Emission Inventories

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Overview

- Emission Inventory 101
- Nonattainment Air Emission Inventories
- Air Emission Reporting Requirements Rule (AERR)
- The National Emission Inventory (NEI) and the Emission Inventory System (EIS)

Emission Inventory 101

What Is an Air Pollutant Emission Inventory?

Inventory - current comprehensive listing by sources of air pollutant emissions in a geographic area during a specific time period

Emission Inventory Characteristics: Base Year

- Base Year
  - Identifies the year for which emissions are estimated
  - Provides a benchmark for comparison with previous and future inventories compiled for different years
  - Provides a common basis for all the emission estimates
- Year is selected based on purpose of the inventory, regulatory requirements, and data availability

Emission Inventory Characteristics: Geographic Area

- Establishes geographic domain for the inventory
- Determines the sources to be included in the inventory based on their location
- Can be based on political boundaries (i.e., city, province, or country borders), air shed boundaries, or other (possibly arbitrary) considerations
- Is determined based on the purpose of the inventory
  - City-, district-, province-level, national analyses of air quality impacts (e.g., 100 to 500 km^2) using modeling

Emission Inventory Characteristics: Modeling Inventories

- Modeling inventories have more specific requirements than other more general tracking inventories
- Modeling inventories need
  - Geographically resolved emissions (gridded or specific dimensions) – spatial allocation of emissions
  - Hourly time resolution – temporal allocation of emissions
  - Pollutant species ("model species") to meet needs of AQ model chemical/physical algorithms
    - *Risk assessors want modeled species to match health effects data
  - Quality Assurance/Quality Control of data
  - All sources represented
    - Anthropogenic, Biogenic (grid models)

Emission Inventory Compilation Steps

- Planning
- Gathering information
- Estimating Emissions
- Compiling the Database
- QA/QC
- Data Augmentation
- Documentation
- Providing Access to Data

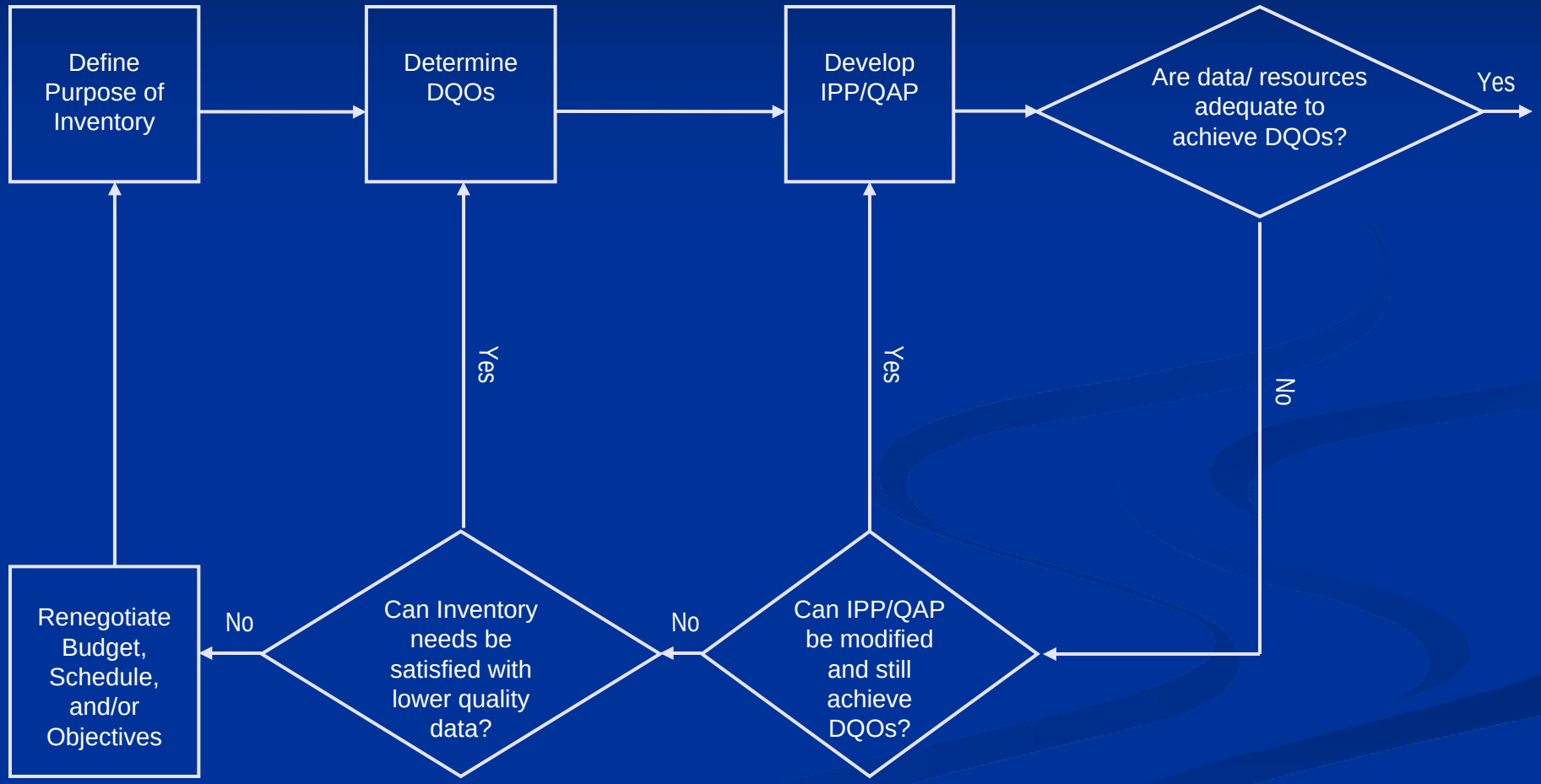
Emission Inventory Compilation: Why is Planning Important?

- Every inventory requires extensive advanced planning
- Emission inventories are the foundation of many decisions
- Planning is needed to ensure that the inventory objectives are met.
- Mistakes early in the process interject errors in downstream calculations
- Redoing work is costly and embarrassing

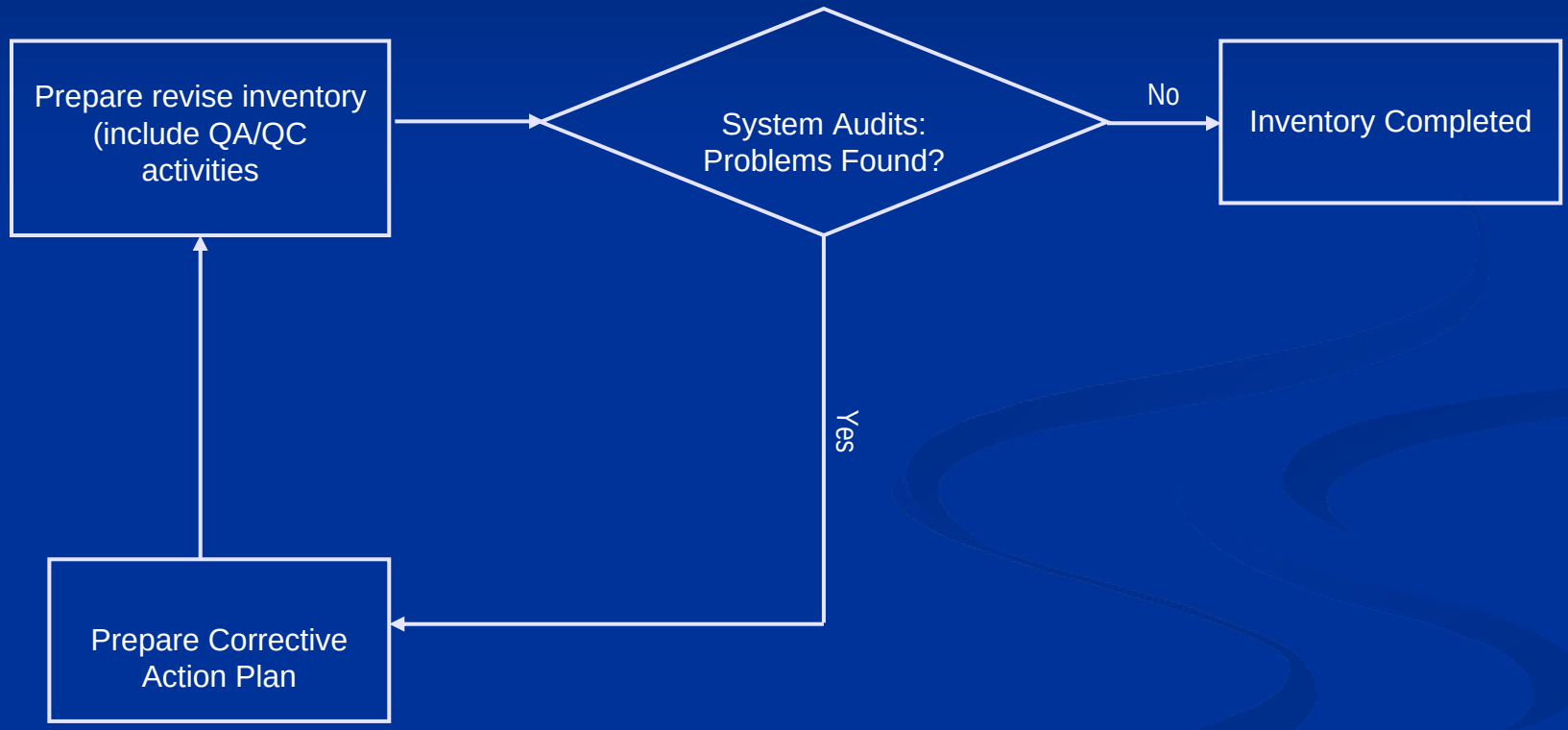
Emissions Inventory Planning

- Step #1 is to define the inventory uses and users
- The end uses of the inventory determine:
  - The required staffing and resource allocation
  - The structure of the inventory
  - The data quality objectives (DQOs)
  - The source types, categories, and pollutants to be included
  - Necessary level of spatial and temporal resolution

Emissions Inventory Development Process: Planning



Process (continued)



Inventory Preparation Plan (IPP)

- An IPP is a concise, prescriptive document that declares how an inventory will be developed and reported
- Important sections of an IPP:
  - Introduction
  - Inventory Scope
  - Description of all Inventory Compilation Steps
  - Emission Estimation Methodology
  - Data Management and Reporting
  - Quality Assurance Plan
  - Documentation
  - Staffing and Resources

Inventory Preparation Plan (IPP)

- Introduction
  - Define uses of inventory and acceptable data quality for uses of inventory
  - Define Data Quality Objectives (DQOs)
- Inventory Scope:
  - Identify pollutants and source categories, geographic area, and time interval to be included in inventory
- Description of all steps in compiling emissions inventory

Inventory Preparation Plan (IPP)

- Emission Estimation Methodology - Define all procedures that will be used to estimate emissions
  - Data collection
  - Emission estimation methodology
    - Methods should be selected for each category
    - Selection of methods is based on several factors
      - Resources available to develop the inventory
      - Data availability
      - Time schedules
      - Priority of the category
      - DQOs and Intended uses of the inventory
    - Preferred" and "Alternative" methods

Inventory Preparation Plan (IPP)

- Data Management and Reporting
- Quality Assurance Plan
- Documentation
- Staffing and Resources
  - Establish resource requirements and schedule
  - Identify partners and develop communication plan
    - Industry
    - Trade Associations
    - Agencies
    - Community groups

Inventory Compilation: Gathering Information - What Data Should I Gather?

- Inventory guidance
- Existing emissions data
- Preliminary screening studies
- Emission Factors and Models
- Source characterization documents
- Activity data references

Gathering Information: How Do I Identify Source Categories?

- Usually dictated by the pollutant of interest
- Past inventory efforts and historical knowledge of the inventory area can help identify categories
- Inventories for other agencies

Gathering Information: How Should I Research Sources of Pollutants?

- Research all available resources to identify sources of pollutants
  - Documents and Tools
  - Existing inventories
  - Source tests
  - Compliance data
  - Permits
  - Risk assessments
- Eliminate any sources that are not found within the inventory area
- Prioritize the list of remaining categories
- Consider time and budget constraints
- Eliminate any categories for which no emission factors or acceptable methods have been developed
- Document your decisions for the benefit of future preparers

How do I Identify Specific Nonpoint Sources in the Geographic Area?

- Determine pollutants emitted by source categories within a geographic area
- Determine which pollutants to inventory
- Identify source categories of pollutants.
- Determine which source categories to inventory as point vs. nonpoint sources in specific geographic areas.

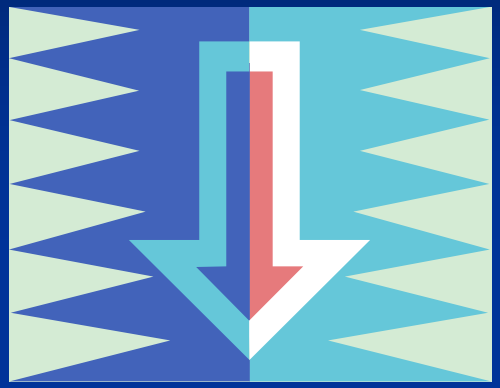
Where Do I Find Emission Factor and Models Information?

- Government agencies
- Industry
- Source test data for compliance purposes
- Professional societies - AWMA

Where Do I Find Source Characterization Information?

- Emission estimation guidance from EPA, UNEP, etc.
- Emission factor documents such as AP-42
- Existing inventory documentation

Emissions Inventory Development Approaches

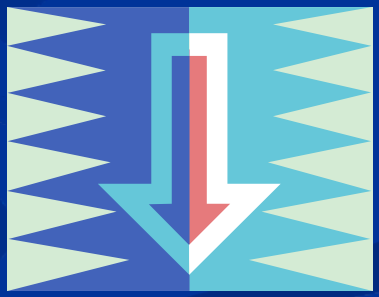


- Top-Down approach

- Bottom-Up approach

Top-Down Approach

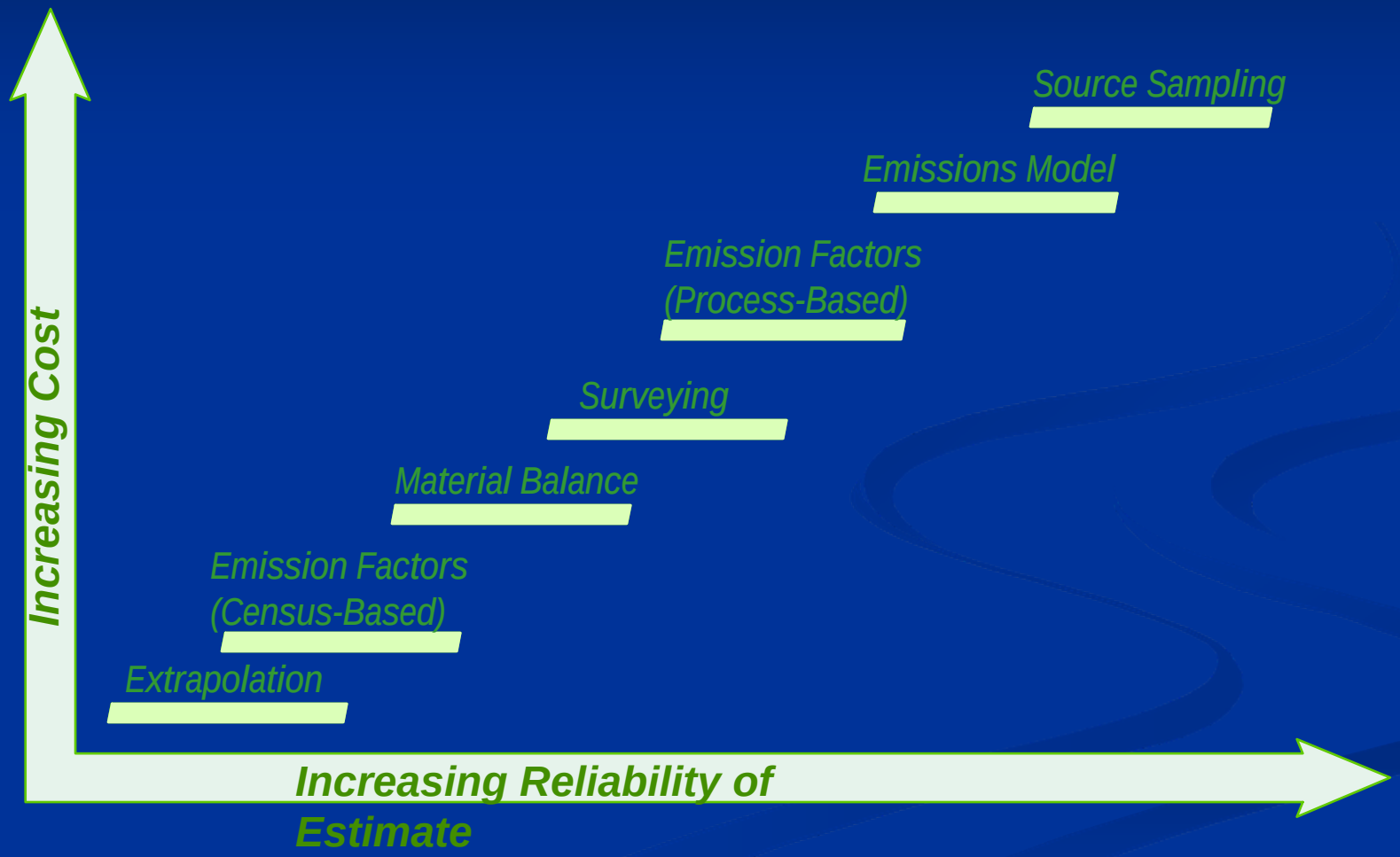
- Methodology:
  - General emission factors combined with high level (national) activity data (e.g., emission factor x national coal consumption) to estimate emissions in country or region
  - National- or regional-level emissions estimates scaled to the inventory domain based on surrogate data (geographic, demographic, economic data)
- Typically used when
  - Local data are not available
  - The cost to gather local information is prohibitive
  - The end use of the data does not justify the cost
- Advantages: Requires minimum resources
- Disadvantages:
  - Emissions generally have high level of uncertainty
  - Loss of accuracy in emission estimates



Bottom-Up Approach

- Methodology
  - Uses source-specific data (for point sources) and category-specific data at the most refined spatial level (for nonpoint and mobile sources)
  - Emission estimates for individual sources (and source categories) are summed to obtain domain-level inventory
- Typically used when:
  - Source/category-specific activity or emissions data are available
  - End use of inventory justifies the cost of collecting site-specific data (e.g., for ozone control strategy demonstration)
- Advantages: Results in more accurate estimates than a top-down approach
- Disadvantages: Requires more resources to collect site-specific information than a top-down approach

Emission Estimation Techniques



How Do I Choose Emission Estimation Methods?

- Choice of methods depends on:
  - Pollutant and source category priorities
  - Intended use of the inventory
  - Resources
  - Availability of data
  - Compromise between method accuracy and cost to implement

Inventory Compilation: Quality Assurance/Quality Control (QA/QC)

- QA/QC is not optional in emission inventory development
  - Integral part of emission inventory compilation
- Why do we need to conduct QC and QA?
  - Instills confidence in emission estimates and their uses
  - Improves accuracy of emission estimates
  - Improves assessment of emissions on air quality
  - Provides a better assessment of emission inputs to air quality models
  - Improves transparency of estimates and provides documentation
  - Lowers program costs for subsequent data base maintenance

Quality Assurance/ Quality Control (QA/QC)

- QA versus QC
- QA Plan
- QA/QC Activities
- QA/QC Tools
- Uncertainty Analysis
- Documentation

QA vs. QC

- External review and audit process
- Independent review by a third party to assess
  - Effectiveness of QC program
  - Overall quality, completeness, accuracy, representativeness of the inventory
- Conducted by person not involved in inventory development

- Routine internal technical activities to measure and control the quality of the inventory ***as it is being compiled***
- Uses standardized procedures
- Includes use of good documentation
- Carried out by members of the inventory team
- Example QC activities
  - Comparing emissions to previous inventories
  - Using checklists to ensure that all inventory development requirements are met
  - Determining outliers by using computer-aided, graphical, or other reviews
  - Conducting accuracy checks

Quality Assurance Plan (QAP)

- A description of specific QA and QC procedures and responsibilities
- Every Inventory Preparation Plan should contain a QAP
- Initial QA/QC planning
  - Identify a Quality Assurance Coordinator
  - Restate the DQOs and DQIs
  - Determine resources needed to implement the QA plan
  - Determine authority and responsibility for QA/QC plan implementation
- Accurate and complete QAPs for inventories are necessary to:
  - Ensure that the final compilation of the data accurately reflects the inventory effort
  - Support QA/QC assessments of inventory
  - Determine quality of emission estimates and data references
  - Allow reproducibility of estimates
  - Ensure inventory will be starting point for future inventories

Components of a Comprehensive QAP

- Policy Statement
  - Declares organization's commitment
- Introduction
- QA Program Summary
  - Data flow
  - Points where QC procedures will be applied
- Technical Work Plan
  - Resources, documentation, schedule
- QA/QC Procedures
  - Techniques, checkpoints
- Inventory Preparation and QA/QC Activities
  - Roles and responsibilities of agencies, personnel
  - Reality checks, peer review, sensitivity checks, audits, etc.
- Corrective Action Mechanisms
- References

Primary QA/QC Methods

- Reality checks
  - Is this number reasonable? Does it make sense?
  - You should never use the reality check as the sole criterion of quality
- Peer review
  - An independent review of calculations, assumptions, and/or documentation by person with a moderate to high level of technical experience
- Sample calculations – Replication of Calculations
  - Most reliable way to detect computational errors
  - General rule, a minimum of 10% of calculations is checked depending on:
    - Complexity of calculations
    - Inventory DQOs
    - Rate of errors encountered

Primary QA/QC Methods

- Computerized checks
  - Automated data checks can be built-in functions of databases, models, or spreadsheets or can be designed as stand-along programs
  - Automate to
    - Check for data format errors
    - Conduct range checks to ensure data falls within specified min/max
    - Provide look-up tables to define permissible entries
- Sensitivity analysis
- Emission estimation validation

Primary QA/QC Methods

- Statistical checks
  - Descriptive statistics
  - Statistical procedure to identify outliers
  - Statistical tests
- Independent Audit
  - Identify staffing issues
  - Evaluate the effectiveness of the technical and quality procedures
  - Provide confidence in the accuracy and completeness of the emission data
  - Determine if DQOs are being met
  - Identify the need for additional QC measures

What QC Procedures Should I Follow?

- Best implemented through standardized checklists
- Use checklist to monitor
  - Data collection
  - Data calculations
  - Evaluation of data reasonableness
  - Evaluation of data completeness
  - Data coding and recording
  - Data tracking

QA/QC Documentation

- QA/QC documentation should include records of QA/QC activities, especially changes made as a result of these activities
- Report should include
  - Procedures used
  - Technical approach used to implement QA plan
  - Any calculation sheets and QA/QC checklists
  - Dates of each audit, and the names of the reviewers
  - Responses to QA/QC audits
  - Results of QA activities, including problems found, correction actions and recommendations
  - Discussion of the inventory quality

Statutory and Regulatory Requirements

- Section 110(a)(2)(F) of CAA- requiring SIPs to provide for the reporting of criteria air pollutants
- Section 172(c)(3)- discretionary authority to require other emissions data
- Section 169(A)- authority for emission inventories to be required in SIPs developed to protect visibility in Federal Class I areas

SIP Base Year Inventory EI Type

- Required by CAA sections 172(c)(3) and 182(a)1).
- Use: Used by States as starting point for emission inventories used in attainment demonstrations & RFP and/or ROP calculations
- Years Covered: 2002 most likely for ozone SIPs
- Pollutants Covered: Ozone precursors, CO, PM: PM10, PM2.5, SO2, NOx, and NH3
- Units: Actual tons/yr. Actual tons/summer weekday for Ozone and CO

RFP Inventories
EI Type

- Use: Used to meet RFP requirements
- Subpart 2 includes several different kinds: (1) Final Base Year inventory; (2) Rate-of-Progress Base Year inventory; (3)Adjusted Base Year inventory; (4) Milestone yr. target level; (5) Milestone yr. projected emissions
- Years Covered: 2002 most likely base yr. for ozone; Base year and each RFP milestone yr. , e.g. 6yrs. after the base yr., and every 3yrs. after the first 6yr. Period
- Pollutants Covered: Ozone (VOC and NOx)
- Units: ActualTons/summer week day

Redesignation Inventories EI Type

- Actual attainment year inventory (one of the 3 yr. of clean data when the area came into attainment for the NAAQS) – Used as the basis for the maintenance plan (beginning yr.) from which projections are done out into the future 10 yr. period to ensure emissions stay under the attainment year level.
- Projected future year inventory (interim yr(s) and final 10th year)
- Years Covered: Beginning yr. inventory (yr. of attainment) and any future yrs. of the maintenance plan.
- Pollutants: O3, PM, and CO - any precursors
- Units: Actual tons/day (tons/summer weekday)

Conformity Budget Inventory EI Type

- 2 Types of Conformity Budgets: (1) Transportation and (2) General
- Transportation conformity budget takes into account on-road emissions – generally is the MVEB budget (last yr. of maint. plan) which is created by control strategies for emissions from cars and trucks in the maintenance plan
- General conformity budget covers the total of direct and indirect emissions in a nonattainment or maintenance area caused by the Federal action & any Other emissions not covered under transportation conformity.
- Years Covered: Duration of project- takes into account emissions before and after the project construction
- Pollutants Covered: All criteria pollutants and their respective precursors.
- Units: Transportation: tons/day; General: tons/year

RPO Inventories
Specific Inventory

- Developed by Regional Planning Organizations – Initially for the Regional Haze Program
- Several Types: VISTAS; MANE-VU; WRAP; Midwest-RPO; CENRAP
- Use: Modeling & control strategy planning
- Years Covered: 2002 Baseline and some future projected years.
- Pollutants Covered: SO2, VOC, NOx, CO, PM10 & 2.5, NH3
- Units: Actual tons/year – some used 3-yr.avg. of actual emissions

Nonattainment Air Emission Inventories

Statutory and Regulatory Requirements

- Section 110(a)(2)(F) of CAA- requiring SIPs to provide for the reporting of criteria air pollutants
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- Units: ActualTons/summer week day

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Air Emission Reporting Requirements Rule (AERR)

Why Was the AERR Developed?

- Early emissions reporting requirements were located in several areas of the Code of Federal Regulations (CFR)
- The Consolidated Emissions Reporting Rule (CERR) initiated the process of organizing and simplifying emissions reporting requirements
- The AERR continued to organize and simplify emissions reporting requirement by:
  - Harmonizing CERR and NOx SIP Call reporting requirements
  - Deleting, adding and revising data elements to update reporting requirements

Who Needs to Report?

- States are responsible for reporting emissions from sources on non-tribal lands
- If local agencies have the lead role for developing emission inventories or inventory categories, the AERR also applies to them
- The AERR can apply to tribes that have been granted “treatment as state” status under the Tribal Authority Rule and have approval to implement rules through a Tribal Implementation Plan.

When Will the AERR be Implemented?

- Implementation begins with the 2009 inventory
- 2009 and 2010 will be Type A source reporting years
- 2011 will be the first triennial (comprehensive) inventory
- Therefore, states will have two years of large point source data reporting to become familiar with the new AERR and EIS requirements before a comprehensive inventory is required

Reporting Changes in AERR

- 40 CFR 70 definition of major source now used for point source reporting
- The AERR requires emissions to be reported within 12 months from the end of the inventory year rather than 17 months under the CERR
- No biogenic emissions requirement

Reporting Changes in AERR (con't)

- Model inputs in lieu of emissions will be acceptable
- Data elements for reporting have been updated
- Summer day emissions of VOC and NOx for ozone nonattainment areas only
- Winter work weekday emissions of CO required for nonattainment areas and areas with maintenance plans.

Reporting Changes in AERR (con't)

- Particulate Matter
  - PM primary (sum of filterable and condensable components) must be reported as under the CERR
  - Reporting of the filterable and condensable components is a new requirement
  - We added the component reporting requirement to help us understand what was being reported as PM primary

What are the Reporting Cycles and Averaging Times?

- Every Year Cycle Reporting
  - Annual emissions from Type A (large) point sources. If one pollutant qualifies source as Type A, all pollutants must be reported
  - Ozone season and summer day emissions of NOx from sources controlled to meet SIP Call requirements

What are the Reporting Cycles and Averaging Times (con't)?

- Three Year Cycle Reporting
  - Annual emissions of criteria pollutants from all sources
  - Ozone season and summer day emissions of NOx from all sources
  - Summer day emissions of NOx and VOC for ozone nonattainment areas
  - Winter work week day emissions of CO for nonattainment areas and attainment areas with maintenance plans

What Pollutants Need to be Reported?

- States must report emissions of the following pollutants:
  - Volatile Organic Compounds (VOC)
  - Primary $PM_{2.5}$
  - Primary PM_{10}
  - Nitrogen Oxides ($NO_{x)}$
  - Carbon Monoxide (CO)
  - Lead and Lead Compounds (Pb)
  - Sulfur Dioxide (SO_2)
  - Ammonia (NH_3)

What About HAPs and GHGs?

- Hazardous Air Pollutants (HAPs) are not required, but we encourage agencies to submit them on a voluntary basis using the requirements of the AERR
- Greenhouse Gases (GHGs) are not required

The National Emission Inventory (NEI) and the Emission Inventory System (EIS)

What is the NEI?

- EPA's National Emission Inventory
  - National Emission Inventory of criteria pollutants (and precursors) and hazardous air pollutants (HAPs)
  - Published annually by EPA's Office of Air Quality Planning and Standards
  - Developed in partnership with State, Local, and Tribal air agencies

Uses of the NEI

- Regional- and local-scale air quality & human exposure modeling
- Control strategy analysis
- Regulatory impact analysis
- Risk assessment studies
- Emission trends and program accountability
- Public reporting
- International reporting

What's in the NEI?

- Geographic Coverage
  - Entire U.S.
  - Individual process level inventory for point sources
  - County level inventory for non-point and mobile sources

What's in the NEI?

- Pollutant Coverage
  - Ozone precursors
    - VOC, NO_X,CO
  - Direct PM emissions
    - PM_{10} and $PM_{2.5}$
  - PM precursors
    - SO_2, NH_3
  - Lead
  - Air toxics
    - 188 HAPs

NEI Data Sources

- State, local and tribal air agencies
- EPA Data Systems
  - Emissions Trading Program
  - Toxic Release Inventory (TRI)
- EPA data collection programs
  - MACT compliance data
  - ICRs for standards development
- Data developed by EPA
  - Mobile Source models
  - EIAG data augmentation
- Industry

Why Reinvent the NEI?

- Critiques of emission inventories
  - External: CAAAC, NARSTO
  - Internal: OAQPS management
- Need for better emissions data to meet increasing demands
- Current process is cumbersome
- Quality issues
- Lack of transparency

The NEI: New Challenges

- Fully integrated multi-pollutant inventory
- Better characterization of smaller source categories
  - Recent rules (e.g., EGU and mobile source rules) were based on the strongest parts of the NEI
- New program requirements will require better resolution: spatially and temporally
  - Sector approach
  - Voluntary/innovative programs
- Shrinking resource base requires more agreement on emission estimates among stakeholders
  - EPA, Regional Planning Organizations, States, Locals, Tribes, Industry

Goals of the Reinvention

- Better quality emission measurements and estimates
- More stakeholder collaboration
  - Not changing S/L/T data
  - AQ community acceptance of NEI
- Better tools
  - Emission Inventory System (EIS)
  - Faster development
    - Improved quality with less burden
  - Better access and more transparency

The Emissions Inventory System: Project Description

- Develop a new process for submitting, developing, quality assuring, storing and distributing emissions inventory data.

- Develop a system and applications to support the new process that conforms to the agency's strategic plans for air quality and information management

Benefits of EIS

- Development of more accurate and comprehensive NEI
- Reduces the time it takes to develop the NEI
- Makes the NEI development process more transparent
- Builds automated and robust quality assurance (QA) steps into the NEI process
- Provides State, Local and Tribal access to the database during development
- Creates public and industry access to the historic and current emission inventory data

EIS Project Status and Milestones

- Project is on schedule and on budget!
- Major milestones met to date:
  - Launch of EIS Gateway – October 2008
  - Opening of EIS Data Flow – July 2009
- Upcoming major milestones
  - Completion of Analysis and EI Processing functions – December 2009
  - Launch of Public Access Web Site – December 2009
  - Completion of 2008 NEI – December 2010

Stakeholder Collaboration

- Working hard to build a tool and EI that is useful to the broad AQ Community
- Collaboration with:
  - State, locals, tribe, RPOs
  - EPA Offices (OEI, OECA, OAP)
  - Environmental Information Exchange Network
  - The Climate Registry
- Excerpts from NACAA's comments on GHG MRR:
  - "State and local agency NEI experts have been closely involved in its design and development, and are confident that the reengineered EIS represents the gold standard in transparency, flexibility and reliability."

EIS Looking forward

- Incorporate GHG data from MRR and other sources for “one-stop” multipollutant inventory
- Develop more robust emissions data for “emerging” pollutants
  - Black Carbon
  - Methane
- More robust air toxics emissions data
  - Mandatory reporting of air toxics?
- Move to annual publication of NEI

For Further information and Training

- EPA's CHIEF website: http://www.epa.gov/ttnchie1