no longer work with current operating systems, and the EPA cannot continue to provide technical support for these models. Therefore, the EPA recommends that for modeling nonroad emissions, latest version of MOVES be used for all new SIP development, although state and local agencies that have

¹⁰ This data category type is different from the air toxics definitional of “area sources” as defined by CAA section 112(a)(2).

¹¹ The EMFAC model name is not an acronym. The documentation and website for EMFAC do not include a further explanation of the name.

already completed significant work with MOVES2014, NONROAD2008, or NMIM2008 can continue to do so to allow for timely submission of the SIP. As a general matter, air agencies should review and possibly update and customize the MOVES model inputs to give better emissions estimates for their state.

Mobile source inventory modelers should use the latest version of MOVES as posted at <https://www.epa.gov/moves>. They should also subscribe to the MOVES email list <https://www.epa.gov/moves/forms/epa-mobilenews-listserv> to be notified of any bug fixes or updates to the MOVES model.

Unlike models for onroad emissions, the EPA does not specifically “approve” nonroad models. However, use of alternative models can be justified as part of a SIP submission. For example, California has previously developed and used a state-specific approach for estimating its nonroad source emissions for SIP purposes, called OFFROAD2007

(http://www.arb.ca.gov/msei/offroad/downloads/models/offroad2007_1215_exe.zip). This model has now been replaced by category-specific methods for many categories (see http://www.arb.ca.gov/msei/categories.htm#offroad_motor_vehicles). As described by the website, the OFFROAD2007 model is still the default approach for categories not listed with newer methods on the website. Any use of such an alternative approach is subject to review by the EPA as part of the review of the SIP, and thus states are encouraged to coordinate with Regional offices on any use of alternative models.

2.5.12 Events

Starting with the 2008 NEI, the EIS introduced a new data category called “Events,” which are discrete and large emissions sources that individually occur over a short period of time, but which can collectively result in a significant amount of emissions. Example events captured by this data category include naturally occurring wildfire and a managed prescribed burns. In EIS, these data are stored as day-specific events that can span many days for a given fire/event. More information on events data and its unique nature is available in Section 4.8.7.

2.5.13 Biogenic Sources

For the purposes of creating emissions inventories, biogenic emissions come from natural sources. They need to be accounted for in photochemical grid models, as many types of biogenic emissions are widespread and ubiquitous contributors to atmospheric chemistry leading to ozone and PM formation. In the NEI, only the emissions from vegetation and soils are included, but other relevant sources include volcanic emissions, lightning, and sea salt spray.

Biogenic emissions from vegetation and soils are computed using models that utilize spatial information on vegetation and land use. The models also use environmental conditions of temperature and solar radiation to apply emission factors. The model inputs are typically horizontally allocated (gridded), and the outputs are gridded biogenic emissions, which can then be summed for use in planning inventories, and speciated for use as input to photochemical grid models. As described in Section 4.8.6, a variety of models are available to estimate the emissions from vegetation and soils.

2.5.14 Inventory Codes

The list provided below is a sample of the codes that can be used in building inventories; it is not a comprehensive list of codes that should be used in building inventories. The EIS is the repository for the most updated valid codes used for building inventories.

Source classification codes: An SCC means a process-level code that describes the equipment, operation, or practice that is emitting pollutants (40 CFR 51.50).¹² These codes are 8 digits for point sources and 10 digits for nonpoint and mobile sources. The codes have multi-level descriptions, which are included in the EIS codes table. The EPA provides the most current list of codes within EIS, in an SCC search page (at <https://ofmpub.epa.gov/scsearch/>), and web service (available at <https://ofmpub.epa.gov/scwebsearch/>). These codes are also used in the emission factors online database WebFire (<https://www.epa.gov/electronic-reporting-air-emissions/webfire>).

North American Industry Classification System (NAICS) codes: The NAICS codes are U.S. Department of Commerce's codes for businesses by products or services and have replaced Standard Industrial Classification (SIC) codes. They are assigned to facilities in inventories to identify the primary industrial activity of the facility. They can be searched at: <https://www.census.gov/eos/www/naics/>.

Federal Information Processing Standards (FIPS) state and county codes: Federal Information Processing Standards (FIPS) codes means the system of unique identifiers maintained by the National Institute of Standards and Technology, which are used to identify counties and county equivalents (e.g., parishes, boroughs) of the U.S. and its territories (e.g., American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and US Virgin Islands). In the EIS Codes Tables, additional codes have been added to support offshore regions and sources, such as asphalt plants, that do not remain in a single county during the entire year. More information can be found at: <https://www.census.gov/geo/reference/codes/cou.html>.

Tribal codes: A three-digit code that represents the American Indian Tribe or Alaskan Native entity. The EIS Table also identifies which EPA region is associated with the tribe. These codes are used instead of FIPS state and county codes when reporting emissions from tribal areas.

Pollutant codes: Pollutant code means a unique code for each reported pollutant assigned by the reporting format specified by the EPA for each inventory year (40 CFR 51.50). All of the criteria pollutants, except for lead, have codes that describe them: CO, NOX, VOC, SO2, NH3, PM10-PRI, PM10-FIL, PM25-PRI, PM25-FIL, and PM-CON. Lead and the hazardous air pollutants (HAPs) use numerical codes¹³ to represent them, for example elemental lead is 7439921 and elemental mercury is 7439976.

Control measure codes: Control measure means the name of the type of control device (e.g., wet scrubber, flare, baghouse) or practice (e.g., product substitution). The EIS Code Tables use a three-digit

¹² Several air agencies have raised the concern that SCC at industrial facilities is considered CBI. However, this field is "emission data" required by the AERR and thus cannot be provided as CBI under CAA section 114(c).

¹³ These numerical codes are the unique numerical identifiers assigned and maintained by the Chemical Abstracts Service (CAS) and are often referred to as CAS numbers or CAS registry numbers. The CAS numbers often appear with dashes embedded in the string of numbers, but these are dropped for most inventory reporting purposes. See: <https://www.cas.org/content/chemical-substances/faqs>

numeric control measure code to represent each of the different types of controls, and identifies each as a device or a practice. The control device type codes were updated with additional codes in 2013. These codes are required when control devices are present because they are critical to understanding the nature of the emissions source and the possibility of additional emissions reductions to achieve attainment.

Emission calculation method: This field is the code describing how the emissions for a pollutant were calculated (e.g., by stack test, continuous emissions monitor, EPA emission factor, etc.) (40 CFR 51.50). This is a required field for inventories because it allows the EPA to get some sense of the quality of the emissions estimate. Comment fields can also be used to further explain the origin of the emissions estimate.

Reporting period type: This field is the code describing the time period covered by the emissions reported (i.e., annual, 5-month ozone season (previously used for NO_x SIP call), ozone season day, or average season day) (40 CFR 51.50). In concert with the release of the final PM SIP Requirements Rule, a new code (“ASD”) has been updated in EIS to support submissions to EIS of average season day emissions used for SIPs addressing the 24-hour PM_{2.5} standard. This field is also called the emission type code in some references.

2.5.15 Point Source Facility Details

See also Section 2.5.5, which points to the spreadsheets available that list all required and optional emissions inventory data elements.

Facility Inventory means the data tables of all facility information included in the EIS, but could also be used to refer to similar data tables for any inventory storage system. The facility inventory is the complete list of facilities, units, processes, and stacks associated with all point sources. It is designed to be the latest repository of facility information and needs updating only when changes occur to facilities. The facility inventory concept was intended to allow facility data to be constant except where real changes occur, allowing easier building and submitting of inventories and encouraging the use of consistent facility IDs, unit ID, process ID, and stack IDs from one inventory year to the next.

Physical address means the location address (street address or other physical location description), locality name, state, and a postal zip code of the facility. This is the physical location where the emissions occur, not the corporate headquarters or a mailing address (40 CFR 51.50).

Site name (also called Facility Site Name) means the name of the facility emitting emissions that are included in the inventory (40 CFR 51.50).

EIS ID means any facility, unit, process, or release point (stack) ID generated by the EIS and intended to remain constant for the life of that facility, unit, process, or stack across inventory years. The proper names of the EIS IDs in the EIS system are EIS Facility Site Identifier, EIS Emission Unit Identifier, EIS Emission Process Identifier, and EIS Release Point Identifier.

Agency ID means any facility, unit, process, or release point (stack) ID generated by an agency reporting emissions to the EPA. These IDs are used in the air agency data systems and may not match the EIS IDs described above. The EPA tracks both the EIS IDs and agency IDs within the EIS. Using consistent agency IDs from year to year is highly encouraged, as it allows the EPA to more readily see which facilities are being reported for the AERR requirements. Using inconsistent agency IDs can result in duplicative facilities, units, processes, and release points within the EPA data systems.

Facility ID code (also called “Facility site identifier”) means the unique codes for a plant or facility treated as a point source, containing one or more pollutant-emitting units (40 CFR 51.50). The EPA's reporting format for a given inventory year may require several facility ID codes to ensure proper matching between databases (e.g., the state's own current and most recent facility ID codes, the EPA-assigned facility ID codes, and the ORIS (Department of Energy) ID code if applicable).

Unit ID code means a unique code for the unit that generates emissions, typically a physical piece of equipment or a closely related set of such equipment (40 CFR 51.50). An example of a closely related set of equipment is a boiler and its control equipment. The EPA's reporting format for a given inventory year may require multiple unit ID codes to ensure proper matching between databases (e.g., the state's own current and most recent unit ID codes, the EPA-assigned unit ID codes if any, and the ORIS (Department of Energy) ID code if applicable).

Process ID code is also called the “emission process identifier” and it means a unique code for the process generating the emissions, typically a description of a process (40 CFR 51.50).

Release Point ID code means a unique code for the point where emissions from one or more processes release into the atmosphere (40 CFR 51.50). Traditionally called a Stack ID, but this was changed with EIS to acknowledge that many emissions releases do not come from stacks, such as fugitive emissions.

Release point type code means the code for physical configuration of the release point (40 CFR 51.50). The physical configurations include fugitive, vertical, horizontal, goose neck, vertical with rain cap, and downward-facing vent. The first two types are the most common. The release point type is particularly important for dispersion modeling needed for permitting, risk modeling, and other purposes.

Release Point Diameter Measure (or Stack diameter) means the inner physical diameter of a stack (40 CFR 51.50). This should be measured at the exit release point of the emissions, and the expected reported units are feet.

Release Point Height Measure (or Stack height) means physical height of a stack above the surrounding terrain (40 CFR 51.50). Expected reported units are feet.

Release Point Exit Gas Flow Rate Measure (or Exit gas flow rate) means the numeric value of the flow rate of a stack gas (40 CFR 51.50). Various units are permitted by the EIS.

Release Point Exit Gas Temperature Measure (or Exit gas temperature) means the numeric value of the temperature of an exit gas stream in degrees Fahrenheit (40 CFR 51.50).

Release Point Exit Gas Velocity Measure (or Exit gas velocity) means the numeric value of the velocity of an exit gas stream (40 CFR 51.50). Various units are permitted by the EIS.

2.5.16 Alternative IDs

In addition to the primary facility, unit, process, and release point IDs, alternative IDs can be very useful for matching information in a given inventory to other databases. In the case of the EIS, it stores not only the EIS unique IDs, but also the air agency IDs. Other IDs are stored as well, including the following:

EIA Plant Code (or ORIS Plant Code). This plant ID is defined by the U.S. Department of Energy (DOE) Energy Information Administration (EIA) and used in its EIA-767 form. It has previously been defined as the Office of Regulatory Information System (ORIS) code, though that term is no longer used by DOE. The EPA's Office of Atmospheric Programs' (OAP) Clean Air Markets Division (CAMD) uses whatever code was originally assigned to the facility as the tracking code for compiling data for its emissions markets in support of the acid rain program and NO_x trading, in particular the CEMS data.

CAMD Unit ID. In addition to the EIA facility IDs, CAMD uses unit IDs for storing the [emissions markets data](#) as well. The EIS stores the unit codes used by CAMD as an alternative ID called "EPACAMD," and the values are usually based on the CAMD hourly CEMS data reports. These have historically also been referred to as ORIS Boiler or ORIS Unit IDs, however, those references are no longer valid.

IPM/NEEDS ID. The EPA [Integrated Planning Model](#) (IPM) is used to forecast future-year electricity demand and emissions. Underlying this model is the National Electric Energy Data System (NEEDS) database that contains the generation unit records used to construct the "model" plants that represent existing and planned/committed units in EPA modeling applications of IPM. This database mostly uses IDs that are often the same as the EIA Plant Codes and the CAMD Unit IDs, but this database has more units than are included in the hourly CEMS data. In the EIS, the EPA stores these alternative IDs as "EPAIPM" IDs.

Toxics Release Inventory (TRI) ID is used by the EPA's Office of Environmental Information to build the [TRI](#) from facility-submitted facility-total emissions to air, water, and land. This database includes NH₃, which is why it can be relevant to the NAAQS for PM_{2.5} implementation. In the EIS, the EPA stores these alternative IDs as "EPATRI" IDs.

Federal Registry Service (FRS) ID is used by the EPA's Office of Environmental Information to link many EPA databases with facility information (see <https://www.epa.gov/enviro/facility-registry-service-frs>).

2.5.17 Location Definitions

Geographic locations are critical in point source inventories for identifying the location of the emissions. In the EIS, locations can be provided for both the facility center and for individual release points. Fugitive release points have additional parameters that can be specified, such as the orientation of the release, and these parameters are listed in the spreadsheets available that list all required and optional emissions inventory data elements, referenced in Section 2.5.5.

Latitude Measure (or just latitude) is the measure of the angular distance from the center of the earth to a point north or south of the equator. Reported as decimal degrees. The geographic coordinate system will have to be specified for example: North American Datum of 1927 (NAD 1927), North American Datum of 1983 (NAD 1983), World Geodetic System of 1984 (WGS 1984). See the Horizontal Reference Datum code below.

Longitude Measure (or just longitude) is the measure of the angular distance from the center of the earth to a point on a meridian east or west of the prime meridian. Reported as decimal degrees. The GCS should be specified as with latitude.

Horizontal Accuracy Measure is the measure of accuracy (in meters) of the latitude/longitude coordinates.

In addition, refer to <https://www.epa.gov/geospatial/latitudelongitude-data-standard> for more information on the proper usage of the following code set.

Horizontal Collection Method Code is the method used to determine the latitude/longitude coordinates for a point on the earth. For example, 001 is address matching-house number, and 004 is address matching nearest intersection.

Horizontal Reference Datum Code is part of the geographic coordinate system and represents the position of the spheroid with respect to the center of the earth (for a geocentric datum like WGS 1984) or with respect to a specific point on the surface of the earth (for local datums such as NAD 1927 and NAD 1983). Options are: 001 (NAD 1927), 002 (NAD of 1983), and 003 (WGS 1984).

Geographic Reference Point Code represents the place for which geographic coordinates were established. Code value should be 106 (e.g., point where substance is released).

2.5.18 Control Data Elements

Control efficiency means the efficiency by which a control device or measure reduces emissions for a particular pollutant. For emissions reporting in accordance with the AERR, this data element applies for both point and nonpoint sources and is called the “*Percent Control Measures Reduction Efficiency*.” For point sources, the data element is included in the “*Control Pollutant Table*” of the facility staging tables. For nonpoint sources, the data element is included in the “*Control Pollutant Table*” of the nonpoint staging tables. In the EIS, it is a percent and should be reported as a value greater than or equal to 0.1 and less than or equal to 99.9 (the EIS allows for one decimal place only).

Control Capture efficiency means the percentage of an exhaust gas stream actually collected for routing to a set of control devices (40 CFR 51.50). It is sometimes combined within the value for the control efficiency, but unlike control efficiency, it is not pollutant-specific. For emissions reporting in accordance with the AERR, this data element is for point sources only, and it is called “*Percent Control Capture Efficiency*” and is included in the “*Control Approach Table*” of the facility staging tables. It is a percent and should be reported as a value greater than or equal to 0.1 and less than or equal to 99.9 (the EIS allows for one decimal place only).

Control Effectiveness means the percentage of time or activity throughput that a control approach is operating as designed, including the capture and reduction devices. This percentage accounts for the fact that controls typically are not 100 percent effective because of equipment downtime, upsets and decreases in control efficiencies (40 CFR 51.50).

Control effectiveness is an estimate of the portion of the reporting period's activity for which the overall control system or measure (including both capture and control measures) were operating as designed (regardless of whether the control measure is due to rule or voluntary). It applies to both point and nonpoint sources and is not pollutant-specific. For point source emissions reporting in accordance with the AERR, this data element is called "*Percent Control Approach Effectiveness*" and is included in the "*Control Approach Table*" of the facility staging tables. For nonpoint source emissions reporting in accordance with the AERR, this data element is also called "*Percent Control Approach Effectiveness*" and is included in the "*Control Approach Table*" of the nonpoint staging tables. In the EIS, it is a percent and should be reported as a value greater than or equal to 0.1 and less than or equal to 99.9 (the EIS allows for one decimal place only). For nonpoint, see also "rule effectiveness," below.

Rule penetration means the percentage of a nonpoint source category activity that is covered by the reported control measures (40 CFR 51.50). For emissions reporting in accordance with the AERR, this data element is called "*Percent Control Approach Penetration*" and is included in the "*Control Approach Table*" of the nonpoint staging tables. In the EIS, it is a percent and should be reported as a value greater than or equal to 0.1 and less than or equal to 99.9 (the EIS allows for one decimal place only).

Rule effectiveness means a rating of how well a regulatory program achieves all possible emissions reductions. It is analogous to the "control effectiveness" above and, for emissions reporting in accordance with the AERR, this information is reported using the EIS Control Effectiveness field for nonpoint (see above). Like control effectiveness, it should reflect the assumption that controls typically are not 100 percent effective because of equipment downtime, upsets, decreases in control efficiencies, noncompliance, and other deficiencies in emission control. Rule effectiveness adjusts the control efficiency from what could be realized under ideal conditions to what is actually emitted in practice due to less than ideal conditions.

2.5.19 EIS Sectors, Tiers, and Facility Type

Because emissions inventories are large and detailed, most reports about emissions inventories include summaries of the contents of those emissions. Some summaries use the data categories described above (point, nonpoint, on-road, nonroad, events, and biogenic). For other summaries, that level of detail is not enough. The EIS SCC tables provide three other mechanisms for summaries, all of which depend on SCC.

First, the SCCs have a four-part description, and the first three levels of this description could be used as a summary category. Second, the SCCs are assigned to "Tiers" using the fields "Tier 1 Description," "Tier 2 Description," and "Tier 3 Description." These Tiers have been used traditionally as part of many EPA reports and trends for criteria emissions. While wildfires are included in the "Miscellaneous" Tier 1, wildfires are sometimes separately broken out from Miscellaneous because of their natural origin and

because they can be a large contributor for some pollutants. Finally, the EIS Sectors can be used to summarize emissions (this is the field “Sector” in the EIS SCC code table). The EIS Sector was added with the creation of the EIS and allocates emissions to about 60 categories with multi-pollutant inventories in mind. Whereas the Tiers are more useful for criteria pollutants, the EIS Sectors work better for the combination of HAPs and CAPs. The EIS Sectors can also be further aggregated to provide custom summaries; one example of this is presented in the report “2008 National Emissions Inventory: Review, Analysis and Highlights” (EPA-454/R-13-005, May 2013).

2.5.20 Other Terms

High electricity demand day (HEDD) means an ozone season day when demand for electricity is high. A study of the Northeast Corridor¹⁴ air quality has indicated that NO_x emissions from EGUs during HEDD periods may be significantly greater than emissions that occur on an average ozone season day.

Distributed generation means the use of small power generators sited at or near the point of energy consumption. This usually occurs during periods of peak energy demand or emergency loss of the normal EGU generating capacity. Distributed generation sources of electricity can include rooftop solar or wind sources, biomass combustion, as well as backup fossil fueled generators or other engines. The combustion sources of distributed generation can cause emissions that could be of interest for SIP planning purposes.

RFP projected emissions means the estimated emissions for direct PM_{2.5} and PM_{2.5} plan precursors by sector for the years in which quantitative milestones are due for a nonattainment area.

¹⁴ “High Electric Demand Day and Air Quality in the Northeast.” White Paper Prepared by the Northeast States for Coordinated Air Use Management. June 5, 2006. Available at: <http://www.nescaum.org/documents/high-electric-demand-day-and-air-quality-in-the-northeast/final-white-paper-hi-electric-demand-day-06052006.pdf>.

3 SIP Inventory Requirements and Recommendations

As described in Section 2, there are many required and potentially required inventory efforts needed as part of a SIP development effort. This section covers the fundamental attributes of planning inventories and their preparation. The topics covered include the timing of the various inventory components (Section 3.1), the inventory preparation plan (Section 3.2), the base year inventories (Section 3.3), the ROP/RFP baseline NAA inventory (Section 3.4), the ozone periodic inventory (Section 3.5), the ozone emissions statement requirement for SIPs (Section 3.6), maintenance inventories (Section 3.7), the projected inventories (Section 3.8), public hearings (Section 3.9), and submitting the inventory to the EPA for approval (Section 3.10). The details of inventory preparation for base year inventories and projected inventories are left for Sections 4 and 5, respectively.

3.1 Inventory Component Timing

Table 8 provides the timing requirements and recommendations (for optional items) for the inventory components of SIPs. Where this table is inconsistent with the ozone, PM_{2.5}, or regional haze regulatory text that is applicable at the time a SIP is prepared and reviewed, the regulations have precedence over the information provided here.

Table 8: Timing of emissions inventory components

Inventory Component	Required:	Timing
Inventory Preparation Plan		Prior to preparation of emissions inventories covered by the SIP.
Base year NAA inventory	Ozone	Within 2 years of the effective date of designations
	PM _{2.5}	Within 18 months from the date of a nonattainment designation.
ROP/RFP baseline NAA inventory	Ozone	<i>Moderate & above:</i> Within 3 years of the effective date of designations. <i>Serious & above:</i> Additional plan within 4 years.
	PM _{2.5}	Within 18 months from the date of a nonattainment designation.
Periodic NAA inventory	Ozone	The end of each 3-year period after SIP submittal until the NAA is redesignated to attainment.
Source Emission Statements requirement for SIPs	Ozone	Within 2 years of the effective date of designations.
Base case statewide inventory	Ozone and PM _{2.5} ⁺	With modeled attainment demonstration (if required, for convenience, can be included with the inventory SIP).
Attainment projected inventory for the NAA	Ozone: summary only	For Ozone with attainment demonstration or ROP/RFP plan. On-road portion can become the motor vehicle emissions budget.
	PM _{2.5}	Within 18 months from the date of a nonattainment designation.
Projected statewide inventory (summaries)	Ozone and PM _{2.5} ⁺	With modeled attainment demonstration (for convenience, can be included with the inventory SIP).

Inventory Component	Required:	Timing
Baseline statewide inventory (summaries)	Haze	Previously completed for initial Regional Haze SIPs. Subsequent progress reports and SIP revisions may refer to this inventory.
Recent statewide inventory (summaries)	Haze	Needed for the SIPs due July 31, 2021, July 31, 2028 and every 10 years thereafter. Needed for progress reports due January 31, 2025, July 31, 2033 and every 10 years thereafter.
Projected statewide inventory for 2018 (summaries)	Haze	Previously completed to support first Regional Haze SIP (due by December 17, 2007)
Projected statewide inventory for 2028, 2038, etc. (summaries)	Haze	To support Regional Haze SIPs for second and subsequent implementation periods, due every 10 years beginning on July 31, 2021.
Public hearing	Ozone and PM _{2.5}	Prior to submittal of inventory for approval by the EPA.
Inventory documentation	All	With associated SIP.
Maintenance NAA inventory	Ozone and PM _{2.5}	After attainment, with a redesignation SIP.

+ Only required in association with modeled attainment demonstration. If the inventory needed for the modeled attainment demonstration is not the entire state, then a “statewide” inventory would not need to be provided, but rather the emissions from the part of the state included in the modeling domain could be provided instead.

3.2 Inventory Preparation Plan

Air agencies can use IPPs as a planning tool to guide inventory preparation and to help ensure that emission estimates are of a high quality and consistent with CAA requirements. In accordance with 40 CFR 51.5(b), states are urged to use applicable, state-of-the art techniques for estimating emissions. In some cases, the EPA Regional offices will have a preset list of expectations for air agencies to include in their SIP and will provide this information to the agency at the start of the SIP planning process. In these cases, an IPP may not be needed, especially for air agencies with prior SIP development experience for a particular NAAQS.

The IPPs are an opportunity for state and local agencies to tell their EPA Regional office how they plan to compile their emissions inventories and allow the EPA to provide feedback prior to the agency spending resources in preparing their inventory. They can also allow the EPA Regional offices to coordinate to maintain consistency across attainment plans where that is advisable. The IPPs can be especially valuable for agencies with new nonattainment problems, less experienced inventory staff or for agencies otherwise needing additional feedback on inventory development.

If used, IPPs precede the development of inventories; therefore, the timing of IPPs is early in the SIP planning process. The EPA recommends that air planning agencies coordinate with their Regional office on the need for a plan, the timing of delivery of the plan, the response time back from the EPA on the plan, and any other IPP approval process details. Agencies should recognize that time may also be needed in their planning schedule to address the EPA comments on the plan, while the EPA Regional offices will attempt to provide as timely feedback as possible.

A high-quality IPP could be a strong foundation for the emissions inventories used in planning and/or attainment modeling, which are themselves critical pieces of SIP development; therefore, the IPP should include enough details for the EPA to properly assess what the agency plans to do. The content can include a number of key elements, for which a checklist is provided in Table 9. The actual elements to include in a specific IPP can depend on a number of factors, depending on the needs of the state or local agency as well as the EPA for understanding the inventory plans.

Table 9: Checklist of elements to consider for including in Inventory Preparation Plans

IPP Element	Important for a High Quality IPP?
Inventory objectives – the purpose and scope of the inventory	Y
The inventory year(s) and rationale for selecting them	Y
The pollutants to be included, including the expected definition of VOC (for inventories needing VOC)	Y
For PM _{2.5} , the temporal basis expected to be used for the SIP emissions, which can include annual, average season day, or both (see Section 4.5)	Y
A list of inventories to be included with the SIP, including the types (e.g., reports, data summaries) and formats of information (i.e., electronic data files and their expected formats, electronic media used for transfer), that the agency intends to include in their SIP	Y
Plans for (or results of) identifying the most important source sectors to the nonattainment problem	Y
The source categories to be included, the emissions level(s) for defining point sources, and if available, the expected priority for these	Y
The plans for compiling the inventory, including any other known inventories and how the agency plans to assess and improve upon what is already available	
A summary of expected approach differences among different inventories that could be the same (e.g., between a base year NAA inventory and a base year modeling inventory)	
For projected inventories: The drivers for future-year emissions growth and reductions	Y ⁺
The source categories to be forecast	Y ⁺
The expected approaches for forecasting each source category	Y ⁺
A plan for public review	
Important sources of emissions or other inventory uncertainties	
Quality assurance steps to be taken	Y
A schedule for inventory preparation, review, and submission to the EPA, including any plans to submit pieces of the inventory separately and in accordance with regulatory timeline requirements	Y

* If a projected inventory is required.

In addition to Table 9, other inventory planning resources may be of use for agency planning purposes. During the preparation of their IPPs, state and local agencies are referred to Volume I of the EIIP guidance, available at <https://www.epa.gov/air-emissions-inventories/volume-1-introduction>, which discusses emissions inventory planning and development. While somewhat out of date, the EIIP volumes

still can help guide new inventory developers, especially with basic information about creating emissions. Users of that document should defer to this guidance where newer information is provided, such as updated versions of mobile models. For stationary point sources, a good resource is EIIP Volume II, Chapter 1, Section 3. For nonpoint sources, EIIP Volume III, Chapter 1, Section 2 gives nonpoint-specific planning information. The mobile source volumes for EIIP are more out of date and the EPA Office of Transportation and Air Quality (OTAQ) mobile source guidance is preferable (see Table 1).

A quality assurance plan should always be a part of the IPP. In cases where a more formal QAPP is developed, the QAPP will satisfy the need for an IPP quality assurance plan. In some cases, the EPA Regional offices will include a QAPP or other quality assurance requirement as part of their CAA section 105 grant to a state that typically includes funding for emissions inventory development. Each Regional office manages its own quality assurance plan. Information about EPA quality assurance specifications and tools as well as a map that links to each Regional office's quality assurance project are available at <https://www.epa.gov/quality>.

For additional information on quality assurance planning, Chapter 2 of Volume VI, "*Quality Assurance Procedures and DARS software*" (<https://www.epa.gov/air-emissions-inventories/volume-6-quality-assurance-procedures-and-dars-software>) provides some general guidance for quality assurance and some specific approaches to uncertainty evaluation. Other quality assurance resources include Section 0 of this guidance, and quality assurance steps described in the latest NEI Technical Support Documentation available at the latest NEI documentation page link on the [main NEI web page](#). Where air agencies are relying on their NEI submission as a starting point for meeting any SIP inventory requirements, a QAPP developed for that air agency's NEI submission may offer a starting point for the SIP inventory QAPP.

3.3 Base Year Inventory

The purpose of the base year inventory is to provide a current and comprehensive data source for emissions contributing to the air quality problem addressed by the SIP. In the case of ozone and PM_{2.5}, the inventory requirement is for the NAA, whereas for regional haze, the inventory requirement is for a statewide inventory. As listed in Table 4 and Table 5, the ozone or PM_{2.5} SIPs can include statewide inventories as part of the modeled attainment demonstration, and these can be included as separate inventory submissions included with the NAA inventory.

The general SIP provisions in CAA section 172(c)(3) explains that base year inventories should include a "comprehensive, accurate, current inventory of actual emissions from all sources" in the applicable area. Details associated with preparing a base year inventory are provided in Section 4, including selection of year(s), temporal extent, spatial extent, pollutants to include, approaches for developing emissions, data codes, and quality assurance. Additionally, CAA section 182(a)(1) provides a specific base year inventory requirement for ozone SIPs. PM_{2.5} SIPs generally rely on the general SIP provisions in CAA 172(c)(3), though some PM-specific elements of CAA section 189 impact the timing and other aspects of PM_{2.5} SIP inventories. Other requirements for SIP inventories are found in the SIP implementation rules as listed in Table 4.

The base year inventory is the starting point from which the other SIP-related inventories are derived. These other inventories should relate to the base year inventory with regard to the emissions sources included, pollutants, temporal aspect, and other key aspects that allow the SIP to be a coherent and connected plan across the various inventories. For planning purposes, the base year inventory provides a way for decision makers to consider the sources of emissions that contribute relevant pollutants and consider emissions reductions strategies needed for the SIP.

Section 4.1 covers the choice of inventory years for the base year inventory. The choice of the inventory year for the planning is a critical one that significantly impacts the workload of inventory staff and greatly depends on availability of data and timing of other inventory efforts required by the EPA.

Section 4.2 covers the pollutants to be included in the base year inventory. These pollutants differ depending on the nature of the air quality problem for a given SIP. Where feasible, the EPA encourages planning agencies to include precursors for all ongoing nonattainment problems in a state to promote efficiency in preparing multiple base year inventories, and to allow for the consideration of emissions reduction strategies that improve air quality across multiple air quality concerns and nonattainment issues. In addition, states may wish to include emissions of HAPs, which can have co-benefit reductions associated with strategies aimed at reducing ozone, PM_{2.5}, and/or regional haze.

The spatial and temporal extent of the base year inventories are also an important inventory characteristic. These topics are covered fully in Sections 4.4 and 4.5. Each of the implementation rules for ozone, PM_{2.5}, or regional haze has different considerations and requirements associated with the planning inventories. For example, ozone NAA inventories must include ozone season day emissions, the PM_{2.5} NAA inventories can be either annual or season day (depending on the nature of the PM_{2.5} nonattainment problem), and the regional haze inventories are only annual.

The Ozone Implementation Rule and PM_{2.5} SIP Requirements Rule require inventories for the NAA. These inventories are called the base year inventory for the NAA. These inventories may need to be updated through multiple iterations of a SIP when they are used as baseline inventories for assessing progress for ROP/RFP. For regional haze, the inventory for a year in the 2000-2004 period is commonly called the baseline inventory. For clarity here, we also call the baseline regional haze inventory the baseline *statewide* inventory to distinguish it from a NAA inventory.

3.4 Rate of Progress and Reasonable Further Progress Baseline NAA Inventory

RFP is a concept included in the CAA under Part D, Title I to assure that states take steps to ensure that the air quality in NAAs makes steady and incremental progress toward attaining air quality standards. The ROP/RFP baseline NAA inventory is necessary for ozone NAAs designated as Moderate and above. This baseline inventory is part of a plan or plans that meet the RFP requirements as described by the CAA and the Ozone Implementation Rule, and summarized here. The PM_{2.5} SIP Requirements Rule also includes requirements for RFP as described below. Though there are specific considerations related to ROP and RFP, **the anthropogenic portion of the base year inventory for the NAA also serves as the base ROP/RFP baseline NAA inventory for both ozone and PM_{2.5} SIP development.**

3.4.1 Ozone ROP/RFP Requirements and Timing

CAA section 182(b)(1)(A) requires Moderate and above NAAs to submit a plan to ensure a 15 percent VOC reduction (accounting for growth) by 6 years after the NAA designation, which is the Moderate area maximum attainment date. The 15 percent reduction requirement is commonly called “rate of progress” or ROP. According to the Ozone Implementation Rule, air agencies must submit this plan within 3 years after the area’s nonattainment designation. This timing aligns with the Moderate NAA deadline for submitting attainment demonstration SIPs.

In addition, CAA section 182(c)(2)(B) requires each Serious and above ozone NAA to submit a plan to achieve at least a further annual 3 percent VOC reduction. Additionally, CAA section 182(c)(2)(C) allows for substitution of NO_x for VOC emissions reductions in the plan under certain conditions. This requirement is also called “annual RFP.” As described by the Ozone Implementation Rule, the annual RFP requirement applies for any remaining 3-year periods out to the attainment date beyond the first 6 years. According to the Ozone Implementation Rule, air agencies with NAAs classified as Serious and higher must submit this plan within 4 years after the area’s nonattainment designation. This timing aligns with the Serious and higher areas’ deadline for submitting attainment demonstration SIPs; however, these NAAs still must submit the plan for ROP within 3 years.

States maintain the flexibility to submit plans early to provide more time for implementation of their SIP control measures. The EPA recommends that states complete their ROP/RFP plans as expeditiously as practicable after designation to provide as much time as possible for sources to implement the emission reductions.

The associated terminology for the various plans and inventories can be confusing, and so the terminology used in this guidance is described here. In this guidance, we use “ROP/RFP plan” to refer generally to all plans (i.e., those addressing just the 15 percent ROP requirement for Moderate areas as well as plans additionally addressing the annual RFP requirement). For Serious and above areas, since the timing allows that two separate plans for ROP and annual RFP could be submitted (i.e., at 3 years and 4 years after designations, respectively), it may also be necessary to refer to such plans separately. Consequently, this guidance uses “ROP/RFP plan(s)” to allow for the idea that multiple plans could be submitted. Lastly, in the case where the individual plans must be referenced, they will be called “ROP plan” and “RFP plan.”

3.4.2 Ozone ROP/RFP Emissions Guidance

The same ROP/RFP baseline NAA inventory is used for all ROP/RFP plan(s), regardless of whether they address the ROP requirement (for Moderate areas) or both ROP and annual RFP (for Serious and above). As implied by the name, these inventories include emissions data just for the NAA region and thus, excludes other areas in a state. The purpose of the ROP/RFP baseline NAA inventory is to provide a reference point to determine the emissions reductions that must be achieved for the 15 percent VOC (or NO_x) reduction and the subsequent 3 percent reductions for Serious areas and above out to the attainment date. This requirement stems from CAA requirements.

For ozone, both VOC and NO_x should be included in the ROP/RFP baseline NAA inventory. Further, the EPA expects that the year of the ROP/RFP baseline NAA inventory will be the same year used for the base year inventory for the NAA. In most cases, the ROP/RFP baseline inventory should also have the same emissions values as are in the base year inventory for the NAA. One key exception is that biogenic emissions should not be included in the ROP/RFP baseline.

The EPA also expects that the spatial extent of the ROP/RFP baseline NAA inventory will also match the base year NAA inventory so that they are both either “whole county” inventories or both consistently “partial county” inventories. Section 4.4.1 provides more information on partial county inventories.

In the event that updated ROP/RFP plan(s) are needed after initial submittal to meet the requirements of the Ozone Implementation Rule, the ROP/RFP baseline NAA inventory may also need to be updated. This can occur with significant methods changes, such as updated mobile models. For example, after an initial ROP/RFP plan has been submitted as part of a SIP, a new mobile model may become available that alters the emissions estimates. It would be inconsistent to compare estimates from a new mobile model at the end of a 6-year period to estimates using an old model at the beginning of that 6-year period, and so the EPA could be unable to determine whether a 15 percent reduction (or subsequent 3 percent reductions) can be (or has been) achieved by an ROP/RFP plan. Thus, an updated ROP/RFP baseline NAA inventory may need to be created using the updated mobile model to appropriately meet the requirements of the Ozone Implementation Rule.

Additional ROP/RFP emissions reductions guidance is provided in Section 3.8.2.

3.4.3 PM_{2.5} RFP Requirements and Timing

Section 172 of the CAA addresses the PM_{2.5} attainment plan provisions in general. In addition, Section 189(c) of the CAA requires that PM_{2.5} SIPs contain quantitative milestones, which are to be achieved every 3 years until the area is redesignated attainment and which demonstrate reasonable further progress. For Moderate areas, these quantitative milestone years would be no later than 4.5 and 7.5 years after designation of the area. For Serious areas, these quantitative milestone years are no later than 7.5 and 10.5 years after designation of the area. Most (if not all) Serious areas will have first been Moderate areas, and thus could also be subject to the quantitative milestone at 4.5 years as well.

In the PM_{2.5} SIP Requirements Rule, one required element of an RFP plan is RFP projected emissions by sector and precursor pollutant for each applicable quantitative milestone year. In addition, the emissions reductions must show that the implementation schedule (of reductions) achieves either (1) generally linear progress toward the projected attainment date; or (2) stepwise progress toward the projected attainment date. The rule also holds out the possibility that a state could develop an approvable RFP plan even if emissions of one or more PM_{2.5} plan precursors were not decreasing; however, additional analysis would need to be done (as described in the rule).

3.4.4 PM_{2.5} RFP Emissions Guidance

For PM_{2.5} SIPs, all plan precursors must be included in the RFP emissions provided as part of the RFP plan. Further, the EPA expects that the year of the RFP baseline emissions will be the same year used for the base year inventory for the NAA.

Unlike other emissions inventory requirements, the PM_{2.5} RFP requirement does not specify that detailed projected emissions *inventory* data must be developed and submitted to the EPA. The emissions requirement for most sectors is for “*RFP projected emissions for direct PM_{2.5} and all PM_{2.5} plan precursors for each applicable milestone year,*” which does not indicate a detailed emissions inventory.¹⁵ In addition, the PM_{2.5} SIP Requirements Rule preamble specifically indicates emissions provided by sector and pollutant are expected. It would be sufficient to include a table that has rows for each sector and columns for the baseline and projected emissions of all relevant pollutants.

States may be able to develop their RFP projected emissions in some cases with less effort than it would take to do a detailed emissions inventory projection. One approach for the calculating sector/pollutant emissions for the milestone years would be to rely on the projected attainment inventory for the NAA and use linear interpolation from the baseline year to the milestone year(s). To take this approach, states should explain why the linear assumption makes sense for a particular sector. For example, residential wood combustion emissions are projected to the future in part through phase-in rate assumptions for newer and lower emitting woodstoves. Using this sort of “% adoption per year” approach would support using a linear rate of change assumption such that the whole residential wood combustion sector could be interpolated between the baseline year and the projected attainment year.

3.5 Periodic Inventories

The Ozone Implementation Rule requires a periodic inventory for the NAA, and the Regional Haze Rule requires a “recent year” statewide inventory. The ozone periodic inventories should be consistent with the base year inventory in the temporal extent (seasonal, annual, or both), spatial extent (statewide, NAA counties, partial counties), and sources inventoried. In some cases, for ozone, it may also be advisable to have the emissions inventory methods of the periodic inventory consistent with the base year inventory, but this decision should be made in consultation with the relevant EPA Regional office. Regional offices may consider additional relaxation of the consistency recommendation above in specific instances. For regional haze, the “recent year” inventory must always be statewide. There is no expectation that the recent year inventories for regional haze will use consistent methodologies as were used for the baseline inventory for a year in the range of 2002-2004 submitted as part of the first Regional Haze SIP revision. Rather, the most recent emission estimation methods would be expected to be used.

3.5.1 Ozone Periodic Inventory

For ozone, the requirement in 182(a)(3)(A) is that the periodic inventory be submitted no later than each 3-year period after the submission of the base year NAA inventory. This language provides the flexibility to air agencies to submit sooner than 3 years, but not later than 3 years. If any other current NAA inventory is being submitted to the EPA for any reason, including ROP/RFP plans, then states should consider also using that data to meet the periodic inventory requirement. Also, if the air agency

¹⁵ For the purposes of motor vehicle emissions budgets for transportation conformity (as required by 40 CFR part 93), an inventory of onroad mobile source emissions in the NAA is required (see 40 CFR 51.1012(a)(2)).

comes into attainment and receives a Clean Data Determination prior to the 3-year period, or if a maintenance plan (with a maintenance inventory) is being submitted prior to or in sync with this 3-year timetable, then these actions are very likely to make it unnecessary for the air agency to submit a separate ozone periodic inventory.

Since the periodic inventory requirement in the CAA does not specify the degree of detail required for the periodic inventory, the EPA has defined the necessary components through the AERR. Thus, whether the inventory is submitted as a separate submission or through the AERR, it would need to be consistent with requirements of the AERR in order to meet the statutory periodic inventory requirements.

The periodic inventory is a check-in with the air agency on how the emissions are trending, and had previously been considered to not have “regulatory significance” or been treated as a SIP submission. This is no longer EPA’s recommended approach. In accordance with the CAA, periodic inventories are a revision to the inventory portion of the ozone SIP and are thus subject to CAA section 110 and 40 CFR 51.102, 103, and Appendix V. For discussion of public hearings, please see Section 3.9 of this guidance document.

To meet the periodic inventory requirement for ozone, the periodic inventories must include ozone season day emissions values. Since this emissions type is allowed to be submitted to the EPA through EIS for the AERR, it is *possible* that the AERR submission could meet the periodic inventory requirement *if the conditions listed in Table 10 apply*. As with all SIP requirements, air agencies should coordinate with the Regional office regarding what is appropriate for a particular NAA.

Table 10: Conditions for AERR submittal to meet ozone periodic inventory requirement

Condition	Comment
Public hearing requirement	A public hearing has been offered and either no party requested a public hearing or a public hearing has been held. Evidence should be provided that this requirement has been met.
Ozone season day emissions must be submitted for the NAA counties	If ozone season day emissions cannot be extracted from the EIS (as is the case in 2014), using an AERR submission to meet the periodic inventory requirement is only acceptable if approved by the Regional office.
Emissions are submitted for mobile sources.	Ongoing review of the AERR may result in requiring mobile model inputs and making emissions data optional. If this occurs, the SIP periodic inventory must still include <i>emissions</i> . Thus, emissions would need to be submitted for the NAA counties regardless of any AERR requirements to be able to meet the periodic ozone inventory requirement.
Complete – all sectors	Using the AERR to meet the periodic inventory requirement is only possible during triennial years (see Section 2.4) because the EIS only accepts nonpoint and mobile data during these years, and these data categories must be included to be complete.
Submitted within 3 years since the base year inventory.	It is acceptable to be less than 3 years, after which time the triennial submissions would be every three years.

Condition	Comment
Partial county approach approved by Regional office	The EIS does not support partial counties. In some cases, it may be acceptable to use the entire county emissions for the periodic submission.
Notification	If the AERR approach is approved, the Regional office should be notified in writing when the submission has been completed.
Documentation	Must be created. Submission is at the request of the EPA Regional office.

3.5.2 Regional Haze Recent Year Inventory

For the Regional Haze Rule, a recent year inventory is needed to support the analyses required with each) periodic progress report or 10-year SIP revision. The inventory is not submitted with the SIP or progress report, but emissions summaries are expected as part of the analysis provided with the SIP. The inventory to be used is a complete statewide annual inventory as was the initial baseline inventory (included in the original Regional Haze SIP). See Table 1 above for the latest reference materials with guidance on the Regional Haze Progress Reports. Since the regional haze requirement is for inventories to be statewide and cover emissions over an annual period, the spatial and temporal aspects better match the AERR reporting requirements as compared to the NAA inventories required for ozone and PM_{2.5} implementation. In addition, since the recent year inventory is not an element of the SIP that must be submitted itself, there is not a public hearing requirement for the inventories used for regional haze. Thus, the AERR inventories are an appropriate starting point for meeting the requirement for the recent year inventory for regional haze. If better information becomes available for particular source sectors at a time when it can be incorporated into a state's long-term strategy development, it should be.

The inventory approach for the recent year inventories needed for periodic progress reports and SIP revisions is relatively straightforward. The following list provides considerations for states in developing their inventories:

- The rule prescribes that the inventory year is the same as triennial AERR year that has most recently been submitted by the state to the EPA, with additional special considerations
 - For the recent year emissions inventory for a 10-year SIP revision, states have a 12-month grace period after submission of inventory information before the regional haze rule requires the state to use that information in a SIP. (see 40 CFR 51.308(f)(2)(iii)). One example of using another year would be to update the EGU portion of the inventory to use more current data that is available because of CEMs. There may also be better information on a particular source sector in a special study that collected more refined source-specific information but for a different year.
 - For the periodic progress reports, 40 CFR 51.308(g)(4) specifically requires that the emissions information in the progress report must extend through the most recent year for which the Administrator has provided a State-level summary via a centralized

emissions data system operated by EPA (like the CEM data) if summaries of the data are available from the EPA 6 months before the state's progress report due date.

- The inventory can be the same as the NEI or can be revised from the NEI. The RHR does not say that the inventory must be the NEI inventory, rather, it says that the year must be the same year. The same applies with respect to an EPA summary of data for a source sector reported directly to the EPA.
- States must identify the recent inventory in their plan, but the inventory does not need to be submitted to the EPA.
- States may rely on EPA-provided parts of the NEI to support the recent year inventory data needed for their plan.

3.6 Emissions Statement Requirement for SIPs

For ozone NAAs, states should develop emission reporting programs for VOC and NO_x sources in accordance with CAA section 182(a)(3)(B). The required state program and associated regulation defines how states obtain emissions data directly from facilities and report it to the EPA as part of SIP inventories and for the AERR. This is called an Emission Statement regulation, and it outlines how facilities must report emissions and facility activity data to an air agency. Once the air agency develops the Emission Statement regulation, the regulation should be sent to the EPA as a SIP for approval by the deadline as specified in Table 8. As an element of a SIP, the public hearing requirements apply to the Emission Statement SIP. Air agencies must ensure that their emissions reporting program, promulgated in accordance with CAA section 182(a)(3)(B), complies with all applicable statutory and regulatory requirements on a continuing basis.

To properly implement the emissions reporting requirements, Emission Statement regulations should be coordinated carefully with the AERR and any associated guidance and specifications, the Modeling Guidance, and this guidance. The required and optional data elements needed for inventories (described in Section 2.5.5) should be included as fields for reporting to the EPA. Where the AERR/EIS has required fields, those fields should be required by the Emission Statement regulations. In addition, the Emission Statement regulations should require ozone season emissions in accordance with the final Ozone Implementation Rule.

Additional details on developing emission statement regulations can be found in a dated, but still relevant guidance document titled, "Guidance on the Implementation of an Emission Statement Program (DRAFT)," available at <https://www.epa.gov/air-emissions-inventories/implementation-emission-statement-program>. Where data elements to be collected are mentioned, users of that guidance should defer to the paragraph above, explaining that data elements should be coordinated with AERR/EIS requirements and the recommendations in this guidance for optional fields.

3.7 Maintenance Inventories

Maintenance inventories reflect the emissions conditions associated with a NAAQS redesignation to attainment following an initial area designation of nonattainment. Thus, the attainment year inventory

for the maintenance demonstration should reflect emissions during one of the three years for which monitoring data showed compliance with the standard. The EPA recommends that the inventory year to be used for the maintenance inventory should be a year for which all air quality monitors in the nonattainment area had ozone concentrations below the level of the standard (e.g., for a nonattainment area for the 2008 ozone NAAQS, all monitors in the area should have 4th high values below 0.075 ppm in order for the year to be used for the maintenance inventory, also see [Calcagni 1992 memo, page 8](#)). Otherwise, all characteristics of the attainment year inventory are the same as the base year inventory submitted with the implementation plan prior to attainment. An attainment year maintenance inventory is a component of a maintenance plan and is, therefore, submitted to the EPA as a SIP revision. Thus all guidance in this document for completeness, temporal extent, spatial extent, public hearings, documentation, and summaries applies to these inventories.

The on-road portion of the inventory for the relevant pollutants and precursors for the last year of the maintenance plan would be the motor vehicle emissions budget(s) required for maintenance areas by 40 CFR 93.118(b). States may elect to also establish motor vehicle emissions budgets for the interim year or years for which they have submitted inventories or for the attainment year of the maintenance plan. Those decisions should be made through the interagency consultation process that is required by CAA section 176(c)(4)(D) and 40 CFR 93.105.

Specific additional guidance for maintenance plan SIPs is also available in the memorandum titled, “Maintenance Plan Guidance Document for Certain 8-hour Ozone Areas Under Section 110(a)(1) of Clean Air Act”, which can be found at [https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/20050520_wegman_maintenance_8-hr_ozone_section_110\(a\)\(1\).pdf](https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/20050520_wegman_maintenance_8-hr_ozone_section_110(a)(1).pdf).

3.8 Projected Inventories

The purpose of a projected inventory is to provide an emissions estimate for a year beyond the base year. These inventories are also called future-year inventories. Projected inventories will reflect the net effect of emissions resulting from anticipated changes in future activity (such as emissions increases due to growth in VMT; emission decreases due to implementation of existing requirements for stationary source and car/truck emissions); and the effects of new control measures needed to reduce emissions and bring nonattainment areas and states into compliance with a particular NAAQS or regional haze program requirement.

Projected inventories are used for a number of purposes in implementing the ozone, PM_{2.5}, and regional haze programs. As listed in Table 4, there are two possible attainment year projection inventories. The first is the *attainment projected inventory for the NAA*. The second is the *projected inventory for the modeled attainment demonstration*, which typically reflects emissions for the entire modeling domain (commonly an area larger than the nonattainment area). Note that the projected inventory for the modeled attainment demonstration represents the future year emissions throughout the entire modeling domain (which will be a larger geographic area than the NAA).

Projected inventories for certain years prior to the attainment year are also used in addressing the rate of progress/reasonable further progress requirements in ozone and PM_{2.5} attainment plans. Projected inventories are also needed for ozone or PM_{2.5} maintenance plans for areas to be redesignated to attainment.

Creating projected inventories includes a large number of data sources and requires estimates for stationary point, nonpoint, on-road mobile, and nonroad mobile sources. In addition, some areas may choose to use average fires to represent these highly variable (from year to year) and large contributors to emissions. Biogenic sources are not generally forecast into the future because they are so dependent on meteorology. Section 5 covers additional details on projected inventories.

3.8.1 Ozone NAAQS Implementation

For ozone NAAQS implementation, projected inventories are used for three main purposes. They are used for modeled attainment demonstrations, which are required for Moderate and above areas; for ROP/RFP plans, which are also required for Moderate and above areas; and in maintenance plans, to show that NO_x and VOC emissions will not exceed attainment year emissions levels at any time after attainment.

Ozone ROP/RFP plans must describe how the required percent reductions of relevant pollutants will be achieved on specific timetables. As described in Section 3.8.2, one possible use of the attainment projected inventory for the NAA is for showing emissions reductions associated with an ROP/RFP plan. While it is conceivably possible to estimate only the emissions reductions (rather than future year emissions inventories) required by the ROP/RFP plan, the most common way to estimate the reductions is by creating future-year inventories and *then* calculating the difference between the ROP/RFP baseline and the attainment projected inventories for the NAA.

As described in Section 3.4 and the Ozone Implementation Rule, Moderate and above NAAs must have a plan for meeting a 15 percent VOC emissions reduction requirement (ROP plan) within 6 years after the NAA designation. Serious and above NAAs must also have a plan (RFP plan) to meet a requirement for an additional 3 percent per year VOC reduction (annual RFP) for each 3-year period after the initial 6 years (after the NAA designation) until the attainment date. In both cases, the VOC reductions can be substituted with NO_x reductions when specific conditions apply. Serious and above areas may submit two separate plans since the annual RFP plan is due 1 year later. Collectively, this guidance calls these plans the ROP/RFP plan(s).

For the ROP requirement, an attainment year projected inventory for the NAA can also meet the ROP requirement by providing a projected inventory that shows the 15 percent VOC (or NO_x, as applicable) reductions when compared to the ROP/RFP baseline NAA inventory. The EPA recommends that summaries of these projected NAA inventories are included in the ROP/RFP plan(s) to communicate the emissions reductions by comparing against the ROP/RFP baseline NAA inventory.

For Serious and above areas, an additional projected inventory may be needed to meet the ROP requirement. This is because the ROP requirement at 6 years can be earlier than the expected

attainment date. In the case for Serious and above areas, ROP plans cannot use the projected attainment inventory for the NAA, but rather should use an inventory projected at the 6-year interval.

To estimate the emissions reductions associated with ROP/RFP plans, air agencies should rely on the same techniques as for other projection purposes, which are described in Section 5. When these reductions are calculated by creating projected inventories, the on-road portion of the inventories may also need to follow transportation conformity guidance (<http://www.epa.gov/otaq/stateresources/transconf/>) so that it can be used to set the motor vehicle emissions budgets.

3.8.2 PM_{2.5} NAAQS Implementation

For PM_{2.5} NAAQS implementation, the projected inventories are used for modeled attainment demonstrations; for RFP plans; and in maintenance plans, to show that PM_{2.5} and PM_{2.5} plan precursor emissions will not exceed attainment year emissions levels at any time after attainment.

For PM_{2.5} SIPs, the attainment projected inventory for the NAA is a required element of the SIP. The detailed requirements for various aspects of this inventory are included in the regulatory text at 40 CFR 51.1008(a)(2) for Moderate areas and 40 CFR 51.1008(b)(2) for Serious areas. For the attainment projected inventory for the NAA, a key difficulty can be calculating projected emissions for partial counties, which would not necessarily be available from the modeling inventory. It may be possible to use the gridding aspect of modeled inventories to estimate emissions in partial counties for nonpoint and mobile sources. This issue is addressed more completely in Section 4.4.1.

The projected inventory for the modeled attainment demonstration represents the future year emissions throughout the entire modeling domain (which will be a larger geographic area than the NAA). This projected inventory represents estimated lower emission levels due to implementation of ongoing and any new emission reduction strategies that are needed to attain the relevant PM_{2.5} NAAQS in a future year, as reflected by air quality modeling.

PM_{2.5} RFP plans must include “RFP projected emissions” for each applicable quantitative milestone year, based on the anticipated control measure implementation schedule. These emissions must be described by source sector, and on a pollutant-by-pollutant basis (see section IV.F. of the PM_{2.5} [NAAQS SIP Requirements rule](#)).

3.8.3 Regional Haze Implementation

For regional haze program implementation, section 308(f)(6)(v) includes the requirement for SIPs to provide for a statewide inventory of estimates of future projected emissions. The purpose of the projected inventory is to address the SIP requirement to focus on emission reduction measures that are designed to achieve reasonable progress by the end of each implementation period (2018, 2028, and every 10 years thereafter) by reducing emissions that lead to regional haze.

In addition, section 308(g)(4) of the regional haze rule addresses the emissions-related requirements for the periodic reports. This section requires emissions changes to be identified by type of source or activity. However, there is no requirement for a projected emissions inventory for progress reports. The

tracking analysis would encompass emissions up to the year of the most recent NEI submission for all sources, and for relevant sources up to the most recent year for which the EPA has provided a summary of emission information submitted by sources directly to the EPA as of a date 6 months prior to the due date of the progress report. More information about this comparison is given in EPA's "[General Principles for the 5-Year Regional Haze Progress Reports](#)" document.

As described in 308(f)(2), the state's long-term strategy to address regional haze must include "enforceable emission limitations. The EPA expects that the estimates of future projected emissions to meet the requirements of 308(f)(6)(v) would therefore reflect the projected impacts of these enforceable emission limitations.

The RHR does not assume that all sources in a state must be subject to an analysis of the four factors laid out in 308(f)(2)(i), but instead requires the state to identify the sources considered by the state in developing its long-term strategy and the criteria used to select the sources considered. However, once the emissions reduction measures for these sources are identified pursuant to the four-factor analysis, the emission reductions from those measures would be reflected in the projection of end-of-implementation period emissions needed to set the reasonable progress goals 308(f)(3). The emissions projection techniques provided in Section 5 below can provide the necessary technical guidance to support states in projecting their future emissions.

3.8.4 Transportation Conformity Program and Motor Vehicle Emission Budgets

The on-road mobile portion of the attainment projected inventory for the NAA can serve as the motor vehicle emissions budgets for transportation conformity purposes for ozone and PM_{2.5} NAAs. Specific requirements for motor vehicle emissions budgets for ozone (NO_x and VOCs) and PM_{2.5} (direct PM_{2.5}, NO_x and possibly VOCs, SO₂ and NH₃) can be found in 40 CFR 93.102(b). Since these budgets are required for transportation conformity purposes by 40 CFR 93.118(b), such inventories provide a convenient and consistent way to meet that requirement. In this case, the on-road inventory should be created in accordance with transportation conformity guidance (<http://www.epa.gov/otaq/stateresources/transconf/>).

3.8.5 Additional Relevant Provisions

Additional relevant provisions of 40 CFR part 51 must be considered for ozone, PM_{2.5}, and regional haze implementation purposes. Subpart G of 40 CFR part 51 provides some foundational regulatory aspects of the control strategy development needed for creating projected inventories, including what SIPs must include with regard to control strategies and their associated inventories. In particular, 40 CFR 51.114 "Emissions data and projections" reads:

- (a) Except for lead, each plan must contain a detailed inventory of emissions from point and area sources. Lead requirements are specified in §51.117. The inventory must be based upon measured emissions or, where measured emissions are not available, documented emission factors.
- (b) Each plan must contain a summary of emission levels projected to result from application of the new control strategy.

- (c) Each plan must identify the sources of the data used in the projection of emissions.

In addition, 40 CFR 51.116 “Data availability” reads:

- (a) The State must retain all detailed data and calculations used in the preparation of each plan or each plan revision, and make them available for public inspection and submit them to the Administrator at his request.
- (b) The detailed data and calculations used in the preparation of plan revisions are not considered a part of the plan.
- (c) Each plan must provide for public availability of emission data reported by source owners or operators or otherwise obtained by a State or local agency. Such emission data must be correlated with applicable emission limitations or other measures. As used in this paragraph, correlated means presented in such a manner as to show the relationship between measured or estimated amounts of emissions and the amounts of such emissions allowable under the applicable emission limitations or other measures.

Thus, states should keep these requirements in mind as they develop their projected inventories so that these required SIP elements can be included.

3.9 Public Hearings

For ozone and PM_{2.5} implementation, some emissions inventories are considered a part of the SIP under the CAA (see sections 172(c)(3), 182(a)(1)(A) and 182(a)(3)(A)), and in this guidance we have called these planning inventories. Thus, for ozone and PM_{2.5} SIPs, detailed emissions inventory data are required to be included in the public participation associated with SIPs as specified in CAA section 110(a)(2). For regional haze, the detailed emissions inventory data are not expected to be a part of the information provided for a public hearing on the regional haze SIP. If emissions inventory information (but not the detailed data) is included as part of a SIP submission, the emissions information in the SIP submission still needs to be included as part of the information provided as specified in CAA section 110(a)(2).

In addition, 40 CFR 51.102(a) further explains that a public hearing requirements means “The State must hold a public hearing or provide the public the opportunity to request a public hearing.” Thus, the phrase “or provide the opportunity to request” means that it is possible that public hearings on inventories will have no one request a public hearing¹⁶.

There are policy reasons that support the need for detailed emissions inventories data to be approved with the SIP. Some emissions inventories must be used as a basis for ozone RFP plans for areas classified

¹⁶ A public hearing must be offered for every SIP submittal, but a hearing does not need to actually occur if no one requests a hearing. The detailed requirements for public notice and hearings are given in 40 CFR 51.102. See also Attachment B of “Regional Consistency for the Administrative Requirements of State Implementation Plan Submittals and the Use of Letter Notices,” EPA memorandum dated April 6, 2011, from Janet McCabe, Deputy Assistant Administrator for the Office of Air & Radiation to the Regional Administrators, www3.epa.gov/airquality/urbanair/sipstatus/docs/FINALSIPGuidelinesSubLtrsPN.pdf.

as Moderate or above. Additionally, all NAAs seeking redesignation to attainment will rely on an emissions inventory for purposes of submitting a maintenance plan under CAA section 175(A). Because the emissions inventories and projections play such a fundamental role in determining the reductions necessary to attain and maintain the standard, they need to receive full public scrutiny and be formally incorporated into the SIP.

As explained in the final Ozone SIP Requirements Rule, the EPA is no longer advising states to follow our existing September 29, 1992, guidance titled, “Public Hearing Requirements for 1990 Base-Year Emissions Inventories for Ozone and Carbon Monoxide Nonattainment Areas” in implementing certain SIP adoption and submission procedures for the emissions inventory requirements under CAA sections 182(a)(1) and 182(a)(3)(A) for purposes of the 2008 ozone NAAQS. In that guidance, the EPA indicated it could provide states with a time-limited “*de minimus*” deferral of the CAA’s state public hearing requirement for the emissions inventory SIP revision until the inventory needs had “regulatory significance.” As there is nothing in the CAA provisions that provides for waiver or delay of the public notification and hearing requirements specified in CAA section 110(a) *de minimus* or otherwise, we no longer believe it is appropriate to advise states to follow the 1992 guidance. We remind states that the EPA’s implementing regulations at 40 CFR part 51 (Requirements for Preparation, Adoption, and Submittal of Implementation Plans) provide flexibility for states to streamline SIP-related public notification and hearing procedures (for example, only holding a public hearing if one is requested, per 40 CFR 51.102), and we encourage states to take advantage of those provisions in meeting the emissions inventory requirements under CAA sections 182(a)(1) and 182(a)(3)(A).

For areas classified as Moderate or above, the state would need to provide the EPA with verification that a public hearing was offered for the emissions inventory for any emissions inventory SIP revision at the time the state submits the emissions inventory SIP.

In instances where a public hearing is held for the emissions inventory SIP revision, the EPA clarifies here what is required by EPA regulations to be published and present for public review. Because emissions inventory data can be voluminous, it is common to summarize that data for public hearing purposes. The EPA does not interpret 40 CFR 51.102 to require that at a public hearing, held in accordance with that provision, every database entry related to the emissions inventory must be summarized, presented, and/or made available. Rather, the EPA expects that, in general, emissions inventory summaries would be the primary source of information for public review, so long as the detailed emissions inventory data are available to the public in accordance with the CAA and EPA regulations. Air agencies must comply with 40 CFR 51.102(d)(2), and 40 CFR part 51, Appendix V.

At a minimum, the state should include summaries of the actual emissions. The EPA recommends using the same tables as those recommended in the EI Guidance for inclusion in the SIP documentation for the purpose of the public review (see Section 3.10.3 of this guidance “What to Submit”).

3.10 Submit Inventory Parts of SIP to the EPA

40 CFR part 51 contains the requirements for SIPs, and many general provisions in Part 51 impact the requirements for emissions inventory SIPs. Section 3.10.1 summarizes the applicable regulations. In addition, the two key concerns for submitting information on inventories are: (1) how to submit, including the format and (2) what to submit. These concerns are addressed in Sections 3.10.2 and 3.10.3, respectively.

3.10.1 Regulatory Requirements in Addition to Implementation Rules

The general regulatory requirements for SIP submissions are available in several subparts of 40 CFR part 51 that have an impact on the emissions inventory SIPs.

- Subpart F – Procedural Requirements
 - §51.102 Public hearings (see Section 3.9 above)
 - §51.103 Submission of plans, preliminary review of plans:
Cites Appendix V as the source of the requirements that constitutes an official plan submission.
- Subpart G – Control Strategy
 - §51.112 Demonstration of adequacy
This section requires a presentation of emissions levels expected to result from implementation of each measure of a control strategy (*in the modeled attainment demonstration*).
 - §51.114 Emissions data and projections
This section has three subsections:
(a) requires a detailed inventory of emissions from point and area sources that are based on measure emissions or, where measured emissions are not available, documented emission factors;
(b) requires that the plan contain a summary of emission levels projected to result from application of the new control strategy; and
(c) requires that each plan must identify the sources of the data used in the projection of emissions.
 - §51.116 Data availability
Subsection (c) requires that each plan must provide for public availability of emission data reported by source owners or operators or otherwise obtained by a state or local agency. It also requires correlation of emission data with applicable emission limitations or other measures.
- Subpart Q – Reports
 - §51.322 – Sources subject to emissions reporting
This section points to Subpart A, which is the AERR.
 - §51.323 – Reportable emissions data and information
This section also points to Subpart A.
- Appendix V – Criteria for Determining the Completeness of Plan Submissions

- 2.2 Technical Support. This subsection of Appendix V lists various parts of the SIP that must be included that can be met as part of the EI SIP, including:
 - (b) Identification of the location of affected sources included the EPA attainment/nonattainment designations of the locations and the status of the attainment plan for the affected area(s).
 - (c) Quantification of the changes in plan allowable emissions from the affected sources; estimates of changes in current actual emissions from affected sources or, where appropriate, quantification of changes in actual emissions from affected sources through calculations of the differences between certain baseline levels and allowable emissions anticipated as a result of the revision.
 - (e) Modeling information required to support the proposed revision, including input data (which includes emissions).
- 3.2 Paper Plan Submissions. This section addresses the EPA’s voluntary guidelines for which states are requested to adhere for paper and electronically formatted submissions.

3.10.2 How to Submit Inventory Parts of a SIP

The EPA generally encourages air agencies to provide all parts of the SIP related to emission inventories using digital media. For the Ozone SIP Requirements Rule, the preamble specifically indicates that “states must make available the inventory data to the EPA as electronic files in ... electronic media, such as FTP, zip drives, or DVDs.” In most cases, it’s simply best practice to provide this information digitally. Because of the challenges that can arise with the use of formats that are supported by one agency and not the other, air agencies should provide documentation at least in formats that are readily transferrable, such as PDF for documentation files. Other formats can also be considered and agreed upon in advance, and such details would be ideal to be included in an IPP.

When paper plans are submitted, some guidelines provided in 40 CFR part 51, Appendix V apply. In accordance with section 3.2(a) of Appendix V, the EPA requires that when submitting one paper plan, it must be accompanied by an electronic duplicate of the entire paper submission, preferably as a word searchable document format (PDF).

For the format, the above information is provided as guidance. There are no specific formatting *requirements* added by this guidance for the inventory data, emissions summaries, or documentation submitted as part of the SIP. Requirements are included in implementation rules, and the ozone, PM_{2.5}, and regional haze implementation rules do not specify required formats for submitting inventory information. For ozone and PM_{2.5}, however, the *data elements* required for submitted emissions inventories are to use the elements required by the AERR.

Currently, the AERR data format does not directly support the use of partial counties. Thus, inventories with partial counties are not currently able to use the EIS formats and states would need to use some identifier in the format to denote partial counties.

The following provides a list of best practices that the EPA encourages air agencies to use when submitting the Inventory Parts of a SIP:

- In accordance with Subpart A, detailed inventory data are required as part of emission inventory SIPs. When providing full detailed inventory data (i.e., facility-SCC-pollutant data for point sources or county-SCC-pollutant data for nonpoint sources):
 - Use the data elements required by the AERR. This is required by the ozone and PM_{2.5} implementation rules.
 - Coordinate with your Regional office about what format is going to be used. If EIS format is used, consider submitting this to the EIS, but first contact the EPA NEI program to make sure any such submission will not conflict with other inventories already submitted to the EIS.
 - If not using the EIS format, use Excel®, Access® or a rigorous delimited text format. For a delimited text format, make sure that the text fields have double quotes and that the delimiter chosen (e.g., a tab) does NOT appear in any of the text fields, since this will prevent the delimited dataset from being imported easily into other data systems.
- For documents, use a readily available word processor format (e.g., Microsoft Word®) or convert the document to PDF format.
- At times, it can be very time consuming to convert tables from a spreadsheet and insert them into a word processor, especially if the information changes and has to be updated. The guidance below recommends a lot of summary tables. Rather than cut/pasting into a text file, states may consider creating a spreadsheet with individual worksheets (tabs) labeled as each table included in the document. Then, just reference those tables/tabs from document. This can be done with words only (e.g., “see Table 1 in Excel file”) or using a more sophisticated data link between the word processor and spreadsheet software.

3.10.3 What to Submit

With regard to exactly what to submit, the information provided here provides guidance on what would be acceptable in most cases. The list of tangible data items and documentation forms the basis of what the EPA will review and ultimately approve for a SIP. Table 11 provides the suggested inventory elements of an Emissions Inventory SIP and indicates whether they are relevant for ozone, PM_{2.5}, and/or Regional Haze SIPs. Refer to the tables in Section 2.3 for more information on which elements are required and which are optional.

This section (and Table 11) does not include RFP inventories since those are submitted with a separate ROP/RFP plan. Similarly, it does not include information needed for a modeling attainment demonstration submittal to the EPA, with the exception of the inclusion of statewide inventory summaries for ozone and PM_{2.5} SIPs for areas that have modeled attainment demonstrations as part of their SIP requirements.

Table 11: Suggested elements of an emissions inventory SIP document

SIP Planning Inventory Documentation Element	Ozone	PM _{2.5}	Haze
Background: Includes key elements explained in this guidance, such as the nature of the air quality problem (or arrival at attainment status for maintenance SIPs), priority source categories and point sources, pollutants covered, spatial extent, and other key inventory aspects.	Y		
<ul style="list-style-type: none"> Overall base year emissions summaries: All emissions are for relevant pollutants only. Data categories would minimally be point, nonpoint, nonroad mobile, and on-road mobile, and fires, though more detailed categories are acceptable. Biogenic sources and other sources can optionally be included as well, and may be required by Regional offices for areas doing modeled attainment demonstrations. 	See Table 12		
<ul style="list-style-type: none"> Overall projected attainment year emissions summaries: The same as the base year summaries except using the attainment projected inventory for the NAA. Required for PM_{2.5} SIPs. <i>These summaries are optional for the ozone Emissions Inventory SIP. For ozone and when developed in accordance with transportation conformity guidance, the on-road portion also can set the motor vehicle emission budgets for VOC and NO_x. If not provided in the Emission Inventory SIP, the summaries would be needed in the Modeled Attainment Demonstration.</i> 	See Table 12	n/a	
<ul style="list-style-type: none"> Overall recent year emissions summaries compared to projected emissions: All emissions are for relevant pollutants only. Data categories would minimally be point, nonpoint, nonroad mobile, on-road mobile, and fires. 		See Table 12	
Stationary Point Sources:			
<ul style="list-style-type: none"> Introduction with more detailed documentation of the emissions from stationary point sources, including the point source emissions threshold, how the point sources were identified, how emission estimates were made including emission factors, activity data, and control assumptions. 	Y		
<ul style="list-style-type: none"> This section includes additional point source emissions summaries. 	See Table 13		
Stationary Area (Nonpoint) Sources:			
<ul style="list-style-type: none"> Introduction with more detailed documentation of the emissions from stationary nonpoint sources, including how the nonpoint sources were identified, the model version used, which sources were not addressed and why, how partial county emissions were estimated, and how emission estimates were made including models or tools, emission factors, activity data, and control assumptions. 	Y		
<ul style="list-style-type: none"> This section includes additional nonpoint source emissions summaries. 	See Table 14		

SIP Planning Inventory Documentation Element	Ozone	PM _{2.5}	Haze
Nonroad Mobile Sources			
<ul style="list-style-type: none"> Introduction with more detailed documentation of the emissions from nonroad mobile sources, including how the nonroad mobile sources were identified, which sources were not addressed and why, how partial county emissions were estimated, and how emissions estimates were made including model version, source of input data, input and output data files, and any post-processing methods used to develop the inventory. 	Y		
<ul style="list-style-type: none"> This section includes additional nonroad source emissions summaries. 	See Table 14		
On-road Mobile Sources			
<ul style="list-style-type: none"> Introduction with more detailed documentation of the emissions from on-road mobile sources, the model and version used, how partial county emissions were estimated, and how emissions estimates were made including sources of input data, input and output data files, and any post-processing methods used to develop the inventory. 	Y		
<ul style="list-style-type: none"> This section includes additional on-road source emissions summaries. 	See Table 14		
Other Sources			
<ul style="list-style-type: none"> If applicable, a description of other sources in the emissions inventory not included and reasons why they are not included. 	Y		
<ul style="list-style-type: none"> If applicable, this section includes summaries of other sources of emissions. 	See Table 14		
Demonstration of Public Hearing: A brief description of the public hearing process, a summary of the results, and any other relevant materials. The purpose of this section is to provide evidence for the public hearing and what the air agency learned through the process.	Y	Y	N

Table 12 provides the summaries to include in the background section. In the table, “data category” is consistent with the definition provided in Table 11 and Section 2.5.1. If both the base year inventory and the attainment projected inventory are included in the background, then the same summaries should generally be provided for both.

Table 12: Suggested summaries to include in the background

Emissions Summaries	Ozone	PM _{2.5}	Haze
Annual baseline, recent year emissions, projected emissions, and emissions difference for the state by data category. The baseline emissions from the original SIP may be used.			Y
Annual base year emissions <i>and/or</i> average season day emissions for the NAA by data category		Y ⁺	
Annual base year emissions <i>and/or</i> average season day emissions for the NAA by data category and county (or partial county) ^λ		Y ⁺	
Ozone season day base year emissions for the NAA by data category	Y		

Emissions Summaries	Ozone	PM _{2.5}	Haze
Ozone season day base year emissions for the NAA by data category and county (or partial county) ^Δ	Y		

+ Either annual or season-day emissions could be reported (but not necessarily both), depending on the temporal basis used for the emissions in the SIP. For areas that have nonattainment for both the annual standard and the 24-hour standard and are using average-season-day inventory for their 24-hour SIP, then summaries of both temporal resolutions would be needed.

‡ For SIPs that include air quality modeling, this section can include both summaries of the planning and the modeling inventories. Since modeling domains are usually much larger, multi-state areas, the resolution of the modeling inventory summaries depends on the modeling guidance and the preferences of the Regional office. One option is to include county-level detail for the state(s) included in the NAA, but state-level detail for surrounding states.

λ Partial county emissions can be included rather than, or in addition to, full county, where applicable.

Δ Providing both the county and partial county could provide more flexibility for states when submitting periodic inventories.

Table 13 provides the recommended minimal contents for summaries to include in the point sources section. If both the base year inventory and attainment projected inventory are included in the background, then the same summaries should generally be provided for both.

Table 13: Summaries to include in the point sources section

Emissions Summaries	Ozone	PM _{2.5}	Haze
Annual recent year emissions, projected emissions, and emissions difference for each AERR point source as a facility total, within the state.			Y
Annual base year emissions <i>and/or</i> PM _{2.5} average season day base year emissions for each point source as a facility total, within the NAA.		Y	
Ozone season day base year emissions for each point source as a facility total, within the NAA.	Y		
These summaries should include: the county, Agency Facility ID, plant name, physical address, total control efficiency, key control devices, NAICS code, and actual and/or projected emissions. Other summaries may be included as well, such as by SCC or other fields that are necessary to describe the inventory effectively. The Agency Facility ID or some other ID should be included that can easily map to the EPA facility records in EIS. This can be more difficult when air agencies change their Agency Facility IDs.			

Table 14 provides the recommended minimal contents for summaries to include in the nonpoint and mobile sources sections. If both the base year inventory and the attainment projected inventory are included in the background, then the same summaries should generally be provided for both.

Table 14: Summaries to include in the nonpoint and mobile sources sections

Emissions Summaries	Ozone	PM_{2.5}	Haze
Annual recent year emissions, projected emissions, and emissions difference by county and SCC (or SCC group [‡]), within the state.			Y
Annual base year emissions <i>and/or</i> average season day emissions by county and SCC (or SCC group [‡]), within the NAA.		Y	
Ozone season day base year emissions by county and SCC (or SCC group [‡]), within the NAA.	Y		
For county and emissions processes reported that have reductions associated with rules, these summaries should include any control efficiencies or rule effectiveness assumed and actual and/or projected emissions. Projected attainment year emissions summaries may also be required for areas performing modeled attainment demonstrations.			

[‡] See additional information below on SCC groups.

SCC groups for on-road and nonroad mobile sources can be useful in limiting the size of summaries without much loss of information. For example, SCC groups can be formed by vehicle type and fuel, dropping the road classifications. Vehicle types can be further grouped into light duty and heavy duty. The amount of grouping appropriate depends on what a particular summary and SIP are trying to communicate. SCC groups can be suggested as appropriate by Regional offices or air agencies as part of the consultation for what will be included in the emissions inventory SIP.

4 Developing Current Emissions inventories

This section covers the decisions that states will need to make regarding any “current” emissions inventory, including a base year NAA or state inventory, RFP baseline inventory, periodic inventory (for ozone) or most recent year inventory (for regional haze), or maintenance inventory. As a reminder, all inventories described in this section are inventories of actual emissions; these inventories do not contain emissions based on potential to emit nor allowable emissions. In accordance with 40 CFR 51.5(b), states are urged to use applicable, state-of-the art techniques for estimating emissions.

4.1 Inventory Years

A fundamental step in creating a base year inventory is the choice of inventory year. The Ozone, PM_{2.5} and Regional Haze Implementation Rules include specific language regarding the choice of inventory years, and those regulatory requirements supersede any guidance provided in this section. Since the purpose of the base year inventory is to represent relatively current emissions conditions, there is a general preference to use as recent a year as practical. This means that the year of emissions estimates is usually several years earlier than the year in which the inventory work is done, given the time that it takes to compile an emissions inventory (for example, an inventory with 2014 emissions may not be compiled until 2016).

The primary considerations in choosing a baseline inventory year as covered in this guidance are: (1) the implementation rule requirements, (2) transportation conformity requirements, and (3) the availability of data. This is in contrast to inventories used for air quality modeling, for which meteorology, and availability of ambient data are the primary considerations, with inventory availability secondary. This is because the meteorological conditions selected should be associated with ozone formation that is representative of either the ambient data relied upon for designation to nonattainment or recent ambient data, as appropriate. Choosing a year based solely on inventory availability could result in choosing an inappropriate year (considering ambient measurements and the meteorology that led to those measured concentrations). As a result, the base year(s) used in the planning inventories can be different than the modeling base year and associated modeling inventory.

4.1.1 Ozone Baseline Inventory Year

For ozone, states should become familiar with the specific rule requirements. The 2008 Ozone Implementation Rule in 40 CFR 51.1115(a) specifies that the “inventory year shall be selected consistent with the baseline year for the RFP plan as required by Section 51.1110(b), which reads as follows:

(b) Baseline emissions inventory for RFP plans. For the RFP plans required under this section, at the time of the designation for the 2008 ozone NAAQS, the baseline emissions inventory shall be the emissions inventory for the most recent calendar year for which a complete triennial inventory is required to be submitted to EPA under the provisions of subpart A of this part. States may use an alternative baseline emissions inventory provided the state demonstrates why it is appropriate to use the alternative baseline year, and provided that the year selected is between the years 2008 to 2012. All states associated with a multi-state nonattainment area must consult and agree on a single alternative baseline year.

Thus, for the 2008 ozone standard, the 2011 inventory year is the presumed inventory year. Guidance on the considerations for using an alternative baseline year is provided below in Section 0.

The consideration of transportation conformity requirements is important because the rule has its own language about selecting a base year. The applicable section of the rule is 40 CFR 93.119(e), which reads:

(e) *Baseline year for various NAAQS.* The baseline year is defined as follows:

...

(4) The most recent year for which EPA's Air Emissions Reporting Rule (40 CFR Part 51, Subpart A) requires submission of on-road mobile source emissions inventories as of the effective date of designations, in areas designated nonattainment for a NAAQS that is promulgated after 1997.

This requirement impacts the 2008 and 2015 ozone standards. For convenience, OTAQ provides an online table that lists the appropriate base year for use for transportation conformity purposes (see <https://www.epa.gov/state-and-local-transportation/baseline-year-baseline-year-test-40-cfr-93119>). Unlike the ozone implementation rule, the transportation conformity rule does not include a provision for an alternative baseline year; thus, states that wish to select an alternative year are advised to consult with their Regional office as part of their SIP development.

Lastly, the consideration of "availability" is simply what data are (or will be) available to the air agency during the time allotted for SIP preparation. Often, the triennial NEI year inventories (as described above) are useful starting points for meeting the various "current" inventory requirements associated with SIPs. For these triennial NEI years, states are already required to have prepared and provided to the EPA inventories of criteria pollutants and precursors as well as model inputs for on-road and nonroad mobile sources. In some cases, the states have submitted their data to the EPA, but the complete NEI is not yet available because there is a 6- to 12-month lag between when the emissions have been submitted and when the inventory is released by the EPA. In this case, the state should make every effort to use the most currently available information and incorporate any new information that is made available by the NEI release at the earliest practical time.

Other benefits of using an NEI year is that NEI data are available for all states, and information from more than one state may be needed for attainment demonstration modeling purposes. Additionally, other data needed for modeling (e.g., meteorology and SMOKE inputs) are more likely to be available for the triennial NEI years.

4.1.2 PM_{2.5} Baseline Inventory Year

For PM_{2.5}, states should become familiar with the specific rule requirements. The PM_{2.5} SIP Requirements Rule at 40 CFR 51.1008(a)(1)(i) states:

(i) The inventory year shall be one of the 3 years for which monitored data were used for the designations or another technically appropriate year if justified by the state in the plan submission.

For the 2012 PM_{2.5} NAAQS, the EPA used ambient data from 2011 through 2013 to designate PM_{2.5} NAAs; thus any of these 3 years can be used as the baseline year. The idea behind this connection is that the inventory should represent the emissions conditions in the local area associated with the nonattainment problem. Given this purpose, situations may arise where the most applicable available inventory year is not one of these 3 ambient-data years.

Two examples of such situations are offered here. In the first, a newer inventory may be advisable. Because of the time that it takes for designations to occur and the period allowed for SIP submittal, a significant increase in emissions could occur between the designation period and the time SIPs are submitted. This has occurred in some areas due to oil and gas development, for example. In this case, it may be more appropriate to use an inventory year that is newer than one of the 3 years of data used for designations, to represent the higher emissions or different source mix associated with a more recent year. Another example is that in an area where mobile sources are a small part of the emissions inventory, emissions may not have changed much from a year prior to the 3-year period of ambient data. In this case, an available inventory prior to one of the 3 years may sufficiently represent the inventory. In both cases, the air agency preparing the SIP should explain these issues as part of its justification for not using one of the 3 years.

The inventory baseline year is the same year used for the RFP baseline year. In addition, states must meet quantitative milestone requirements as described in 40 CFR 51.1013(a). Within the 3 years available for choosing a base year, a large source of emissions may be reduced. If a state chooses a year after those reductions have occurred, then the state would not get the benefit of those reductions in meeting their RFP and quantitative milestone requirements. In addition, if those emissions were a key part of the nonattainment problem, then the choice of the later year would not follow the guidance that the year selected be representative of the conditions leading to nonattainment.

The considerations for availability of emissions for PM_{2.5} planning inventories are the same as for ozone as described in the previous subsection.

4.1.3 Regional Haze Inventory Years

As described in Section 2.3.3, the year of the baseline inventory has previously been set. For the initial Regional Haze SIPs, the year used should have fallen between and be inclusive of the 2000 to 2004 baseline period. Most areas used 2002 as their baseline inventory year in their initial SIPs based on an [OAQPS memo about this issue](#).

The RHR addresses what states must do for subsequent planning periods, and requires that states create and use a recent year inventory as part of their SIP analysis. As described in Section 2.3.3 above, the 10-year SIP revisions and the progress reports in between SIP revisions include specific language regarding the inventory year to use for developing those plans, which we address here in more detail.

For the progress reports, an inventory is used to compare back to the most recent previous inventory from the previous SIP revision. The year for this comparison is the most recent year for which the state has submitted emission inventory information to the EPA in compliance with the triennial reporting requirements of the AERR. In addition, the rule 308(g)(4) states that: “With respect to sources that

report directly to a centralized emissions data system operated by the Administrator, the analysis must extend through the most recent year for which the Administrator has provided a State-level summary of such reported data or an internet-based tool by which the state may obtain such a summary as of a date 6 months preceding the required date of the progress report.” This latter requirement refers (at least) to the direct reporting of the CEM data for EGU sources. Thus, the emissions year(s) for the progress report tracking analysis would include the most recent NEI year that had been reported by the state and any newer EGU (or other) data available through direct facility reporting.

For the 10-year SIP revisions, an inventory is used as a starting point to examine future emissions reductions and assess expected progress on visibility improvements. Similar to the progress report requirement, the rule at 40 CFR 51.308(f)(2)(iii) would require this starting year to be “at least as recent as the year for which the state has submitted emission inventory information to the EPA in compliance with the triennial reporting requirements of the AERR. However, if a State has made a submission for a new inventory year to meet the requirements of subpart A in the period 12 months prior to submission of the SIP, the State may use the inventory year of its prior submission.” Section 4.1.4 provides more information on considerations for choosing an alternative year.

4.1.4 Considerations for Choosing an Alternative Baseline Year

For both ozone and PM_{2.5} SIPs, the governing implementation rules allow states to choose a different year than one of the presumptive years as described in the subsections above. In general, states seeking to use newer inventory years will be easily able to justify that choice on the basis of improvement in meeting the CAA requirement for a “current” inventory (see CAA section 172(c)(3) for PM_{2.5} and section 182(a)(1) for ozone). It is presumed that because of ongoing control programs for mobile and stationary sources, which get additional reductions each year, more recent year inventories will reflect lower emissions levels.

Another common reason for choosing a different base year includes a desire to have the base year for planning inventories consistent with the base year used for modeling inventories. The modeling base year is determined in part by meteorology that is conducive to formation of ambient levels of a NAAQS pollutant that are above the NAAQS. Other reasons may also exist for choosing a different year, and these should be provided as part of SIP documentation. Ideally, any such decisions would be made in the planning phase of SIP development, in consultation with the Regional office.

4.2 Pollutants and Pollutant Precursors to Include in Inventories

This section describes the pollutants and precursors that should be included in the planning inventories for the ozone, PM_{2.5}, and regional haze rules. Pollutants for ROP/RFP inventories are also described in Section 3.4.2. Because many sources emit more than one of the precursor pollutants, and because the precursor pollutants have the potential to be transported across state boundaries, the EPA encourages air agencies to develop inventories for all pollutants, where possible, to support integrated, regional-scale modeling and control strategy development for ozone, PM_{2.5}, and regional haze.

Section 172(c)(3) of the CAA requires “the relevant pollutant or pollutants” to be included in inventories for SIPs. The ozone, PM_{2.5} and regional haze implementation rules include specific language regarding

the pollutants and precursors to be included, and those regulatory requirements supersede any guidance provided in this section.

For the 8-hour ozone NAAQS, the pollutants to be inventoried are VOC and NO_x. The ROP/RFP baseline NAA inventory for ozone should also include VOC and NO_x. For the PM_{2.5} NAAQS, the pollutants to be inventoried are primary emissions (including both the filterable and condensable portions) of PM₁₀ and PM_{2.5}, and emissions of SO₂, NH₃, VOC, and NO_x. The EPA has finalized the requirement that PM₁₀ emissions are to be reported with the PM_{2.5} inventories because PM₁₀ emissions are often used as the basis for calculating PM_{2.5} emissions. For regional haze, the pollutants to be inventoried include all of the pollutants and precursor pollutants identified for ozone and PM_{2.5}.

4.2.1 Condensable PM Emissions

As mentioned previously, the AERR identifies reporting requirements for the implementation rules. In the past, a source of confusion has been the AERR requirement for reporting primary PM₁₀ and primary PM_{2.5} emissions, which states, “As applicable, also report filterable and condensable components.” The AERR also defines condensable PM as:

Material that is vapor phase at stack conditions but which condenses and/or reacts upon cooling and dilution in the ambient air to form solid or liquid PM immediately after discharge from the stack. Note that all condensable PM, if present from a source, is typically in the PM_{2.5} size fraction and, therefore, all of it is a component of both primary PM_{2.5} and primary PM₁₀.

While the wording in the AERR is clear that the EPA expects reporting of all components of primary PM including condensable portion (and as individual components), the rule does not clarify “as applicable” by identifying those sources that are expected to have condensable PM. To clarify this issue, Table 15 provides a list of source types for which condensable PM is expected by the AERR.

Table 15: Source types expected to include condensable PM

EIS Sectors (and subsectors)	Subsectors and Degree of Condensable	Data Categories
Commercial Cooking	High	Nonpoint
Fuel Combustion – Electric Generating Utilities – all fuel types	Low, except Gas Turbines are negligible	Point
Fuel Combustion – Industrial Boilers – all fuel types		Point Nonpoint
Fuel Combustion – Commercial/Institutional – all fuel types	Moderate and depends on control technology	Point Nonpoint
Fuel Combustion – Residential – Oil, Natural Gas, Other	Significant	Nonpoint
Industrial Processes – Cement Manufacturing (Kilns)	Low	Point
Industrial Processes – Chemical Manufacturing (Fuel Fired Process Heaters, Carbon Black Fuel Fired Furnaces and Dryers, Charcoal Manufacturing, Fuel Fired Ore Calciners,	Low – Moderate, depends on industry	Point

EIS Sectors (and subsectors)	Subsectors and Degree of Condensable	Data Categories
Ammonia Production Fuel Fired Reformers, Fuel Fired Incinerators, other fuel fired equipment)		
Industrial Processes – Ferrous Metals (Silicon Metal Electric Smelting Furnaces, Electric Arc Furnaces, Electric Induction Furnaces, Basic Oxygen Furnaces, Iron & Steel Pouring/Casting, Foundry Cupolas, fuel fired equipment)	Primary metals: High, others Low - Moderate	Point
Industrial Processes – NEC ⁺ (Brick Manufacturing Kilns, Lime Manufacturing Kilns, Glass Manufacturing Furnaces, Mineral Wool Blow Chambers, Fuel Fired Process Heaters, Coke Manufacturing Ovens, other fuel fired equipment)	Coke Ovens: High, others Low	Point
Industrial Processes – Non-ferrous Metals (Aluminum Ore Electro-reduction, Smelting Furnaces, Zinc Electrothermal Furnaces, Pouring/Casting, Rolling/Drawing/Extruding, Fuel Fired Process Heaters, other fuel fired equipment)	Primary metals: High, Asphalt electrode facilities: High, Drying: High; Others: Low	Point
Industrial Processes – Oil & Gas Production (Gas Well Dehydrators, Gas & Oil Well Heaters, Fuel Fired Compressor Engines, Heater Treaters, Process Heaters, Steam Generators)	High	Point Nonpoint
Industrial Processes – Petroleum Refineries (Process Heaters, Catalytic Cracking Units, Coke Calciners, Flares, Process Gas Incinerators, other fuel combustion)	Low	Point
Industrial Processes – Pulp & Paper (Recovery Furnaces, Lime Kilns, Paper Machine/Pulp Dryer, Sawmill Sanding: Cyclone Exhaust, Particleboard Cooler or Dryer, Smelt Dissolving Tank, Particleboard Presses)	Moderate – High	Point
Waste Disposal (Landfill Flares, Other Landfill Gas Waste Gas Combustion, Incinerators)	Low - Moderate	Point

For stationary point and nonpoint sources, the EPA recognizes that emission factors for condensable PM are limited, as well as emission factors for many industrial sources of filterable PM_{2.5}. Resource constraints for many years have made it infeasible for the EPA to conduct sufficient testing programs to populate all of the necessary emission factors. Nevertheless, state and local air agencies and their facilities are responsible for estimating emissions from sources required by the AERR.

In response to this issue, the EPA continues to work to help state and local air agencies meet their responsibilities. The EPA has devised a mechanism to more readily collect source test data for use in developing improved emission factors. More information on this approach can be found at <https://www.epa.gov/electronic-reporting-air-emissions/electronic-reporting-tool-ert>. The EPA invites

industry, state, local and tribal agencies to provide source test data they may collect during the preparation of PM inventories to support the development of emission factors.

Additionally, the EPA has used available existing emission factors to develop a “PM augmentation tool” (see <https://www.epa.gov/air-emissions-inventories/pm-augmentation>). The tool uses ratios of the most applicable available emission factors to calculate one PM component from another. In the absence of improved PM condensable emission factors or facility-specific source data, inventory developers can use this tool to calculate PM condensable emissions from filterable PM_{2.5} or total PM_{2.5} emissions.

Condensable PM emissions are not an issue associated with mobile sources. The MOVES model used for these sectors produces primary emission estimates for PM, including particle components (e.g., elemental carbon and organic carbon) and gaseous hydrocarbons (e.g., VOC, non-methane organic gases). These pollutant metrics would include both “filterable” and “condensable” PM. These are currently not separable in MOVES, and for SIP inventory purposes, they can be reported as they are output from MOVES without additional modification.

4.2.2 Regulatory Definition of VOC

The EPA’s current regulatory definition of VOC (40 CFR 51.100(s)) excludes constituents considered to be negligibly reactive in atmospheric photochemistry. These include methane, ethane, methylene chloride, 1,1,1-trichloroethane (TCA), several Freon compounds, acetone, perchloroethylene, and others. States should use the CFR reference above to find the complete list. Over time, additional compounds may be exempted from this VOC definition. The exempt compounds are considered negligibly reactive, although some can influence the formation of ozone when present in sufficient amounts; for example, methane impacts on ozone have been observed in areas of high methane emissions associated with oil and gas development. The emission factors used to estimate organic emissions generally account for nonmethane hydrocarbons (NMHCs).

For SIP purposes, state, local and tribal agencies should report VOC as defined by the EPA (40 CFR 51.100(s)). This is the case regardless of the treatment of methane for modeling inventories, which is addressed in more detail below.

4.2.3 Treatment of Methane

The treatment of methane in emissions inventories may be relevant for emissions used in modeled attainment demonstrations. Methane is not expected in other planning inventories associated with SIPs. This section is included to explain the context for which methane emissions can be important and to specifically note its possible relationship to the VOC emissions that are associated with SIP planning inventories. In some cases, air agencies interested in considering non-VOC-based estimates of methane in their modeling inventories may optionally choose to consider methane as part of non-modeling inventories as well.

The air quality models used for modeled attainment demonstrations use methane as one of the modeled pollutants. However, these models have typically used a fixed concentration of methane that does not change. Thus, typical applications have not used methane emissions from emissions inventories.

Unlike the air quality models, the emissions processing steps to prepare emissions inventories for use in air quality models do compute methane emissions. Methane has traditionally been calculated by applying a factor to the VOC emissions to calculate total organic gases (TOG). These TOG emissions are then split during emissions processing into “model species” that include methane. With the low reactivity of methane and the absence of its use in air quality modeling for ozone, the VOC-to-TOG factors and the methane part of the speciation factors were not given much scrutiny. Previous versions of this guidance encouraged inventory developers to simply use the default VOC-to-TOG factors that were associated with the speciation profiles without further analysis, since the methane emissions were not used. This approach may still be appropriate for most or all NAAs for their modeled attainment demonstration.

In limited situations, air agencies may want to investigate the extent that methane emissions play a role in ozone episodes. Hence, additional efforts going beyond the use of the default VOC-to-TOG profiles and default methane fractions from the speciation profiles may develop over time. In this case, it may be of interest to include methane emissions inputs to air quality models to achieve sufficient model performance for a modeled attainment demonstration. Approaches can include incorporating methane emissions from other sources into emissions inventories used for modeled air quality. For example, the MOVES model estimates methane emissions directly, so there would be no need to use VOC speciation to estimate those emissions. Air agencies considering methane as a contributing factor should consult with their EPA Regional office to discuss the best sources for such data as this inventory development area is undergoing many changes at this time. Furthermore, more specific VOC-to-TOG factors and speciation profiles may be useful, particularly for analysis related to areas of very high methane emissions. These issues are all associated with modeled attainment demonstrations, and do not affect the VOC emissions reported as part of the emissions inventory SIP.

4.3 Identification of Priority Sources

The Ozone Implementation Rule and PM_{2.5} SIP Requirements Rule refer to the AERR requirements for creating the inventories used for SIPs. This includes the AERR requirement that inventories must include all sources of emissions. Thus, inventories used for SIPs are expected to be complete, with emissions from all sources characterized in some way. In addition, to better understand routine emissions sources, emissions from known or quantifiable fugitive sources such as leaking tanks or valves should be included in inventories when these emissions can be quantified in both the base and future years and because their reductions could help in achieving attainment. These emissions should not be excluded based on an invalid assumption that they are “malfunctions.” In addition, startup/shutdown emissions should be included in inventories (see Section 4.8.1).

While completeness is required, there is no requirement that all parts of an emissions inventory be completed with the same degree of rigor. Because emissions inventory development is time consuming and expensive, it is wise for inventory developers first to focus their resources on the sources of emissions making up the bulk of the pollutants relevant for the NAAQS in question. To the extent that an inventory is to be used for multiple NAAQS or for multi-pollutant analysis, then the larger sources important for all relevant pollutants should be characterized with as much technical rigor as is feasible.

Fortunately, existing inventories can help states guide their initial understanding of the sources of pollutants in a particular area. Air agencies can rely on the latest NEI or previously compiled SIP inventories to guide further development. The NEI is commonly used as a starting point for state and regional planning purposes for NAAQS implementation and regional haze planning. The EIS can help by providing emissions summaries for counties or groups of counties and for emissions sectors or SCCs (See Appendix A).

For additional information, the Particulate Emissions volume of the EIIP technical report (see <https://www.epa.gov/air-emissions-inventories/volume-9-particulate-emissions>) provides thorough recommendations for identifying sources of PM emissions. These recommendations can be useful for other pollutants as well.

Starting with an existing inventory poses some risks and challenges. Here we try to address the most common issues associated with SIP inventories when starting with existing inventories:

1. How do I know which sources in an existing inventory should get further review?

The EPA suggests the following considerations in deciding which sources to be reviewed:

- a. The largest contributors to the pollutants of interest (i.e., the pollutants contributing to ozone and/or PM_{2.5} formation) using some coarse groupings, such as the EIS Sectors, Tier 2, or Tier 3 groups.
- b. Sources within the NAA (or contributing to it in the case of modeling attainment demonstration inventories). Special considerations to sources closest to and upwind of violating monitors may deserve special attention.
- c. Knowledge about the growth or retraction of a particular sector of the economy. Oil and gas production is a recent example of a quickly growing industrial source of emissions.
- d. Considering whether the proportion of emissions associated with a particular source is likely to have an impact on the outcome of decisions. Emissions methods/changes for sectors that are likely to have a large impact on the planning process should get higher priority.
- e. Assessing whether the approaches used in the preparation of SIP emissions are updated with current approaches, including appropriate emission factors. This is particularly important for source categories for which there is large uncertainty and those with ongoing research.

2. What if the original inventory does not use good approaches?

The EPA recommends starting with inventories that have available and clear documentation. If an inventory developer cannot figure out how the emissions were estimated, then it will be difficult to build upon those results.

With documentation, inventory developers should be able to evaluate the quality of approaches used. As part of the NEI program, the EPA publishes updated methods for many nonpoint emissions categories. The highest quality point source emissions estimates are based on facility-specific testing, and where not available, current emission factors. Mobile emissions should be

based on the latest mobile models, using as many location-specific inputs as possible.

If it is determined that a starting inventory does not use the latest methods, it is advisable to reassess those emissions with newer methods (or other available inventories) prior to deciding if that category requires even further work.

3. If I need to make updates, where are the latest approaches available?

The EPA's NEI program is a good source of the latest approaches and approaches in development. In many cases, multi-jurisdictional organizations also have updated approaches for various emissions sectors. The EIIP volumes still have a lot of valuable information on emissions, though some sections are outdated (see <https://www.epa.gov/air-emissions-inventories/emission-inventory-improvement-program-eiip>). Approaches have historically included AP-42 and WebFire emission factors, though these resources are outdated for some sectors. For more information on updated emission factors, see Section 4.6.

4. What do I do if the NEI approach has added PM or other emissions that I did not report, and I think that they are invalid?

The EPA commonly augments PM emissions provided by states in the NEI because many states do not report total PM_{2.5} and neglect the condensable portion of PM emissions (see also Section 4.2.1). Consistent with the requirements for complete SIP inventories, the EPA works to create a complete and accurate NEI. If emissions have been added erroneously, states should make those improvements, but should also let the NEI program staff know that there may be a flaw in their methods and provide a better source of information. Just because a source has not reported condensable PM emissions does not mean that they do not exist or should not have been characterized. In some cases, states may need to go back to sources to clarify that condensable PM emissions must be provided to the state agencies.

Another source for added EPA criteria pollutant and precursor emissions is NH₃ for point sources from the TRI. Since these are emissions that the facility submits to the EPA through the TRI program, they should potentially be considered as a source of information when identifying sources of NH₃.

Only the facility total emissions are available from the TRI program (with stack and fugitive emissions denoted separately). This is not generally enough detail for a SIP inventory. For SIP inventories for PM_{2.5}, air agencies would need to follow up with their Regional office to develop more refined information about the facility NH₃ so that NH₃ emissions could be included in the SIP inventories. If the source is a "point source" based on the AERR thresholds for other pollutants, then including NH₃ emissions as part of the point source emissions is required by the AERR and, therefore, in PM_{2.5} SIP inventories in accordance with the PM_{2.5} SIP Requirements Rule. If the source is not a point source based on thresholds of other pollutants, then the AERR NH₃ threshold of 100 tpy potential to emit would apply in determining if the facility should be reported as a point source. Otherwise, the emissions should be included as a nonpoint source in

the SIP inventory. If a state air agency believes that these emissions are erroneous or unimportant, some discussion of these sources should be included in their SIP as to why the NH₃ emissions as identified by TRI are not being included in a SIP inventory in some form. For incorrect TRI emissions, states should consider coordinating with the facility and the EPA's TRI program to improve the emission estimates.

4.4 Spatial Extent

The spatial extent of an inventory refers to counties, states, or other geographic regions covered by the emissions data. As described in previous sections, inventories included in or supporting SIPs are either for the NAA area only (for ozone and PM_{2.5}) or are for the entire state (for regional haze and ozone or PM_{2.5} when modeled attainment demonstrations are needed). Modeled attainment demonstrations are likely to use emissions from a regional multi-state area. While it is not a SIP requirement to submit an inventory for other states, the emissions are needed to do the modeling.

A number of complicating issues related to spatial extent arise with inventories. Below, more information is provided on partial counties, when point-source locations are needed for emissions that have traditionally been nonpoint sources, shapefile-based inventories, and link-based mobile emissions.

4.4.1 Nonattainment Areas with Partial Counties

In some cases, NAAs do not follow county boundaries. Since most inventories and many underlying datasets are available at the county level, this poses a challenge for emissions calculations, in particular for nonroad and mobile sources.

Air agencies may wish to use full-county emissions in meeting some SIP requirements, despite the designation of partial-county NAAs. The EPA has considered the advisability of using whole-county emissions to represent partial county emissions and has determined that this is not possible. In particular, using whole-county emissions would pose a challenge for using these inventories for ROP/RFP analyses, which can only include reductions within the NAA. Thus, areas designated as partial counties should estimate those partial county emissions using one of the approaches described here.

For point sources, Geographic Information System (GIS) technology enables straightforward selection of point sources into a partial-county NAA by intersecting a dataset of point source latitude/longitude coordinates with a shapefile of the NAA boundaries.

For nonpoint and mobile sources, available inventories and methods are often designed to create county totals, making partial counties much more difficult. A variety of acceptable approaches exist for calculating partial county emissions, though the particular approaches chosen should be agreed to as part of developing the plan for the SIP planning inventory as described in Section 2.2.

1. Custom calculations: Air agencies could develop a custom approach to estimate emissions using activity data estimated for the partial county area. Since many source categories need to be estimated, this could be a very labor intensive approach, or could be used for just key categories where other approaches are insufficient.

2. Shapefile-based inventories: See Section 4.4.3.
3. Use of spatial allocation surrogates: Some sources of data exist at sub-county resolution, including road networks, travel demand model results (see also Section 4.4.4), and census data that are available at census tracts or blocks. When the emissions activity can be reasonably assumed to follow an allocation method based on one such surrogate dataset, GIS techniques can be followed to apportion a county emissions estimate to a partial county NAA based on the patterns of these sub-county data.
4. Use of gridded modeling data: Modeled attainment demonstrations rely on air quality modeling that uses gridded emissions data, which could be resolved at a sub-county resolution. Gridding resolutions of 12-km, 4-km, or even 1-km have been used. Similar to what was described above in the previous approach, emissions processing relies on spatial surrogates to apportion county-level data to grid cells needed for modeling. Rather than take a custom spatial surrogate approach, these gridded data may be sufficient to apportion county-level data to a partial-county NAA using GIS overlay techniques. Such an approach would sum the parts of the gridded data intersecting the partial county area to provide the partial county area inventory. The primary difference in this approach compared to the previous approach is the intermediate step of using the gridded data. This could be appealing since those gridded data may already be available from modeling done for attainment demonstrations.
5. Expert judgment: When there is no appropriate sub-county data surrogate available, when air quality modeling is not part of the SIP process, or when a category is relatively unimportant to the SIP planning process, other methods may be advisable. In this case, an air agency should explain their rationale to the respective EPA Regional office and come to agreement on a technically reasonable approach. Such approaches could include using the entire county estimated emissions, assuming some fraction based on understanding of county activities, or taking an area-proportional (uniform distribution) approach. In this latter approach, the partial county emissions are assumed to be the total county emissions times the area of the partial county divided by the area of the total county.

Since these partial county emissions calculations could need to be done for a variety of inventories and for SIP revisions, considerations should be made for the repeatability of the approach so that it does not become overwhelming to the analysis. In collaboration with the EPA Regional office, a balance needs to be found among level of effort, technical credibility, and repeatability.

The latest spatial approaches and data are available with the latest emissions modeling platform data on the [Emissions Modeling Clearinghouse \(EMCH\)](#). The EIIP Volume III, Chapter 1, Section 4.3 provides some additional information on spatial allocation; however, the examples used for spatial allocation approaches are much too old for most applications, and more sophisticated spatial surrogate approaches are available than those given as examples. In particular, except in rare circumstances, the use of population data as an allocation method is outdated and not recommended.

4.4.2 Point Source Locations Needed for Modeling of Traditional Nonpoint Sources

In some cases, the details needed in a modeled attainment demonstration will push inventory developers to use point-source locations for source categories that have traditionally been nonpoint sources. Some examples include sources of agricultural ammonia, dry cleaners, and gas stations. Rather than creating a much larger point source inventory, one approach is to keep a source as nonpoint, but use an emissions processing technique for modeling known as area-to-point allocation.

While this topic is primarily one for consideration in modeling inventories, it is included here because the planning inventory often provides a starting point for the modeling inventory (for the NAA counties). To the extent that modeling needs can drive additional detail in the planning inventories, this area-to-point feature can allow small sources to be included as nonpoint sources in a planning inventory but still allow point source locations to be used for modeling.

In area-to-point allocation, the emissions processor for modeling starts with county-wide estimates and a user-provided dataset that allocates county wide emissions to discrete latitude/longitude points (within the county). The inventory developer still must obtain the point source locations and proportion of countywide emissions, but the point source inventory remains more focused on the largest sources. Using an area-to-point allocation approach also avoids having to define stack parameters for inclusion of small sources in the point source inventory, which is useful because the stack parameters are not necessarily relevant to or available for these source categories.

4.4.3 Shapefile-based Inventories

The EPA collects inventories for the NEI for commercial marine and locomotives using GIS shapefile-based inventories. Rather than including emissions as a county total, the emissions are allocated to individual sub-county areas or lines, each with its own GIS polygon shape. This approach was developed primarily to support fine scale and risk modeling that are done at a scale finer than most modeled attainment demonstrations.

These inventories can be useful for computing partial county emissions for those categories using this approach. Otherwise, it is not expected that states would need to start with the shapefile-based inventories for SIP planning. In some cases, states may wish to use such inventories in circumstances where the CMV and locomotive emissions spatial distribution is critical to the modeled attainment demonstration in some way. This may be important in NAAs that contain large ports and/or are near major coastal or inland waterways. Even in this case, use of county total inventories with appropriate spatial allocation using other techniques will still be able to allocate emissions sufficiently for both nonattainment area inventories (if partial counties are needed) and for modeled attainment demonstrations.

4.4.4 Link-based On-road Mobile Emissions and Travel Demand Models

SIP planning and modeling inventories often put great focus on mobile sources through the use of detailed emissions by roadway segments (or links) and the use of travel demand models (TDMs). These models require their own sets of inputs, which depend on the specific TDM used. The MOVES Technical Guidance provides general guidance on the development of MOVES inputs. Details on using TDMs for

link-based on-road mobile emissions are available from the EIP document “Use of Locality-Specific Transportation Data for the Development of Source Emission Inventories” (<https://www.epa.gov/sites/production/files/2015-08/documents/iv02.pdf>). An example of the use of TDMs can be found in “Use of Travel Demand Model Data to Improve Inventories in Philadelphia” (<http://www.epa.gov/ttnchie1/conference/ei15/session1/cook.pdf>). This possibility is simply mentioned here for completeness and is not necessarily recommended, since these efforts are often substantial. The approach can also help with partial county emissions estimates.

4.5 Temporal Basis

Various temporal bases may be needed for meeting different inventory requirements for SIPs. These can be different for ozone, PM_{2.5}, and regional haze. The emissions that should be used in planning inventories for ozone SIPs are ozone season day emissions. The emissions that should be used in planning inventories for PM_{2.5} SIPs are annual emissions for SIPs addressing the annual or 24-hour PM_{2.5} NAAQS or seasonal emissions for SIPs addressing the 24-hour PM_{2.5} NAAQS. At a state’s option, an inventory may contain both annual and average season data emissions for SIPs addressing the 24-hour PM_{2.5} NAAQS. The temporal basis for emissions summaries in Regional Haze SIPs is always annual actual emissions, but air quality modeling for regional haze should use more temporally disaggregated emission inputs.

4.5.1 Temporal Considerations for Ozone SIPs

For ozone SIPs, ozone season day emissions (as defined in Section 2.5.2) are used for the base year inventory for the NAA. Since other planning inventories must be consistent with the base year inventory, inventories such as the projected attainment year inventory for the NAA and the periodic inventories must also include ozone season day emissions. Additionally, for states that include modeled attainment demonstrations in their SIP, statewide (or modeling domain-wide) ozone season day emissions and statewide annual emissions may also be important for Regional office evaluation and approval of the modeled attainment demonstration.

Ozone season day emissions are defined in Section 2.5.2. As explained in the definition, states must select the representative months and work week days to include in the calculation of the ozone season day emissions. The temporal basis for these emissions should be representative of the conditions leading to nonattainment, as recommended by the state and approved by the EPA prior to finalizing the emissions approach to be used. The EPA acknowledges that there could be instances where ozone values are elevated above the level of the NAAQS only in non-summer months or on weekend days, including when winter emissions or weekend emissions dominate the episode. In recognition of this situation, the terminology used has changed from “summer day emissions” to “ozone season emissions.” The general expectation of high emissions activity on weekdays is the basis for the weekday specification in the definition of ozone season day emissions. However, in the event that weekend emissions were to be higher than weekday emissions, the state should consider whether weekday emissions are sufficiently representative of the nonattainment problem. Since the goal of the definition of ozone season day emissions is representativeness of the emissions contributing to the ozone nonattainment problem, if including the weekend emissions resulted in a better representation of

emissions, then states may be able to justify including weekend emissions in coordination with the EPA Regional office.

In general, to calculate ozone season day emissions for any inventory, reporting agencies should estimate emissions for a specific period (month, week, selected days, or a day) where emissions (and other factors) resulted in ozone values above the level of the NAAQS leading to nonattainment. The preference should be given for weekdays as previously described, unless there is a reason to use other days. An ozone season day emissions value should be calculated by summing the emissions on those days and dividing by the number of days included in the sum.

For mobile source emissions, mobile source emissions models can produce output for an average weekday or weekend day. Consult the EPA's MOVES Technical Guidance. This guidance provides numerous recommendations including how to determine temperatures to use in calculating emissions for base year and attainment year NAA inventories. The most current version of this document is available on the MOVES website (<https://www.epa.gov/moves>) at the link that directs to the current version of MOVES.

As noted in the preamble for the Ozone Implementation Rule, HEDD periods could have higher emissions than during other periods, which could contribute to ozone formation in a particular nonattainment area. Additional contributing factors to HEDD-period impacts include location and timing of the HEDD-related emissions, amounts of emissions from other sources during the HEDD period, and meteorology. If an air agency determines that emissions increases (within a NAA) associated with HEDD periods significantly contribute to ozone nonattainment, then the air agency should include those higher emissions in the planning inventories: the base year inventory for the NAA (which also serves as the ROP/RFP baseline), and the attainment projected inventory for the NAA. As described above, in consultation with the EPA Regional office, air agencies should select periods to use for defining the appropriate days to include in the calculation of ozone season day emissions that are representative of the conditions leading to nonattainment. Thus, air agencies that have determined HEDD periods are important should select such periods as part of their ozone season day emissions estimation approach. As a result, air agencies could estimate HEDD emissions in a way that represents an appropriate portion of their NAA emissions inventories. More information on how to estimate HEDD-related emissions is provided in Section 4.8.1.

4.5.2 Temporal Considerations for PM_{2.5} SIPs

The emissions must be reported as annual total emissions, average-season-day emissions, or both, as appropriate for the relevant PM_{2.5} NAAQS. The rationale for the type(s) of emissions provided must be included as part of the attainment plan. When seasonal emissions are included, the rationale for the seasonal period must also be included as part of the attainment plan. A discussion of the EPA's rationale for including the option of seasonal or annual inventories is provided in Section IV.B.2.d of the PM_{2.5} Implementation Rule preamble. The regulatory text for this requirement is also provided at 40 CFR 51.1008(a)(1)(iii).

In the case of the 24-hour NAAQS, the form of the NAAQS is based upon monitored values on particular days with high levels of ambient PM_{2.5}, and in some nonattainment areas, those days may occur only during a distinct and definable season of the year. For the PM_{2.5} NAAQS, states can meet the inventory requirement with different combinations of temporal resolutions for the emissions. For the annual standard, annual emissions must be submitted. For the 24-hour standard, states must submit either an annual or an average-season-day inventory and optionally may submit both. For a nonattainment area for both the annual and 24-hour standard, states can meet the inventory requirement with only an annual inventory or with both an annual and average-season-day inventory.

In contrast with the annual PM_{2.5} NAAQS, the 24-hour PM_{2.5} NAAQS is designed to protect against peak exposures. Thus, for the 24-hour PM_{2.5} NAAQS, there are circumstances in which the EPA believes that a seasonal emissions inventory alone may be sufficient for attainment planning purposes. 40 CFR 51.1008(a)(1)(iii) allows states to use seasonal inventories for attainment plan development for attaining the 24-hour PM_{2.5} standard in areas that are designated nonattainment for only the 24-hour standard. Use of a seasonal emissions inventory will also be appropriate only if the monitored violations of the 24-hour PM_{2.5} NAAQS in the area occur during an identifiable season. In the event that it is appropriate to rely solely on a seasonal emissions inventory, the state should confer with the EPA concerning the exact length of the season and the start and stop dates of the season. The duration and start and stop dates of the season will be an important component of the attainment plan and must be approved by the EPA along with other elements of the attainment plan for a given nonattainment area. Further, seasonal inventories must use average-season-day emissions values for this purpose, as defined by 40 CFR 51.1000. The nature of some seasonal PM_{2.5} emissions sources (e.g., residential wood combustion) does not allow for only weekday emissions to be included in the inventory; therefore, all days must be included. The state would need to explain the rationale for the duration of the season used for the inventory as part of the attainment plan submission. To justify the use of a seasonal emissions inventory, the state must demonstrate why a seasonal emissions inventory is appropriate for the particular PM_{2.5} nonattainment area in question.

4.6 Emission Factors for SIP Emissions Inventories

As expressed in 40 CFR 51.114(a), inventories “must be based on measured emissions or, where measured emissions are not available, documented emission factors.” Given that the preference is measured data, the intent of the regulations is for emissions to be specific to the source of the emissions. To ensure that emissions estimates that use factors are high quality, the emission factors for SIP development should come from credible sources. The possible sources necessarily differ for stationary, on-road mobile, and nonroad sources. The mobile sources with EPA models are the most straightforward. For all states but California, on-road mobile emissions should be estimated with the latest EPA on-road model, MOVES. For California, the most recent EPA-approved version of EMFAC should be used. For stationary sources and remaining nonroad mobile categories, there are several approaches that can be acceptable, with the guiding principle of using credible sources of data. Where emissions inventory SIPs are to be approved by the EPA, inventory developers should work with the appropriate EPA Regional office to make sure the emission factors are acceptable.

Air agencies should pay close attention to the methods that they are using to calculate emissions to ensure updated approaches are used. It would be difficult for an EPA Regional office to approve an inventory that used an outdated method for an important part of the inventory if an updated method was available at the start of the SIP planning inventory development effort. Since the EPA could have multiple approaches posted for the same sector and some of those approaches could be outdated, air agencies should not assume that all EPA-posted methods are equivalent and acceptable. For example, some emission factors from AP-42 for nonpoint sources are outdated when compared to nonpoint methods and factors used for the NEI. The EPA recommends that air agencies refer to the latest NEI development web pages and contact Regional offices to confirm that their planned approaches are up to date. The IPP process described above can be helpful in this process.

For most stationary point sources, air agencies have rules in place that require the submission of point source data to the state for air planning purposes. Much of these data are then submitted to the EPA as part of the NEI and used as the basis for point source inventories in SIPs. These state rules may have their own requirements about emission factors and source tests to be used; where possible, these rules should follow this guidance.

The EPA recommends selecting emission factors based on the hierarchy of emission factor sources shown in Table 16, which is consistent with the requirement in 40 CFR 51.114(a) that emission inventories for SIPs use measured data or emissions factors if measured data are not available. The higher up on this hierarchy the emission factor chosen, the better the quality of the emissions estimate. Based on the emission factor approach used, the states should also set the required “emission calculation method code” (see Section 2.5.14) for inclusion in their inventory data.

Table 16: Hierarchy of emission factors for use in point source emissions inventories

Rank	Emission Factor Approach	Emission factor method code to use
1	Continuous emissions monitoring system	1
2	Facility/process-specific emission factor. Average of representative stack tests (on one stack) downstream of controls (or if no controls).	4
3	Single representative facility/process-specific stack test downstream of controls (or if no controls).	4
4	Facility/process-specific uncontrolled emission factor, plus control efficiency. Average of representative stack tests (on one stack) upstream of controls, adjusted based on expected control efficiency.	24
5	Single representative facility/process-specific stack test upstream of controls, adjusted based on expected control efficiency.	24
6	Site-specific emission factor. Average of representative stack tests across multiple stacks or processes, downstream of controls (or if no controls).	10
7	Site-specific uncontrolled emission factor, plus control efficiency. Average of representative stack tests across multiple stacks or processes, upstream of controls, adjusted based on expected	30

Rank	Emission Factor Approach	Emission factor method code to use
	control efficiency. Only makes sense when all processes measured are fed to the same type/combination of control devices.	
8	Material balance	3
9	Manufacturer specification	7
10	Best available other emission factor for uncontrolled or including controls, which is one of:	
	EPA emission factor	8
	S/L/T emission factor	9
	Vendor emission factor	11
	Trade group emission factor	12
	Other emission factor	13
11	Best available pre-control emission factor, plus control efficiency, which is one of:	
	EPA emission factor, plus control efficiency	28
	S/L/T emission factor, plus control efficiency	29
	Vendor emission factor, plus control efficiency	31
	Trade group emission factor, plus control efficiency	32
	Other emission factor, plus control efficiency	33
12	Engineering judgement	2
13	Emission factor with best available speciation profile, one of:	
	EPA speciation profile	5
	S/L/T speciation profile – e.g., to calculate metals emissions from filterable PM _{2.5} or volatile HAP from VOC.	6

4.7 Inventory Data Codes

Building inventories includes the use of various codes, such as SCCs, state/county FIPS, tribal, control measure, NAICS, pollutant and emission method codes. A full accounting of all possible codes is available as part of the EIS “Reporting Code Tables” available to EIS users using the “Reporting Code Tables” link at the left-hand side. There are more than 60 separate lists of codes that define all of the required and optional coded data elements based on the AERR. As we have noted above, the AERR is relevant as the rule that codifies the correct development of all inventories submitted to the EPA. The SCCs are also searchable at: <https://ofmpub.epa.gov/scsearch/>.

4.7.1 Codes to Use for Nonattainment Area Inventories

Air agencies developing inventories for SIP planning should use valid EIS codes in all of their inventories. Since codes change over time, the EPA has adopted the approach in the EIS to “retire” codes when no longer needed and to add codes when needed. Codes are generally retired in coordination with NEI development cycles, ideally retiring codes only when plenty of notice has been provided to states in advance of an NEI inventory submission period. As such, codes that are retired may have already been used as part of a SIP development process, and that is okay. This is the advantage to retiring codes rather than removing them. Conversely, the EPA may not be able to retire a code until an appropriate

point in the triennial NEI cycle. If an air agency wishes to submit a SIP-related inventory to the EIS for the NEI or another purpose, it will need to use valid (and not retired) codes for the year being submitted.

4.7.2 How to Request New Codes or Code Retirements

In general, if a new code is needed for compiling an inventory, then an air agency staff member should contact the EPA to request a new code. The recommended contact method is to use the call or email using the contact information listed for “Facility Inventory and Point Emissions” on the EIS contacts page at <https://www.epa.gov/air-emissions-inventories>. Requests for codes should include which code table(s) are affected, why existing codes are not sufficient, and a recommendation for a code and its definition and purpose. While the EPA anticipates that code retirement requests will usually come from the EPA rather than from external groups, a code retirement request should be made using the same mechanisms.

The EPA most often gets requests for new SCC codes since new emissions processes arise in industries, or processes are newly identified as having emissions associated with them. If an air agency inventory developer cannot find an appropriate SCC code for an inventory process, a choice needs to be made to either use a generic (“miscellaneous”) SCC or to request a new SCC. For cases in which the contribution of the emissions process to any one precursor pollutant is minimal, inventory developers may choose to report using one of the miscellaneous SCCs. If the process is a significant source of one or more pollutants or that process might be a part of a control program, then an SCC request is probably warranted. The EPA staff will evaluate the SCC request to make sure that a similar code does not already exist, consider codes that have been created but not yet activated for use in submitted inventories¹⁷, assess the need for the SCC, and either indicate an existing appropriate SCC to use or assign a new appropriate code.

4.8 Estimation of Base Year Emissions

This section describes the estimation of base year (or “recent year” in the case of regional haze) emissions for use in planning inventories for ozone, PM_{2.5} and regional haze implementation. Subsections cover point, nonpoint, on-road mobile, nonroad mobile, biogenic sources, and fires, respectively.

4.8.1 Stationary Point

Stationary point sources can be estimated through continuous measurements and through more traditional methods. [EIIP Volume II, Chapter 1](#), Sections 1 through 7 provide still-relevant information on compilation and calculation of point source inventories. Readers developing point source inventories should also use that report as a resource.

¹⁷ Some SCCs are set up for use in collecting source test data and developing emission factors. Sometime after that, the SCCs can be used for creating and submitting inventories, depending on the availability of emission factors and/or the interest for using those SCCs by industry and air agencies.

Sources estimated with CEMS

The best estimate of stationary point source emissions is obtained through the use of CEMS. Several pollutants, including NO_x, SO₂, CO₂, and mercury (Hg) can be measured with CEMS. Fuel heat input on an hourly basis is usually also collected as part of the EPA's CEMS programs, and heat content can be used to estimate emissions for other pollutants using emission factors (with specific test-based factors preferred). More information and guidance on CEMS can be found at <http://www.epa.gov/airmarkets/emissions/continuous-factsheet.html>.

The vast majority of CEMS-equipped sources use these measurements as part of reporting programs to the EPA. In particular, the Acid Rain Program and NO_x SIP call and other trading programs collect data as part of the EPA's [Clean Air Markets](#). Through that program, CEMS-based emissions are available through the "Data and Maps" resource, including emissions summaries and files ready to be used in the SMOKE system used for emissions modeling.

For a few sources, emissions must be reported only for part of the year. In these cases, users of the data should be careful not to override the annual emissions estimates for such units with the partial-year data included in the CEMS databases. This can be a particular challenge for modeling inventories, where the more temporal resolution is useful for the time periods covered, but the other time periods must use a different approach to apportion the remaining emissions to the rest of the year.

Other (non-CEMS) sources

[EIIP Volume II, Chapter 1](#), Section 4 provides general emission estimation procedure information. It provides a table similar to Table 16, but also focuses on the cost associated with the different approaches. It acknowledges that the cost incurred with collecting the more specific source test data should be commensurate with the need for a higher data quality. Like the EIIP figure, Table 16 also lists the costlier (and better) approaches higher on the list. The EIIP volume provides guidance on each of the various methods of computing emissions.

The remainder of EIIP Volume II includes chapters that address various combustion, manufacturing, and production activities that are point sources. Information in these chapters can be used to estimate ozone, PM_{2.5}, and regional haze precursor emissions where they address the source categories of interest. In some cases, the EIIP chapters are somewhat dated and so may not cover newer emissions processes. In these cases, inventory developers should adapt the techniques or develop new techniques to ensure their estimates are relevant to the sources. The EIIP point source chapters within Volume II cover topics as follows (numbers correspond to chapter numbers):

2. Boilers
3. Hot mix asphalt plants
4. Fugitive emissions from equipment leaks
5. Wastewater collection and treatment
6. Semiconductor manufacturing
7. Surface coating operations

8. Paint and ink manufacturing
9. Secondary metal production
10. Oil and gas production
11. Plastic products manufacturing
12. Effects of control device efficiencies and malfunctions
13. Stone mining and quarrying
14. Uncontrolled emission factors for criteria pollutants
15. Packaging and graphic arts
16. Chemical manufacturing

Each industry- or source-specific document contains a brief description; identification of emission points; an overview of methods available for estimating emissions; example calculations for each technique presented; a brief discussion on quality assurance (QA) and quality control (QC); and the SCCs needed for entry of the data into a database management system. The SCCs included in each volume apply to the process emission points, in-process fuel use, storage tank emissions, fugitive emissions, and control device fuel (if applicable).

For NH₃ sources, a report is also available in the “nonpoint” section of EIIP entitled “Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources - Draft Final Report” (April 2004) and covers many point source processes as well as nonpoint ones. Although a lot of research has been done on possible new approaches to agricultural NH₃ estimation as point sources, these “farm-based” approaches have not been completed yet. At this time, the EPA augments agricultural NH₃ sources only as nonpoint sources, rather than as point sources. Readers should see Section 4.8.2 for more information on emissions estimation from nonpoint sources.

A final resource is to use the facility-total NH₃ from the TRI. For SIP planning inventory purposes, these emissions should be apportioned to individual processes, but at least can be a starting point in the absence of other information. TRI provides emissions by stack and fugitive, with all stack emissions summed together and all fugitive emissions together. This level of detail would not be sufficient for a significant NH₃ source and so, while TRI can be a starting point, additional information would need to be gathered from the facility to apportion the emissions to the processes at the facility.

Startup/shutdown emissions

The regulatory expectations for SSM emissions are included as part of 40 CFR part 52 in the EPA’s “State Implementation Plans: Response to Petition for Rulemaking; Restatement and Update of EPA’s SSM Policy Applicable to SIPs; Findings of Substantial Inadequacy; and SIP Calls to Amend Provisions Applying Excess Emissions During Periods of Startup, Shutdown, and Malfunction” final rule (SSM rule). A fact sheet and list of affected states is available on the [website for this action](#).

The requirements of the Ozone and PM_{2.5} Implementation Rules and the Regional Haze Rule require the reporting of historical annual-total emissions only (and in some areas “typical” seasonal and/or daily emissions for certain pollutants), not day-to-day emissions. As noted in the preamble of the final SSM rule:

“Actual emissions during SSM events should be included in these annual emissions. While data formats are available from the EPA to allow a state to segregate the total annual emissions during SSM events from annual emissions during other types of operation, segregation is not a requirement and few states do so” (80 FR 113, page 33950).

The key takeaway message from this guidance is that since startup/shutdown emissions are planned and predictable, they should be included in SIP planning inventories. While the final SSM rule generalizes that “SSM” emissions should be included, this guidance clarifies that this means startup/shutdown rather than malfunction as further described below. In addition, states should pay particular attention to estimating startup/shutdown emissions if these types of emissions are believed by the air agency to have a significant contribution to the NAAQS design values.

Since malfunctions are, by nature, unpredictable and given the myriad different types of malfunctions that can occur, malfunction emissions would be difficult to estimate and future-year malfunction events cannot be readily predicted. Thus, states are not obligated to include malfunction emissions in the base inventory for the NAA, ROP/RFP plans, or attainment projected inventory for the NAA. However, to the extent that malfunctions become a regular and predictable event, then such emissions should be quantified with regular and predictable emissions and included in emission inventories for planning purposes. The elimination of high emissions during routinely reoccurring malfunctions could potentially help achieve significant emissions reductions needed by a state in attaining the relevant NAAQS.

For sources with CEMs that capture emission rates at all times, the CEM will capture the startup/shutdown emissions without taking any of the other steps described below. Without CEMs, estimating startup/shutdown emissions becomes more complicated.

Startup/shutdown emissions can be quantified by assessing the emissions during startup or shutdown periods using traditional emissions estimation approaches of throughput and emission factors. However, the throughput and emission factors must be customized for the activity during these periods. Generally, emissions rates during these periods are higher and less well characterized than a typical operating emissions rate, and so some degree of expert judgement may be needed in assessing these emissions. For example, if control devices are not effective or active during these periods, the emissions during these types would not be able to reflect controlled emissions rates. If device emissions rates are associated with an operating temperature and the emissions are higher during a warm-up period, adjustments to the emissions during the startup period could be made.

In addition to estimating the actual emissions during startup/shutdown periods, another approach to estimate startup/shutdown emissions is to adjust control parameters via the emissions calculation parameters of rule effectiveness or primary capture efficiency. Using these parameters for startup/shutdown adjustments is not their original purpose, but can be a simple way to account for the emissions and still have a record of the routine versus startup/shutdown portions of the emissions. For example, a lower capture efficiency or rule effectiveness can adjust the estimate of emissions to be higher, accounting for extra emissions from startup/shutdown activities. In the absence of measurements of throughput and/or emissions rates during startup/shutdown periods, expert judgment

may need to be used to define the adjustment factors to use. This approach, however, can complicate the use of the control parameters during development and documentation of control strategies since the control parameters reflect things other than controls – thus, care should be taken when using this approach.

Emissions associated with HEDD periods

As described in Section 4.5, when air agencies have determined that emissions associated with HEDD periods are important for addressing their nonattainment problem, those air agencies should include HEDD-related emissions in their planning inventories. This subsection first describes what information is available to help assess when HEDD periods occur and to help provide activity data that could be used as part of estimating the associated emissions. Second, this subsection describes how to consider HEDD-related emissions in planning inventories (e.g., the base year inventory for the NAA) as compared to those in modeling inventories.

Emissions from HEDD periods can include additional emissions from more typical EGU boilers, turbines, and other units (collectively called peaking units), and also from combustion-based sources of distributed generation such as large back-up generators and other engines. A key challenge in developing emissions estimates for HEDD-periods is determining when the peaking units and distributed generation units were operating and consequently produced emissions. In the case of peaking units, many of these sources have CEMS that record activity and emissions levels, and these data are reported to EPA. In the case of distributed generation units, little or no information may be readily available in part because the energy produced by the backup generators and other engines is not measured by the electric utilities and independent system operators (ISOs), but rather may be experienced by the utilities and ISOs as an unmeasured demand reduction.

During HEDD periods, energy customers may use backup generators to participate in demand response programs. Though some useful information may be available from the utilities and ISOs running those programs, there may also be no information available. The specific rules, reporting, and frequency of use will vary by the utility or ISO that is offering the demand response program. Demand response program requirements vary and can include: (a) completely excluding the use of backup generators, (b) allowing the use of backup generators and requiring some reporting, and (c) not requiring customers to report anything about actions taken to provide the demand response. The lack of data on demand response backup activity has been noted by others based on past analyses.^{18,19} Where emissions from demand response programs may be important, air agencies should first collaborate with their state energy and public utility commission counterparts who may have established mechanisms for information collection and sharing. Air agencies may also need to assess the demand response programs in their area by working directly with utilities and/or ISOs.

¹⁸ White paper: “Air Quality, Electricity, and Back-up Stationary Diesel Engines in the Northeast,” Northeast States for Coordinated Air Use Management (NESCAUM), August 1, 2012.

¹⁹ See also the Mid-Atlantic Distributed Resources Initiative (MADRI) working group meeting information available at http://sites.energetics.com/madri/meetings_2012.html.

Starting in 2015, the National Emission Standard for Hazardous Air Pollutants (NESHAP) and New Source Performance Standards for Reciprocating Internal Combustion Engines (RICE) (40 CFR part 60, Subparts IIII and JJJJ, and 40 CFR part 63, Subpart ZZZZ), also called the RICE rules, now require owners/operators of emergency engines participating in emergency demand response programs to report the dates and times that the engines operate for emergency demand response as well as engine information such as horsepower and model year. While the RICE rules do not require the reporting of NO_x emissions or information about non-emergency programs, they will start to help provide information useful for understanding the activity of these back-up generators and engines, which may also be helpful for ozone planning purposes.

While it may continue to be difficult to find data needed for assessing HEDD-related emissions, air agencies may still include these emissions in both their modeling inventories and planning inventories. The HEDD-related emissions included by air agencies in planning inventories should have some logical relationship with the emissions in modeling inventories. The planning inventories will of course be limited spatially to the NAA, while the modeling inventories will cover a larger area. Air agencies should extract the appropriate NAAs to include in the planning inventories. Temporally, the modeling inventories will include day- and hour-specific emissions for seasonal or episodic periods, which can include HEDD periods, while the planning inventories will be an ozone season day emissions value. As explained in Section 4.5, the days used to calculate the ozone season day emissions are chosen for the particular SIP in consultation with the Regional office. Some examples of possible relationships between the modeling inventories (episode-specific) and the planning inventories (ozone season day) are as follows:

- Ozone season day emissions could be an average across all days of the episode-specific emissions used in the modeled attainment demonstration.
- Ozone season day emissions could be an average of a longer episode or series of episodes that overlap with the episodic period used for the modeled attainment demonstration.
- Ozone season day emissions could be a representative selection of the episodic-specific emissions, such as a median emissions value or using a single day emissions value that somehow is representative of other days.

These are not the only possible examples. Any approach chosen to determine appropriate HEDD-related ozone season day emissions should be developed in consultation with the Regional office and should seek to meet the overall goal for the base year inventory. Namely, the NAA inventory should be representative of the emissions conditions within the NAA that typically lead to nonattainment problems.

4.8.2 Stationary Nonpoint

Nonpoint sources collectively represent individual sources that have not been inventoried as specific point or mobile sources. These individual sources treated collectively as nonpoint sources are typically too small, numerous, or difficult to inventory using the methods for the other classes of sources.

Stationary nonpoint sources can be estimated through numerous different approaches. Though some approaches are outdated, the [EIIP Volume III, Chapter 1](#), Sections 1 through 6 provide relevant information on compilation and calculation of nonpoint source inventories. Also, the Volume III webpage contains numerous supplemental reports for specific source categories.

For many categories, more updated approaches are included in the EPA tools developed for use by air agencies in developing inventories. The latest tools are provided as part of the materials for the latest NEI – either as developmental materials for an ongoing NEI effort, or as supporting materials to document a completed NEI effort.

Table 17 provides a list of emissions categories, pollutants, and available approaches documentation and/or tools. Tools are constantly being updated so that the reader should verify if a newer version of a tool exists by consulting the Air Emissions Inventories website and looking at the most current [NEI page](#) for the latest tools and documentation. In addition, the EPA maintains a Sharepoint site with developmental tools for in-progress inventories. SLT agencies may request access to the EPA Sharepoint site by using the Contact Us link on the Air Emissions Inventories website.

Table 17: List of nonpoint categories, pollutants, and available approaches and tools

EPA-estimated emissions source description	Possible Overlap with Point	Available Nonpoint Resources (Posted year)
Agricultural Fertilizer Application		2014 Fertilizer Application v1.0 22apr2016.zip (2016) Old: ag_fertilizer_application_2011.zip (2013)
Agricultural Fires		2014 Draft Agricultural Burning and Grass/Pasture Estimated Emissions (2016)
Agricultural Tilling		2014 Agricultural Tilling v3.1 10mar2016.zip (2016)
Animal Husbandry		2014 Ag Livestock v1.0 20may2016.zip (2016) Old: animal_livestock_emissions_2011.zip (2009)
Architectural Coatings		Solvent Tool v1 5.zip (2016) EIIP, Volume III , Chapter 3 (1995)
Asphalt Paving	Y	2014 NPt Asphalt 18nov2015_edit03302016.zip (2016) EIIP, Volume III , Chapter 17 (2001)
Asphalt Roofing Kettles	Y	See abstract available with the EIIP Volume III website (2000)
Autobody Refinishing	Y	Solvent Tool v1 5.zip (2016)
Aviation Gasoline		2014 Av Gas Stage 1 15nov2015.zip (2015) 2014 Av Gas Stage 2 15nov2015.zip (2015)
Backyard Barbecues		2014 Backyard BBQs 15nov2015.zip (2016)
Commercial Cooking		2014 Commercial Cooking v1.2 08mar2016.zip (2016)
Consumer & Commercial – All personal care products		Solvent Tool v1 5.zip (2016) EIIP Volume III , Chapter 5 (1996)
Consumer & Commercial – All household products		Solvent Tool v1 5.zip (2016) EIIP Volume III , Chapter 5 (1996)
Consumer & Commercial – All coatings and related products		Solvent Tool v1 5.zip (2016)

EPA-estimated emissions source description	Possible Overlap with Point	Available Nonpoint Resources (Posted year)	
Consumer & Commercial – All adhesives and sealants		Solvent Tool v1 5.zip (2016) EIIP Volume III , Chapter 5 (1996)	
Consumer & Commercial – All FIFRA related products		Solvent Tool v1 5.zip (2016)	
Degreasing	Y	Solvent Tool v1 5.zip (2016)	
Dental Preparation and Use		epa mercury dataset 62714(2).zip (2015) Documentation for the 1999 Base Year Nonpoint area source National Emissions inventory for HAPs, page A-30 (2000)	
Dry Cleaning	Y	Solvent Tool v1 5.zip (2016) EIIP, Volume III , Chapter 4 (1996)	
Dust – Paved Roads		2014 Road Dust v2.1 09mar2016.zip (2016)	
Dust – Unpaved Roads		2014 Road Dust v2.1 09mar2016.zip (2016)	
Dust – Construction		2014 Construction Dust v3.0 18feb2016.zip (2016)	
Gasoline Distribution/Marketing	Y	2014 Gasoline Distribution v1.0 with PT subtraction 01apr2016.zip (2016) EIIP, Volume III , Chapter 11 (2001)	
General Laboratory Activities		epa mercury dataset 62714(2).zip (2015)	
Graphic Arts	Y	Solvent Tool v1 5.zip (2016) EIIP Volume III , Chapter 7 (1996)	
Human Cremation	Y	cremation_2011.zip (2013)	
Industrial, Commercial/Institutional Fuel Combustion	Y	ICI Tool v1 4.zip (2015) Estimating Ammonia Emissions From Anthropogenic Nonagricultural Sources - Draft Final Report (April 2004)	
Industrial Surface Coating	Y	Solvent Tool v1 5.zip (2016) EIIP, Volume III , Chapter 8 (1997)	
Lamp Breakage (Landfill emissions)		epa mercury dataset 62714(2).zip (2015)	
Lamp (Fluorescent) Recycling		epa mercury dataset 62714(2).zip (2015)	
Landfills	Y	EIIP, Volume III , Chapter 15 (2001)*	
Mining and Quarrying		2014 Mining and Quarrying v2.3 09mar2016.zip (2016)	
Oil and Gas Production	Y	OIL GAS TOOL 2014 NEI EXPLORATION V1 5.zip (2016) OIL GAS TOOL 2014 NEI PRODUCTION V1 5 Access2007.zip (2016) OIL GAS TOOL 2014 NEI PRODUCTION V1 5 Access2013.zip (2016)	
Open Burning (Leaves, Brush, Residential Household Waste, Land Clearing)		2014 Open Burning v1.1 03mar2016.zip (2016)	
Other Special Purpose Coatings	Y	Solvent Tool v1 5.zip (2016)	
Pesticide Application		2014 Agricultural Pesticides v2.0 18feb2016.zip (2016) EIIP Volume III , Chapter 9 (2001)	
Portable Gas Cans (Residential and Commercial)		2014 Portable Fuel Containers 25nov2015.zip (2016)	

EPA-estimated emissions source description	Possible Overlap with Point	Available Nonpoint Resources (Posted year)
Publicly Owned Treatment Works	Y	2014 POTW nonpoint emissions 23march2016.zip (2016)
Residential Heating - Fossil Fuels		2014 Residential Heating non-Wood v1.2 09mar2016.zip (2016) See also abstracts available for coal, fuel oil & kerosene, gas & liquified petroleum gas (LPG) available with the EIIP Volume III website (1999).
Residential Heating – Wood		2014 RWC v3.0 28apr2016.zip (2016) EIIP, Volume III , Chapter 2 (2001)
Structure Fires		EIIP, Volume III , Chapter 18 (2001)
Traffic Markings		Solvent Tool v1 5.zip (2016) EIIP, Volume III , Chapter 14 (1997)
Vehicle Fires		See abstract available with the EIIP Volume III website (2000)
Waste Disposal (Incineration)		Estimating Ammonia Emissions From Anthropogenic Nonagricultural Sources - Draft Final Report (April 2004)

* Landfill emissions estimates are available in the NEI as point sources, based on the activity information submitted to the EPA as part of the Greenhouse Gas Reporting Rule.

As indicated in Table 17 by the column “Possible Overlap with Point,” some source types can have emissions in both the point source data category and the nonpoint one. Some categories that may have both types of sources are denoted, and this list is based on what has been seen in the NEI. The list of categories in this situation depend on an individual state’s policies, such as what the emissions size threshold is for a point source and whether any categories are treated as point sources despite having low individual emissions.

To prevent overestimation of nonpoint emissions for sectors that also have point sources, it is important to perform point/nonpoint reconciliation. This reconciliation starts by subtracting the activity associated with the point sources from the total activity data (prior to computing the nonpoint emissions). Since point sources often have emissions controls, it is usually not sufficient to just subtract point source *emissions* from total activity-based emissions to prevent double counting. Subtracting *controlled* point source emissions from *uncontrolled* total activity-based emissions would result in too much nonpoint emissions. Rather, the point source activity must be determined and subtracted from total activity to get the nonpoint activity estimate. Alternatively, *uncontrolled* point source emissions can be calculated and subtracted from the total activity-based emissions estimates to derive a nonpoint emissions estimate.

Part of developing refined nonpoint emissions estimates for a SIP could involve the use of surveys to collect data. Inventory preparers often use survey questionnaires to gather point source emissions inventory data. The [EIIP Volume III, Chapter 24](#), written in 2000, provides guidance on developing and conducting surveys for area source inventories. Since this document predates some of the newer online survey techniques, the sections describing the use of the internet are outdated. As part of the documentation for inventories, survey design and results should be kept and included in any documentation reports or appendices.

4.8.3 On-road Mobile

Emissions from on-road vehicles are the result of several emission processes, including the combustion of fuel while vehicles are starting, idling, and moving, evaporation of fuel from the fuel system and during refueling, and from brake wear and tire wear.

For all states but California, on-road mobile emissions should be estimated with the latest EPA on-road mobile model, MOVES. MOVES estimates emissions for many combinations of vehicle classifications and fuel types. Readers should follow the latest [MOVES guidance](#). For California, the most recent EPA-approved version of EMFAC should be used.

The available guidance covers using MOVES for inventory development in SIPs in states other than California. The guidance focuses on determining what the appropriate inputs are and how MOVES should be run to develop emissions estimates for on-road vehicles. It describes when default MOVES inputs are appropriate for SIPs and regional conformity analysis and what factors to consider for providing locality-specific MOVES inputs.

MOVES estimates emissions for multiple source use types (the terminology that MOVES uses to describe vehicle type) and fuel types. MOVES also estimates emissions for different road types that represent rural and urban unrestricted and restricted (accessed only by an on or off ramp) access roads, as well as off-network emissions such as vehicle starts, evaporative emissions while parked, and hoteling emissions when long-haul combination trucks are parked for long periods with the engine running under load.

One of the key elements for use of MOVES is creating a Run Specification (RunSpec) file, which defines the place and time period of the analysis as well as the vehicle types, road types, fuel types, and the emission-producing processes and pollutants that will be included in the MOVES run. The MOVES Technical Guidance describes using the MOVES graphical user interface GUI to set up a MOVES run for a particular scale (e.g., county), time period, set of pollutants, and the vehicle types, road types, and fuel types applicable to a particular area and time.

Another key element for use of MOVES is entering local meteorology, fleet, activity, fuel, and control measure information using the County Data Manager. The MOVES Technical Guidance discusses when local data should be used in place of model default data, as well as potential sources of local data.

For some input parameters, there is overlap with the inputs needed for other models, such as the nonroad mobile models (e.g., meteorology and fuels). Efforts should be made to use the same source of data across multiple categories when the inputs are shared. Not doing so calls into question the validity of one or both approaches. Air agencies should explain the use of shared inputs, or reasons for not using them, as part of the documentation provided with their inventories.

4.8.4 Nonroad Mobile Equipment

Nonroad mobile equipment emissions result from the use of fuel in a diverse collection of vehicles and equipment, including:

- recreational vehicles, such as all-terrain vehicles and off-road motorcycles;
- logging equipment, such as chain saws;
- agricultural equipment, such as tractors;
- construction equipment, such as graders and back hoes;
- industrial equipment, such as forklifts and sweepers;
- residential and commercial lawn and garden equipment, such as leaf and snow blowers;
- recreational marine vessels, such as power boats.

Starting with MOVES 2014, MOVES incorporates and expands upon the capabilities of the older NONROAD model. States are required to use MOVES for any nonroad source emissions estimates for SIP development that is started since the October 2014 release of MOVES 2014.

MOVES nonroad capabilities include predicting emissions for all of these nonroad equipment categories listed above. Emissions from CMVs, locomotives, and aircraft are estimated in other ways and described in Section 4.8.5. The MOVES nonroad capabilities include more than 80 basic and 260 specific types of nonroad equipment and further stratifies equipment types by horsepower rating. Fuel types include gasoline, diesel, compressed natural gas (CNG), and Liquified Petroleum Gas (LPG).

The nonroad capabilities of the MOVES model estimates emissions for all criteria pollutant and precursors from both exhaust and non-exhaust processes (diurnal, refueling spillage, vapor displacement, hot soak, running loss, take permeation, hose permeation, and crankcase emissions). NONROAD supports many SIP-related inventory development needs, including support for partial counties and seasonal emissions.

Air agencies have the option of replacing default model inputs with more representative data. Common input adjustments include equipment population, geographic allocations, and local growth rates. If agencies make changes to default model values, the agency should submit the input files to the EPA as well as a description of why the defaults were changed. Additional guidance on improving nonroad estimates for lawn and garden equipment can be found in [EIIP, Volume IV](#), Chapter 3.

For some input parameters, there is overlap with the inputs needed for other models, such as the on-road mobile models (e.g., meteorology and fuels). Efforts should be made to use the same source of data across multiple categories when the inputs are shared. Not doing so calls into question the validity of one or both approaches. Air agencies should explain the use of shared inputs, or reasons for not using them, as part of the documentation provided with their inventories.

4.8.5 Other Nonroad Mobile

The MOVES model does not provide air agencies with a tool for estimating emissions for CMVs, aircraft, and locomotives. Thus, separate methods are used for each of these emissions sectors.

For purposes of reporting data to the EPA, aircraft emissions are often reported as point sources, with this being a requirement for reporting data to the EIS for use in the NEI. Likewise, the CMV and locomotive data are included in the nonpoint data category in the EIS. While these sources are still

mobile sources from the traditional standpoint of emissions categories, for data formatting and reporting purposes in the EIS, they are treated along with these non-mobile data categories.

4.8.5.1 Aircraft

The aircraft sector includes all aircraft types used for public, private, and military purposes. This includes four types of aircraft: commercial, air taxis (AT), general aviation (GA), and military. A critical detail about the aircraft is whether each aircraft is turbine- or piston-driven, which allows the emissions estimation model to assign the fuel used, jet fuel or aviation gas, respectively. The fraction of turbine- and piston-driven aircraft is either collected or assumed for all aircraft types. The NEI data are available for this sector for use as a starting point in SIPs, though the NEI includes military aircraft only where state or local air agencies have submitted military aircraft emissions data.

Commercial aircraft include those used for transporting passengers, freight, or both. Commercial aircraft tend to be larger aircraft powered with jet engines. Air taxis carry passengers, freight, or both, but usually are smaller aircraft and operate on a more limited basis than the commercial aircraft. General aviation includes most other aircraft used for recreational flying and personal transportation. Finally, military aircraft are associated with military purposes, and they sometimes have activity at non-military airports.

The national AT and GA fleet includes both jet- and piston-powered aircraft. Most of the AT and GA fleet are made up of larger piston-powered aircraft, though smaller business jets can also be found in these categories. Military aircraft cover a wide range of aircraft types such as training aircraft, fighter jets, helicopters, and jet-powered and piston-powered planes of varying sizes.

Emissions at airports also include other sources that are a part of the nonroad equipment emissions described in Section 4.8.4. These emissions come from aircraft auxiliary power units (APUs) and aircraft ground support equipment (GSE) typically found at airports, such as aircraft refueling vehicles, baggage handling vehicles, and equipment, aircraft towing vehicles, and passenger buses. In the NEI point source inventory, these APUs and GSE are located at the airport facilities as point sources along with the aircraft exhaust emissions (though not as part of the aircraft sector). Emissions from APUs and from GSE can be calculated using the EPA's NONROAD model and by the Federal Aviation Administration (FAA) [Emissions and Dispersion Modeling System](#) (EDMS). If the air agency chooses to calculate these emissions with the EDMS, care should be taken to remove exclude those emissions from emissions associated with the NONROAD model.

The EPA collaborates with the FAA to develop and maintain methods for estimating aircraft emissions using EDMS, which also estimates emissions from aircraft in addition to the APUs and GSE as noted above. The emissions developed in this way are associated with aircrafts' landing and takeoff (LTO) cycle. The EPA encourages state and local air agencies to collect aircraft LTO activity data that can be used in improving estimates using the EPA EDMS-based methods. More details on the EPA methods are available in the documentation and methods associated with the latest NEI year found at <https://www.epa.gov/air-emissions-inventories/national-emissions-inventory>.

The aircraft sector includes numerous SCCs as shown in Table 18, and all but two of these are associated with the NEI point source inventory. Historically, airport emissions have been calculated as a nonpoint source, but with the latest approaches having all airport locations readily available, such a simplification is no longer needed. The result of this change from nonpoint to point sources is that most of the SCCs are shown as 10-digit SCCs (usually used just for nonpoint sources) but are now used as point SCCs.

Table 18: Aircraft SCCs and data categories in EPA estimates

SCC	Data Category	SCC Description	EPA estimates
2275001000	Point	Mobile Sources; Aircraft; Military Aircraft; Total	X
2275020000	Point	Mobile Sources; Aircraft; Commercial Aircraft; Total: All Types	X
2275050011	Point	Mobile Sources; Aircraft; General Aviation; Piston	X
2275050012	Point	Mobile Sources; Aircraft; General Aviation; Turbine	X
2275060011	Point	Mobile Sources; Aircraft; Air Taxi; Piston	X
2275060012	Point	Mobile Sources; Aircraft; Air Taxi; Turbine	X
2260008005	Point	Mobile Sources; Off-highway Vehicle Gasoline 2-Stroke; Aircraft Ground Support Equipment	X
2265008005	Point	Mobile Sources; Off-highway Vehicle Gasoline 4-Stroke; Aircraft Ground Support Equipment	X
2267008005	Point	Mobile Sources; LPG; Aircraft Ground Support Equipment	X
2268008005	Point	Mobile Sources; CNG; Aircraft Ground Support Equipment	X
2270008005	Point	Mobile Sources; Off-highway Vehicle Diesel; Aircraft Ground Support Equipment	X
2275070000	Point	Mobile Sources; Aircraft; Aircraft Auxiliary Power Total	X
2275085000	Nonpoint	Mobile Sources; Aircraft; Unpaved Airstrips; Total	
2275087000	Nonpoint	Mobile Sources; Aircraft; In-flight (non-Landing-Takeoff cycle)	X

In June 2012, the EPA promulgated standards for NO_x emissions from commercial aircraft engines. Information about this rule including fact sheets, test procedures, and emissions documentation is available on the [EPA website for this purpose](#). In that rule, the EPA adopted Tier 6 and Tier 8 standards for NO_x on new aircraft engines, with compliance dates in 2013 and 2014. Prior rules published in 2005 and 1997 also reduce aircraft NO_x emissions with engine standards (documented on the same website). When estimating emissions from aircraft, it is best practice to consider the impacts of these rules for improving the accuracy of emissions inventories. This is why the EPA recommends using the EPA EDMS-based approach with locality-specific data.

State or local air agencies may determine that the EPA default method is not appropriate for SIP purposes, though the EPA recommends considering the approach but using more locality-specific activity information. For areas that have provided the EPA locality-specific airport activity data, the NEI estimates may very well provide emissions needed to meet SIP requirements. The EPA method is more

robust than older methods and includes national control programs as noted below. As shown in the table above, the EPA's methods do not estimate emissions from unpaved airstrips (SCC 2275085000). Furthermore, the "in-flight" SCC (2275087000) is covered by the EPA's method for only lead (Pb) emissions and is related to general aviation aircraft that still use leaded fuel. Air agencies may want to consider unpaved airstrips and/or in-flight emissions for other pollutants as part of their inventories for improved model performance or other reasons, though doing so may not be necessary depending on the significance of those emissions in a particular area. Any locality-specific data or custom emissions associated with aircraft sources are expected to be included with supporting documentation for the emissions inventory used for a SIP.

4.8.5.2 Commercial Marine

The CMV emissions category includes boats and ships used either directly or indirectly in the conduct of commerce or military activity. The majority of vessels in this category are powered by diesel engines that are either fueled with distillate or residual fuel oil blends. For the purpose of this inventory, we assume that Category 3 (C3) vessels primarily use residual blends while Category 1 and 2 (C1 and C2) vessels typically use distillate fuels. Another consideration for emissions estimation of CMV sources is auxiliary engines. All three types of vessels may have auxiliary engines that are used for onboard power generation or other needs.

The C3 inventory includes vessels which use C3 engines for propulsion. C3 engines are defined as having displacement above 30 liters per cylinder. C3 inventories typically include emissions from both propulsion and auxiliary engines used on these vessels, as well as those on gas and steam turbine vessels. Geographically, the inventories include port and interport emissions that occur within the area that extends 200 nautical miles (nm) from the official U.S. shoreline, which is roughly equivalent to the border of the U.S. Exclusive Economic Zone. For national inventories created by the EPA, only some of these emissions are allocated to states based on official state boundaries that typically extend 3 nm offshore. The EPA recommends that state water boundaries also be used when determining which emissions should be included with a particular state or county.

The C1 and C2 vessels tend to be smaller ships that operate closer to shore, and along inland and intercoastal waterways, with engines greater than or equal to 37kW. Naval vessels are not included in C1 and C2 vessel inventories, though Coast Guard vessels are included. While these C1/C2 vessels are most often associated with near-land applications and thus included as within state waters, sometimes these vessels are used outside of state waters, particularly in the Gulf of Mexico. In these cases, as with C3 vessels, the EPA recommends that state water boundaries be used when calculating emissions associated with a particular state or county.

The CMV source category does not include recreational marine vessels, which are generally less than 100 feet in length, most being less than 30 feet and powered by either inboard or outboard engines. The calculation of these emissions is included in the NONROAD model, and these emissions are, therefore, considered "nonroad equipment."

The EPA develops and maintains methods for estimating CMVs, and these methods are used as “fallback” methods for use in the NEI. They are also available as a fallback for states without other data for this sector. At this time, the EPA’s methods are top-down national methods, which apportion nationally estimated emissions values to the states and counties. In the latest such approaches (used for the 2008 and 2011 NEI), this apportionment includes allocation to GIS shapefiles for ports and underway emissions. These shapefiles are available with the latest NEI documentation and include separate files for ports and underway. Key differences associated with various EPA methods from the 2002 NEI through the 2011 NEI have focused on allocation of emissions to the shapefiles, which has been done in collaboration with state and local air agencies.

The current EPA methods also use emissions types. Each of the CMV SCCs requires an appropriate emissions type (M=maneuvering, H=hoteling, C=cruise, Z=reduced speed zone), because emission factors vary by emission type. For the NEI, each SCC and emissions type combination was allocated to a shapefile identifier in the nonpoint inventory. The allowed combinations of SCCs and emission types are shown in Table 19. The default values are those assumed when the actual emission type may be unknown; for example, emissions that occur in shipping lanes are assumed to be ‘cruising’ and cannot be ‘hoteling,’ which only occurs at ports.

Table 19: Commercial marine SCCs and emission types in EPA emissions

SCC	SCC Description	Allowed	Default
2280002100	Marine Vessels, Commercial Diesel Port	M	M
2280002200	Marine Vessels, Commercial Diesel Underway	C	C
2280003100	Marine Vessels, Commercial Residual Port	H	H
2280003100	Marine Vessels, Commercial Residual Port	M	H
2280003200	Marine Vessels, Commercial Residual Underway	C	C
2280003200	Marine Vessels, Commercial Residual Underway	Z	C

State or local agencies may determine that the EPA default method is not appropriate for SIP purposes or may need further refinement by air agencies in developing SIPs. For example, the general calculation method may be a reasonable approach, but the activity and spatial allocation achieved from a top-down approach could be improved by using the same methods with locally resolved input data to calculate emissions for specific areas.

When estimating CMV emissions, reporting agencies should consider national regulations that decrease emissions from this sector, such as increasingly stringent emissions requirements for new marine diesel engines and sulfur requirements for marine diesel fuel and adjust their estimates accordingly. Emissions reductions resulting from requirements for new marine engines are generally not immediately reflected in inventories as newer engines are gradually incorporated into the vessel fleet and as older engines/vessels are retired. Emissions reductions resulting from the use of lower sulfur fuels are generally seen more quickly, though estimating impacts can be complicated by vessels coming from other parts of the world with different fuel standards. Table 20 provides a list of more recent relevant regulations and associated references for the CMV category. Older Tier 1 and 2 regulations on marine diesel engines, dating back to 1999, are also listed on the websites shown in the table.

Table 20: Commercial marine vessel recent regulations and impacted pollutants

Regulation	Pollutants impacted	Reference
<i>Great Lakes Steamship Repower Incentive Program (January, 2012)</i>	SO ₂ , PM _{2.5}	Regulations for Emissions from Marine Vessels
<i>Tier 2 and Tier 3 Emissions Standards for Category 3 Marine Diesel (April, 2010).</i> Includes both engine standards and fuel sulfur limits.	SO ₂ , NO _x , PM _{2.5}	
<i>Tier 3 and Tier 4 Emission Standards for Category 1 and 2 Marine Diesel Engines (June, 2008).</i>	PM _{2.5} , NO _x	
<i>Nonroad Diesel Tier 4 Rule (May 2004).</i> Decreased allowable levels of sulfur in marine diesel fuel by 99%, taking effect in 2007.	SO ₂	

For states needing to refine their emissions estimates beyond the values produced by the EPA's default methods, Table 21 provides a list of the latest resources for states in better understanding how to calculate emissions for the CMV sources. The newer references are included higher in the table. The EPA's recent method updates have occurred in conjunction with rule development efforts, and so some of these documents are associated with inventories developed for the rules listed above. Even newer methods may become available over time and can be considered for use in SIP planning inventory development. Much of this information is also available on the EPA nonroad mobile website under "[Other Nonroad Reference Material](#)". Any locality-specific data or custom emissions associated with CMV emissions are expected to be included with supporting documentation for the emissions inventory used for a SIP.

Table 21: Current EPA methods for commercial marine vessel emissions.

Inventory approach resource	CMV Approaches For...	Reference
Current Methodologies in Preparing Mobile Source Port-Related Emissions Inventories (April, 2009)	Ocean going (generally C3) vessels, harbor craft, cargo handling,	https://archive.epa.gov/sectors/web/pdf/ports-emission-inv-april09.pdf
Regulatory Impact Analysis: Control of Emissions of Air Pollution from Category 3 Marine Diesel Engines (June, 2009)	Bottom-up port C3 emissions for 89 deep water and 28 Great Lake ports in the U.S. and interport emissions from the Waterway Network Ship Traffic, Energy and Environmental Model (STEEM).	https://nepis.epa.gov/Exe/ZyPDF.cgi/P1005ZGH.PDF?Dockkey=P1005ZGH.PDF See Chapter 3.
Category 2 Vessel Census, and Spatial Allocation Assessment and Category 1 and Category 2 in-Port/At-Sea Splits (EPA-HQ-OAR-2003-0190-0423)	C1 and C2 vessels	https://www.regulations.gov/document?D=EPA-HQ-OAR-2003-0190-0423
Final Regulatory Impact Analysis: Control of	C1 and C2 propulsion, C1 marine auxiliary, <37kW commercial	https://nepis.epa.gov/Exe/ZyPDF.cgi/P10024CN.PDF?Dockkey=P10024CN.

Inventory approach resource	CMV Approaches For...	Reference
Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters per Cylinder (May 2008)	propulsion, and <37kW marine auxiliary.	PDF . Chapter 1 provides more in-depth description of engine types, while Chapter 3 provides emissions calculation approach.
Emissions Inventory Improvement Program	Evaporative VOC emissions from marine transport of petroleum liquids, including the loading and unloading of the petroleum liquids. [‡]	EIIP, Volume III , Chapter 12 “Marine Vessel Loading, Ballasting, and Transit.”

‡ These emissions are often included in as part of the nonpoint inventory rather than associated with the CMV sector.

Older approaches are also available. In 1999, the EPA sponsored two studies, “Commercial Marine Activity for Great Lake and Inland River Ports in the United States,” and “Commercial Marine Activity for Deep Sea Ports in the United States.” Both of these reports are available at the website for [Reports related to Emissions Control Areas for Marine Vessels](#). These studies provide activity profiles for approximately 150 ocean, lake, and river ports, and present a method for an inventory preparer to allocate time-in-mode activity data from one of four typical ports to another port that has similar characteristics. Activity profiles for a typical port include: 1) number of vessels in each category; 2) vessel characterization, including propulsion size (horsepower), capacity tonnage, and engine age; and 3) number of hours at each time-in-mode associated with cruising, reduced speed, maneuvering, and hoteling. These methods provide alternative approaches for state and local air agencies in preparing SIP inventories, but care should be taken to incorporate the impact of national rules incorporated into the newer approaches as documented in Table 21.

4.8.5.3 Locomotives

The locomotive emissions category includes diesel-electric engines, which use 2- or 4-stroke diesel engines and an alternator or a generator to produce the electricity required to power its traction motors. The EPA default approach does not include locomotives powered by electricity or steam. It is believed that the number of wood or coal driven steam locomotives in the U.S. is currently very small; therefore, these types of locomotives are not generally included. In specific instances, if such sources are relevant to a NAA, then they may need to be included. The locomotive sources are further divided into categories: Class I line haul; Class II/III line haul; Passenger; Commuter; and Yard.

In the NEI, rail yard emissions are treated as point sources. Whether rail yards should be treated as a point source for SIP planning purposes depends on the importance of these emissions to the NAA and the analyses that need to be done for any modelled attainment demonstration. Emissions at these sources can include both stationary sources (e.g., switching engines) and mobile sources (locomotives). Because of the mobile source component, a rail yard doesn’t necessary meet the technical definition of a major source. Nevertheless, for NAAs where rail yards are a significant source, the EPA recommends that states consider treating these as point sources so that the best spatial allocation can be used for modeled attainment demonstration.

Several definitions come into play in determining the locomotive category, which impacts the SCC that should be used.

- Class I railroads are those that operate in many different states over thousands of miles of track. They are defined by the U.S. Surface Transportation Board as having annual carrier operating revenues of \$250 million or more. As of 2014, there were 8 such railroads in the U.S.: Amtrak and seven freight railroads, designated Class I based on 2011 measurements released in 2013 (["Class I Railroad Statistics"](#)). Association of American Railroads. April 17, 2013.)
- Class II/III railroads are also known as short line and regional railroads, and they range in size from very small (a few carloads of freight per month) to multi-state railroads just under Class I size. Class II railroads are defined as having revenues greater than \$20.5 million but less than \$277.7 million for a least 3 consecutive years. Switching and terminal railroads are excluded from Class II status. A Class III railroad is defined as a rail company with annual operating revenue of less than \$20 million.
- Line haul refers to higher power usage of locomotive engines during extended mileage. It is also associated with a test cycle used for estimating emission factors intended to represent emissions during line-haul activity.

The EPA develops and maintains methods for estimating locomotive emissions, and these methods are used in the NEI in the absence of more updated data from air agencies. They are also available as a fallback for states without other data for this sector. The EPA's 2011 national rail estimates were developed by applying growth factors to the 2008 NEI values based on railroad freight traffic data from the 2008 and 2011 "R-1" reports submitted by all Class I rail lines to the Surface Transportation Board and employment statistics from the American Short Lines and Regional Railroad Association for Class II and III. In the latest such approaches (used for the 2008 and 2011 NEI), this apportionment includes allocation to GIS shapefiles for line-haul and rail yard emissions. The EPA project report [Development of 2011 Railroad Component for National Emissions Inventory](#) (September 2012) provides the EPA's latest estimation approach and references the 2008 approach as well. The report for the 2008 NEI was another project report, called Documentation for Locomotive Component of the National Emissions Inventory methodology (May 2011) and available in the zip file posted with the [2008 NEI documentation](#). Ongoing work for the 2014 NEI and future inventories will further improve upon past methods.

The 2008 and 2011 EPA default method was developed with a consortium of the EPA, state, and industry, led by the Eastern Regional Technical Advisory Committee (ERTAC). The ERTAC group provided data and reviewed methods as is described in the 2008 NEI Technical Support Document and associated documentation. Table 22 lists the locomotive SCCs used in the EPA default methodology. Other SCCs exist as valid SCCs, but are not used in the EPA method, so states should consider this when comparing the EPA estimates to locality-specific estimates and when merging emissions inventories that include both state/local components and the EPA estimates.

Table 22: Locomotive SCCs

SCC	Description	EPA Estimated?	Data Category
2285002006	Mobile Sources Railroad Equipment Diesel Line Haul Locomotives: Class I Operations	Yes – in shape files	Nonpoint
2285002007	Mobile Sources Railroad Equipment Diesel Line Haul Locomotives: Class II / III Operations	Yes-in shape files	Nonpoint
2285002008	Mobile Sources Railroad Equipment Diesel Line Haul Locomotives: Passenger Trains (Amtrak)	no	Nonpoint
2285002009	Mobile Sources Railroad Equipment Diesel Line Haul Locomotives: Commuter Lines	no	Nonpoint
2285002010	Railroad Equipment Diesel Yard Locomotives	no	Nonpoint
28500201	Internal Combustion Engines Railroad Equipment Diesel Yard	Yes – as point sources	Point

State or local agencies may determine that the EPA default method is not appropriate for SIP purposes or may need further refinement by air agencies in developing SIPs. A number of ways to improve the EPA estimates were noted in the original 2011 report (see ftp://ftp.epa.gov/EmisInventory/2011/doc/2008nei_locomotive_report.pdf) that documented the approach used for the 2008 NEI. For the Class I line-haul emissions, the report identifies the most important considerations such as the rail link-level freight tonnage. Other variables were not addressed in the methodology, including track grade and track speed. While the method calculated railroad-specific fleet- averaged emission factors from industry fleet data, it is noted that emissions from individual engines are highly variable even for the regulated engine categories depending on variables such as the specific locomotive model, operation cycle, and conditions of operation. Furthermore, the EPA approach does not address the seasonality of the emissions, while activity levels of different engines do vary seasonally and could impact emissions for seasonal inventories. Any locality-specific data or custom emissions associated with locomotive sources are expected to be included with supporting documentation for the emissions inventory used for a SIP.

For the rail yard emissions, we have already noted above the consideration of rail yards as point sources. In addition, the 2011 report mentioned in the last paragraph notes additional considerations for improvements. For example, using the tonnage hauled as an indicator of the amount of switching activity is an assumption that could reduce uncertainty. The variability associated with actual switching duty-cycles and in the number of switchers operating at some rail yards seasonally was not considered in the method.

Locomotive idling emissions is another issue that is not clearly considered in the default EPA methodology and could have an impact on emissions estimates. During normal operations, locomotives have numerous reasons why they may remain idling including the switching operations noted above. The EPA has included regulations on idle emissions to help address this source. More details on idling emissions from locomotives is available in “[Control of Emissions from Idling Locomotives](#)” (EPA, March 2008).

The EPA [website on locomotive emissions regulations](#) provides a resources for understanding the regulations that apply to locomotives and how those may impact emissions. Only one recent regulation impacts emissions from locomotives, while several older regulations also apply. In June 2008, the EPA published the *Control of Emissions of Air Pollution for Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters Per Cylinder*. This rule includes standards for existing and remanufactured locomotives, Tier 3 and Tier 4 standards for newly built locomotives, and idle reduction requirements for new and remanufactured locomotives. The rule reduces emissions of PM_{2.5} and NO_x. The emissions estimation approach used for this rule is available in Chapter 3 of the [Regulatory Impact Assessment for the rule](#), and this approach differs from the EPA method used for the NEI. Associated with the rule, the EPA developed a [fact sheet on locomotive emission factors](#) (April, 2009) that can be used in estimating emissions from locomotives.

4.8.6 Biogenic and Geogenic Sources

Biogenic sources are a subset of natural emissions sources that may contribute significantly to an emissions inventory. Vegetation (i.e., forests and agriculture) is the predominant biogenic source of VOC and is typically the only source that is included in a biogenic VOC emissions inventory. Microbial activity in the soil contributes to natural biogenic NO_x and CO emissions.

The EPA makes available biogenic emissions estimates as part of the NEI. Starting with the 2008 NEI, the biogenic vegetation and soil emissions have been included in the official NEI releases. In some cases, these EPA-generated emissions may be sufficient for use in SIP inventories other than modeling inventories.

Biogenic emissions from vegetation and soils are computed using a model which utilizes spatial information on vegetation and land use and environmental conditions of temperature and solar radiation.²⁰ The model inputs are typically horizontally allocated (gridded) data, and the outputs are gridded biogenic emissions that can then be speciated and utilized as input to photochemical grid models. Several models exist, as described in the following subsections.

Modeled biogenic vegetation emissions are significant for understanding ozone formation, particularly in the Eastern U.S., and the dependence on meteorology makes using case-specific meteorology very important. In addition, the impact and model characterization of biogenic terpene and sesquiterpene on secondary aerosol formation for PM modeling is thought to be important. Emissions data developers should consider the latest available information on this issue where biogenic sources are key sources in their modeling region.

Biogenic Emissions Inventory System (BEIS)

The EPA has developed the Biogenic Emissions Inventory System, version 3.6 (BEIS3.6) for use in estimating biogenic emissions. This model can be run both as part of a CMAQ model run and

²⁰ In most cases, ozone, PM, and regional haze modeling includes the emissions from vegetation and soils, but not other potentially relevant sources such as volcanic emissions, lightning, and sea salt.

alternatively as a module of the SMOKE system. The CMAQ approach is described by the CMAQ wiki at [https://www.airqualitymodeling.org/index.php/CMAQv5.1_Biogenic_Emissions_\(BEIS\)_Update](https://www.airqualitymodeling.org/index.php/CMAQv5.1_Biogenic_Emissions_(BEIS)_Update). The latest documentation on the SMOKE approach to run BEIS is available at <http://www.cmascenter.org/smoke/>.

The key inputs to BEIS include:

- Temperature data at 2 meters, which can be obtained from modeled meteorological data, such as data from the Weather Research and Forecasting (WRF) Model. Such data are also needed for input to air quality models used for modeled attainment demonstrations sometimes needed as part of SIPs. The BEIS3.14 documentation has more information on the meteorological inputs.
- Land-use data from the Biogenic Emissions Land Use Database, version 4.1 (BELD4). BELD4 data provides data on the 230 vegetation classes at 1-km resolution over most of North America. These data are available at <https://www.epa.gov/air-emissions-modeling/biogenic-emission-sources>. These land use data can be created with the Multimedia Integrated Modeling System (MIMS) Spatial Allocator (<https://www.cmascenter.org/sa-tools/>). Air agencies can alternatively rely on the EPA's 12-km gridded data for modeling domains that overlap with the EPA national domain, provided with the EPA's latest modeling platform on the [Emissions Modeling Clearinghouse](#).

Other Biogenic Models

Other biogenic models such as Model of Emissions of Gases and Aerosols from Nature (MEGAN) (http://wiki.seas.harvard.edu/geos-chem/index.php/MEGAN_v2.1_plus_Guenther_2012_biogenic_emissions) are acceptable as well, provided that the users have demonstrated their suitability for the modeling application through model performance evaluation (see Modeling Guidance for more information). A version of MEGAN has also been incorporated into an air quality model called the WRF model coupled with Chemistry (WRF-CHEM) (<http://www.pnl.gov/atmospheric/research/wrf-chem/>). California has developed a GIS-based biogenic model called BEIGIS (<http://www.arb.ca.gov/ei/biogeniciei.htm>). The EPA previously made a comparison between BEIS and MEGAN (available at http://www.cmascenter.org/conference/2008/slides/pouliot_tale_two_cmas08.ppt).

BEIS, MEGAN, and other models continue to evolve and so agencies using these models should evaluate the suitability of one model over the other as part of a modeled attainment demonstration. Once a choice has been made for modeling purposes, emissions should also be summed across the NAA for inclusion in the base year inventory for the NAA and/or the attainment projected inventory for the NAA.

Geogenic and Other Natural Sources

Geogenic emissions are primarily the result of oil or natural gas seeps and soil wind erosion. In addition, lightning may also be a significant contributor to natural NO_x emissions in an inventory area. Volcanoes and fumaroles (i.e., vapor or gas vents in a volcanic region) can be additional sources of geogenic emissions.

As a source of ozone precursor emissions, geogenic sources are usually less significant than biogenic sources. However, geogenic wind erosion may contribute substantially to PM emissions in an area. In 2012, the EPA released CMAQ v5.0 that includes a module that dynamically estimates hourly natural emissions of fine and coarse dust particles due to wind action over arid and agricultural land. This allows the contribution of this source to be included in a modeled attainment demonstration without the need to prepare an emissions inventory first. The windblown dust approach is based on the work of J.S. Fu et al. (2016). For the emissions inventory SIP, air agencies using this feature should evaluate the results of the CMAQ-based approach to determine if it provides a reasonable representation of dust emissions in their modeling domain. Often times, CMAQ overestimates ambient crustal matter concentrations without the addition of windblown dust and so adding emissions may not be advisable.

If windblown dust emissions are included in SIP planning, such emissions should be included in the base year and attainment projected inventories to meet the requirements for a complete emissions inventory. In the case of using CMAQ, this would require that the CMAQ-based emissions be summed for the NAA. Since CMAQ produces gridded emissions estimates, air agencies would need to sum emissions from the relevant grid cells or portions of cells associated with the NAA and/or other geopolitical regions as appropriate. One relevant detail about the AERR regarding windblown dust is that they are specifically exempted from the reporting requirements in 40 CFR 51.20(d)

State, local and tribal agencies should also prepare an inventory of all other significant geogenic sources in the inventory area. Methods for estimating VOC emissions from oil and gas seeps, as well as NO_x emissions from lightning, are described in the EIIP document, *Volume V, Biogenic Sources Preferred Methods* available at <https://www.epa.gov/air-emissions-inventories/volume-5-biogenic-sources>. For oil and gas seeps, the preferred method is to develop a local emission factor based on the study of oil or gas seeps in the inventory area.

Lightning produces NO, which is oxidized to NO₂ in the presence of ozone or in a photochemically reactive atmosphere. This NO_x is formed in the mid-upper troposphere and can impact the distribution of reactive nitrogen as well as ozone. NO emissions from lightning can be estimated by collecting activity data on the cloud-to-ground lightning flashes, assuming a frequency of intra-cloud flashes based on the value for cloud-to-ground lightning flashes, and applying appropriate emission factors (in molecules NO per flash) to these activity levels. Because lightning is not a direct source of NO₂, accounting for this source category is more important for air quality modeling purposes than for SIP planning inventory purposes. Given the altitude of these emissions, it is not usually important to include these emissions in the base year inventory for the NAA or in the attainment projected inventory for the NAA.

CMAQ v5.0 includes a parameterized approach to estimate NO_x emissions and its vertical distribution that is generated from lightning. Over the Continental U.S., the approach can use lightning flash totals from the National Lightning Detection Network (NLDN). For cases where such data are not available, an alternate algorithm can be used that estimates the number of lightning flashes based on the modeled convective precipitation. The peer reviewed literature contains both a description of the approach (Allen et al., 2011) and a model evaluation (Appel et al., 2010). More information is available from the CMAQ v5.0 wiki (see

[https://www.airqualitymodeling.org/index.php/CMAQ_version_5.0_\(February_2012_release\)_Technical_Documentation#Lightning_NOx_emissions](https://www.airqualitymodeling.org/index.php/CMAQ_version_5.0_(February_2012_release)_Technical_Documentation#Lightning_NOx_emissions)).

4.8.7 Wildland Fires

Because the CAA specifies that planning inventories (e.g., the base year inventory for the NAA) must include all sources of emissions, the inventories should, therefore, include fires. Thus, wildfires and prescribed fires, including wildland fire use, should be included in the NAA inventories when they overlap with NAA boundaries. Generally, areas will find that the estimates available in the NEI will suffice for providing a reasonable estimate of these emissions, with the purpose of providing a general idea of the level of contribution to the overall emissions within the NAA.

Wildland fires (WLFs) are generally defined as any non-structure fire that occurs in the wild land (an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities). The National Wildfire Coordinating Group²¹ has identified the following two types of WLFs.²²

- *Prescribed fire* is any fire intentionally ignited by management actions in accordance with applicable laws, policies, and regulations to meet specific land or resource management objectives.
- *Wildfire* is any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire.

Wildland fires are a unique source of emissions with respect to NAAQS attainment planning. For ozone, PM_{2.5}, and regional haze planning purposes, these fires are major sources of primary PM_{2.5} and VOC and a moderate source of NO_x. They can consequently impact the ambient PM_{2.5} and ozone; however, they have a number of unique properties:

- Depending on the fuel source and acreage burned, both prescribed and wildfires can emit significant emissions, but emissions from prescribed fires are generally lower due to the burning characteristics and the relative amounts of flaming and smoldering emissions. In addition, prescribed fires can be used to prevent future wildfires, which are generally larger, hotter, more dangerous, and more polluting.
- Wildfires are naturally occurring events for which the emissions are generally not reasonable to prevent or control. As such, air agencies may request that the EPA exclude from regulatory determinations ambient data influenced by the wildfire if the request meets the criteria, schedule, and procedural requirements for an exceptional event set forth in 40 CFR 50.14.²³

²¹ The National Wildfire Coordinating Group was formed under a cooperative agreement between the Departments of Agriculture and the Interior and consists of representatives from each of the Federal Land Management agencies and the National Association of State Foresters.

²² Definitions are derived from the *Glossary of Wildland Fire Terminology*, National Wildfire Coordinating Group, PMS 205, July 2012. Available at <http://www.nwccg.gov/glossary-of-wildland-fire-terminology>.

²³ "Treatment of Data Influenced by Exceptional Events; Final Rule" (81 FR 68216, October 3, 2016).

- Fire emissions can rise very high in the atmosphere on plumes, and the pollutants can be transported beyond state boundaries. Fires occurring outside NAAs can have impacts within NAAs on days that may not be determined to be exceptional events.
- Since wildfires and prescribed fires generally occur in forests and rangelands, they are less likely to be within the boundaries of NAAs, which are usually urbanized areas.
- Fires can also reduce ozone formation because their smoke can block sunlight that otherwise would result in more ozone.

SmartFire emissions

The EPA has adopted for use in the NEI a satellite-based approach to estimate fire emissions at specific locations and as daily emissions. The SmartFire approach (see <http://www.airfire.org/smartfire/>) was developed by researchers with support from the U.S. Forest Service (USFS). The EPA and USFS have worked together to implement approaches for collecting activity data from states to feed SmartFire for use in calculating emissions. The SmartFire approach uses the following general equation to estimate wildfires and prescribed fires. Accurate estimates of fire emissions rely on accurate estimates of the terms in the equation below.

$$\text{Emissions} = \text{Area burned} * \text{Fuel Load Available} * \text{Fuel Consumed (Burn Efficiency)} * \text{Emission Factors}$$

The SmartFire2 (SF2) approach has been used most recently for the 2011 and 2014 NEIs.

SF2 estimates the “area burned” term in the above equation, in conjunction with the BlueSky framework model that estimates the last three terms in the above equation. The “fuel load available” term is estimated using the Fuel Characteristic Classification System (FCCS) maps in the BlueSky model. The “fuel consumed” term is estimated from BlueSky using the CONSUME3 model, which predicts the fraction of fuel that burns based on many parameters including fuel moisture. Finally, the “emission factors” term is estimated in BlueSky using the Fire Emissions Prediction Simulator which relies on EFs from the literature apportioned by flaming and smoldering combustion. Since SF2 was recently developed, direct references to its development in conjunction with updated BlueSky methods are not yet available; however, the following reference can be used in general for past applications of these process models in the SF/BlueSky process: <https://www.airfire.org/smartfire/>. Reid (2013) provides more exacting details on the specific procedures used in developing the NEI prescribed and wildfires. As new NEI years are developed and resources are available, additional improvements to SF2 are expected.

Some states have determined that SF2 is not sufficient for their needs because the satellite-based methods can miss detection of prescribed burning that occurs under thick tree canopies. As a general matter, the EPA encourages all users of SmartFire to work with their forestry agencies to obtain and use local-specific information about area burned, fuel types, fuel load, burn efficiency, and emission factors.

Exceptional Events and Inventories

When developing design values for a particular NAA, certain ambient monitoring data may be excluded if an exceptional events submittal is approved by the EPA (see 40 CFR 50.1, 40 CFR 50.14, and 40 CFR

51.930). It has been suggested during the course of developing this guidance that emissions associated with exceptional events should be removed from the inventories. The purpose of this recommendation was the improvement of model performance evaluations and projected attainment modeling.

In spite of potential impacts on modeled concentrations, in most cases, the EPA does not recommend removing fire emissions from inventories for the following reasons. First, it is not necessary to remove fires from use in the model performance evaluation because the EPA does not expect ambient data to be removed from the model performance evaluation (www3.epa.gov/ttn/scram/guidance_sip.htm). Second, the EPA recommends holding the emissions of fires constant between the base and future years for the purpose of future year inventories (such as are required for PM_{2.5} NAAQS) and for calculating a modeled relative response as part of a modeled attainment demonstration. This approach ensures that the modeled fires have a minimal influence on estimated future year concentrations that are calculated using the relative change in modeled concentrations. Third, even though in some cases there may be a direct causal link between fire emissions and monitored air quality data, resulting in exceptional events, removing fire emissions directly associated with an exceptional event from an inventory requires knowledge of exactly which fire(s) at specific locations on specific days and hours contributed to the exceptional event. This may be especially difficult when multiple fires over multiple days lead to identified exceptional events. Therefore, from an inventory perspective, it may not be straightforward to remove emissions specifically associated with any particular exceptional event. Determining which emissions to remove from the inventory could be a significant effort with limited benefit.

The EPA, therefore, encourages states to use a representative mix of prescribed fire and wildfire in their inventories. In the past, some plans under previous PM_{2.5} NAAQS have estimated the actual fire emissions and temporal and spatial patterns from a given year and used this estimate as the assumed future baseline for planning, while others have used average emissions over multiple years. Other approaches may be appropriate as well. Moreover, regardless of the approach used, the EPA still encourages states to submit actual wildfire and prescribed fire activity data that are critical to developing emissions estimates to the NEI as suggested in the AERR. Additionally, the EPA encourages states to consult with their EPA Regional office about the fire approach to be used. While other approaches may be more suitable in particular situations, the recommendations provided here provide a starting point for discussions about the most appropriate approach for a particular area.

4.9 Quality Assurance

As part of the 8-hour ozone NAAQS, PM_{2.5} NAAQS rules, state, local and tribal agencies are strongly encouraged to perform QA checks and procedures on their inventories. State, local and tribal agencies can develop and select the QA procedures they will perform, and should include the details of their QA program (including specific procedures) in their IPPs.

The purpose of QA is to ensure the development of a complete, accurate, and consistent emissions inventory. A well-developed and well-implemented QA program fosters confidence in the inventory and in any resulting regulatory and/or control program.

When air agencies are using data from the NEI, additional QA is warranted considering the purpose for SIPs is not the purpose for which the NEI was developed. Since a great deal of QA is done on the data used for the NEI, most of the QA work has been done and so starting with the NEI can often save time.

The overall QA program provides routine and consistent checks and documentation points in the inventory development process to verify data integrity, correctness, and completeness; identifies and reduces errors and omissions; maximizes consistency within the inventory preparation and documentation process; and facilitates internal and external inventory review processes. Quality assurance activities include technical reviews, accuracy checks, and the use of approved, standardized procedures for emission calculations, and should be included in inventory development planning, data collection and analysis, emission calculations, and reporting.

4.9.1 QA Reference Materials and Planning

The EPA has developed several guidance documents designed to assist state, local and tribal agencies in designing and implementing their QA programs. The [EIIP Volume VI](#), addresses QA issues, including the following:

- Chapter 1: *Introduction - The Value of QA/QC*
- Chapter 2: *Planning and Documentation*
- Chapter 3: *General QA/QC Methods*
- Chapter 4: *Evaluating the Uncertainty of Emission Estimates*
- Chapter 5: *Model QA Plan*
- Appendix A: *Example Audit Report*
- Appendix B: *Technical Systems Audit Checklist Example*
- Appendix C: *Example 1 of Data Quality Audit Checklist*
- Appendix D: *Example 2 of Data Quality Audit Checklist*
- Appendix E: *Performance Evaluation Checklist Example*
- Appendix F: *EIIP Recommended Approach to Using the Data Attribute Rating System (DARS)*

On October 20, 2008, the EPA issued the latest version of the EPA Quality Program Policy (CIO 2106.0). This policy supersedes the previous CIO 2105.0 (formerly EPA Order 5360.1 A2). This policy established among other things, the requirement for QAPPs for all EPA-supported programs that generate environmental data. As described by the “EPA Requirements for QA Project Plans” guidance:

The purpose of a QA Project Plan is to document planning results for environment data operations and to provide a project-specific blueprint for obtaining the type and quality of environmental data needed for a specific decision or use.

The orders describing the QA requirements are available at the EPA’s website for Agency-wide Quality System Documents (<https://www.epa.gov/quality/agency-wide-quality-system-documents>). That website also includes specifications for non-EPA organizations: “[EPA Requirements for Quality Management Plans](#)” (EPA/240/B-01/001; March 2001) and “[EPA Requirements for QA Project Plans](#)” (EPA/240/B-01/003; March 2001). Additional documentation is also available on the same website under the subheading of “General Guidance” that air agencies may find helpful in developing their own QA plans for their inventory development efforts.

States should also consult with their EPA Regional office to determine how to meet the QA planning requirements for the SIP planning inventory development.

4.9.2 Types of Problems in Emissions Inventories

Emissions inventories are compiled from a large number of disparate data sources, which can lead to many types of data problems. These problems can be divided into *value* errors and *structure* errors. *Value* errors are errors in the values of emissions inventory data fields, such as the emissions amounts, incorrect codes, missing values that are required, or incorrect data such as facility names, stack heights, or latitude/longitude locations. Correct QA can identify these errors and allow data developers to correct them before the data are used for their intended purpose.

Structure errors refers to those data problems that cause databases to not work, such as missing records in relational database tables (e.g., “widows” and “orphans”), duplicate records (i.e., multiple records that represent the same emissions, causing double counting), or incorrect formats (e.g., the wrong number of fields, missing fields that are required, mismatched data types, such as integer versus text). Data with no structure errors are described as having good “data integrity.” Generally, these types of problems should be automatically prevented by using robust data systems to manage the data in ways that match the expected downstream data use, but this is not always the case. For example, data systems managing emissions inventory data should be developed with the AERR requirements in mind, since these are the governing requirements for SIP-related inventories.

4.9.3 Checks Available through the EPA’s Emissions Inventory System

While many inventories used for SIPs are not also submitted to the EPA through its EIS (the system the EPA uses to build the NEI), the EIS does have a large number of documented QA checks that the system performs as it is loading data submitted by air agencies. This automated QA provides a large number of data integrity checks that air agencies can consider including in their own data systems or checking as part of their inventory QA. To access a list of these checks, EIS users must use the EIS Gateway and use the “QA Checks” link under the “Reference Data” heading on the left of the Gateway interface. The checks are not otherwise published on the EPA’s website and can be requested by non-EIS users by using the “Contact Us” link provided at <https://www.epa.gov/chief>. The list has more than 600 data checks that are performed automatically by the EIS. While many of these checks are only relevant for getting data into the EIS, they promote standardization of inventories and proper formatting in accordance with the AERR, which (as noted previously) provides the EPA’s standards for inventory preparation including for SIP inventories.

Since the timing of development of SIP inventories is rarely, if ever, coincident with the timing required for submitting emissions for the NEI, it is generally not feasible for air agencies to submit SIP inventories to EIS. However, the same types of checks can and should be done on SIP inventories to insure appropriate inventory quality.

The EIS checks include both critical errors and warnings. Critical errors prevent data getting into the EPA data system until they are corrected, whereas warnings allow the data to go through, but may need to be resolved to ensure the data transmitted to the EPA are correct. Examples of critical errors include:

- Checks that data codes for required fields use valid values (for the given inventory year; see also Section 4.7).
- Fields required by the AERR and for data integrity are present.
- Certain fields are within a critical range check (e.g., a year is between 1900 and 2050, stack height is between 1 and 1300 meters).
- Certain fields have appropriate lengths (e.g., ZIP codes are between 5 and 10 characters).
- Percentages are provided as percentages (1 to 100) and not as a fraction.
- Data element types (e.g., integer, text, numerical) of required data fields are provided consistent with their required type.
- MOVES county database submission contains the correct files.
- NMIM county database submission contains the correct files.
- Conflict with pollutants reported for grouped pollutants versus individual members of the group.
- If stack diameter information is reported, the release point exit gas flow rate or velocity should be reported. Both may also be reported.

Examples of warnings include:

- Checks that data codes for optional fields use valid values (for the given inventory year).
- Data value is longer than the allowable width (some text fields will be truncated if longer than what the EIS allows).
- Emissions value is outside of a presumed valid range.
- Exit Gas Stack temperature is outside an appropriate range.
- When submitting monthly data, all months are not submitted together.
- File names of mobile data files use incorrect file extensions.
- Data element types (e.g., integer, text, numerical) of optional data fields are inconsistent with their required type.

4.9.4 Inventory Comparisons

Inventory comparisons can be used in multiple ways to effectively identify problems in new inventories. This is most useful when a high-quality prior inventory is already available. In states with a long history of developing SIPs, past inventories will be readily available for such comparisons. In states with new or emerging attainment problems, the EPA suggests comparing SIP inventories to the NEI. Even when the comparisons reveal problems not with the new inventory but with the one being compared, this can increase confidence in the inventory of interest.

Emissions are one of the obvious things to compare, and these comparisons are usually done on a pollutant-by-pollutant basis for pollutants important to a given analysis. As noted in the section on ranking techniques (Section 4.9.7), ranked emissions (e.g., facility, unit, county, SCC group) can be compared to the same ranked emissions from other inventories. Such comparisons will often identify differences worth further exploration when one large source appears on one list and not the other.

In addition to ranking, all records across an inventory (or inventory summary) can be compared and percent differences can be computed. This is usually done by computing “new emissions – old emissions” divided by “old emissions.” Large or unexpected percent differences can be investigated further to make sure that the differences have some reasonable explanation, such as newer emissions being controlled, a downturn in activity for one inventory, process changes, fuel changes, or a partial or complete facility closure. In some cases, methods changes may be the reason for such differences, including updated emission factors or test data.

For nonpoint emissions, graphical inventory comparisons can be useful. This can be done by not only using calculated percent differences or ranking, but also using GIS techniques to map county level emissions and their differences. It can be very useful to map the old emissions, new emissions, and the computed difference or percent difference side-by-side. This can reveal areas of large emissions that have significantly changed from one inventory to the next, raising questions for further exploration. When comparing to an EPA inventory that used EPA methods for a particular sector, this could reveal that the SIP planning inventory is a better inventory with updated methods, or it could reveal that outdated methods are being used. In any case, making the comparison will help inventory developers understand the potential improvements that could be made or that have been made, which will help in understanding reviewers’ expected reactions to the data.

For multi-state inventories needed for SIP development, state-to-state comparisons may be useful in addition to county maps. This is especially true if emissions for one state were developed differently from emissions for another state. The EPA encourages states to work together to promote consistent approaches across a multi-state NAA, but a final QA check of the consistency can be done using the comparison techniques described here.

4.9.5 Checking Data Codes

As described in Section 4.7, air agencies should check the inventory data codes they are using against valid codes. Valid codes are defined by the EPA within the EIS. Air agencies that start with the NEI may significantly minimize the burden of this recommendation.

4.9.6 Point Versus Nonpoint and Reconciliation

Several QA issues arise related to point versus nonpoint sources and inventories: (1) correct identification of point sources, (2) prevention of double counting across point and nonpoint, and (3) prevention of missing nonpoint emissions.

Minimum thresholds are specified in the AERR for which sources with facility total potential to emit emissions above those thresholds must be treated as a point source in SIP planning inventories. This is more fully explained in Section 2.5.8, with lower thresholds relevant for ozone and PM NAAs. Air agencies should implement a QA check (or otherwise have a data collection process) that ensures all facilities with potential emissions (potential controlled emissions, if applicable) that are greater than these thresholds are included in their inventory as point sources. See also Section 2.5.2 for more information on calculating potential emissions.

When a particular type of source includes contributions from both point and nonpoint sources, double counting can occur. Quality assurance steps should be taken to ensure that double counted emissions have been prevented. A good example of this is smaller boilers. Both point source facilities (based on the potential to emit thresholds) and smaller facilities are likely to have emissions from non-industrial boilers. For instance, some large institutional facilities such as hospitals may be included as a point source with their associated boiler emissions, whereas smaller institutional facilities are not included as point sources and would thus be included as a nonpoint source under an “institutional/commercial” boiler SCC.

The EPA provides calculation approaches for many nonpoint emissions that allow for subtracting out the activity of the point source parts prior to estimating nonpoint emissions, including that for the institutional/commercial boiler example. This is called “point/nonpoint reconciliation.” Whether nonpoint emissions are estimated by the EPA or by air agencies, an assessment of quality should be done to ensure that sectors associated with both point and nonpoint sources do not double count emissions. See also Section 4.8.2 for additional information on preventing double counting. A list of source sectors with potential point/nonpoint overlap is provided in Table 17 above and in the latest NEI Technical Support Document, available at <https://www.epa.gov/air-emissions-inventories/national-emissions-inventory>.

A third type of QA should be done for categories that have both point and nonpoint contributions. It involves an assessment of potentially missing nonpoint emissions. Because the requirement for SIP inventories is to include emissions from all sources, it is not sufficient to exclude nonpoint emissions when part of a sector is covered by point sources, unless it can be shown that the nonpoint portion is negligible. At a minimum, air agencies should consider the tools available from the EPA to estimate nonpoint sectors (see Section 4.8.2) and evaluate whether or not their point source inventory covers all of the activity associated with the nonpoint categories. For inventory years not covered by EPA tools, agencies should compare point total activity as collected from point sources versus the same type of activity data used in the EPA tools. For example, U.S. DOE fuel consumption data can be used for industrial, commercial, and institutional boilers. The source of the activity data used for the latest EPA nonpoint methods is included in the descriptions of those methods in the nonpoint tools described in Section 4.8.2 and with the latest NEI documentation.

4.9.7 Ranking Techniques

Ranking emissions records can be a very useful tool to identifying value errors in emissions values or other numeric inventory data fields, or at least in finding records that need further investigation. Ranking involves first defining a set of sources and a level of aggregation of emissions and then ordering those emissions values from highest to lowest or lowest to highest. This analysis must be done one pollutant at a time. An analyst then considers whether those sources at the top of the list make sense.

Point sources, facility level emissions ranking

For point sources, ranking can be done at the facility total, unit total, or process level (i.e., at the SCC level), and each level has its place for reviewing inventories. A facility level ranking can often be followed

by subsequent investigation to understand the reasons (at the unit and/or process level) for very high or very low values. An analyst using a ranking procedure would assess the facilities with the largest emissions and seek to understand whether they make sense. For example, for combustion products such as NO_x or SO₂, one would expect to see large EGUs and other industrial sources. Ranking of emissions values is usually done for one pollutant at a time, reviewing most carefully those pollutants that are most critical to the particular purpose of the inventory. For example, an inventory supporting ozone analysis would want to review NO_x and VOC most carefully.

It can be useful to compare the list of top facilities for a given pollutant from one inventory to a previous or alternative inventory for a given state or NAA. This can raise questions regarding large changes from one inventory to another, which could be explained (e.g., a decrease due to controls) or could identify a problem (e.g., a missing value or data entry problem). In addition, facility-level ranking can use additional grouping such as by industry code (i.e., NAICS), to identify unexpectedly high or low emissions for facilities within a particular industry.

Point sources, sub-facility emissions ranking

Unit- and process-level summaries can additionally be ranked for more specific analyses. For example, all boilers could be ranked and particularly high or low emissions values investigated. Similarly, all natural gas processes at particular unit types (e.g., boilers) or by industry (NAICS) could be ranked. These rankings can show real variations, but they can also find incorrect values that stand out when ordered and reviewed in this way. There are many variations that could produce useful results, and which ones are useful for a particular inventory depends on many factors and the purpose of the inventory.

Nonpoint and mobile source ranking

Nonpoint and mobile emissions can also be ranked as a technique to help with QA. Since these inventories are primarily compiled at the county/SCC resolution, the ranking can be done only at combinations of county, SCC, and for specific pollutants. Total county nonpoint emissions could be ranked to look for overly high or low values, but the same effect can be accomplished in a visual way with mapping approaches (see Section 4.9.9). Specific SCCs can also be selected and the emissions by county ranked, or individual counties selected and SCCs ranked and compared to other counties.

Since nonpoint emissions are based on various types of activity data that also has a county or other spatial resolution (such as census tract), these activity data can be used to “normalize” the nonpoint emissions prior to ranking. For example, emissions coming from households (e.g., residential heating, residential wood combustion, consumer solvents) can be divided by population or housing data and ranked for identify possibly strange results. Since some of the activity data used for these categories starts with state or regional resolution and is subdivided to apportion to the county resolution, such comparisons can reveal illogical outcomes of such approaches. For example, while it makes sense that residential wood combustion occurs more per household in rural areas, it wouldn’t make sense for a very low population county to have a disproportionate amount of emissions and urban areas have none.

4.9.8 Outlier Analyses

One result of the ranking approaches described above will be to identify outliers. However, such ranking is a relatively unsophisticated way of identifying such outliers. A more robust approach can be used for point sources where states have the underlying activity data reported by facilities on a per-process basis. Dividing emissions by activity values would produce a set of implied emission factors, or rates. The rates for a similar set of processes (based on SCC) and control devices in use might be expected to be within an order of magnitude of each other. Emission rate values that are too far outside the expected relationship could be further investigated to better understand the source of any unexpected values, which might include an error in the units of measure or the presence of controls or an incorrect SCC, as well as data entry errors for emission values or other related fields.

4.9.9 Using Maps to QA Nonpoint Emissions

Nonpoint and mobile source emissions data are associated with states and counties and, therefore, are ideal candidates for mapping with GIS software. By mapping emissions values for individual SCCs or groups of SCCs, data analysts can identify unexpected patterns in the data that could signal an error in creating the data. Though it is technically more challenging to use GIS software, this approach can often be more valuable than ranking in identifying data problems.

Like the ranking techniques, GIS maps can also use emissions data normalized by some other underlying or related spatial data, such as population, land use, urban/rural designations, or housing. This type of information is increasingly available online from the U.S. Census Bureau and other sources. Data analysts can use the other data to identify unexpected relationships that possibly indicate bad assumptions made in the underlying methods.

4.9.10 Expected Pollutants

Air agencies can use their expertise with emissions sources to identify which pollutants are expected from particular processes. In addition, for the 2014 NEI cycle, the EPA has provided a list of expected pollutants for each SCC. While this list is not comprehensive for any pollutant that can be associated with a process, it provides a bare minimum of essential pollutants associated with SCCs. For example, NO_x is always expected as a by-product of combustion processes. In addition to expected pollutants, analysts can also identify pollutants that are not expected from a particular process, such as SO₂ from an evaporative process.

Once identified, such lists can be used to cross-check inventories to identify either problems with reported emissions, pollutant codes used, or process codes used. For example, if a combustion process does not have NO_x emissions, it could be that the wrong pollutant code was used in reporting the NO_x and its showing up as something else. Or, the process itself may be incorrectly using a combustion process code.

Expected pollutants can also help with making sure the correct PM components are provided for PM inventories, in particular that condensable PM emissions are included in the total PM emissions and that both filterable and condensable PM emissions are reported. This issue was described in Section 4.2.1 along with a list of the types of sources expected to have such emissions.

Some emissions data analysts may not be familiar with various sources enough to know which pollutants should be expected. For point sources, agency staff can rely on the sum total of all reported data across multiple sources for a particular process to get a good idea of what should be expected. For example, if all but one industrial boiler burning natural gas reported VOC, then it would be worth further investigation as to why VOC was not reported for that one. Since the AERR specifies that all criteria pollutants must be reported if any one pollutant exceeds the potential to emit threshold, one should expect that similar processes from multiple facilities would have many, if not all, the same pollutants.

There are other ways to identify expected pollutants. These include looking at past inventories created by the same air agency or looking at the NEI. Another way is to see what emission factors are available for the process in Webfire. While these are not foolproof ways of finding expected pollutants, they can be very helpful. Comparing a draft inventory with such a list can also identify unexpected pollutants to consider. Used with ranking techniques, knowing what pollutants are expected can also help when you find zero or null values for a facility, unit, or process.

4.9.11 Facility and Release Point Locations

Facility and release point (e.g., stack) locations are key elements of inventories that are used primarily in preparation of inventories for air quality modeling and also in permit modeling. Facility locations are also used in mapping point sources for various public communications purposes or other reasons needing less precision. While facility resolution is acceptable for many modeling applications, including 12-km gridded modeling, the need for release point locations increases for finer resolution modeling. Thus, for 4-km or 1-km modeling, release point location information should be considered.

With regard to the more detailed release point coordinates, the EPA recognizes the need for air agencies to leverage SIP inventory development efforts for possible use for other inventory needs. Thus, air agencies should be particularly attuned to release point geographic coordinates for sources that could be involved in permitting or risk analysis. For regulatory dispersion modeling, release point location is critical (rather than only facility location).

The EPA's EIS and other inventory data systems support two types of locations: facility and release point. There are four key errors that can occur, and each can be identified with their own type of check, as listed below.

- Facility is not consistent with the state/county FIPS code
This error can be found using GIS, SAS® or other calculations to compare the latitude/longitude location with the county boundaries using some tolerance. Because county boundaries have varying degrees of accuracy, a tolerance should be used that allows for locations near, but not always 100% within, county boundaries.
- Facility location is not consistent with the physical location of the facility
Since some facilities can be on very large tracts of land, facility locations developed using geocoded addresses or facility entrances are often not accurate with regard to the actual location of the facility. For emissions inventory purposes, the EPA encourages that facility locations be positioned on top of a part of the facility that emits one or more pollutants, and the

facility centroid is often sufficient for doing so. Using freely available mapping software such as Google Maps, latitude/longitude locations can be plotted on satellite images to ensure that values are on top of an emitting source and not on the road, at the corporate headquarters, or in some other invalid location.

- Release point location is not consistent with facility location
This check is only useful once the facility location is accurate. Such an error can be found using GIS, SAS® or other calculations to determine the distance between the facility location and the release point locations. Alternatively, a subtraction of the absolute values of the latitudes and longitudes can be used to determine the difference in degrees. If that linear distance or the distance in degrees is greater than some preset criteria, then the locations can be investigated further. For some types of facilities such as refineries or major chemical complexes, the facilities may be very spread out and therefore may have legitimately large distances between release points.
- Release point location is not consistent with the physical location of the release points
For many applications, including some SIP modeling applications, all release points using the same (usually facility) latitude/longitude is sufficient. However, with the availability of inexpensive GPS technology, it is more realistic for facilities to collect and submit individual release point location information. Furthermore, for some types of analysis, particular fine scale modeling for permitting and risk analysis, correct release point locations can make the difference between a good analysis and a useless one. It is very difficult to check the accuracy of release point locations, but using mapping software overlaid on satellite images can provide some sense of whether the release points are meaningful or not. Coordinates reported to one-ten-thousandth of a degree (four digits after the decimal point) give a precision of approximately 30 feet. Thus, a simple check to see if such values are useful is to examine the number of decimal places included in a given database.

Since a facility's location is not likely to change, the EPA has implemented a procedure in the EIS that allows latitude/longitudes to be locked, meaning that they cannot be changed accidentally during a data exchange with a state. We encourage air agencies to implement a similar approach in their data systems so that the efforts of QA done on one inventory can be inherited by other inventories created by that agency. Locking mechanisms prevent the data from being changed inadvertently through a new data collection that relies on data from an unverified data source. Thus, a comparison of the locations used in the SIP inventory to any locked and verified site coordinates in EIS would also highlight potential errors.

4.9.12 Release Point Parameters

Like release point locations, release point parameters (also called stack parameters) are key elements of inventories that are used primarily in preparation of inventories for air quality modeling. The release point parameters impact the modeling of emissions from facilities because they specify details of the way the emissions are released (e.g., they specify how high off the ground the pollutants are emitted and the exit velocity and temperature of those emissions). One basic and important distinction for release points is whether the release point is a stack or a fugitive type of emissions, and different types of parameters are specified for stacks than for fugitive emissions sources.

Correct release point parameters for stacks are important for modeling done for ozone and PM_{2.5} modeled attainment demonstrations as well as modeling done for Regional Haze SIPs, whereas fugitive release parameters are not as critical for that purpose. This is because stack emissions parameters impact the modeling of plume rise and, therefore, determine how high the emissions rise in the modeled layers of the air quality model. Fugitive emissions are emitted in the modeled surface layer with no additional characterization. This is in contrast to more detailed plant-level modeling (i.e., done for permit modeling or risk modeling purposes), where both stack and fugitive parameters are critical. Because the focus of this document is on SIP purposes, we focus on stack parameters here.

Stack parameters included in the EIS and historically are stack height, stack diameter (at the exit point of the emissions), exit gas velocity, exit gas flow rate, and exit gas temperature. Additionally, a release point type is available in the EIS to specify a code for whether the “stack” has a particular orientation of vertical, horizontal, goose neck, vertical with rain cap, or a downward facing vent. Valid release point codes are available in the EIS reporting code tables in the EIS Gateway.

Quality assurance for stack parameters can be done using several of the QA methods already described. Range checks can be applied; these can be the default EIS range checks (see Section 4.9.3) or range checks developed by an air agency. A more robust range check could be developed for specific types of processes associated with a release point or for specific NAICS codes. For example, one would expect higher stacks for EGUs than for lumber mills. Additionally, ranking techniques can be applied to stack parameters (see Section 4.9.7), including options for grouping ranked stack parameters by facility, unit, process and/or specific types of facilities, units, or processes. This is somewhat complicated by the fact that multiple units or processes can feed a given release point, and when this happens, the predominant unit or process could be used for grouping purposes. Finally, more sophisticated outlier analysis could additionally be used, by finding correlations between stack parameters such as height and diameter and investigating those combinations that statistically fall outside an expected relationship or ratio.

4.9.13 Biogenic QA/QC

Biogenic emissions are somewhat more challenging to QA than emissions for other source categories because they may be generated differently (i.e., as part of a gridded, hourly modeling exercise rather than more basic inventory development techniques). The following list provides some basic checks that can be done as part of the generation of biogenic emissions:

1. Check the biogenic emissions tool logs for warnings/errors.
2. Check the logs to confirm that the expected inputs were used.
3. Compare state or county total emissions to another year or case’s biogenic emission totals.
4. Ensure that summer emissions are greater than winter emissions. This can be done by summing the emissions across the modeled summer days (e.g., May-October) and for the other models and then comparing the totals on a state and/or county basis. As a quick (but less rigorous) check, example summer hourly or daily emissions can be visually compared to example winter hourly or daily emissions using software that displays the gridded emissions.

5. Visually inspect sample days of the gridded, hourly emissions using software that displays the gridded emissions. The VOC emissions should generally be higher in southern latitudes because of warmer temperatures. This difference should be more pronounced in winter in cases where the southern areas have more actively growing vegetation. The NO emission should generally be higher in agricultural areas with significant fertilizer application.

4.9.14 Timing of QA and Follow-up

As air agencies, as well as the EPA Regional offices, work quickly to meet relevant inventory and SIP deadlines, data problems are exacerbated when they are discovered too late in the process. A key part of making sure that a QA plan is effective is deciding (as part of the planning) when a given QA check is to be done and ensuring (as part of implementing that plan) that it is actually done. To do this effectively, QA steps should be timed in a QA plan at the earliest possible time that the step can be performed so that errors are caught as early in the process as possible. Furthermore, assurances must be put in place that someone is confirming that the checks have been done along the way, so that errors are caught. At the end of the data development process, some accounting for the history of the QA should be available along with the data, so that others can confirm that the checks have been done and can be reassured. Where possible, evidence of completion of each QA step should be referenced, such as a comparison report.

5 Developing Projected Emissions Inventories

5.1 Projected Emissions Overview

Emissions estimates for future years²⁴ are called “emissions projections” or “projected emissions.” These projections include emissions growth (due to increased or decreased activities) and emissions controls due to regulations, settlement agreements (or consent decrees), fuel-switches, or other programs that reduce emissions in specific ways in the future. Emissions controls can be either on-the-books or considered as part of a control strategy to reduce emissions as part of SIP planning. For point sources, emissions projections can also include facility and/or unit-level shutdowns due to settlement agreements (or consent decrees) and/or ownership decisions.

The primary goal in making projections is to obtain a reasonable and technically credible estimate of future-year emissions that accounts for key variables. The EPA encourages the air agencies to incorporate in their analyses the variables that have historically been shown to drive their economy and emissions, as well as the changes in growth patterns and regulations that are expected to take place between the time of their base year and projected attainment year. For details on which future year(s) should be modeled for attainment demonstrations, readers should refer to the Modeling Guidance (https://www3.epa.gov/ttn/scram/guidance_sip.htm).

5.1.1 Readily Available Projections Information

The EPA’s latest projection approaches and data are available as a part of the EPA’s “emissions modeling platform” development. These platforms are released and updated periodically in accordance with the EPA regulatory and analysis activity on the Emissions Modeling Clearinghouse at <https://www.epa.gov/air-emissions-modeling>. While each platform comes with a single or limited set of future years included, the data and thoroughly documented approaches can help air agencies to develop and improve their own emissions projections.

Additionally, as part of SIP planning, various situations lead to requirements for states to implement Reasonably Available Control Technology (RACT) and Best Available Control Technology (BACT) as part of their attainment planning. The emissions reductions expected based on these programs would need to be include in emissions projections used for modeled attainment demonstrations and other projected emissions such as the projected attainment inventory for the nonattainment area (see also Section 3.8.1).

5.1.2 Background Materials

For point sources, Volume II “Point Sources” of the EIIP series includes Chapter 12 “[How to Incorporate the Effects of Air Pollution Control Device Efficiencies and Malfunctions into Emission Inventory Estimates](#)” was published in 2000 and still provides the authoritative information related to point source projections. In particular, Appendix A “Clearing Up the Rule Effectiveness Confusion” and Appendix B

²⁴ Technically, projected emissions could be made from a base year to a year that has already occurred when data are not yet available for a very recent year. However, for the purposes of the remainder of this guidance, we will assume projected emissions refers to future year projected emissions.

“Emission Inventories and Proper Uses of Rule Effectiveness” provide a thorough discussion of rule effectiveness that is relevant for current emissions projections.

In addition, the 1999 EIIP report entitled “Procedures for Preparing Emissions Projections” (<https://www.epa.gov/air-emissions-inventories/volume-10-emissions-projections-final-report>) introduces the basic concepts behind emissions projections issues and approaches. The concepts of control efficiency, capture efficiency, rule effectiveness, and rule penetration are introduced in Section 2.5.18. The EIIP document provides information on how to use these factors to estimate projected emissions. However, some key features of this document need to be updated, including the reference to the Economic Growth and Analysis System, which is no longer supported by the EPA. Other outdated concepts include the assumption that economic growth can be a good indicator of emissions growth. While some correlation can exist, it cannot be assumed but rather must be demonstrated for a particular industry or facility. The correlation has not been well observed historically in the NEI data because of various issues including technology improvements and fuel-switching that often reduce emissions without regulation.

In this section, we will address an overall approach for tackling emissions projection issues that incorporates use of this document and points out where other approaches or new data are available to amend the information included in that report.

Some general aspects of the EIIP projections document that are now out of date are as follows.

- The latest SCC codes are available as described in Section 2.5.14.
- The AP-42 emission factor website is now <https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors>.
- The reference in the Table 2.1-1 web link is no longer applicable. Instead, the following information can be used to help provide similar information:
 - Energy consumption by industry report, 2002:
<http://www.eia.doe.gov/oiaf/analysispaper/industry/consumption.html>
 - Annual Energy outlook report, early release 2014:
<http://www.eia.gov/forecasts/aeo/er/index.cfm>
- The references in Table 2.1-2 are also out of date and should be updated as follows:
 - U.S. EPA Emissions trends reports. These reports can be used to provide the historical trends of emissions sectors based on the NEI: <https://www.epa.gov/air-trends>
 - Integrated Planning Model: See reference provided above in Section 1.2
 - Multiple Projections System - is no longer in use
 - California Emission Forecasting System:
<http://www.arb.ca.gov/ei/drei/maintain/database.htm>

The EPA recommends that developers of projected emissions take the steps in the bulleted list below. Each of these steps corresponds to a subsequent subsection.

- Identify sectors of the inventory that require projections and sectors for which projections are not advisable, and prioritize these sectors based on their expected impact on the modeling region (Section 5.2).
- Collect the available data and models that can be used to project emissions for each of the sectors (Section 5.3).
- For key sectors, determine what information will impact the projection results the most, and ensure that the data values reflect conditions or expectations of the inventory region (Section 5.4).
- Quality assurance (Section 5.5)

5.2 Identify and Prioritize Key Sectors and Regions for Projections

Emissions data developers should evaluate their inventories for those sectors and regions that are most critical to their modeling results. The purpose of identifying these key sectors is to direct more resources and efforts to estimating future-year emissions for these sectors in the subsequent steps.

Sectors can be subsets of the larger groups of stationary area, on-road mobile, nonroad mobile, and point sources. For ozone modeling, it will be most important to ensure correct projections for sectors with higher NO_x emissions. In larger urban areas that contain VOC-limited regions, sectors with higher VOC emissions will also be important. Mobile sources are typically large contributors to both VOC and NO_x; therefore, they are usually a priority in estimation of future-year emissions, particularly for urban areas. For PM and regional haze modeling, the relative importance of primary PM_{2.5} emissions and its precursors will depend on the area of the country. Primary PM_{2.5} emissions may be important in urban areas or areas heavily influenced by local sources such as residential wood combustion or industrial facilities. In the East, SO₂ emissions may be of primary importance. For PM_{2.5} planning, NO_x, VOC, and NH₃ will vary in importance depending on the particular situation, which needs to be assessed as part of the SIP planning process.

Emissions data developers should consider the proximity of the emissions and the expectation of long-range transport when reviewing projection assumptions. Those emissions that have an impact on the nonattainment status (whether transported from outside areas or locally generated) should be given highest priority in evaluating the projection assumptions. For example, less priority can be given to emissions from distant states and/or for pollutants that do not transport from those states to the NAA.

In some cases, there are sectors that are very difficult or highly uncertain to project into the future. Wildfire emissions is a common example of such a sector, since models are not readily available that estimate the magnitude and location of future-year emissions. In these cases, it is reasonable to create an “average year” inventory and temporal distribution of the emissions. Other approaches to future-year fire emissions include holding the emissions constant at the same levels as included in the base year.

5.3 Collect Available Data and Models for Each Sector Needing Projections

For each sector needing projections (and in particular for the priority sectors), air agency staff should collect and review growth and control information. The sources of such information depend upon the

sector of interest. Some data resources and approaches are available and provided here, and new data and approaches will become available subsequent to the publication of this document. The information provided here is a snapshot of information that will grow and adapt over time, and emissions modelers should seek out such new information as part of this step.

Emissions modelers can rely on available default data for sectors and regions with lower priority for consideration (as described in the previous section). For sectors and regions that are important to modeling the NAA, emissions modelers should spend additional effort obtaining improved information from other modeling applications (such as modeling done by RPOs or other states) or developing the improved information themselves.

As mentioned previously, the EPA provides control assumptions with its modeling data used for promulgating air quality rules and impact assessments. The EPA approaches typically include the impacts of federal rules that have been finalized. Impacts of proposed rules are rarely included, as the changes in emissions impacts can be very large between the proposed and final rules. These data are posted at the [Emissions Modeling Clearinghouse](#). Sometimes, more current information is available than what is available from the EPA, for example, when reconsideration amendments are developed and finalized after the EPA has publicly released its projected inventories. In the subsequent subsections, we focus on sources of growth information.

5.3.1 Electric Generating Units

This section conveys the general principles and key criteria that inform development and review of EGU emission projections in support of CAA-related state regulatory actions (such as SIPs) subject to EPA approval. The section includes technical information related to EGU emission inventories, key modeling/projection input assumptions, appropriate data sources, and general methodological criteria to be used by states and EPA Regional offices.

This guidance does not recommend or restrict the use of any specific tool to generate credible projections of EGU emissions. It explains a process for documenting credible data and input assumptions with accompanying justifications; describes how to demonstrate a reasonable relationship between inputs and outputs for a given application; and identifies relevant resources that should be taken into consideration. Therefore, this section is not intended to be an exhaustive representation or study of models and specific approaches. Rather, this document is intended to provide the user guidance in choosing an appropriate approach. Many factors contribute to the selection of the adequate and appropriate EGU projection approach to use in a specific application. The user is encouraged to consider different approaches appropriate for each application, taking into consideration the type of input data available, the level of detail needed to meet the end goal of the application.

Emission projections for EGUs do not tend to follow a simple growth path from historical emission data. The composition and behavior of the generating fleet, and resulting power sector emission patterns across facilities, states, and regions, vary substantially over time based on changing economic conditions as well as changes in fuel markets and regulatory requirements. Therefore, evaluating the credibility of power sector emission projections necessitates evaluating the reasonableness of several key projection

elements or assumptions, while keeping in mind that appropriateness of the method also depends on the span of future year(s) being projected (the “modeling horizon”). These projection elements include:

1. Electricity demand, taking into account the on-the-books energy efficiency programs and policies directly influencing demand growth over the modeling horizon
2. The composition of the future generating fleet; if the future year(s) provides enough lead time, consideration of economic entry (new facility construction) and exit (existing facility retirement) that would change the composition of the fleet.
3. Generation pattern across facilities that is consistent with economic factors, power system operability, reliability, and environmental regulatory constraints
4. Potential emissions at each generator, taking into account pollution content of available fuels as well as the ability of control equipment or processes to capture that pollution

State, tribal and local agencies have the choice to independently develop power sector emission projections or to use emissions projections from other entities (federal or regional bodies, including RTOs and ISOs). If a state, tribal or local agency chooses to develop independent projections (or to derive such projections from other available forecasts), data sources should be referenced and clear justification should be stated for the projection methodology, including a clear demonstration of the relationship between demand, cost, generation capacity and emissions. Documentation supporting any set of power sector emission projections should include:

1. Inventory of all sources of generation accounted for in the projections, including but not limited to all individual emitting EGUs.
2. Information regarding electricity demand for the future year:
 - a. The demand forecast for EGU projections should be referenced and documented (potential sources include AEO, NERC, regional transmission organizations, independent system operators, state energy offices or public utility commissions, and regional councils that develop energy planning).
 - b. Identify the energy efficiency (EE) programs and/or policies explicitly included in the demand forecast. This clarifies which EE programs or policies are influencing the growth rate assumptions. (For example, AEO explicitly includes federal appliance standards, lighting efficiency standards, building energy codes and other federal energy efficiency programs).²⁵
3. A detailed profile of future capacity, including:
 - a. Projected changes to the operable fleet, such as retired capacity, new capacity (including renewable sources such as wind, solar, geothermal, and hydro), changes to capacity type (e.g., refueling), and pollution control retrofits.

²⁵ Refer to the EPA’s Resource for States on estimating EE/RE relative to EIA’s Annual Energy Outlook for SIPs located in Section 5.3.1.2 of this document for more information.

- b. Physical characteristics of the operable fleet, including capacity, fuel type, heat rate, renewable energy capacity factor and pollution controls (i.e., list of emissions controls and their associated removal efficiencies for pollutants of concern).
4. A detailed unit-level profile of projected power system operation, including generation, fuel type and use, pollution control configuration, and emissions.
5. A detailed list of all constraints (with corresponding future compliance dates) that apply to reduce emissions at one or more sources, such as:
 - a. Federal, state and local rules
 - b. NSR settlements
 - c. Consent decrees
 - d. Rate or permit requirements
 - e. All other on-the-books regulatory requirements
6. Representations of the following, or if not directly factored in, reasoning and methodology explaining how these elements are accounted for indirectly:
 - a. Fuel supplies and/or prices
 - b. Generator availability constraints
 - c. Minimum generation requirements (such as qualifying renewable energy (RE) generation to meet RPS targets)
 - d. Cost and performance characteristics of existing and potential new generation and pollution control technology options
 - e. Transmission, reserve margin, and other system operating constraints
7. Any other information used in and/or relevant to the projections, such as: considerations for appropriate time horizon, appropriate geographic coverage, internally consistent assumptions, and preventing double-counting of emissions sources between EGUs and other categories²⁶.

²⁶ To prevent double-counting of emissions sources between EGUs and other categories, emissions developers should be careful to match the sources of emissions from external models with the base year emissions sources. This helps to ensure that the EGU part of the point source inventory is separated from the non-EGU part based on the facilities included in the future-year EGU model. For any projection approaches that use the National Electric Energy Data System (NEEDS) as an EGU source inventory, the NEEDS records should be compared to the base year point inventory using the ORIS Plant ID field from both. In some cases (e.g., co-generation facilities), only some of the units at the facilities are included in NEEDS; therefore, the separation of EGUs from non-EGUs should be done at the unit level, not by facility. One resource for this information is also in the NEI, which contains a field that indicates whether the units are NEEDS units or not.

Electric generating unit projections for different purposes (such as attainment demonstrations, maintenance plans, and reasonable further progress plans), as well as varying factors such as pollutants, geographic areas, and/or how far the projection period is into the future, may prompt adaptation of different approaches.

Some approaches use computational algorithmic models that determine dispatch based on economic assumptions while obeying physical constraints of generators within the selected universe of EGUs. Examples of typical constraints may include, but are not limited to, ramp rates, outage schedules, transmission limits, system reserve margin limits, and emission limitations.

Other approaches follow a user-prescribed set of rules and relationships to simulate the behavior of EGUs based on electricity demand trends, historical electricity production trends and data from other forecasting models. Analysts may also consider combining elements of or outputs from different projection approaches so long as the resulting set of emission projections across EGUs respects reasonable systemic limitations, such as maintaining the expected net energy needed for load in a given region.

States should provide information to EPA that documents the methodology and how the chosen projection approach adequately addresses the analytic drivers described above, in the context of the associated regulatory action and with the timeframe of the projections taken into account. For example, the state should explain how its projections are consistent with expected changes in economic and regulatory drivers over the timeframe of the analysis that would affect fleet composition as well as patterns of generation and associated emissions across the fleet composition as well as patterns of generation and associated emissions across the fleet.

A state may also consider whether limited modifications to other EGU projections (such as those provided by EPA, EIA, or ISO/RTOs) may reasonably address the analytic drivers described above. Such an approach should include documentation of where and how the modified set of EGU projections differs from the unmodified (original) set of projections, and why it is appropriate for the given regulatory action or future scenario to make such modifications without conducting a more thorough or complete analysis.

5.3.1.1 Examples of Existing EGU Projection Tools

There are specific tools and approaches available that can be used in ways that meet the general principles and key criteria explained in Section 5.3.1. Mention of specific tools in this guidance should not be taken as an endorsement or guarantee that any set of projections from any such tool will necessarily meet the criteria described in this guidance that EPA will use to evaluate EGU emissions projections, as any tool or model may be used appropriately or inappropriately for a given application. Examples of EGU projection tools include.

The ERTAC EGU Growth Tool is an open-source tool developed by the ERTAC (Eastern Regional Technical Advisory Committee) group of state and regional associations that benefits from an in-depth collaboration among a large multi-state region. More information on this tool is available on the ERTAC

EGU website (<http://www.marama.org/2013-ertac-egu-forecasting-tool-documentation>), including sample files and documentation.

RFF's Haiku Model is a simulation of regional electricity markets and interregional electricity trade in the continental United States. The model accounts for capacity planning, investment, and retirement over a multi-year horizon and for system operation over seasons of the year and times of day. The model identifies least-cost compliance strategies for compliance with various types of regulations of air pollutants. Documentation of this model can be found at <http://www.rff.org/research/publications/haiku-documentation-rff-s-electricity-market-model-version-20>

The Integrated Planning Model (IPM) is a multi-regional, dynamic, deterministic linear programming model of the U.S. electric power sector. It provides forecasts of least cost capacity expansion, electricity dispatch, and emission control strategies while meeting energy demand and environmental, transmission, dispatch, and reliability constraints. The IPM can be used to evaluate the cost and emissions impacts of proposed policies to limit emissions of SO₂, NO_x, carbon dioxide (CO₂), mercury (Hg), and HCl from the electric power sector. More information on IPM is available at the Power Sector Modeling EPA website (<https://www.epa.gov/airmarkets/power-sector-modeling>).

The Market Allocation (MARKAL) model is a data-driven energy system model. NE-MARKAL is a state-based and regionally specific version of MARKAL. NE-MARKAL represents each Northeast jurisdiction and can examine the criteria air pollutant outcomes with plant-specific detail from various technology options and overall system constraints. More information is available at: <http://www.nescaum.org/topics/ne-markal-model>.

The National Energy Modeling System (NEMS) was developed by the EIA and it is used to produce Annual Energy Outlook (AEO) projections of energy supply, demand and prices, as well as environmental regulatory constraints and known future pollution control installations to create future year NO_x, SO₂ and heat input estimates. More information on NEMS can be found at https://www.eia.gov/forecasts/aeo/info_nems_archive.cfm.

The Regional Energy Deployment System (ReEDS), developed by National Renewable Energy Labs (NREL) is a long-term capacity-expansion model for the deployment of electric power generation technologies and transmission infrastructure throughout the contiguous United States. More information on ReEDS can be found at <http://www.nrel.gov/analysis/reeds>.

The US Regional Economy, Greenhouse Gas, and Energy Model (US-REGEN) is a model developed by the Electric Power Research Institute. It combines a detailed dispatch and capacity expansion model of the United States electric sector with a high-level dynamic computable general equilibrium (CGE) model of the United States economy, including sectoral detail in electric power production, energy demand, and transportation. The US-REGEN is capable of modeling a wide range of environmental and energy policies in both the electric and non-electric sectors. More information can be found at <http://eea.epri.com/models.html>.

A variety of proprietary load forecast optimization models are utilized by ISO's and system operators to assess and control more limited and shorter term wholesale power flows across the grid. These tools can provide very useful feedback to forecasts derived from more planning focused tools but may require supplemental information to reflect the scale of geographies required for air quality inventory forecasts.

5.3.1.2 Existing Material for More Information

The resources listed in this section can provide additional information that may be helpful for EGU emissions projections.

Guidance for 1-Hour SO₂ Nonattainment Area SIP Submissions. This document describes non-binding recommendations on a wide range of issues that are likely to arise as state, local and tribal governments develop nonattainment SIPs for the 1-hour SO₂ NAAQS. This document is available at <https://www.epa.gov/so2-pollution/guidance-1-hour-sulfur-dioxide-so2-nonattainment-area-state-implementation-plans-sip>.

Roadmap for Incorporating Energy Efficiency and Renewable Energy in SIPs/TIPs. This document provides a roadmap to assist state, tribal and local agencies with accounting for and incorporating energy efficiency (EE) and RE policies and programs in SIPs and TIPs. The roadmap accomplishes this task by clarifying guidance the EPA issued in 2004 on incorporating EE/RE policies and programs into SIPs, as well as related guidance EPA issued in 2004 and in 2005. This document is available at <https://www.epa.gov/energy-efficiency-and-renewable-energy-sips-and-tips/energy-efficiencyrenewable-energy-roadmap>.

Resource for States on estimating EE/RE relative to EIA's Annual Energy Outlook for SIPs. This document helps states identify their on-the-books energy efficiency and renewable energy policies and estimate the incremental electricity savings of these policies; develop a methodology for projecting a jurisdiction's energy demand both with and without the incremental electricity savings; and estimate the change in power sector emissions attributable to the incremental electricity savings. For more information visit: https://www.epa.gov/sites/production/files/2015-08/documents/including_ee_and_re_policies_in_ed_projections_03302015_final_508.pdf.

Assessing the Multiple Benefits of Clean Energy Programs: A Resource for States. This document helps state energy, environmental, and economic policy makers identify the spectrum of EGU projection tools and methodologies to quantify the energy, environmental (specifically greenhouse gas, criteria air pollutants, and health), and economic benefits of clean energy. This document is available at <https://www.epa.gov/statelocalclimate/assessing-multiple-benefits-clean-energy-resource-states>.

EPA's AVERT (AVoided Emissions geneRation Tool). This tool estimates the NO_x, SO₂ and CO₂ EGU emissions from implementing EE/RE programs and policies. This tool can estimate the EGU emission impacts at the EGU, county, state and regional levels in the short-term future (1-5 years). Outputs from AVERT are compatible with the SMOKE interface. For more information, visit: <https://www.epa.gov/avert>.

TSD for Incorporating RE and Demand-Side EE Impacts into State Plan Demonstrations for the Clean Power Plan (CPP). This technical support document describes various quantitative approaches for projecting the future year direct energy impacts (MWhs) of energy efficiency and renewable energy programs and policies. This document is available at <https://www.epa.gov/sites/production/files/2015-11/documents/tsd-cpp-incorporating-re-ee.pdf>

5.3.2 Non-EGU Stationary Sources

Non-EGU stationary sources include both the point and nonpoint sources, but the methods for projecting them to the future can rely on many of the same sources of information.

Since 2006 (EPA, 2006a), the EPA has been assuming that emissions growth does not track with economic growth for many stationary sources (both point and nonpoint). This “no-growth” assumption is based on an examination of historical emissions and economic data. Emissions (as of 2005) had declined for several years and those reductions could not be directly attributed to specific control programs despite increasing economic-based growth factors for many metrics over the same time period. While the EPA continues to work toward improving the projection approach in its own work, we are still using this no-growth assumption for many emissions sectors. Of course, where air agencies have better data about the expected growth in emissions or the possibility of sources reaching their permit limits, that information should be included in developing more refined emissions projections.

The EPA creates and uses data that quantify assumed base year growth (projections), controls, settlement agreements (or consent decrees), and other unit and facility-specific information on non-EGU point and stationary area sources. These are included in the most recent emissions platform Technical Support Document (TSD) available at the Emissions Modeling Clearinghouse. The TSDs include the methodologies and background information for projecting sources such as Portland cement, refineries, oil and gas, industrial/commercial/institutional boilers, residential wood combustion, agricultural sources, fuel sulfur rules, corn and cellulosic ethanol and biodiesel plants, and several other categories. The data sources include national sources with regional and state-specific information as well as projection information provided by regional modeling centers and states and local air agencies.

In addition, the EPA encourages air agencies to consider the latest settlement agreements and consent decrees that are updated periodically by the EPA’s Office of Enforcement and Compliance Assurance (OECA) at: <https://www.epa.gov/enforcement/air-enforcement>.

The additional resources described in Section 5.3.6 are also used by the EPA to develop projections used in its modeling platforms. These same resources are available to state, local, and tribal agencies to develop their own projection methods for non-EGU stationary sources.

Finally, for nonpoint sources, Section 3 of the EIIP projections document provides additional details about projecting nonpoint-source. However, several of the references or statements in that document are now out of date, as follows.

- The web sites for SCCs, AP-42 emission factors, and more information about area-source inventories are out of date. These should be updated to the same sites as were listed in the

point sources section above. Furthermore, this guidance includes more updated information than the EIIP report referenced.

- The ASEM model mentioned in Section 3.2 of the EIIP projection document was not completed and is not available.
- The references in Table 3.1-2 are out of date and should be updated as follows:
 - U.S. EPA Emissions trends reports. These reports can be used to provide the historical trends of emissions sectors based on the National Emissions inventory:
<https://www.epa.gov/air-trends/>.
 - Multiple Projections System is no longer in use
 - California Emission Forecasting System: this system is no longer available. Interested parties should contact California Air Resources Board for more information on their latest emissions projection approaches.

The tools and data sources described in Section 5.3.6 below should also be considered for use for projection of point and nonpoint stationary source emissions.

5.3.3 On-Road Mobile Sources

As described in Section 4.8.3, for all states but California, on-road mobile emissions should be estimated with the latest EPA on-road mobile model, MOVES, following the EPA's latest guidance available at [the MOVES website](#). For California, the latest EPA-approved version of EMFAC should be used.

Emissions preparation with MOVES for projected emissions is much like preparation for a base year. MOVES includes assumptions about emissions reductions associated with national emissions programs including the effects of national vehicle and fuel standards. Some MOVES inputs, such as meteorology, should be the same as for the base year inventory. Others, such as VMT and vehicle population should be grown/reduced to reflect expected changes in population and activity. MOVES default estimates for future VMT and vehicle population are based on national growth rates and should not be used for SIP inventory purposes because growth rates vary substantially from county to county.

Because of the change to the using the MOVES model and the newer guidance provided on the OTAQ websites, the EIIP projections document is no longer relevant for on-road mobile sources.

5.3.4 Nonroad Mobile Equipment

Section 5 of the EIIP projections document provides details about projecting nonroad mobile sources. While some information is still valid, several of the references or statements in that document are now out of date, as follows.

- The name "Office of Mobile Sources" has changed to "OTAQ" and it has [a new primary website](#).
- The EPA's NONROAD model has been incorporated into the MOVES model and should no longer be used for new SIP development.
- According to a California Air Resources Board website, category-specific inventory models and methods have replaced most uses of California's OFFROAD model. The information on California's nonroad emissions is available at [a different website URL](#). A link to the

OFFROAD2007 model is also available from this page to be used for categories not listed on that page.

MOVES includes assumptions about emissions reductions associated with nonroad source national emissions programs. MOVES also includes assumptions about national growth in nonroad activity and equipment population. Local estimates of future activity and equipment populations should be substituted for the national estimates when possible.

5.3.5 Other Nonroad Mobile Sources

Aircraft, locomotives, and CMV sources of emissions do not have a specific model designed for projections, and so additional effort is needed for these three inventory components.

For aircraft emissions, FAA data can be used to estimate growth for aircraft emissions. The FAA provides summary historical and forecast statistics on passenger demand and aviation activity at U.S. airports. The summary level forecasts are based on individual airport projections. The Terminal Area Forecast (TAF) includes forecasts for active airports in the National Plan of Integrated Airport Systems (NPIAS). The TAF system can be accessed at the [FAA's TAF query page](#). The TAF system allows users to create their own forecast scenarios. The TAF database, which contains a query data application, allows the public to access and print historical and forecast (up to 2040) aviation activity data by individual airport, state or FAA region. Air agencies can use this information to adjust their base year emissions based on projected airport activity.

For locomotives and marine vessel emissions, the best source of data on the impact of national rules from OTAQ is the websites provided for each of the rules and their associated *Federal Register* notices. As described for the base year emissions in Section 4.8.5, the locomotive marine rule information is included at the [EPA website for that regulation](#). For CMV sources, Table 20 (from the base year emissions section) provides a good list of individual rules and references. Since each rule is different, there is no single guidance that can be made about how these should be incorporated. However, the EPA incorporates these data into their modeling platforms, and the most recent projection methodologies are documented in the TSDs included with the modeling platforms on the Emissions Modeling Clearinghouse at <https://www.epa.gov/air-emissions-modeling>.

Additionally for C3 vessels, emissions data are available from an [Emissions Control Area-International Maritime Organization \(ECA-IMO\) collaboration](#). These emissions are available at a fine-grid resolution and are subject to various engine and fuel standards in the future. Like base year emissions, air agencies should consider the state versus federal waters when deciding what parts of the ECA-IMO data to use (see Section 4.8.5.2). Growth/control factors have been developed for this C3 CMV inventory, and the EPA is using them for future year C3 CMV inventory development. New approaches are likely to develop over time, so air agency staff should consult the web pages listed here for the latest available information. The latest EPA modeling platform projection methodology for C3 marine emissions is also available in the latest emissions modeling platform TSD at the Emissions Modeling Clearinghouse mentioned previously.

5.3.6 Other Projection Resources

In addition to sector-specific resources, there are other sources of information that projection developers can use for more than a single sector as information to help determine the most applicable growth rates for the modeling region. These include the Bureau of Labor Statistics “Employment Outlook,” Census Bureau data, Trade Organizations and individual facilities, and the Chemical Economics Handbook. The following paragraphs provide a brief description and additional references for each of the sources of data just listed.

Sources for EPA nonpoint methods

As described in Section 4.8.2, the EPA develops methods for numerous nonpoint methods. Each of these methods depends on some surrogate activity. Many of these activity sources come from USDA, DOE, U.S. Census Bureau, and Department of Labor databases available online. Appendix B provides a list of nonpoint sectors and associated activity reports and websites. These data do not include future-year projections, but may include newer information than were used for estimating the base year information. As such, these data can help with understanding the possible changes in activity (and perhaps emissions) from the date of the underlying base year activity data to the present day. It should be noted that emissions for 1 year (e.g., 2011) may be estimated using activity data from a prior year (e.g., 2009) because of timing needed for preparing the data does not match with the timing of the release of the underlying data. When emissions are estimated using data earlier than the emissions base year, it further strengthens the benefit of newer activity data. Furthermore, these datasets often include historical trends, which could be of use in understanding what may happen in the future.

Since the base year emissions for nonpoint methods are calculated based on direct activity indicators such as population, fuel consumption, employment, and VMT, projections of these direct activity indicators may also be used to estimate future emissions. Population is related to sectors such as consumer products, architectural coatings, portable fuel containers, and commercial cooking. VMT also plays a major role in calculation of paved road emissions. Growth projections for population and fuel consumption are readily available from the U.S. Census and the DOE’s Annual Energy Outlook (see below). VMT projections are provided periodically as part of the EPA emissions modeling platforms and may be available in some states from other sources. Employment projections may also be available in some states and could be used for industrial categories where the state believes that employment is an appropriate surrogate for facility activity and therefore emissions growth or retraction.

MARKAL

The MARKAL model is a public sector, data-driven, energy-system optimization model. A user inputs the structure of the energy system to be modeled and data to characterize each of the technologies and resources included in the model run. MARKAL calculates the least cost set of technologies over time to satisfy specific demands, using linear and mixed-integer linear programming techniques. Outputs of the model include the technological mix at intervals in the future, energy demand, and estimates of criteria and GHG emissions, among others. The DOE uses MARKAL for its System for the Analysis of Global Energy Markets (SAGE) model. SAGE is used to produce EIA’s annual International Energy Outlook.

The EPA has applied MARKAL for technology and emissions evaluations, which required the development of the EPA MARKAL technology database (EPANMD). This technology-rich database represents the major sectors in the U.S. energy system, including the commercial, industrial, residential, transportation, and electricity generation sectors. The DOE's AEO and the NEMS were used to construct the energy supply, demand, and technology characterizations. Data for technologies not represented in the AEO and NEMS were derived from other widely recognized authoritative sources (e.g., Electric Power Research Institute's Technical Assessment Guide and DOE's Office of Transportation Technology's Quality Metrics report). More information on the EPA's use of MARKAL and the EPANMD can be found on the website for "[EPAUS9R - An Energy Systems Database for use with the Market Allocation \(MARKAL\) Model](#)" and EPA report number NRMRL-RTP-375 (EPA, 2006b).

Control Strategy Tool (CoST)

The purpose of CoST is to estimate the emission reductions and engineering costs associated with control strategies applied to point, nonpoint, and mobile sources of air pollutant emissions to support the analyses of air pollution policies and regulations. Control strategy results can be exported to CSV files or viewed in a graphical table that supports sorting, filtering, and plotting. The results can also be merged with the original inventory to create controlled emissions inventories that can be exported to files that can be input to the emissions model SMOKE. CoST allows for user-supplied control measures data, provides tracking of analyses and outputs, and supports built-in QA.

The Control Measure dataset focuses on criteria pollutants and their precursors, and it includes primary control efficiencies, co-pollutant control efficiencies, and control costs. The data also includes an extensive set of mobile source control measures. More information on the Control Measure dataset and CoST is available at <https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-analysis-modelstools-air-pollution>.

Annual Energy Outlook

The EIA's AEO forecast data was a primary input for the final version of EGAS. However, with EGAS no longer being supported by the EPA, the latest versions of the AEO are the best available source of socioeconomic forecast data for many industrial sectors. The latest AEO data are available at: <http://www.eia.gov/forecasts/aeo/er/index.cfm>.

Census Bureau

The U.S. Census Bureau provides data on total employees, total payroll, number of establishments, and value of shipments by NAICS code (2 digit - 6 digit) for specific years. This database is ideal for examining changes in the number of establishments between the two latest available years and also for historical changes. Therefore, the actual census data are useful primarily to evaluate emissions changes from the base year to the present (or most recently available year) and comparing to the data included in the AEO. The census data are available at <http://www.census.gov/2010census/data/>.

In addition, the Census Bureau projects future population, which is available at <http://www.census.gov/population/projections/>. This information can be used to help project nonpoint emissions categories that include population as an activity input for the base year emissions.

Trade Organizations and Individual Facilities

Trade organizations can also be a helpful resource because they often have projections for future-year growth of their industry and may be aware of pending facility closures or new facility construction. This resource is most relevant for large industrial sources that usually are included in point source inventories. In addition, emissions modelers should consider contacting large sources of emissions in their modeling region for their expectations of emissions growth or reduction. In many cases, large industries may be willing to provide such information when presented with what will be used if no additional information can be provided. Additional information may be found in permit applications for future development or controls at individual facilities. Except in the case of permit applications, emissions projections developers should be aware of possible conflicts of interest for this source of information. For example, industry groups or facilities may have an incentive to under-represent future-year emissions in hopes of avoiding additional requirements for reducing emissions. However, many industrial representations have been valuable stakeholders who are interested in providing accurate information.

Chemical Economics Handbook

The Chemical Economics Handbook, produced by SRI Consulting (a part of IHS, Inc.²⁷), is a series of reports on prices, production and consumption of hundreds of chemical industry products and commodities. Past and current information on chemical products and commodities is available, and projections of future prices, production and consumption are often available. Reports on specific industries are also available. Reports at an industry level can often be used to verify the efficacy of future industry modeling results. Each report is updated every 3 years. Projections, some up to 5 years from the current day, are often prepared using proprietary methods. Reports are available by subscription, and can be obtained as hard copy, CD, or at <http://www.sriconsulting.com/CEH/Public/index.html>.

5.4 Evaluate and Refine Data for Projections in Inventory Region

For key sectors, emissions projections developers should determine what information will impact the projection results the most, and ensure that the data values reflect conditions or expectations of the modeling region. The key information is identified based on a combination of base-year emissions data and growth and control rates. An iterative process is helpful to complete this step, as follows:

1. Estimate future-year emissions by combining the base-year emissions with the projection information (as described in the EIIP document referenced in Section 5.1).

²⁷ A number of other industry reports appears to be available from the IHS home page from the “Industries” tab. Some of these websites appear to have databases available for a fee, but they have yet not been assessed by EPA for applicability to emissions projections.

2. Review future-year emissions data to identify large sectors of key pollutants (e.g. NO_x, SO₂, PM_{2.5}, NH₃ and VOC). Emissions summaries by state/SCC or state/NAICS for point sources can be helpful for this step to consolidate the data to review.
3. For the largest future-year emissions sectors, review the growth and control assumptions, compare among all available data sources, and/or collect additional information to refine the assumptions. A representative growth rate should be identified from the available data sources and all information known about the sources and sectors. Stakeholder review of the data can be helpful during this step; for example, an industrial facility with large projected emissions may be able to review the data and provide additional information (e.g., expected capacities, fuels or controls) for a more informed future-year emissions estimate.
4. Additionally, data developers should also compare the future-year emissions to base-year emissions, and if economic-based growth is used, to identify overall growth rates for industrial sectors and scrutinize excessively high growth rates, especially when associated with significant emissions.
5. Using the new information, repeat step 1 and continue these steps until a satisfactory future-year projection across the entire inventory has been completed.

Emissions models (e.g., CoST, SMOKE, MOVES, IPM, etc.) provide the capability to create future-year inventories using base year inventories and projection information. Emissions modelers will need to convert the projected emissions data into specific formats for input to these models. Prior to starting this step, data developers should determine which emissions model will be used to perform the calculations and make sure that the type of information needed by the model is being collected.

5.5 QA for Projected Inventories

As mentioned in the previous subsection, final review of the inventories is an iterative process. During each iteration, adaptations of the methods described in Section 4.9 can be used for QA of projected emissions inventories. The following list gives examples of some of the ways of the methods for base year inventories can be adapted for projected emissions inventories.

- The same checks used for finding structure errors for base year emissions should be used for ensuring the projected inventories use the correct structures. The EIS checks are less relevant since projected emissions are more likely to be in a modeling format (since they are used for modeling) than are base year inventories. Even so, data developers should make sure that data structure or formatting problems do not lead to incorrect emissions data being used in planning inventories or modeling.
- Like base year inventories, data codes should be compared to lists of valid codes. It is just as important to have future-year SCCs be valid as it is for base year SCCs.
- Ranking techniques can be used to identify facilities, units, and processes that have been grown to unrealistic values. Ranking sources by emissions values can identify any that rise to the top of the list of largest sources without a good reason why. Ranking techniques can also be used for projected nonpoint emissions data.

- Inventory comparisons can be made between projected and base year inventories to help make sure:
 - Location information is consistent between base and future year (needed for modeling only).
 - Release point parameters are consistent between base and future year. Where controls have been added, one may expect that the release point parameters could change, for example, with higher stacks or lower exit gas temperatures (needed primarily for modeling).
 - Emissions increases and decreases at the facility, unit, and process level are consistent with what is expected.
 - Emissions increases and decreases at the county and county/SCC levels are consistent with what is expected. If certain sectors are being held constant (i.e., no better data/approaches are available), then data developers can confirm that these sectors did not change emissions.

6 References

- Allen, D. J., Pickering, K. E., Pinder, R. W., Henderson, B. H., Appel, K. W., and Prados, A.: Impact of lightning-NO on Eastern United States photochemistry during the summer of 2006 as determined using the CMAQ model, *Atmos. Chem. Phys. Discuss.*, 11, 17699-17757, doi:10.5194/acpd-11-17699-2011, 2011.
- Appel, K. W., Foley, K. M., Bash, J. O., Pinder, R. W., Dennis, R. L., Allen, D. J., and Pickering, K.: A multi-resolution assessment of the Community Multiscale Air Quality (CMAQ) Model v4.7 wet deposition estimates for 2002–2006, *Geosci. Model Dev. Discuss.*, 3, 2315-2360, doi:10.5194/gmdd-3-2315-2010, 2010.
- EPA, 2006a. Regulatory Impact Analyses, 2006 National Ambient Air Quality Standards for Particle Pollution. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, October, 2006. Docket # EPA-HQ-OAR-2001-0017, # EPAHQ-OAR-2006-0834. Appendix D: <http://www.epa.gov/ttn/ecas/regdata/RIAs/Appendix%20D--Inventory.pdf>.
- EPA, 2006b. Shay, C. L., S. Yeh, J. Decarolis, D. H. Loughlin, C. L. Gage, And E. Wright. EPA U.S. National MARKAL Database: Database Documentation. U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-06/057, 2006.
- Fu, J.S., Dong, X., Huang, K., Tong, D., and Zhuang, G.: Model development of dust emission and heterogeneous chemistry within the Community Multiscale Air Quality modeling system and its application over East Asia, *Atmospheric Chemistry and Physics*, 16, 8157-8180, 2016.
- Reid, S.B., Technical Memorandum, Sonoma Technology, Inc., Preparation of Version 2 of the Wildland Fire Emissions Inventory for 2011, April 26, 2013.

Appendix A

Emissions Inventory System - Quick Reference

How to Create County and Facility NO_x and VOC Summaries for Select Counties

For access to the Emissions Inventory System (EIS), refer to
<https://www.epa.gov/air-emissions-inventories/emission-inventory-system-eis-gateway> .

See also Online EIS training "Reports – May 2012" at
<https://www.epa.gov/air-emissions-inventories/emission-inventory-training>

Create a summary of NO_x and VOC emissions BY SECTOR and COUNTY for a group of counties

1. Select "Request Reports" from the left hand sidebar on the EIS Gateway.
2. Under the Emissions Summaries heading, select "By Geography."
3. Select *Report Type* "County by Sector."
4. Click the *Data Set or Selection* bar. This brings you to a "filter" that allows you to select an inventory on which to run a report.

To find a version of the NEI, type "NEI V" in the search box under the *Data Set or Selection*. Then, click the appropriate row for the year and version of the inventory for your needs.

5. Click on the *Pollutants* bar to access the pollutant filter. Use the search box provided and type in "VOC" and select that resulting row for VOC (click on it with the mouse). Repeat this for NO_x. Typing both filters at the same time will not work.
6. Because we are looking at counties, go directly to the County filter. DO NOT SELECT A STATE FIRST from the *State* filter (this will select all counties in selected states, even if you then select specific counties in the *county* filter). Use the search box in the *County* filter to find the counties of interest either by name or State/County FIPS code. Select the counties of interest by clicking on those rows. If no counties are selected, all counties will be returned.
7. Lastly, select your *Sectors* using the *Sectors* search box. If no sectors are selected, the report will be created with all sectors. The EIS Sectors are explained in more detail in Section of the [2011 NEI technical documentation](#).
8. Click the "Request Download" button at the bottom of the screen. These reports are run by EIS every 15 minutes and are available under the Report Download section on the left hand sidebar of the Gateway.

Note: Using the "Run Report" button will give you a faster response and display the summary on the screen, but may not include all records for your report. A warning is given at the top of the screen if the "Run Report" result is incomplete.

Create a summary of NO_x and VOC emissions BY FACILITY for a group of counties

1. Select "Request Reports" from the left hand sidebar on the EIS Gateway.
2. Under the Emissions Summaries heading, select "By Facility."

3. Select *Report Type* "Facility". For more detailed (sub-facility) data, you may select "Emissions Unit" or "Emissions Process."
4. Follow Step 4 in the list above.
5. Follow Step 5 in the list above.
6. Follow Step 6 in the list above.
7. Lastly, you may refine your search even more using the optional filters of *Facility Types*, *NAICS*, *Regulations*, or *Source Classifications*. If you do not use these filters, all facilities for the selected counties that include NO_x and VOC emissions will be returned in the report.
8. Follow Step 8 in the list above.

Appendix B

EPA Nonpoint Methods and Associated Activity Data and Websites

Category	Data Type	Last Release Date	Data Lag (years)	Report	Source	Link
Agriculture Production - Livestock	Livestock Population	May 2014 (2012 data)	2	Census of Agriculture	USDA	https://www.agcensus.usda.gov/
Agriculture Production - Livestock	Livestock Population	Continuous Updates		USDA NASS Quick Stats	USDA	https://www.nass.usda.gov/Quick_Stats/
Asphalt Paving - Cutback	Cutback Asphalt Use			2008 Asphalt Usage Survey for the United States and Canada	Asphalt Institute	http://www.asphaltinstitute.org/
Asphalt Paving - Cutback	VMT	2014	2	Highway Statistics 2014	FHWA	http://www.fhwa.dot.gov/policyinformation/quickfinddata/qftravel.cfm
Asphalt Paving - Emulsified	Emulsified Asphalt Use			2008 Asphalt Usage Survey for the United States and Canada	Asphalt Institute	http://www.asphaltinstitute.org/
Asphalt Paving - Emulsified	VMT	2014	2	Highway Statistics 2014	FHWA	http://www.fhwa.dot.gov/policyinformation/quickfinddata/qftravel.cfm
Aviation Gasoline Distribution - Stage 1	AvGas Consumption	Sept 2015 (2014 data)	1.5	Petroleum Supply Annual	EIA	http://www.eia.gov/petroleum/supply/annual/volume1/
Aviation Gasoline Distribution - Stage 2	AvGas Consumption	Sept 2015 (2014 data)	1.5	Petroleum Supply Annual	EIA	http://www.eia.gov/petroleum/supply/annual/volume1/
Commercial Cooking	Population	June 2016 (2015 data)	1.5	Population Estimates Program GCT-T1: Population Estimates	U.S. Census Bureau	http://www.census.gov/popest/
Construction Dust - NonResidential Construction	Value of Construction	April 2016	0	Annual Value of Construction Put in Place	U.S. Census Bureau	http://www.census.gov/construction/c30/c30index.html
Construction Dust - NonResidential Construction	Business Patterns	2014	2	County Business Patterns (e.g., no. establishments, employees)	U.S. Census Bureau	http://www.census.gov/econ/cbp/index.html
Construction Dust - NonResidential Construction	Construction Costs	June 2016	1 mo.	Producer Price Index	U.S. Dept. of Labor	http://www.bls.gov/ppi/#tables
Construction Dust - Residential Construction	Housing Units	(2014 data)	2	Annual Housing Units Authorized by Building Permits CO2010A	U.S. Census Bureau	https://www.census.gov/popest/data/housing/totals/2014/
Construction Dust - Residential Construction	Housing Starts	June 2016	2 mo.	New Privately Owned Housing Units Started for previous quarter	U.S. Census Bureau	http://www.census.gov/construction/nrc/index.html
Construction Dust - Residential Construction	Ratio for 5 or more units	May 2016 (2015 data)	5 mo	Table 2au. New Privately Owned Housing Units Authorized Unadjusted Units for Regions, Divisions, and States 2009	U.S. Census Bureau	http://www.census.gov/construction/bps/stateannual.html
Construction Dust - Residential Construction	Types of Foundation	(2015 data)		Type of Foundation in New One-Family Houses Completed	U.S. Census Bureau	http://www.census.gov/construction/chars/completed.html (see row for "Foundation").
Construction Dust - Road Construction	VMT	2014	2	Highway Statistics 2014	FHWA	http://www.fhwa.dot.gov/policyinformation/quickfinddata/qftravel.cfm

Category	Data Type	Last Release Date	Data Lag (years)	Report	Source	Link
Construction Dust - Road Construction	Housing Starts	June 2016	2 mo.	New Privately Owned Housing Units Started for previous quarter	U.S. Census Bureau	http://www.census.gov/construction/nrc/index.html
Fertilizer Application	Commercial Fertilizer Usage	2012		Commercial Fertilizers	Association of American Plant Food Control Officials	http://www.aapfco.org/publications.html#comm (must order)
Fuel Combustion - Commercial	Fuel Sales	2014	2	Fuel Oil and Kerosene Sales	EIA	http://www.eia.gov/dnav/pet/pet_cons_821use_dcu_nus_a.htm
Fuel Combustion - Commercial	Business Patterns	2014	2	County Business Patterns (e.g., no. establishments, employees)	U.S. Census Bureau	http://www.census.gov/econ/cbp/index.html
Fuel Combustion - Commercial	Gov't Payrolls	2016 (2012 data)	4	Census of Governments	U.S. Census Bureau	https://www.census.gov/govs/cog/
Fuel Combustion - Commercial	Fuel Consumption	2014	2	State Energy Data System (SEDS)	EIA	http://www.eia.gov/state/seds/
Fuel Combustion - Industrial	Fuel Sales	2014	2	Fuel Oil and Kerosene Sales	EIA	http://www.eia.gov/dnav/pet/pet_cons_821use_dcu_nus_a.htm
Fuel Combustion - Industrial	Business Patterns	2014	2	County Business Patterns (e.g., no. establishments, employees)	U.S. Census Bureau	http://www.census.gov/econ/cbp/index.html
Fuel Combustion - Industrial	Energy Consumption	March 2012 (2010 data)	3.5	Energy consumption as a fuel, by industry and region	EIA	http://www.eia.gov/consumption/manufacturing/
Fuel Combustion - Industrial	Fuel Consumption	2014	2	State Energy Data System (SEDS)	EIA	http://www.eia.gov/state/seds/
Gasoline Distribution - PFCs						
Gasoline Distribution - Stage 1	Business Patterns	2014	2	County Business Patterns (e.g., no. establishments, employees)	U.S. Census Bureau	http://www.census.gov/econ/cbp/index.html
Gasoline Distribution - Stage 1	Fuel Consumption	Sept 2015 (2014 data)	1.5	Petroleum Supply Annual	EIA	http://www.eia.gov/petroleum/supply/annual/volume1/
Gasoline Distribution - Stage 2						
Industrial Fuel Combustion	Business Patterns	2014	2	County Business Patterns (e.g., no. establishments, employees)	U.S. Census Bureau	http://www.census.gov/econ/cbp/index.html
Industrial Fuel Combustion	Fuel Sales	2011	2	Fuel Oil and Kerosene Sales	EIA	http://www.eia.gov/dnav/pet/pet_cons_821use_dcu_nus_a.htm
Industrial Fuel Combustion	Energy Consumption	June 2009	3.5	2006 Manufacturing Energy Consumption Survey	EIA	http://www.eia.gov/emeu/mecs/mecs2006/2006tables.html
Industrial Fuel Combustion	Fuel Consumption	2014	2	State Energy Data System (SEDS)	EIA	http://www.eia.gov/state/seds/
Open Burning - Household Waste	Solid Waste Generation	2011	2	Municipal Solid Waste in the United States: 2009 Facts and Figures	EPA	https://nepis.epa.gov/Exe/ZyPDF.cgi/P100GMT6.PDF?Dockey=P100GMT6.PDF

Category	Data Type	Last Release Date	Data Lag (years)	Report	Source	Link
Open Burning - Household Waste	Population	June 2016 (2015 data)	1.5	Population Estimates Program GCT-T1: Population Estimates	U.S. Census Bureau	http://www.census.gov/popest/
Open Burning - Land Clearing	Business Patterns	2014	2	County Business Patterns (e.g., no. establishments, employees)	U.S. Census Bureau	http://www.census.gov/econ/cbp/index.html
Open Burning - Land Clearing	Housing Units	(2014 data)	2	Annual Housing Units Authorized by Building Permits CO2010A	U.S. Census Bureau	https://www.census.gov/popest/data/housing/totals/2014/
Open Burning - Land Clearing	Value of Construction	2016	0	Annual Value of Construction Put in Place	U.S. Census Bureau	https://www.census.gov/construction/c30/c30index.html
Open Burning - Land Clearing	Housing Starts	June 2016	2 mo.	New Privately Owned Housing Units Started for previous quarter	U.S. Census Bureau	http://www.census.gov/construction/nrc/index.html
Open Burning - Land Clearing	Ratio for 5 or more units	May 2016 (2015 data)	5 mo	Table 2au. New Privately Owned Housing Units Authorized Unadjusted Units for Regions, Divisions, and States 2009	U.S. Census Bureau	http://www.census.gov/construction/bps/stateannual.html
Open Burning - Leaves and Brush	Solid Waste Generation	2013	3	Municipal Solid Waste in the United States: 2013 Facts and Figures	EPA	https://www.epa.gov/smm/advancing-sustainable-materials-management-facts-and-figures-report
Open Burning - Leaves and Brush	Population	June 2016 (2015 data)	1.5	Population Estimates Program GCT-T1: Population Estimates	U.S. Census Bureau	http://www.census.gov/popest/
Paved Road Dust	VMT	2014	2	Highway Statistics 2014	FHWA	http://www.fhwa.dot.gov/policyinformation/quickfinddata/qftravel.cfm
Publicly Owned Treatment Works	Nationwide Flow rate	January 2016	4	Clean Watersheds Needs Survey 2012 Data and Reports, Detail Report	EPA	https://www.epa.gov/cwns/clean-watersheds-needs-survey-cwns-2012-report-and-data#access
Publicly Owned Treatment Works	Population	June 2016 (2015 data)	1.5	Population Estimates Program GCT-T1: Population Estimates	U.S. Census Bureau	http://www.census.gov/popest/
Residential Coal	Coal Distribution	Dec 2016 (2014 data)	2	Annual Coal Distribution	EIA	http://www.eia.gov/cneaf/coal/page/coaldistrib/a_distributions.html
Residential Coal	Fuel Consumption	2014	2	State Energy Data System (SEDS)	EIA	http://www.eia.gov/state/seds/
Residential Coal	House Heating Fuel Type	2014	2	House Heating Fuel (online report from "Advanced Search")	U.S. Census Bureau	http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none (Enter: "heating fuel" in search field)
Residential Distillate Fuel	Fuel Consumption	2014	2	State Energy Data System (SEDS)	EIA	http://www.eia.gov/state/seds/
Residential Distillate Fuel	House Heating Fuel Type	2014	2	House Heating Fuel (online report from "Advanced Search")	U.S. Census Bureau	http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none (Enter: "heating fuel" in search field)

Category	Data Type	Last Release Date	Data Lag (years)	Report	Source	Link
Residential Kerosene	Fuel Consumption	2014	2	State Energy Data System (SEDS)	EIA	http://www.eia.gov/state/seds/
Residential Kerosene	House Heating Fuel Type	2014	2	House Heating Fuel (online report from "Advanced Search")	U.S. Census Bureau	http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none (Enter: "heating fuel" in search field)
Residential LPG	Fuel Consumption	2014	2	State Energy Data System (SEDS)	EIA	http://www.eia.gov/state/seds/
Residential LPG	House Heating Fuel Type	2014	2	House Heating Fuel (online report from "Advanced Search")	U.S. Census Bureau	http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none (Enter: "heating fuel" in search field)
Residential Natural Gas	Fuel Consumption	2014	2	State Energy Data System (SEDS)	EIA	http://www.eia.gov/state/seds/
Residential Natural Gas	House Heating Fuel Type	2014	2	House Heating Fuel (online report from "Advanced Search")	U.S. Census Bureau	http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none (Enter: "heating fuel" in search field)
Residential Wood	Timber Output	2012	4	Timber Products Output Reports	USDA	http://srsfia2.fs.fed.us/php/tpo_2009/tpo_rpa_int1.php
Residential Wood	House Heating Fuel Type	2014	2	House Heating Fuel (online report from "Advanced Search")	U.S. Census Bureau	http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none (Enter: "heating fuel" in search field)
Residential Wood	Heating Equipment Type	2013	3	American Housing Survey for the United States: 2013 Summary Tables, Table C-03-AO: Heating, Air Conditioning, and Appliances – All Occupied Units	U.S. Census Bureau	http://www.census.gov/programs-surveys/ahs/data.html
Residential Wood	Metropolitan Characteristics	2013	3	American Housing Survey Metropolitan Data	U.S. Census Bureau	http://www.census.gov/programs-surveys/ahs/data/2013/ahs-2013-summary-tables/metropolitan-summary-tables---ahs-2013.html
Solvent Usage - Other	Population	June 2016 (2015 data)	1.5	Population Estimates Program GCT-T1: Population Estimates	U.S. Census Bureau	http://www.census.gov/popest/
Solvent Usage - Other	Business Patterns	2014	2	County Business Patterns (e.g., no. establishments, employees)	U.S. Census Bureau	http://www.census.gov/econ/cbp/index.html
Solvent Usage - Surface Coatings	Population	June 2016 (2015 data)	1.5	Population Estimates Program GCT-T1: Population Estimates	U.S. Census Bureau	http://www.census.gov/popest/
Solvent Usage - Surface Coatings	Business Patterns	2014	2	County Business Patterns (e.g., no. establishments, employees)	U.S. Census Bureau	http://www.census.gov/econ/cbp/index.html
Unpaved Road Dust	VMT	2014	2	Highway Statistics 2014	FHWA	http://www.fhwa.dot.gov/policyinformation/quickfinddata/qftravel.cfm

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