United States
Environmental Protection
Agency

Air Pollution Training Institute (APTI)
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**Air**

# Introduction to Emission Inventories

## Text Only Version

# Lesson 1- Welcome

**Page 1-**
**Welcome to the Introduction to Emission Inventories interactive training course**.

This introductory course is designed to assist air pollution professionals and others in understanding the process of developing an air emissions inventory. The course will define common terms and concepts associated with the development of an emissions inventory as well as presenting and explaining the various components of developing an air emissions inventory.

This course is an introductory course that should be taken before
APTI 419B – Preparation of PM Fine Emission Inventories and
APTI 419C – Preparation of HAP Emission Inventories

**Page 2-**
**Course Overview**

This course will cover the major aspects of preparing emission inventories by examining each step in the emissions inventory development process. Each of these steps will be addressed a separate lesson. However, keep in mind that, in reality, many of these steps are reiterative and are not isolated. Also keep in mind, that in this introductory course, we will not delve into the specifics of differences between inventories for various types of pollutants, but rather stress the process that is common to all inventories.

For the purpose of this training, the different parts of the process are taught in a linear fashion. Of course, you may use the menu button on the left to jump to any lesson at any time. However, some information presented in early lessons will be needed in later lessons, so it is recommended that you view each lesson in sequence.

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**Directions**

Before starting with the course, lets first cover some basic navigation.

On the left side of the screen is a menu bar. Click on any of these links to go directly to a lesson.

Along the bottom of the screen, are a series of controls.

In the circle to the left, are four buttons, Help, represented by the question mark, a print feature which will allow you to print a text version of this course. The “folder” will bring you to a reference section. In the reference section there will be links, documents and a glossary. The “X” will exit the course.

Along the bottom of the page are controls to move from lesson to lesson. On the right of the screen there are controls to allow you to Play, Pause and Rewind the animation and sounds. The next and back buttons will advance you though a lesson.

If at any time you have a question about a feature, click on the question mark.

**Page 4-**
**Congratulations**

You have completed the Introduction lesson.

Continue by selecting a lesson using the Menu, or, just go to the next lesson.

# Lesson 2 – Background Information

**Page 1**
This is the Background Information lesson.

Upon completion of this lesson, you will be able to:
- Define the term Emissions Inventory.
- Describe the contents of a complete EI.
- Describe the uses of an accurate EI.
- Name the types of pollutants inventoried.
- Describe the six components in creating an inventory.

**Page 2**
**Emission Inventories**

An emission inventory, or EI, is a current, comprehensive listing, by source, of air pollutant emissions associated with a specific geographic area for a specific time interval.

**Page 3**
**Contents of Emission Inventories**

A complete emission inventory contains the following information:
- Background information about the need for an inventory,
- A tabular summary of emission estimates by source category,
- A description of the geographic area covered,
- The time interval represented (for example, annual, seasonal, or hourly),
- Population, employment and economic data used to estimate and allocate the emissions, and
- A complete narrative of each source category describing how the data was collected, the sources, and the emission estimation methods and calculations. Also, copies of any questionnaires and the results, and the documentation of assumptions and references should be included. Finally, the sources that are not included in the inventory should be identified.

**Page 4**
**Uses for Emission Inventories**

Emission inventories are most often developed in response to regulations and are used for a wide variety of purposes. For example, emission inventory data are used to evaluate the status of existing air quality as related to air quality standards and air pollution problems. They are also used to assess the effectiveness of air pollution policy, and to initiate changes as needed. Individual states may have their own specific inventory requirements, while at the federal level, requirements for emission inventories stem mainly from the Clean Air Act.

Some specific uses for an inventory include:
- Meeting Clean Air Act mandates for specific inventories as part of State Implementation Plans (SIPs);

- Tracking progress towards National Ambient Air Quality Standards (NAAQS) attainment and emission reductions;
- Determining compliance with emission regulations and setting the baseline for policy planning;
- Identifying sources and general emission levels, patterns, and trends to develop control strategies and new regulations;
- Predicting pollutant concentrations in the ambient air through the use of dispersion modeling;
- Providing input for human health risk assessment studies;
- Developing residual risk standards;
- Serving as the basis for preparing construction and operating permits; and
- Siting ambient air monitors.

**Page 5**
**The Importance of a Complete, Accurate Emissions Inventory**

A technically defensible emissions inventory serves as the foundation for sound public policy. Formulation of appropriate control strategies requires a reliable base of quality emissions estimates. If the data used to derive control strategies are flawed, the public policy resulting from the strategy will also be in error. These errors can be costly as the public is exposed to pollutants, the industry becomes subject to control, and the environment is damaged.

**Page 6**
**Types of Pollutants Inventoried**

This course will discuss 2 categories of pollutants: **Criteria Pollutants** and **Hazardous Air Pollutants** (**HAPs).**

The Clean Air Act directs the EPA to identify and set National Ambient Air Quality Standards or NAAQS for the most common air pollutants. EPA uses these "**criteria pollutants**" as indicators of air quality. These pollutants are: Ozone, Carbon Monoxide, Sulfur Dioxide, Nitrogen Oxides, PM 10 and PM 2.5, and Lead.

Currently, **188 HAPs** or Hazardous Air Pollutants are regulated under Section 112 of the Clean Air Act, and thousands of other potentially toxic substances are being emitted into the environment. Your agency may not have the resources to pursue each of these pollutants and might choose to prioritize the pollutants it needs to inventory. Moreover, some source categories may be of greater importance in your state and of more concern to your agency; therefore, the pollutants emitted from these sources would be of greater concern.

- Elemental **lead** emitted by stationary and mobile sources can cause several types of developmental effects in children including anemia and neurobehavioral and metabolic disorders. Non-ferrous smelters and battery plants are the most significant contributors to atmospheric lead emissions.

- **PM 10 and PM 2.5**
  Air pollutants called particulate matter include dust, dirt, soot, smoke, and liquid droplets. PM originates from a variety of sources, including:
  - Natural sources such as windblown dust and fires;
  - Combustion sources such as motor vehicles, power generation, fuel combustion at industrial facilities, residential fireplaces, and wood stoves. Combustion sources emit particles of ash or incompletely burned materials;
  - Activities such as materials handling, crushing and grinding operations, and travel on unpaved roads; and
  - Interaction of gases (such as ammonia, SO2, NOx, and VOC) with other compounds in the air to form PM.

- **Sulfur dioxide** is a colorless, pungent gas that is a respiratory irritant and like NOx , is a precursor to acid rain. Sulfur dioxide can also interact with other compounds in the air to form PM. Thus, sulfur compounds in the air contribute to visibility impairment in large parts of the country and is especially problematic in national parks. Ambient sulfur dioxide results largely from stationary sources such as coal and oil combustion, steel mills, refineries, pulp and paper mills, and nonferrous smelters.

- **Carbon monoxide** is a colorless, odorless, and poisonous gas produced by incomplete burning of carbon in fuels. More than 75 percent of the CO emissions in the United States are from transportation sources, particularly highway motor vehicles. Other major CO sources are wood-burning stoves, incinerators, and fuel combustion at industrial sources. When CO is inhaled, it enters the bloodstream, and reduces the delivery of oxygen to organs and tissues.

- **Nitrogen oxides** are important precursors to both ozone and acid rain, and as a result may affect not only human health, but also both terrestrial and aquatic ecosystems. Nitrogen oxides can interact with other compounds in the air to form PM.

  Nitrogen oxides form when fuel is burned at high temperatures. The two major emissions sources are motor vehicles and stationary fuel combustion sources such as electric utility and industrial boilers. The major mechanism for the formation of nitrogen dioxide in the atmosphere is the oxidation of the primary air pollutant nitric oxide. When inhaled, nitrogen dioxide can irritate the lungs, cause bronchitis and pneumonia, and lower resistance to respiratory infections.

- **Ozone** , a colorless gas, is the major component of smog. Ozone is not emitted directly into the air but is formed through complex chemical reactions between precursor emissions of VOC and NOx in the presence of sunlight. These reactions are accelerated by sunlight and increased temperatures. Peak ozone levels typically occur during the warmer times of the year. Ozone causes health problems because it damages lung tissue, reduces lung function, and sensitizes the lungs to other irritants.

- **Hazardous air pollutants**, also known as toxic air pollutants or air toxics, are those pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects.

EPA is required by the Clean Air Act to control 188 hazardous air pollutants. Examples of toxic air pollutants include benzene, which is found in gasoline; perchlorethlyene, which is emitted from some dry cleaning facilities; and methylene chloride, which is used as a solvent and paint stripper by a number of industries. A complete list of HAPs can be found on the EPA web site.

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**Types of Pollutants Inventoried- VOC's**

In addition to Criteria Pollutants and HAPs, EPA also regulates emissions of volatile organic compounds or VOCs under the criteria pollutant program. VOCs are ozone precursors—they react with nitrogen oxides in the atmosphere to form ozone. VOCs are emitted from motor vehicles, fuel distribution, chemical manufacturing, and a wide variety of industrial, commercial, and consumer solvent uses.

EPA's current regulatory definition of VOC is located in 40 CFR § 51.100. This definition excludes certain organic compounds considered to be negligibly photochemically reactive.

**Page 8**
**Types of Sources Inventoried**

Criteria Pollutants and HAPs are produced by 3 basic source types:
Point, Nonpoint and Onroad Mobile.

- **Point sources** are stationary sources of emissions identified individually in the inventory. Point sources may have a minimum reporting threshold; that is, sources emitting above a certain level must be included as point sources in the inventory. Thresholds can be based on level of emissions, potential emissions, type of source, or toxicity of the pollutant. There are often significant differences in the thresholds of emissions for HAPs and Criteria Pollutants.

- For **criteria pollutants**, the emission thresholds vary according to the attainment status and classification of the area in which the source is located, as shown in the chart below.

  Any stationary source emitting pollutants at levels equal to or greater than those shown in the preceding table must be inventoried and reported as point sources. In addition, many states also inventory and report stationary sources **below** these thresholds as point sources.

- Point sources are defined for **HAPs** as sources that emit 10 tons per year of any of the listed toxic air pollutants, or 25 tons per year of a mixture of air toxics. These sources may release air toxics from equipment leaks, when materials are transferred from one location to another, or during discharge through emission stacks or vents

- **Nonpoint sources** are facilities or activities whose individual emissions do not qualify them as point sources. Nonpoint sources represent numerous facilities or activities that individually release small amounts of a given pollutant, but collectively they can release significant amounts of a pollutant. For example, a single dry cleaner within an inventory area typically will not qualify as a point source, but collectively the emissions from all of the dry cleaning facilities in the inventory area may be significant; thus they must be included in the inventory.

- **Mobile sources** can be divided into onroad vehicles, which include automobiles, light trucks, heavy-duty trucks, buses, motorcycles and nonroad vehicles, such as airplanes, trains, farm and construction equipment, marine engines, and lawn mowers.

**Page 9**
**Overview of the EI Process**

An Emission Inventory has 6 parts of the process: Planning, Development, QA/QC Procedures, Documentation, Reporting, and Maintenance and Update.

In the following Lessons, each step will be discussed in more detail.

- **Planning Activities-** Careful and thorough planning of the inventory procedures will greatly facilitate the process and can prevent the need for costly revisions to the inventory during and after review. Planning includes detailing inventory objectives and general procedures and addresses important issues such as: How do I determine which pollutants to inventory, How do I identify sources of concern, and What data do I report? By considering all of the components of developing an inventory up front, the planning process ensures that proper action can be taken.

- **Inventory Development:** This is the main part of the inventory development process where the data collection and actual estimating and calculating of emissions takes place. Selection of the estimation method and approaches based on the best available data are critical to ensure that the most accurate and representative emissions estimates are included in the inventory.

- **QA/QC Procedures:** A comprehensive Quality Assurance/Quality Control (QA/QC) program is essential to the preparation of a reliable, defensible emissions inventory. Without certain checks along the way, flaws can compound and ruin the entire inventory.

- **Documentation-** Complete and well-organized documentation is necessary to prepare a reliable and technically defensible inventory document. The goal of inventory documentation is to ensure that the final written compilation of the data accurately reflects the inventory effort.

- **Reporting** - The reporting phase in developing an emissions inventory involves the presentation of the data which have been collected, compiled, and analyzed. Proper reporting of the data ensures that the information collected will be used and interpreted correctly.

- **Maintenance and Update -** Compiling an emissions inventory is a continuous process. Maintaining and updating the inventory will ensure its usefulness beyond the year it was first developed.

**Page 10**
**Summary**

Now that you have completed this lesson, you should be able to:

- Define the term Emissions Inventory.
- Describe the contents of a complete EI.
- Describe the uses of an accurate EI.
- Name the types of pollutants inventoried.
- Describe the six components in creating an inventory.

There are no review questions for this lesson, but concepts discussed here will be important in later lessons.

Continue by selecting a lesson using the Menu, or, just go to the next lesson.

# Lesson 3 – Planning for an Inventory

**Page 1**

This lesson is on planning for an inventory.

Upon completion of this lesson, you will be able to:

- Describe why planning and initial documentation is important,
- Identify the key resource issues to consider,
- Describe the main approaches to inventory development,
- Contrast the two emission estimation approaches, and
- Describe the different emission types to be inventoried.

**Page 2**
**Importance of Planning**

Careful and thorough planning of the inventory procedures will greatly facilitate the process and can prevent the need for costly revisions to the inventory during and after review. Air quality agencies compile emission inventories for a variety of purposes including: providing data required to evaluate ambient air quality, responding to legislation, or assessing the effectiveness of an air pollution policy. The anticipated purpose of the inventory will dictate the level of complexity and accuracy required, but each inventory requires extensive advanced planning.

When planning, it is important to consider all the steps in the process and resources available.

**Page 3**
**The Inventory Preparation Plan**

Before the inventory process begins, your agency should prepare an **inventory preparation plan (IPP)** to identify the required staffing levels, resource allocations, major milestones, and schedule for completion.

An IPP (sometimes referred to as an inventory work plan) is a concise, prescriptive document that states exactly how an agency intends to develop and present its inventory. The plan should include inventory objectives and general procedures, and should clearly describe how the inventory preparer will present and document the inventory for submission to EPA and/or others.

As part of the IPP process, you should consider the following:

- End uses of the data - The inventory preparer should be clear on the intended uses of the data. Examples of emission inventory uses are rulemaking, air toxics risk assessment, and regional scale air quality modeling.
- Scope of the inventory - The inventory preparer should know what the time period, geographic coverage, pollutants, and other coverages will be in the inventory.
- Availability and usefulness of existing data - The inventory preparer should learn about existing emission inventory and related data, how comprehensive and accurate the data are, and how useful the data would be in the preparation of an updated emission inventory.

- Strategy for data collection and management - The inventory preparer should consider how data will be collected and managed during and after the emission inventory preparation process. What data system will be used? How will data be reported and distributed?
- QA/QC procedures - The inventory preparer should consider how the data will be QC'd during collection, preparation, and finalization of the inventory.

**Page 4**
**Scope of the Inventory**

When considering the scope of the inventory, keep in mind some of these questions:

- What year should the inventory cover?
- What sectors will the inventory cover, point, nonpoint, and/or mobile?
- Geographic coverage? (County, tribal area, state or region)
- Pollutant coverage? (Criteria and or HAPs. Which HAPs)
- There are many things that need to be decided in the planning phase.

Deciding on them now will save you lots of time and money later.

**Page 5**
**Topics for the IPP**

The IPP is where Quality Assurance and Quality Control and Documentation procedures need to be established. Setting documentation guidelines at the outset is a good first step in creating a credible inventory.

Other details that should be established during planning are:

- File contents: Each member of the team should be aware of what materials must be placed in the project files;
- Location of all paper and electronic records;
- Ensuring that all hard copy records, as well as electronic databases and spreadsheets, are kept up-to-date;
- Procedures for adding data or background documentation to the file, including log-in procedures;
- Data tracking: To document who entered or manipulated data;
- Access to files: Checkout policies for paper documents, computer security policies for electronic files;
- Backup and maintenance of electronic files;
- File name conventions; and
- Reporting of data – who will the final inventory be reported to and in what format?

**Page 6**
**Resources Issues to Consider**

A key component of planning, is determining what resources are available to perform the tasks needed. In general, the data quality needs of the program will dictate the level of effort required for planning, executing, and quality assuring the results.

- **Staff-** What experience level is required and who is available to perform the task? Do you have the right people? When are they available?
- **Budget-** Is there enough money? Is it coming from local or federal sources? Do you need to request funding for inventory development in the Section 105 Grant Process?
- **Time-** How much time will it take to gather the information, calculate the emissions, compile the inventory, and perform the quality assurance/quality control tasks? What will the effort cost the agency in labor hours and time?
- **Data Processing-** Do you have adequate computer hardware (including storage capacity and backup capability) and the necessary software capable of processing and exchanging data with other organizations?
- **Communication-** What will be the coordination of effort within the agency? How will we work with people outside the agency?

**Page 7**
**Please answer the following review question.**
**Match the resource consideration, with the question that best pertains to it.**

| | |
|---|---|
| Time | Does the Section 105 Grant negotiations address inventory development? |
| Funding | What will the effort cost the agency in labor hours and time? |
| Proper Staffing | Who needs to give us approval to work with their people? |
| Intra- agency cooperation | Do we have the right skill sets on the team? |

**Page 8**
**Approaches to Inventory Development**

When planning the inventory, consider which approach will be used for estimating emissions. There are two main techniques to consider: top-down and bottom up.

A **top-down approach** means that your agency develops emission estimates based on national, regional or state data. You scale the national or regional estimates to your inventory area using some measure of activity data thought to be directly or indirectly related to the emissions in your area of study. Typically, sales data, or per employee, or per capita emission factors are used.

A **bottom-up approach** means you estimate emissions for individual sources and sum all sources to obtain state- or national-level estimates.

**Page 9**
**Summary of Approaches**

Both approaches have their advantages and disadvantages. The top-down approach is usually used when local data are not available, the cost to gather local information is prohibitive, or the end use of the data does not justify the cost of collecting detailed site-specific data.

The chart on the screen summarizes some of the key characteristics of each approach.

**Page 10**
**Emissions to be Inventoried**

Irrespective of whether a top-down or a bottom-up approach is used, inventories can be compiled using actual emissions, allowable emissions, or emissions based on a facility's potential to emit depending on the purpose of the inventory. The type of emissions should conform to the end use of the inventory and the availability of data.

**Actual emissions** are defined as the actual rate of emissions of a pollutant from a source (or emission unit within a source) calculated using actual operating hours, production rate, and where applicable, fuel combusted during the period of interest. For example, base year inventories developed in support of a SIP are compiled using actual emissions.

**Allowable emissions** are the product of an enforceable emissions rate (e.g., permitted pounds of VOC per gallon of solids applied), the anticipated operating rate or activity level (e.g., gallons of solids applied per hour), and the anticipated operating schedule (hours per day). In general, allowable emissions may be required when emission projections are being developed for use in SIP modeling.

**Potential to emit** (i.e., potential emissions) is the capability of a source, at maximum design capacity, to emit a pollutant after the application of air pollution control equipment. Potential to emit estimates are based on the maximum capacity of a source after taking into consideration enforceable permit conditions such as the type of materials combusted, the type of material processed, and the annual hours of operation. In general, potential emissions are estimated and reported in inventories in support of permitting activities under Title V of the Clean Air Act and may also be used in risk assessment analyses.

**Page 11**
**Review Question**

**True or false:**
The top-down approach is the preferred method for developing an emissions inventory because it requires less manpower to conduct the inventory and is just as accurate as other approaches.

a.True
**b.**False

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**Types of Sources to be Inventoried**

After you identify the pollutants to be inventoried, you will need to identify the source categories to be included in the emissions inventory. The number and types of the sources to be included is generally determined by the regulations driving the need for the inventory. It is important that the inventory planners specify which sources are to be included.

The approaches and sources of information for identifying which sources to include in your inventory vary according to the type of source that is being inventoried. As such, the approaches and sources of information for point sources and Nonpoint sources are discussed separately.

**Page 13**
**Types of Point Sources to be Inventoried**

EPA has published several documents containing general guidance for compiling emission inventories. These EPA documents identify numerous source categories for point sources and these are good starting points for developing a list of point source categories in the inventory area. However, not all the sources listed in these documents may be operating in your inventory area. Since the source category coverage is driven by the pollutants of interest, you should research possible sources for the particular pollutants and determine if any are operating in the inventory area.

**Page 14**
**Approaches to Identifying Point Sources**

There are many techniques for identifying point sources for the inventory. Some are:

- Research all of the documents and tools made available by EPA, the historical and current knowledge of your inventory area, and current research publications. All possible source categories for the given pollutant and inventory type should be investigated;
- Eliminate any sources that are not found within the inventory area.
- Prioritize the list of remaining categories based on the expected magnitude of emissions or some other measure of importance, such as the purpose of the inventory, regulated sources, sources under study for future regulations, or sources of specifically targeted pollutants;
- Consider the time and budget constraints under which you are operating; such constraints may require that the list of remaining source categories be reduced further. Resources should be allocated preferentially to the sources that are most important for meeting the inventory objectives;
- Eliminate from your source category list any categories for which no emission factors or acceptable methods have been developed.
- Document your decisions for the benefit of future preparers who may be able to expand the inventory's coverage or scope.

**Page 15**
**Sources of Information for Identifying Point Sources to be Inventoried**

Sources of information that are useful for identifying which point sources to inventory are as follows:

- The National Emissions Inventory, NEI database
- State and local commerce directories
- Existing state inventories of criteria pollutants and HAPs. An existing point source inventory is the best source of information, particularly if it has been frequently updated and well documented. A list prepared from the existing inventory will require updating by deleting any point source that has discontinued operation, making appropriate changes for any source that has changed status, and adding new point sources.
- Other agency files: Existing registration program of point sources (through annual inventory submittal programs, permit renewal programs, Risk Management Plan submittals, and/or upset and malfunction reports) though such programs usually do not include smaller significant point sources or fugitive emissions. Also, compliance, enforcement, and permit files are a useful source of information.

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**Sources of Information for Identifying Point Sources to be Inventoried (Cont.)**

- Toxic Release Inventory (TRI) data for your state
- Files of other government agencies such as labor, tax, commerce and trade agencies. State and local industrial directories typically contain companies listed alphabetically by SIC code and county;
- Standard and Poors, Registration of Corporations;
- Thomas Register;
- Trade and professional societies;
- The Dun and Bradstreet Million Dollar Directory listing companies with sales over $1,000,000 per year by SIC code and county that can be located at www.dnb.com; and
- Information regarding industries that are prevalent in the state. Finally, it should be noted that your agency may establish emission cutoff levels to exclude smaller sources from the inventory.

**Page 17**
**Types of Nonpoint Sources to be Inventoried**

A Nonpoint source inventory enables the agency to estimate emissions collectively for those sources that release small amounts of a given pollutant and/or are too numerous to be inventoried individually as part of the point source inventory.

To compile a Nonpoint source inventory, you will need to identify two different types of sources:

- Facilities, or activities within facilities, that emit levels of pollutants below the threshold level for point sources: Such facilities include dry cleaners and segments of the graphics arts industry, and

- Activities that result in emissions of pollutants below the threshold level for point sources: You will need to consider a diverse group of activities including surface coating, pesticide application, solvent use, asphalt use, agricultural burning, construction, residential wood combustion, and livestock production.

**Page 18**
**Approaches to Identifying Nonpoint Sources**

Because the source categories included in the inventory are driven by the pollutants of interest, you should research possible sources of pollutants and determine if any are operating in your inventory area. Specifically, you should:

- First review existing inventories for your area;
- Research all of the documents and tools made available by EPA, the historical and current knowledge of your inventory area, and current research publications. All possible source categories for the given pollutant and inventory type should be investigated;
- Eliminate any sources that are not found within the inventory area. For example, aviation gasoline distribution and open burning of scrap tires may not occur in the inventory area;
- Prioritize the list of remaining categories based on the expected magnitude of emissions or some other measure of importance, such as the purpose of the inventory, regulated sources, sources under study for future regulations, or sources of specifically-targeted pollutants;
- Consider the time and budget constraints under which you are operating; such constraints may require that the list of remaining source categories be reduced further. Resources should be allocated preferentially to the sources that are most important for meeting the inventory objectives;
- Eliminate from your source category list any categories for which no emission factors or acceptable methods have been developed.
- Document your decisions for the benefit of future preparers who may be able to expand the inventory's coverage or scope.

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**Sources of Information for Identifying Nonpoint Sources to be Inventoried**

Sources of information that are useful for identifying which Nonpoint source categories to inventory are existing state/local inventories of criteria pollutants and HAPs. An existing Nonpoint source inventory is the best source of information, particularly if it has been frequently updated and well documented. A list prepared from the existing inventory will require updating by:

- Deleting any Nonpoint source that has discontinued operation;
- Making appropriate changes for any source that has changed status; and
- Adding new Nonpoint sources.

Another source of information that is useful for identifying which Nonpoint source categories to inventory is the Toxic Release Inventory or TRI data for your state.

**Page 20**
**Cautions**

You should also be aware that some source categories such as electric utilities are usually treated as point sources and some source categories such as woodstove and fireplace use, are almost always treated as Nonpoint sources. However, others, such as dry cleaners and service stations, can be either point or Nonpoint sources depending on the size of the operation and the corresponding emission levels. Even within a point source facility, some activities occur that are more easily treated as Nonpoint source emissions. Some emissions associated with surface coating operations such as equipment cleaning, for example, can be more practically estimated using Nonpoint source methods. When a point source inventory and a Nonpoint source inventory estimate emissions from the same process, there is the possibility that emissions could be double counted. You may need to adjust the Nonpoint source inventory to avoid double counting.

You should also be cautious when using existing inventories or existing registration programs as sources of information on facilities. In general, you will be dealing with the same type of sources in both criteria and HAP inventories because most HAPs are a subset of either PM or VOC. However, not every source of criteria pollutant emissions will be included in the HAPs inventory. In addition, some pollutants may be considered as HAPs, but not a criteria pollutant. Moreover, you must not rely solely on an existing inventory for a complete list of sources to be covered in your criteria pollutant or HAP inventory.

**Page 21**
**Review Question**

Which of the following types of source categories can be classified as either a point source or a nonpoint source depending on the size of the operation and the corresponding emission levels?

a. Forest wildfires
b. Petroleum refineries
**c.** Degreasing operations
d. Solvent use

**Page 22**
**Data Resources**

The types of data needed to compile an emissions inventory include:

- **Inventory guidance** – The primary guidance on emission inventory development is summarized in the Emission Inventory Improvement Program volumes. These volumes present EPA's recognized standard for the development of reliable, quality-rated inventories.
- **Source characterization documents** – Source characterization information is needed to identify the sources that must be included in the inventory.
- **Emission factor resources** – Some of the most commonly used emission factor resources include AP-42, and emission factor databases such as the Factor Information Retrieval (FIRE) Data System and the Air Clearinghouse for Inventories and Emission Factors (Air CHIEF)

- **Existing inventories** – A well-documented, existing air emissions inventory is a good source of emissions data. Information contained in these inventories can at least serve as a starting point for developing extensive data and support information.
- **Activity data reference** – Activity data may be used to estimate emissions from Nonpoint and point sources. For point sources, this information can be obtained from contacts with individual facilities or other traditional sources of activity data. Nonpoint source emission estimates are generally based on surrogate activity data and an emission factor specifically for that activity. Activity data include population, employment, fuel or product usage, product sales, and type of land use correlated with air emissions.
- **Model resources** – Several emission estimation models are available for download free-of-charge. Some of these models include: TANKS, WATER and PM Calc.

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**Preliminary Screening Studies**

It may prove helpful during the planning process to conduct a screening study before commencing with a detailed air emissions inventory. The general idea behind a screening study is to develop preliminary estimates of emissions in order for the agency to focus its program and resources on the most important sources and pollutants. Ideally, a screening study should be performed quickly and inexpensively and yet yield results that allow the agency to make confidant decisions concerning program directions. A screening study should provide the agency with enough information to determine the following:

- What pollutants should be addressed in more detail?
- What source categories should be emphasized?
- What geographic areas should be included?
- What is the relative importance of major sources and Nonpoint sources?
- To what extent can the existing inventories and permit files be used as a foundation for the inventory? and
- Can upset or equipment malfunction reports provide useful emissions data?

**Page 24**
**Summary**

Now that you have completed this lesson, you should be able to:

- Describe why planning and initial documentation is important.
- Identify the key resources issues to consider.
- Describe the main approaches to inventory development.
- Contrast the two emission estimation approaches.
- Describe the different emission types to be inventoried.

Continue by selecting a lesson using the Menu, or, just go to the next lesson.

# Lesson 4 – Inventory Development

**Page 1**

This is the Inventory Development lesson.

Upon completion of this lesson, you will be able to:
- Describe the main approaches to inventory development,
- Describe the methods for estimating emissions,
- Explain how to select a method to estimate emissions,
- Explain the methods for collecting data for an emissions inventory, and
- Identify the sources of data for the inventory.

**Page 2**
**Methods for Estimating Emissions**

In Lesson 3 we covered the two main approaches that your agency can follow in estimating emissions: the top-down approach and the bottom-up approach. Whether using the top-down or the bottom-up approach, the main methods used in estimating emissions of criteria and toxic pollutants include:
- Emission factors;
- Material balance (including fuel analysis);
- Source testing;
- Emission estimation models (usually software);
- Surveys and questionnaires; and
- Engineering judgment/best approximation.

Each of these methods are discussed in detail in the following pages.

**3**
**Emission Factor Method for Estimating Emissions**

An emission factor is a ratio that relates the emissions of a pollutant to an activity level at a plant that can be easily measured, such as an amount of material processed, or an amount of fuel used. Given an emission factor and a known activity level, a simple multiplication yields an estimate of the emissions. Emission factors are generally developed from measured data for one or more facilities within an industry category, so they represent typical values for an industry, but do not necessarily represent what is occurring at a specific source. Published emission factors are available in numerous sources. Emission factors allow the development of generalized estimates of typical emissions from source categories or individual sources.

To calculate emissions using emission factors, three basic inputs to the estimation algorithm are required:

Activity information;

An emission factor; and

Information on capture and control efficiencies of any control device when using an uncontrolled emission factor.

The basic emission estimation equation when using an uncontrolled emission factor is: E = R x EF(uncontrolled) x (100 – C)/100

where: E = emission estimate for the process
R = activity level such as throughput
EF = emission factor assuming no control
C = capture efficiency x control efficiency (expressed in percent);
C = O if no control device is in place The basic emission estimation equation when using a controlled emission factor is: E = R x EF(controlled)

Nonpoint source emissions sometimes are not easily estimated by a direct measure of activity. In such a case, an emission factor that is based on a surrogate measure for activity level such as population or employment in an industry ***can be used***.

**Page 4**
**Material Balance Method for Estimating Emissions**

Material balance emissions are determined based on the amount of material that enters a process, the amount that leaves the process, and the amount shipped as part of the product itself. Fuel analysis is an example of a material balance. Emissions are determined based on the application of conservation laws. The presence of certain elements in fuels may be used to predict their presence in emission streams. For example, sulfur dioxide or SO2 emissions from oil combustion can be calculated based on the concentration of sulfur in the oil. This approach assumes complete conversion of sulfur to SO2 . For every pound of sulfur burned, two pounds of SO2 are emitted.

This technique is equally applicable to both point and nonpoint sources. Material balance is particularly useful for sources resulting in evaporative losses. Typical processes for which a material balance is particularly useful are solvent degreasing operations and surface coating operations. Material balance should not be used for processes where material reacts to form secondary products or where the material otherwise undergoes significant chemical changes.

The basic emission estimation equation for mass balance is:

$$E_x = (Q_{in} - Q_{out}) * C_x$$

where: $E_x$ = total emissions for pollutant x
$Q_{in}$ = quantity of material entering the process
$Q_{out}$ = quantity of material leaving the process as waste, recovered, or in product
$C_x$ = concentration of pollutant x in the material.

The term $Q_{out}$ could involve several different fates for an individual pollutant. This could include the amount recovered (or recycled) or the amount leaving the process in the product or waste stream.

**Page 5**
**Source Testing Method for Estimating Emissions**

Source testing emission rates are derived from short-term emission measurements taken at a stack or vent. Emission data can then be extrapolated to estimate long-term emissions from the same or similar sources. Continuous emission monitors or CEMs continuously measure and record actual emissions during the time of monitor operation. CEMs data can also be used to estimate emissions for different operating and longer averaging times. Results of source testing conducted by either a state or local agency or by the source itself can be used for estimating air emissions.

Although source testing generally yields more accurate emission estimates than emission factors or material balance, its use in emissions inventories may be limited for several reasons. First, source testing can be expensive. Second, source testing provides a snapshot of emissions from a process. As a result, uncertainties in source testing emission estimates arise because the process conditions may change over time while the test results can only reflect the emission rate and conditions during the test runs. Finally, standardized source testing reference methods have not been developed for all air pollutants particularly HAPs.

Source test data are of great value for obtaining general information on the characteristics of a particular industry and for obtaining specific information on pollutants being emitted and control device operational parameters. The raw data contained in source test reports can be used to develop emission factors for ***each pollutant and process tested***. Although source test data are site-specific, these data can be extrapolated to apply to other representative emission sources for purposes of calculating emissions.

**Page 6**
**Emission Estimation Model Method for Estimating Emissions**

Emission estimation models are empirically developed process equations used to estimate emissions from certain sources. An example emission estimation model is the TANKS software for estimating volatile organic compound emissions from fixed- and floating-roof storage tanks. Some emission estimation models currently available are based on measured or empirical values. Emission estimation software is used when a large number of equations and interactions must be manipulated and the effect of many different parameters must be accounted for in order to estimate emissions. The most widely used emission estimation models are:

- The Landfill Air Emissions Estimation Model
- TANKS to estimate emissions from fixed- and floating-roof storage tanks
- WATER to estimate air emissions from wastewater collection and treatment systems
- MOBILE for estimating emissions from cars and trucks
- NONROAD for estimating emissions from nonroad mobile sources such as construction and agricultural equipment

Additional emission estimation models are described in the various chapters of the Emissions Inventory Improvement Program, EIIP, series.

If you choose to use a non-EPA model to estimate emissions, you should do a thorough evaluation of that model/software and you should get prior approval from your EPA Regional Office.

**Page 7**
**Survey and Questionnaire Method for Estimating Emissions**

Surveys and questionnaires are commonly used to obtain facility-specific data on emissions and their sources. Also, they can be used to collect local or statewide data for certain source categories, such as wood burning for home heating.

The scope of the survey must be determined during the planning phase of the inventory. For example, a detailed survey may target all facilities within a specific source category or may list specific pollutants. This approach would reduce the number of sources contacted and improve the quality of the data collected because the survey questionnaire is tailored to specific types of sources with similar processes. Alternatively, the survey may not target specific sources nor limit the pollutants inventoried. This approach will require a more generic design of the survey questionnaire and consequently may result in less detailed and possibly less accurate data. In either case, you should ensure early on that your agency has the staff and resources to design, mail, process, administer, and analyze the results of a survey.

**Page 8**
**Engineering Judgment Method for Estimating Emissions**
An engineering judgment is made when the specific emission estimation techniques such as stack testing, material balance, or emission factor are not possible. This estimation is usually made by an engineer familiar with the specific process, and is based on whatever knowledge may be available.

Engineering judgment or best approximation must be considered as a last resort if none of the methods previously described can be used to generate accurate emission estimates. Engineering judgment may involve the application of speculative or innovative ideas, a poorly documented emission factor, or a crude material balance. In cases where no emission factors are available but adverse risk is low, it may be acceptable to apply factors from a similar source category using engineering judgment.

**Page 9**
**Selecting an Emissions Estimation Method**
Selecting a method to estimate emissions warrants a case-by-case analysis considering the cost and required accuracy in the specific situation. When selecting an emissions estimation method, you should consider several issues when analyzing the tradeoffs between cost and accuracy of the resulting estimates. These issues include:

- Availability of quality data needed for developing emissions estimates;
- Practicality of the method for the specific source category;
- Intended end use of the inventory (for example, an inventory in support of significant regulatory implications such as residual risk or environmental justice issues may require that more accurate and costly emission estimation methods be used than would an inventory intended for simply a source characterization);
- Source category priority (for example, if a source category is of relatively high priority, it may require a more accurate emission estimation method);
- Time available to prepare the inventory; and
- Resources available in terms of staff and funding. To help you decide which estimation methods to use, you should refer to the EIIP series of documents. An important aspect of

the EIIP's selection of methods was the identification of "preferred" and "alternative" methods.

**Page 10**
**Review Question**

The use of a fuel analysis for estimating emissions from a coal-fired boiler represents which method of estimating emissions?

a. Emission factors
**b.** Materials balance
c. Source testing
d. Emission estimation modeling

**Page 11**
**Data Collection Methods for Point Sources**
For point source inventories, you can obtain information by contacting each point source in the inventory area. The two most common types of plant contacts are: Surveys and Plant Inspections.

You can use the survey technique to obtain source and emissions data by sending a questionnaire to each point source in the inventory area.

Plant inspections give you the opportunity to examine the various processes at a particular facility, interview plant personnel, and review operations and process schematics. While plant inspection is a very resource-intensive data collection technique, it tends to be more accurate then the survey technique, and may be appropriate for larger sources.

You can also use indirect plant contact techniques to gather data for point source inventories, such as examining permit applications and compliance files. You may need to use a combination of data gathering techniques to ensure complete and accurate data are available for compilation of an inventory. Appropriate methods are selected during the planning phase of the inventory process, based on the goals of the inventory and availability of resources.

**Page 12**
**Data Collection Methods for Nonpoint Sources**

Data resources for nonpoint source inventories vary much more than those for point sources. You can collect nonpoint source data from a number of diverse sources.

Surveys - You can use surveys of a representative sample to collect data that can be extrapolated to the nonpoint source category. You must use caution to ensure that the surveyed subset is representative of the entire population. You may use the same steps to survey nonpoint sources as you use for point sources, but often the steps taken are driven by available resources and data.

Examination of Local, State, and Federal Documents and Databases - State, local, and federal agencies such as the U.S. Bureau of the Census and the Energy Information Administration generate summary reports containing information on population trends, land use, business patterns, agricultural trends, fuel use, chemical production and use, and meteorological conditions. You will find that these documents are often valuable resources for determining appropriate activity data or parameters for apportioning data. Many of these documents are available on the Internet. You may also find that personnel at these agencies can be valuable data resources.

Examination of Trade Association Reports, Journals, and Databases - Trade association documents, journals, and market research reports can provide information on past sales and future trends for specific industry sectors. You can use this information to determine appropriate activity data or parameters for apportioning data.

**Page 13**
**Data Resources for Compiling an Emissions Inventory**

This section introduces the various data resources available to you in compiling an emissions inventory. The types of data you will need to compile a complete emissions inventory include:

- Inventory guidance;
- Existing emission data;
- Emission factor resources;
- Models resources;
- Source characterization documents that characterize an industry, including a description of processes, operating parameters, equipment used, emissions generated; and volume and type of output produced; and
- Applicable Activity Parameters.

In many cases a single document can provide information on one or more of the types of data needed for your inventory. For example, EIIP is an excellent resource for inventory guidance as well as source characterization, and AP-42 is an excellent resource for both emission factors and source categorization.

Each of these data resources will be covered in the next few pages.

**Page 14**
**Inventory Guidance**

The primary guidance on emission inventory development is summarized in the EIIP volumes.

The EIIP volumes were developed through a joint process involving state and local agencies and EPA. These volumes present EPA's recognized standard for the development of reliable, quality-rated inventories. The EIIP documents present preferred and alternative methods for estimating emissions from point, nonpoint, mobile, and biogenic source categories. Hard copies of these manuals are available from the National Technical Information Service. Electronic copies of the EIIP documents can be downloaded off the World Wide Web through the EIIP Web site.

Additional emissions inventory guidance, such as EPA's SIP Emission Inventory Guidance, can be downloaded off the World Wide Web through EPA's CHIEF Web site.

**Page 15**
**Existing Emission Data**

A well-documented, existing air emissions inventory is a good starting point for preparing a new inventory. Information from an existing inventory could be incorporated into questionnaires to facilities, asking them to update activity, emissions and other appropriate information. The existing inventory could also be used as a resource for estimation methods for the new inventory.

Be aware that existing inventories may focus on pollutants other than those needed in the inventory being prepared. Thus, certain sources that emit only one type of pollutant may not be well represented.

In addition to previous inventories, there are other current and accessible national emission databases available for review and assessment in developing an emissions inventory.

A less desirable but possible source of emissions data is through the extrapolation of emissions from one geographic region to another. This approach may be most appropriate when the socioeconomic conditions between two regions are comparable. In these situations, the emissions data for one region can be extrapolated to the other region based on population, employment, or other representative surrogates of the activity causing the emissions.

**Page 16**
**Emission Factor and Material Balance Information**

The following four main types of resources can be used to locate emission factors:

**Emission Factor Documents**
Emission factors have long been used as a cost-effective means to develop emission inventories. They are simply multipled by activity levels to estimate emissions. The primary documents for emission factors are:
• Compilation of Air Pollutant Emission Factors (AP-42); and
• Locating and Estimating Air Emissions Documents.

**Emission Factor Databases**
The most widely used emission factor database for state and local agencies is:
•Factor Information Retrieval Data System or FIRE.

**Source testing data** used for compliance purposes and in developing operating permits for stationary sources may be readily available through state and local air permitting agencies.

**Material Safety Data Sheets and Certified Product Data Sheets.**
The MSDS and CPDS are sources of speciation profiles. Each MSDS and CPDS lists specific compounds and weight percentages of hazardous ingredients present in a certain material. The MSDS and CPDS are especially important when using material balances as an emissions estimation tool. The MSDS and CPDS are easy to obtain as a result of state and federal right-to-know laws that require that information be made available on the composition of products being used in the work place.

**Page 17**
**Models Information**

Several emission estimation models are available for download free-of-charge from EPA’s web site.

- Landfill Gas Emissions Model
- TANKS to estimate emissions from fixed- and floating-roof storage tanks
- WATER to estimate air emissions from wastewater collection and treatment systems
- PM Calc for estimating PM emissions

**Page 18**
**Source Characterization Information**

You will need source characterization information to identify the sources you must include in the inventory. Source characterization information includes:

- Description of the sources, facilities, or activities included in the source category. For example, the boiler source category comprises sources that combust fuels to produce hot water and/or steam. The source category definition can include the North American Industrial Classification System code, Maximum Available Control Technology code, or the EPA Source Category Code or SCC,
- Description of emission sources within the source category. For example, the boilers category includes coal-fired boilers, oil-fired boilers, boilers using other types of fuel, cogeneration units, and auxiliary sources, and
- Discussion of the factors influencing emissions such as control techniques, influences of weather conditions, or process operating factors.

Several resources are available to you for source characterization. Primary resources include:

- AP-42.
- Locating and Estimating Air Emissions from Sources of (Source Category or Substance) Documents. About 30 Locating and Estimating, L&E. documents are currently available. Although L&E documents concentrate on hazardous air pollutants (HAPs), these documents can be useful for criteria pollutant inventories because each volume includes general descriptions of the emitting processes, and provides source characterization.
- Industry Sector Notebooks: The EPA's Office of Compliance has developed a series of notebooks profiling selected major industrial groups. Each sector-specific notebook brings comprehensive details that include an environmental profile, industrial process information, and bibliographic references.

**Page 19**
**Applicable Activity Parameters**

You may need to use different types of activity data to estimate emissions from nonpoint and point sources - even within the same source category. Point sources may require direct measurement or direct activity such as throughput applied to an emission factor, while emissions from nonpoint sources are often estimated using surrogate activity factors, such as population or employment.

For point sources, activity parameters are generally reported as fuel consumption rates or process weight rates for fuel-burning equipment and industrial processes, respectively. You will need detailed data on process equipment, throughput, capacity, and other parameters to estimate emissions from point sources. You can obtain this information from contacts with individual facilities. The two most common types of plant contacts are surveys and questionnaires, and direct plant inspections. A type of indirect plant contact also commonly employed is the use of permit applications or compliance files.

Nonpoint source emission estimates are generally based on surrogate activity data and an emission factor developed specifically for that activity. Activity data include population, employment, fuel or product usage, product sales, and types of land use correlated with air emissions.

**Page 20**
**Review Question**

Material Safety Data Sheets and Certified Product Data Sheets are most useful for which method of estimating emissions?

a.Emission factors
**b.**Materials balance
c.Source testing
d.Emission estimation modeling

**Page 21**
**Summary**

Now that you have completed this lesson, you should be able to:

- Describe the main approaches to inventory development.
- Describe the methods for estimating emissions.
- Explain how to select a method to estimate emissions.
- Explain the methods for collecting data for an emissions inventory
- Identify the sources of data for the inventory.

Continue by selecting a lesson using the Menu, or, just go to the next lesson.

# Lesson 5 – QA/QC

**Page 1**
This lesson is about Quality Control and Quality Assurance or QA/QC.

Upon completion of this lesson, you will be able to:
- Define Quality Control,
- Define Quality Assurance,
- Describe the difference between Data Quality Indicators and Data Quality Objectives,
- Describe commonly used QA/QC techniques,
- Describe the procedures for correcting typical errors, and
- List what QA/QC procedures need to be documented.

**Page 2**
**Introduction to QA/QC**

A comprehensive Quality Assurance program is essential to the preparation of a reliable, defensible emissions inventory. In addition, a thorough QA/QC system ensures confidence in the inventory.

**Page 3**
**Definitions**

A QA program comprises two distinct components: Quality Control and Quality Assurance.

Quality Control or QC is a system of routine technical activities implemented by **the inventory development team** to measure and control the quality of the inventory as it is being compiled. QC procedures include technical reviews, accuracy checks, and the use of approved standardized procedures for emissions calculations.

Quality Assurance or QA is a system of external review and audit procedures conducted by **personnel not involved** in the inventory development process. QA is an independent, objective review by a third party to assess the effectiveness of the QC program and the quality, completeness, accuracy, precision, and representativeness of the inventory.

**Page 4**
**Don't Overlook QA/QC**

A common shortcoming of many inventory development programs is that inadequate resources are devoted to QA/QC activities. A general rule of thumb used by many QA professionals is that 10 percent of the allocated resources should be used for QA activities. This does not include the costs of QC, which are assumed to be built into the process.

Too often, QA activities are concentrated at the end of the inventory process. An effective QA program will include planning, numerous QC checks during inventory development, and QA audits at strategic points in the process.

Although the QA/QC process can take significant time and effort, it will save you time and money in the long run by reducing invalid results

**Page 5**
**DQOs**

**DQOs, data quality objectives**, are qualitative and quantitative statements to identify the level of uncertainty that a decision-maker is willing to accept. The purpose of DQOs is to ensure that the final data will be sufficient for the intended use.

DQOs are identified as part of the inventory planning process. They are determined based on the end use of the inventory, but should realistically reflect the limitations resulting from time constraints, resource (staff and funding) limitations, and lack of data. A statement of DQOs should be prepared as part of the inventory preparation plan.

The development of a DQO statement is an iterative process. The managers must work together to balance the quality objectives and the available resources. It is important to acknowledge the constraints that limit the ultimate quality of the inventory, especially if the achievable DQOs fall short of the desired DQOs.

Your task manager is responsible for defining the DQOs for the inventory. Your responsibility as the inventory preparer is to make sure your results meet the agreed upon DQOs.

**Page 6**
**DQIs**

**DQIs or data quality indicators** are qualitative and quantitative descriptors used to interpret the degree of acceptability or utility of the data. The principal DQIs are:

**Accuracy:** The closeness of a measurement to the true value, or the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of error (precision) and systematic error (bias) that are due to sampling and analytical operations;

**Comparability:** The degree to which different methods, data sets, or decisions agree or can be represented as similar;

**Completeness:** The amount of valid data obtained compared to the planned amount; and

**Representativeness:** The degree to which an inventory is representative of the region and sources it is meant to cover.

**Page 7**
**Review Question**

After data is collected a team member reports that there was a problem with the measurement device on which some of the data are based. The problem lead to measurement readings that were in error by plus or minus 3%. A team manager reviews the tolerance levels set forth in the planning stages and determines that the data should be collected again.

This situation best represents which combination of the following terms?
a. QA and DQOs
b. QA and DQIs
c. QC and DQOs
**d.** QC and DQIs

**Page 8**
**Quality Control Procedures**

Quality control is best implemented through the use of standardized checklists that assess the adequacy of the data and procedures at various intervals in the inventory development process. QC checklists should be used to monitor data collection procedures, data calculations, evaluations of data and data tracking.

Checklists can assist you in finalizing the inventory prior to submitting it to a reviewing agency (e.g., EPA). The checklist includes questions concerning completeness, use of approved procedures, and reasonableness.

**Page 9**
**QA/QC Techniques**

Some common QA/QC techniques are: Reality Check, Computerized Checks, Peer Review, Statistical Checks, Replication of Calculations and QA Audits.
These techniques can aid in ensuring a defensible inventory is compiled. Keep in mind that each technique has its own strengths and weaknesses and therefore a combination of techniques should be used throughout the process.

- The **reality check** is the most commonly used QA/QC method and is used to catch large errors early in the estimation process. This check is in the form of the questions "Is this number reasonable?" or "Does this number make sense?" You should never use the reality check as the sole criterion of quality. Each reviewer should carefully document the results of the reality check, using standardized forms or report formats, when applicable.

- **Computerized data checks** can be built-in functions of databases, models, or spreadsheets or can be designed as stand-alone programs. You can use automated QA/QC functions to facilitate peer review or, in some cases, replace manual reality checks. Computer-based QC checks can process large volumes of data quickly, significantly reducing the amount of time needed to compile and QA an inventory.

  When using automated data checks, keep in mind that human reasoning and judgment are necessary to evaluate the data for errors. Automated data checks are not a substitute for evaluation of the data by an auditor; they serve as a tool to allow an auditor to evaluate the data efficiently. EPA has various QC tools available to state, local and tribal emission inventory preparers to assist in the QC of their data.

- **Peer review** is an independent review of calculations, assumptions, and/or documentation by a person with a moderate to high level of technical experience. Peer review generally involves reading or reviewing documentation. Peer review is conducted to ensure that assumptions and procedures are reasonable, but might not include rigorous certification of data or references.

  No specific tools are required to conduct replication of calculations, but the use of checklists or review forms is recommended. A checklist ensures that reviewers have a clear understanding of what they are expected to do. Also, checklists provide an efficient means to document the QC procedure.

- **Statistical check** procedures can be used as tools to facilitate reality checks, peer reviews, and independent audits. They can be used to compare results or to identify unusual or unlikely values. Statistical data checks can process large amounts of data and reduce the subjectivity of informal reality checks.

- **Replication of calculations** is the most reliable way to detect computational errors and can be done by any team member involved in the inventory. Replication of calculations should be conducted throughout the inventory process by the author of the original calculations as a self-check, by the team member conducting QC checks, and as part of the QA audit.

  When using replication of calculations as a QC check of the data, you must keep in mind that replication of calculations does not check to ensure that the approach and assumptions are correct, and does not involve a check of the accuracy or quality of the original data. Also, this is a labor-intensive process.

- **QA audits** are independent audits that involve a systematic evaluation of the emission inventory preparation process. They are a managerial tool to evaluate how effectively the emissions inventory team complies with predetermined specifications for developing an accurate and complete inventory. QA audits are conducted to determine whether QC procedures are effective and being followed, and whether additional QC is necessary to the inventory development process.

**Page 10**
**Review Question**

**Match the term, with the definition**

| | |
|---|---|
| Reality Check | Can be used to compare results or to identify unusual or unlikely values and by processing large amounts of data and reduce the subjectivity of informal reality checks. |
| Peer Review | Most commonly used QA/QC method and is used to catch large errors early in the estimation process. |
| Replicaitons of Caluculations | A review of procedures and quality of data by people outside of the inventory team. |
| Statistical Checks | Conducted to ensure that assumptions and procedures are reasonable, but might not include rigorous certification of data or references. |
| QA Audits | Detects computational errors, but does not check to ensure that the approach, assumptions or data are correct. |

**Page 11**
**Typical Errors**

A key part of Quality Control is recognizing where errors typically happen and making a plan to avoid them. This is something that should take place in the planning stages.

Typical errors found in inventories include:
- Missing facilities;
- Duplicate facilities that could occur as a result of name changes through corporate acquisitions;
- Improper facility location data;
- Missing operating or technical data;
- Erroneous technical data including misinterpretation of data or transcription errors;
- Inconsistent point and nonpoint source size designation or failure to designate inventory size cutoffs;
- Errors in calculations such as transposition of digits; decimal errors; entering wrong numbers; and misinterpreting emission factor applications; and, finally,
- Data entry and transposition errors and data coding errors.

**Page 12**
**Identifying Gaps in the Inventory**

Data gaps in the inventory may be the result of:

- Pollutants unaccounted for due to a lack of credible emission factors;
- Facilities that are missing or unaccounted for due to incomplete source lists
- Source categories that have not been considered due to a lack of credible emission factors or activity data;
- Oversight of a facility or source category during inventory compilation; and
- Data entry error resulting in some data not being included in the inventory database.

**Page 13**
**Filling Gaps in the Inventory**

Filling data gaps is done on a case-by-case basis and depends on the nature of the data gap and the importance of the source category under review. You should prioritize your gap filling effort. You must carefully document your gap filling actions, including all assumptions made and all resources used.

Data quality issues may surface when filling data gaps. For example, you might derive emissions from a certain source category by projecting emissions from previous national inventories based upon growth indicators. These emissions estimates may not adequately capture facility shutdowns, new facilities, changes in operations relative to the previous inventory levels, or additions of new controls. Thus, while there are emission estimates available for gap filling, the data quality will not be of the same level as the emission estimates developed using actual and current data.

You should discuss this tradeoff between accuracy and completeness with your task manager before you make a decision on gap filling strategy.

**Page 14**
**Double Counting**

Double counting occurs when the emissions from one source are included twice in the same inventory. Double counting can result from:

- Overlap between point and nonpoint sources, and
- Overlap between nonpoint source categories
- Note that it is acceptable to overlap emissions for certain pollutants in the criteria and air toxics inventories. For example, certain organic compounds, which are a subset of VOC's, may be included in the air toxics inventory, while the class of VOC's are included in the criteria pollutant inventory.

For example, emissions from large dry cleaning facilities (above the threshold for point sources) are included in the point source inventory. If you do not take steps to ensure that these emissions are not included in the nonpoint source inventory for dry cleaning facilities, the emissions will be counted twice. Inventory preparers should compare the lists of point and nonpoint emission sources to see if any sources have been included in both inventories. If the emissions from a process at a facility have been included in both the point and nonpoint source inventories, then the nonpoint source inventory must be adjusted downward to avoid double counting the emissions. **(Point/ nonpoint overlap)**

For example, when compiling an emission estimate for the prescribed burning nonpoint source category, you must be careful not to include emissions from agricultural burning. To avoid this type of double counting, you must become very familiar with the definitions of each nonpoint source category and understand the processes.

**Page 15**
**Documenting QA/QC Procedures**

Each member of the inventory project team should follow the QA/QC documentation procedures prescribed in the inventory preparation plan. All QA/QC activities and results must be documented and reported, either as part of the inventory report, or as a separate document. The report should include:

- Procedures used to meet the QA/QC objectives of the project;
- Technical approach used to implement the QA plan;
- Dates of each audit, and the names of the reviewers;
- Results of QA activities, including problems found, corrective actions, and recommendations; and
- Discussion of the inventory quality.

As a rule, document everything that pertains to the quality of the inventory. This will help to resolve conflict and increase the credibility of the final report.

**Page 16**
**Review Question**

The following scenario most accurately depicts which of the terms listed below.

A local agency has identified three factories for inclusion in a county level emissions inventory. Factories A, B, and C emit a total of 20, 30, and 40 lbs per year of benzene, respectively. A total of 90 lbs of benzene is recorded in the inventory. Upon further review, it is learned that factories B and C share some of the benzene emission sources.

a. Independent audits
**b.** Double counting
c. Data gaps
d. Filling gaps

**Page 17**
**Summary**

Now that you have completed this lesson, you should be able to:

- Define Quality Control (QC).
- Define Quality Assurance (QA).
- Describe the difference between Data Quality Indicators and Data Quality Objectives.
- Describe commonly used QA/QC techniques.
- Describe the procedures for correcting typical errors.
- List what QA/QC procedures need to be documented.

Continue by selecting a lesson using the Menu, or, just go to the next lesson.

# Lesson 6 - Documentation

**Page 1**
This is the Documentation lesson.

Upon completion of this lesson, you will be able to:

- Cite reasons to properly document an inventory, and
- Identify what records must be kept during the process.

**Page 2**
**Reasons Documentation is Important**

Complete and well-organized documentation is necessary to prepare a reliable and technically defensible inventory document. The goal of inventory documentation is to ensure that the final written compilation of the data accurately reflects the inventory effort.

In addition, thorough documentation is necessary to:

- Support QA/QC assessments of the inventory. During the inventory compilation process, QA/QC and technical review of the documentation can identify errors in assumptions, calculations, or methods. Remedial actions can be taken to correct any errors.
- Ensure the reproducibility of the inventory estimates. The inventory documentation should include all of the information necessary for an inventory user or reviewer to reproduce the results of each estimate. A well-documented inventory will provide a "paper trail" for each data point, allowing a user or reviewer to identify all of the resources used to calculate each value presented in the report.
- Enable an inventory user or reviewer to assess the quality of the emission estimates and identify the data references, and
- Ensure that the inventory will serve as a solid foundation for future inventories compiled for that inventory area.

**Page 3**
**Record Keeping**

The documentation of an inventory involves keeping a record of all data collection and emission estimates activities, as well as the compilation of a final written report. The type of information records to be maintained depends on the source of the data.

- **Survey-** Original survey forms
- **Site visits -** Site visit notes and reports
- **Source test reports -** Complete copies of the reports.
- **Internet pages or electronic bulletin boards -**
    - Hard copy printouts of the pertinent data
    - Electronic copies of complete original data
    - Complete reference citation
- **Published documents**
    - Complete reference citation
    - When possible, copies of the pages with the data used in the inventory
- **Unpublished documents or reports**

  - Complete reference citation
  - Copies of all pages with data used in the inventory
  - When possible, a copy of the entire document
- **Personal written communication**
  - Complete reference citation (contact name, affiliation, address or phone number, date of communication)
  - Copies of all pages with data used in the inventory
  - When possible, a copy of the entire document
- **Personal verbal communication**
  - Standardized Contact Report Form should be completed to record information obtained by telephone or at a meeting. An example Contact Report form is presented in EIIP Volume VI, Chapter 2.

**Page 4**
**What to Include on a Record?**

In general, certain items must be included on all documentation to maintain its integrity. There will be some differences for manual and spreadsheet calculation sheets, but the general rule is to be sure that everything is named, dated and referenced. On this page, you will see a form that contains all the required information for a spreadsheet calculation. Roll your mouse over the different areas to explore what they are.

**Page 5**
**Review Question**

Which of the following sentences best summarizes the concept of documentation as presented in this Lesson?

a.Documentation is the act of collating information to generate a large, impressive looking report.
**b.**Documentation is the thorough process of referencing all the sources and data to create a defensible and reproducible inventory.
c.Documentation is useful only when creating a new emissions inventory.
d.Documentation is important only to those that hope to find flaws in the inventory.

**Page 6**
**Summary**

Now that you have completed this lesson, you should be able to:

- Cite reasons to properly document an inventory.
- Identify what records must be kept during the process.

Continue by selecting a lesson using the Menu, or, just go to the next lesson.

# Lesson 7 – Reporting

**Page 1**
This lesson will review Reporting procedures.

Upon completion of this lesson, you will be able to:

- Identify the various forms for reporting emissions inventory data,
- Describe the Toxic Release Inventory,
- Describe the National Emissions Inventory, and
- Describe the Consolidated Emission Reporting Rule.

**Page 2**
**Overview**

The final phase in developing an emissions inventory is the presentation of the data which have been collected, compiled, and analyzed. The data can be presented in a variety of forms, from unorganized raw data listings to aggregate summary reports. Generally, the form in which the data will be presented is determined by how the data can be most efficiently summarized, and more importantly, why the inventory was conducted.

**Page 3**
**Reporting Forms**

The purpose of the emissions inventory is the primary consideration in deciding on a reporting format. An inventory developed only for research purposes can be presented in many forms. For example, a raw data listing, which basically presents the data compiled in the inventory, could consist of computer printouts of sources and emissions.

On the other hand, reports which are for use outside of your agency will usually be more formal than reports for internal use. External reports such as public information pamphlets and emission control program documents, require formatting which clearly presents summarized inventory data. These summary reports include information that has been aggregated and organized in some manner during the reporting process. For instance, a summary report of total toxic emissions from all degreasers in an area would involve totaling emission estimates stored in certain file records. A more formal summary report will convey the inventory information clearly and concisely to the document reader.

In addition to required reporting formats, a wide variety of tables and graphic displays can be used to present inventory data. Charts, tables, and graphs can quickly convey to the reader emission breakdowns by industries, geographical areas or source size. Emissions trends and the effects of control programs can also be tabulated or graphed.

**Page 4**
**Specific Reporting Programs**

In addition to summary reports, certain regulatory reporting programs require or encourage the submission of emissions data in a specific format. Some examples of programs that involve the reporting of emissions data to the EPA include:

**Toxic Release Inventory** Section 313 of the Emergency Planning and Community Right-to-Know Act requires EPA and the States to annually collect data on releases and transfers of certain toxic chemicals from industrial facilities, and make the data available to the public in the Toxics Release Inventory. TRI is a publicly available database that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industries. Each year, facilities that meet certain thresholds must report their releases and other waste management activities for listed toxic chemicals to EPA and to the state or tribal entity in whose jurisdiction the facility is located. Reports for each calendar year are due by July 1 of the following year. After completion of data entry and data quality assurance activities, EPA makes the data available to the public in printed reports, in a computer database, and through a variety of other information products.

**National Emissions Inventory** The National Emissions Inventory (NEI) is a comprehensive inventory covering all criteria pollutants and hazardous air pollutants for all areas of the United States. These data are used for air dispersion modeling, regional strategy development, regulation setting, air toxics risk assessment, and tracking trends in emissions over time. The database has evolved from the National Emissions Trends database and the National Toxics Inventory database.

EPA prepares this inventory with input from State, local and Tribal air agencies and encourages these agencies to provide emissions data for their areas to improve the reliability of the National Emissions Inventory. The format for reporting data to the NEI is the NEI Input Format (NIF). Data may also be reported using the XML schema for the NEI. All data reported for incorporation into the NEI must be reported through EPA's Central Data Exchange.

**Page 5**
**Consolidated Emission Reporting Rule**

Finally, no discussion of reporting of emissions inventory data would be complete without a discussion of the Consolidated Emissions Reporting Rule or CERR. The CERR was published in the Federal Register on June 10, 2002. The purpose of the CERR is to simplify reporting, offer options for data collection and exchange, and unify reporting dates for various categories of criteria pollutant emission inventories. The rule applies to State and local agencies and consolidates the emission reporting requirements found in various parts of the Clean Air Act. It is important to note, however, that the CERR does not require states to report air toxic emissions.

**Page 6**
**Review Question**

Which of the following emissions data reporting programs requires industrial facilities to submit data directly to EPA?

**a.** Toxic Release Inventory
b. National Emissions Inventory
c. Consolidated Emissions Reporting Rule

**Page 7**
**Summary**

Now that you have completed this lesson, you should be able to:

- Identify the various forms for reporting emissions inventory data.
- Describe the Toxic Release Inventory.
- Describe the National Emissions Inventory.
- Describe the Consolidated Emission Reporting Rule.

Continue by selecting a lesson using the Menu, or, just go to the next lesson.

# Lesson 8 – Maintenance and Update

**Page 1**
This is the Maintenance and Update lesson.

Upon completion of this lesson, you will be able to:

- Identify reasons for maintaining and updating an inventory.

**Page 2**
**A Continuous Process**

Compiling an air toxics emissions inventory is a continuous process. Maintaining and updating the inventory will ensure its usefulness beyond the year it was first developed.

**Page 3**
**Reasons to Update**

Changes in the total number of sources must be monitored as well as changes in the operation of existing sources. During a year, changes can occur that might impact the emissions inventory. For example:

- Existing facilities could deactivate process equipment or close completely;
- New facilities and/or processes could come online;
- Existing facilities could increase or decrease production schedules;
- Existing facilities could modify their product line;
- Population changes could affect the number and type of nonpoint sources;
- Changes in land use patterns could affect the number and type of nonpoint sources;
- Changes in regulations could impact the inventory scope; and
- Updates in emission factors or other emission estimation tools could require recalculation of certain emission estimates.

**Page 4**
**Updating the Inventory**

To maintain an accurate emission inventory, complete, concise documentation and QA procedures must be implemented as well as good data management practices.

It is necessary to collect new data and information to calculate emissions to represent current conditions. Existing inventories should serve as a starting point because they contain extensive data and support information files. For effective use of resources, build upon and improve the quality of existing data to fulfill inventory requirements. Document these changes as they become known and update the emission estimates accordingly.

**Page 5**
**Review Question**

Which of the following is **NOT** a reason to update an inventory?

a. A new facility becomes operational.
b. An existing facility makes major changes to its production line.
c. The urban area is in a boom and the population triples.
d. A change in EPA policy that changes the scope of the inventory.
**e.** All of the above are reasons to update.

**Page 6**
**Summary**

Now that you have completed this lesson, you should be able to:

- Identify reasons for maintaining and updating an inventory.

That concludes the last lesson of this course. Please use the menu to review any lessons, or press the “X” in the lower left corner to exit the course.