Emission Inventories – The Basics

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What Will We Cover?

- Resources
- Definitions
- Applicable Regulations
- Nomenclature
- National Emission Pie Charts
- Emission Estimation Techniques
- AP42 Emission Factors
- Stationary Point Sources
- Stationary Area Sources
- Mobile Sources (not much)
- NIF
- Submitting EI to EPA
- Remaining Issues

Resources

- *Handbook for Criteria Pollutant Inventory Development* (A beginner's guide)
  - Found on EPA's CHIEF website
    - http://www.epa.gov/ttn/chief/eidocs/publications.html
- EIIP Technical Documents
  - Introduction to Point and Area Source Emission Inventories
    - http://www.epa.gov/ttn/chief/eiip/techreport/index.html

Resources, Cont.

- CHIEF
  - Clearinghouse for Inventories and Emission Factors
    - http://www.epa.gov/ttn/chief/
  - List Server
  - Emission Factors
  - Links to Inventory Data, EIIP, AP-42
- Consolidated Emission Reporting Rule

What Is An Emission Inventory?

- Comprehensive listing, by source, of the air pollutant emissions
- Specific geographic area
- Specific time period

Why Do We Need Inventories?

- Required by Clean Air Act
  - CERR – Consolidated Emission Reporting Rule
- The inventory is a fundamental building block in developing an air quality control and maintenance strategy
- Primarily used for Modeling

To CERR with Love

- What are the Federal Requirements?
  - Consolidated Emission Reporting Rule (CERR)
- Promulgated June 10, 2002
- See handout

Federal Requirements

- Sectors
  - Point, Area, Mobile, Biogenic
- Pollutants
  - Sulfur Oxides, VOC, NOx, CO, Pb, Primary PM2.5, Primary PM 10, NH3
- When to Report?
  - Annual Cycle and 3 year Cycle
  - Year 2002 inventory due June 1, 2004
- Data Elements, etc. See CERR

Definitions

- SCC – Source Classification Code
  - Maintained by EPA
- Available on Web at http://www.epa.gov/ttn/chief/codes/index.html
  - 10,341 codes
  - Either an 8 digit code or a 10 digit code
    - 8 – Pt Source, 10 – Area Source

SCC - Example

- 10100202
  - External Combustion, Electric Generation, Pulverized Coal, Dry Bottom, Bituminous Coal
- 20100101
  - Internal Combustion, Electric Generation, Distillate Oil, Turbine
- 2610030000
  - Open Burning, Household Waste

Definitions

- SIC – Source Industrial Codes, reflects economic sectors of US economy
- Superceded by NAICS – North America Industrial Classification System
  - Available on Web at http://www.epa.gov/ttn/chief/codes/naics.pdf

Definitions

- NEI – National Emissions Inventory
  - New Terminology
  - Includes both criteria and toxics
- NET – National Emissions Trends
  - Just Criteria
  - Old Terminology
- NTI – National Toxic Inventory
  - Just Toxics
  - Old Terminology

NEI

- Data available on Web
  - http://www.epa.gov/ttn/chief/net/index.html#dwnld

  By State in Microsoft Access, version 97
- Summary Files
  - Point summaries
  - Area source summaries
  - Tier summaries
- AirData
  - http://www.epa.gov/air/data/index.html

Definitions

- NIF
  - NEI Input Format
  - Format EPA needs when submitting Inventories
  - Available on Web http://www.epa.gov/ttn/chief/nif/index.html

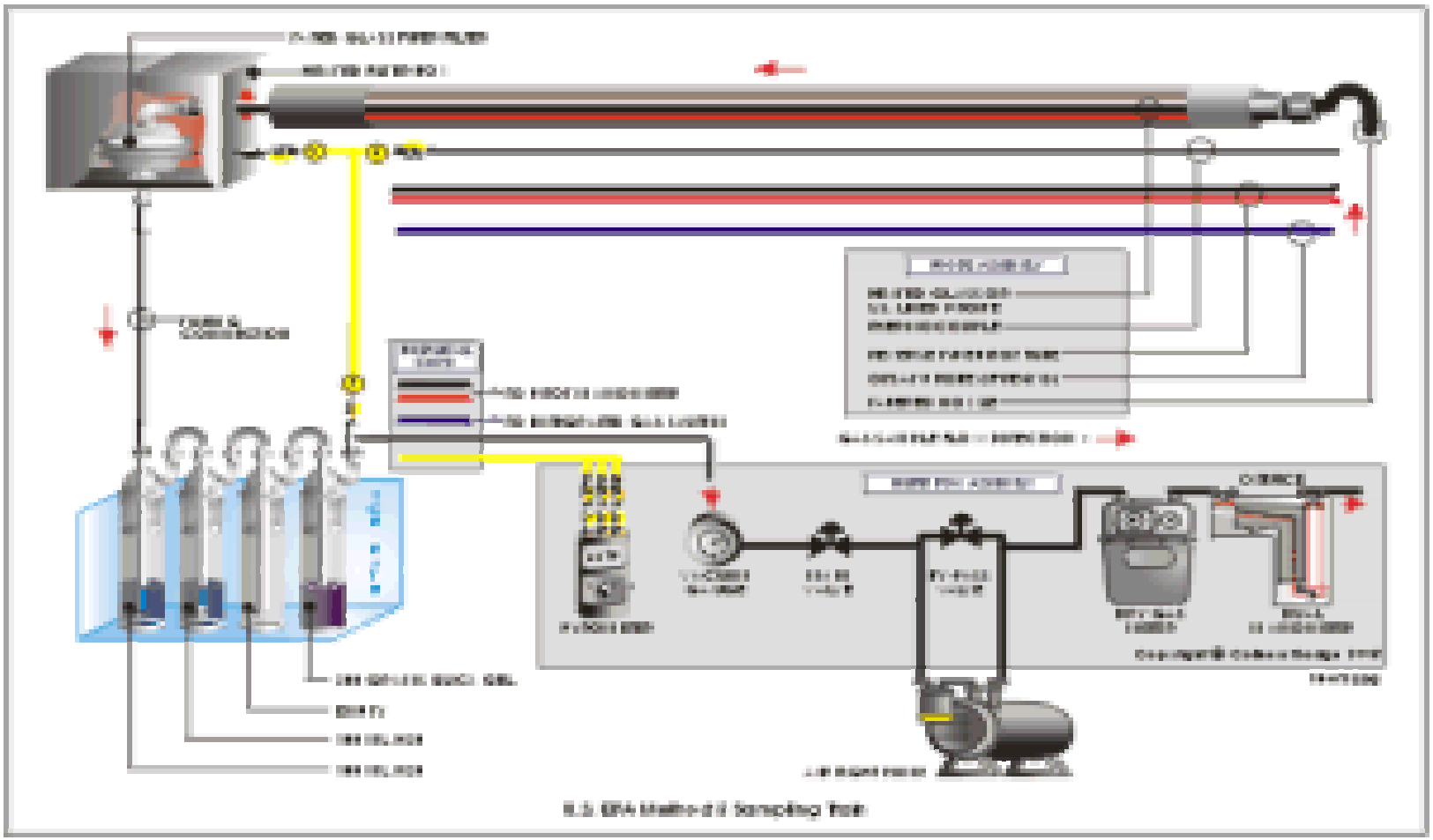
Definitions

- FIPS codes
  - Federal Information Processing Standard
  - Codes for states, counties
    - Ex, 37 = North Carolina, 183 = Wake County
    - 37183

Particulate Matter

- Filterable Emissions
  - That PM captured by front half (i.e. filter) of sampling train
- Condensible Emissions
  - That PM that exists as a gas at stack conditions and condenses after leaving the stack
- Primary Emissions
  - That PM directly emitted by source
  - Sum of filterable and condensible
- Secondary Emissions
  - PM emitted as gas at the source (SO2, NOx)

Method 5 Sampling Train



Size Cuts

- PM10 – those particles less than or equal to 10 um in aerodynamic size
- PM2.5 - those particles less than or equal to 2.5 um in aerodynamic size
- PM condensible – all less than 1 um

EPA Nomenclature for PM

- PM10-FIL – PM10 filterable less than 10um aerodynamic size
- PM10-PRI – PM10-FIL plus PM-CON
- PM2.5-FIL- PM2.5 filterable less than 2.5um aerodynamic size
- PM2.5-PRI – PM2.5 filterable plus PM-CON
- PM-CON – PM condensible

Trends Report

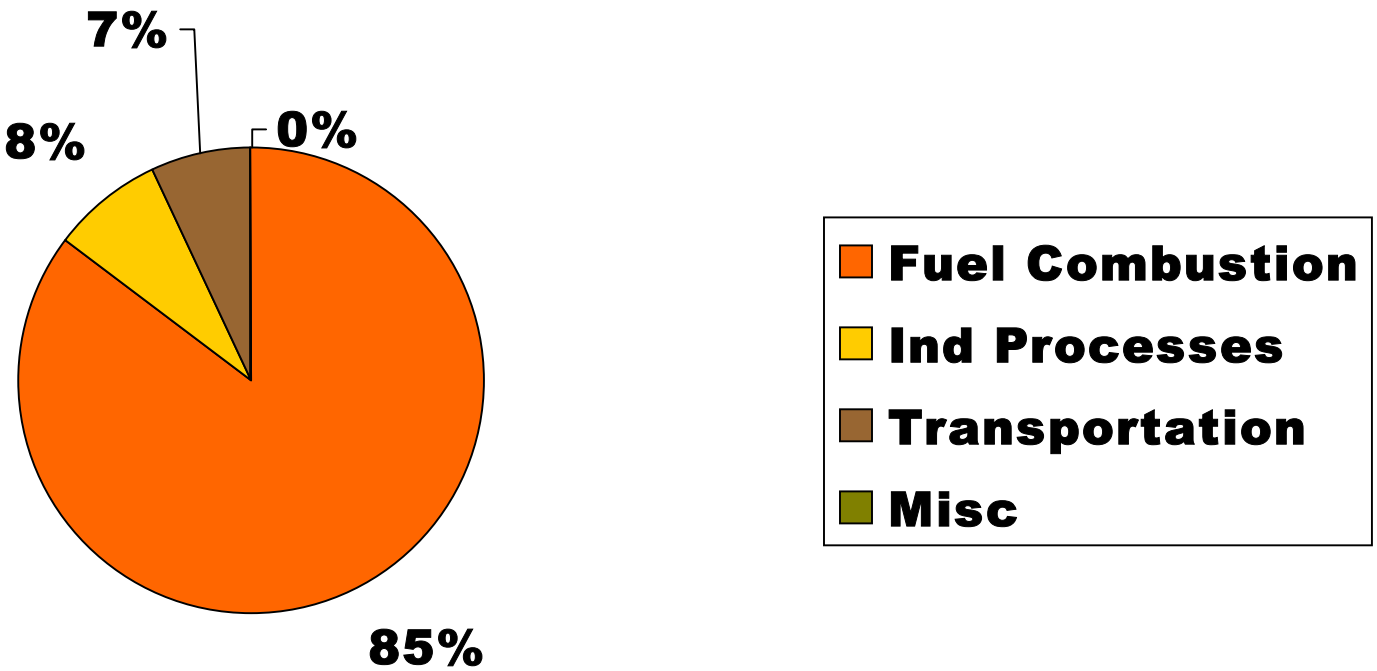
Air Quality and Emission Trends Data

http://www.epa.gov/airtrends/

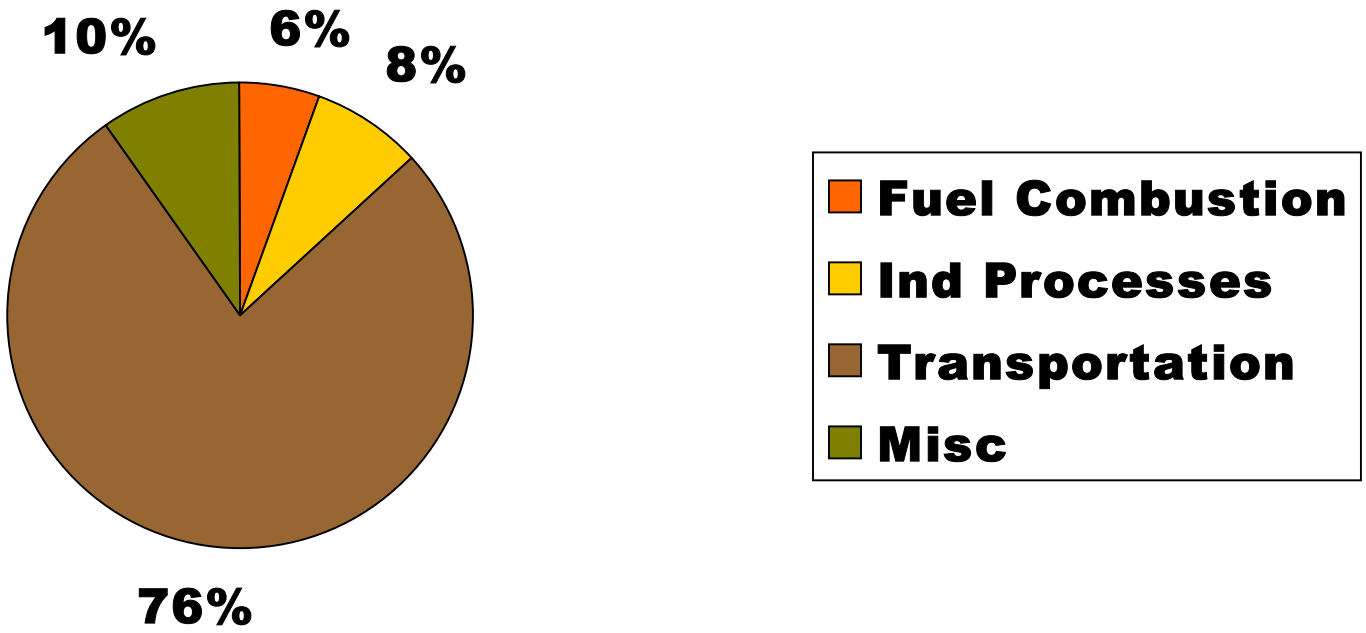
National Emissions

Pie Charts from Trends Report

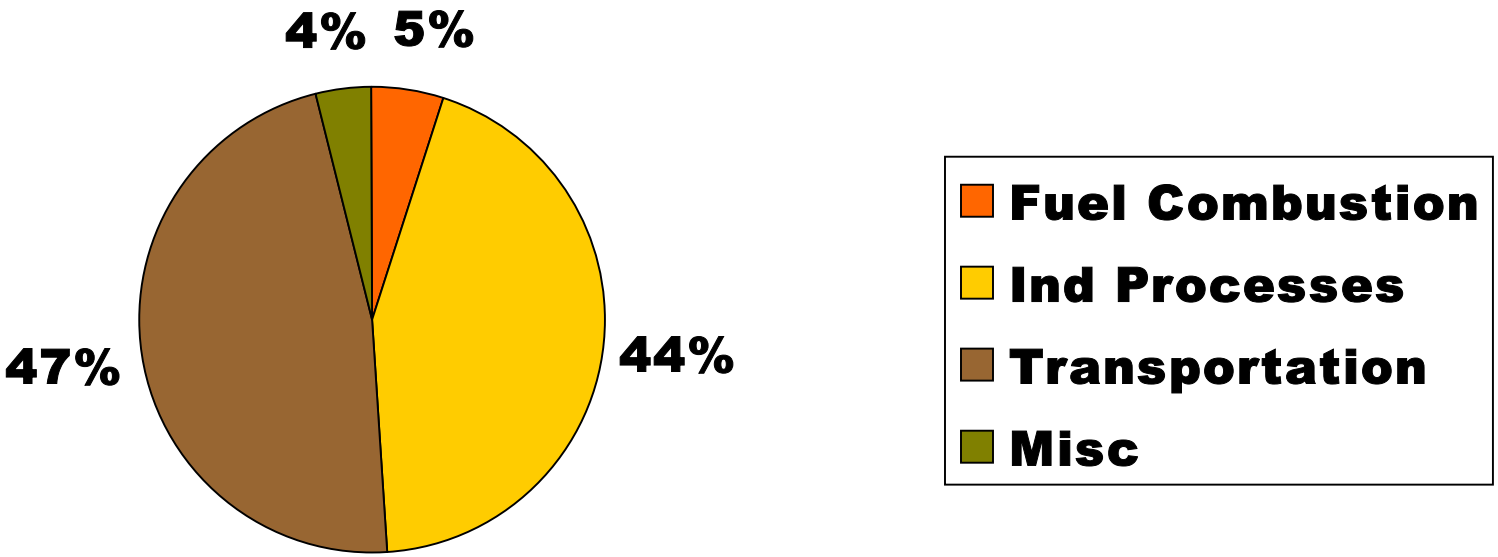
National SO2 Emissions- 1999



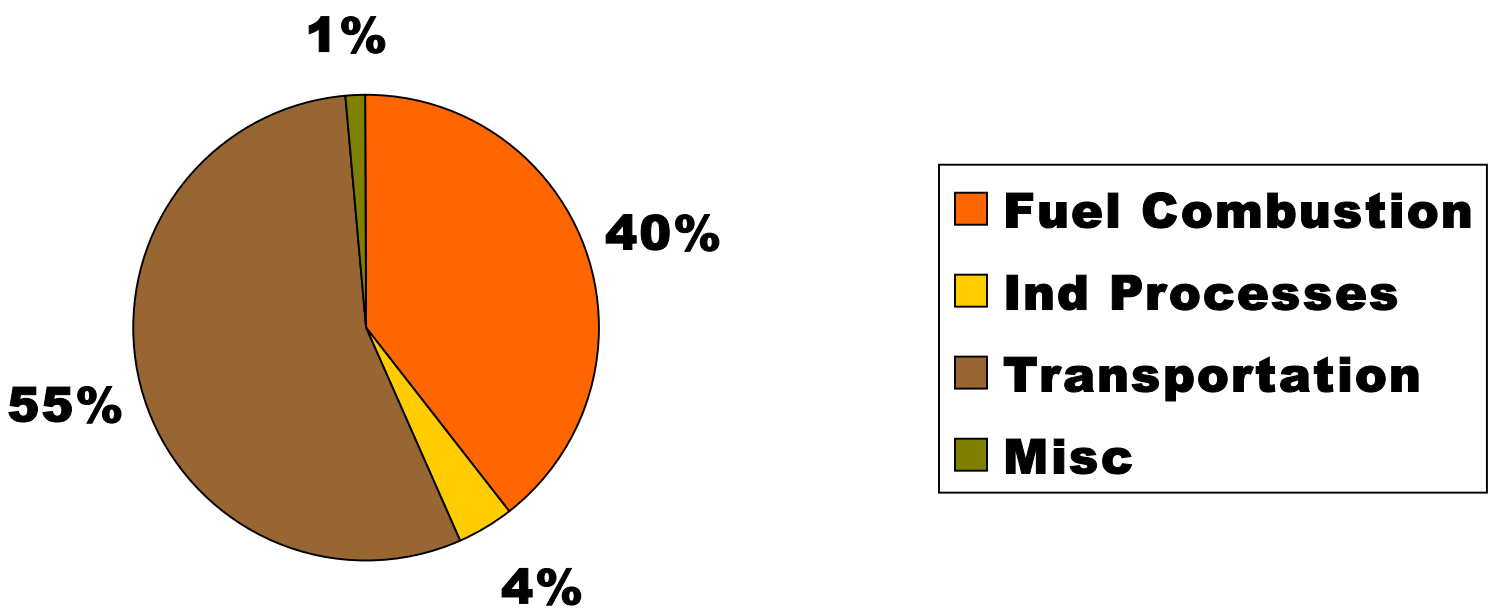
National CO Emissions- 1999



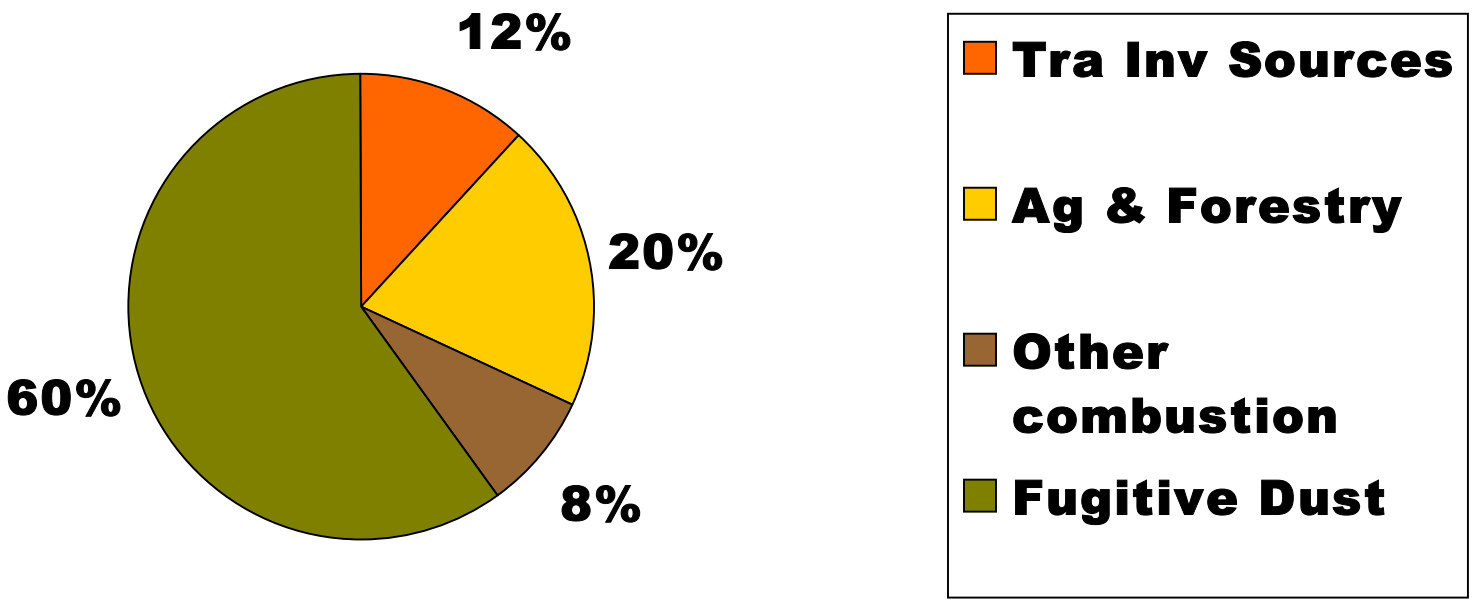
National VOC Emissions- 1999



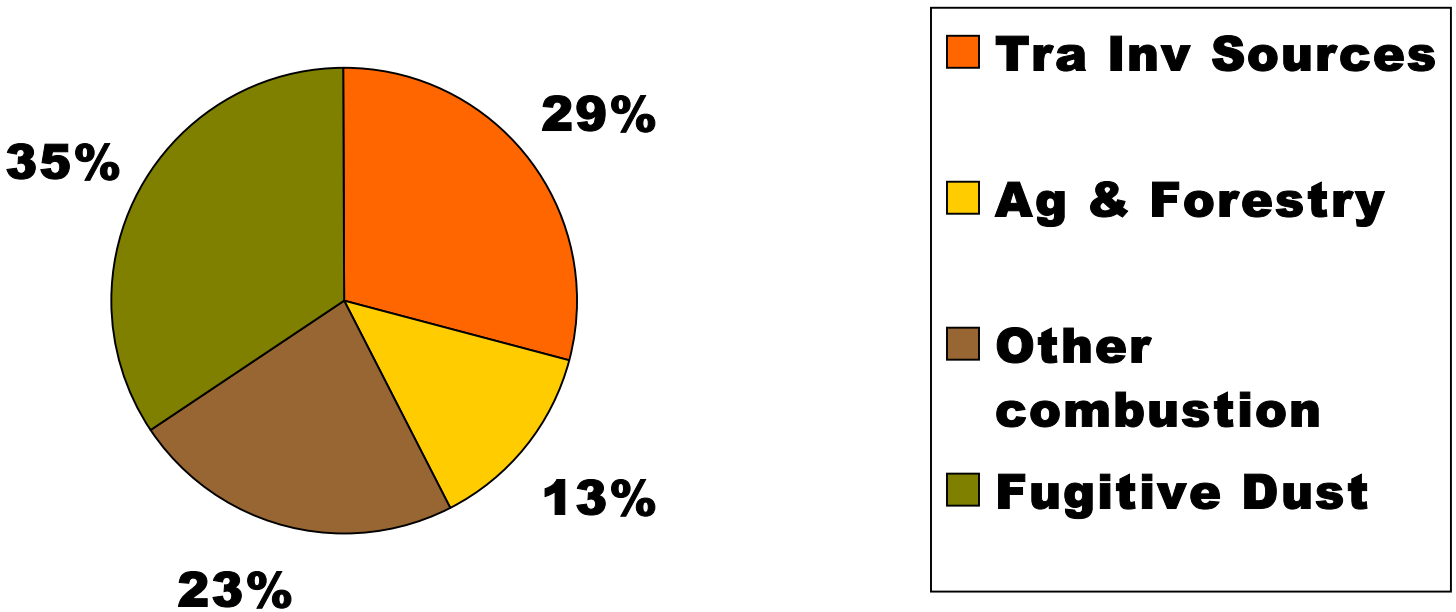
National NOx Emissions- 1999



National PM10 Emissions-1999

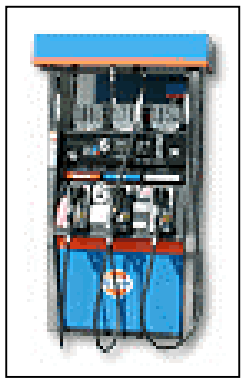


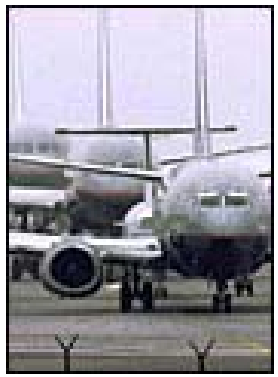
National PM2.5 Emissions-1999



Building an Inventory

Compile emissions data for various sources:



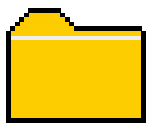


Point Sources

Area Sources

NonRoad Mobile Sources

OnRoad Mobile Sources



Inventory

Five Types of Sources

- Stationary Point
- Stationary Area (non-point)
- Onroad Mobile
- Nonroad Mobile
- Biogenic – Not in the NEI. Accounted for in modeling.

Point Sources

What is a Point Source?

- Source treated as an individual stationary source of emissions that release pollutants to the atmosphere.
- Quantities above emission threshold
- Emission thresholds vary according to type of pollutant and nonattainment area classification for criteria pollutants.
- See the CERR for details

Major Source Thresholds

- Any stationary source with the potential to emit, considering controls, over a set threshold of the regulated pollutant.
  - For criteria pollutants, definition depends on area attainment designation and the pollutant.
    - 100 tpy for most pollutants, 5 tpy for lead and 1000 tpy for CO
    - In a serious nonattainment area, a major source of VOC is a source with the potential to emit at least 50 tpy VOC.

How Are Point Sources Categorized?

- Fuel Combustion
- Waste disposal
- Food and agriculture industry
- Metallurgical industry
- Petroleum-related industries
- MACT categories
- Mineral products industry
- Chemical process industry
- Wood products industry
- Storage tanks

At What Level of Detail Are Point Source Inventories Compiled?

- Plant level
- Unit level
- Process level

What Data Elements Do I Inventory?

- See CERR

How do I Identify Specific Point Sources in the Inventory Area?

- Compile a list of facilities
  - Name and address, size and SIC
- Sources useful for identifying point sources
  - NEI
  - S/L/T commerce directories
- Existing state inventories
- State Permit Files
- TRI data
- MACT data
- Standard & Poor's
- Thomas Register
- Dun and Bradstreet Million Dollar Directory

What Are the Types of Emissions Estimation Methods?

- Continuous emissions monitor (CEMs)
- Source testing
- Material balance
- Emission factors
- Fuel analysis
- Emission estimation models
- Engineering judgment

How Do I Select a Method When Multiple Methods Are Applicable?

- Consider the issues when analyzing the tradeoffs between cost and accuracy of the resulting estimates
- Issues
  - Availability of quality data needed
  - Practicality of the method for the specific source category
  - Intended end use of the inventory
  - Pollutant and source category priority
  - Time available to prepare the inventory
  - Resources available in terms of staff and funding

CEMS

Continuous Emissions Monitoring System

- Measures and records actual emissions in the stack during the time period the monitor is operating and the data produced can be used to estimate emissions for different operating periods.
- Considered High Quality Data

Manuel Stack Sampling

Test Platform

Party Ice
Party Ice
Party Ice
Party Ice

Manual Stack Testing

- Short-term emission measurements typically taken at a stack or vent.
- Stack testing data used to develop emission factors
- Summarize emissions for each pollutant by expressing them in terms of
  - Mass loading rate
  - Emission factor
  - Flue gas concentration

Manual Stack Testing, cont

- Source Specific data
- Snapshot of true emissions
  - Will not reflect changes in operating conditions, different fuels, etc
- Question of how representative is the data?
- Still considered high quality data

Emission Factors

- Estimates the rate at which a pollutant is released to the atmosphere as a result of some process
- Provide a reasonable estimate of pollutant emissions across an entire source category

EFIG Sources of Emission Factors

- AP-42
- FIRE
- AIR CHIEF CD-ROM
- NEI Documentation
- EIIP
- L&Es (Locating and Estimating Documents)

Material Balance

- Used when
  - Source test data, emission factors, or other developed methods are not available (some exceptions)
  - Where accurate measurements can be made of all process parameters
  - OK for processes like solvent degreasing operations, and surface coating operations
  - Should not be used for processes where material reacts to form secondary products or undergoes significant chemical change

Fuel Analysis

- Used to predict emissions based on the application of conservation laws
- $E = Q_f$ x Pollutant in fuel x (MW_p/MW_f)
  where:
  Q_f = throughput of the fuel, mass rate (e.g. lb/hr)
  MW_p = molecular weight of pollutant emitted (lb/lb-mole)
  MW_f = molecular weight of pollutant in fuel (lb/lb-mole)

Emission Estimation Models

- Used when
  - Calculations are very complex
  - Combination of parameters has been identified that affect emissions, but individually, do not provide a direct correlation

Emission Estimation Models

- TANKS - storage tanks
- LAEEM - landfill
- WATER9 - wastewater
- Available on CHIEF website
  - http://www.epa.gov/ttn/chief

Engineering Judgment

- Last resort to be used only if none of the methods described can be used to generate accurate emission estimates

How to Submit to EPA?

- NEI Input Format (NIF)
  - Version 2.0 and 3.0
  - Details on EPA website
- Important Fields
  - Site ID, State and Federal
    - Please do not change Site ID's
    - If you must, please tell us!
  - Stack Parameters

Incorporating Pt Source Inv Submitted by S/L/T Agencies into the NEI

Point Source Inventories

- EPA Accepts S/L/T data, except for EGU's
- Runs QA
  - Format, content, & referential integrity checks
- Checks for completeness
- Overlays SO2/NOx data for EGU's
- Augments for Stationary NH3
- Gap Fills (PM2.5)
- Augments for stack parameters
- Grows emission in the off years

Point Source Inv Issues

- NIF format upgrading to version 3.0
- Changing Facility ID's, Name
  - FRS ID
- State/Local Agency Review of Point Sources
  - Lat/Lon, Other Stack Parameters, Missing Facilities
- Incomplete Pollutant Coverage

Area Sources

What is an Area Source?

- Individual emissions do not qualify as Point Sources
- Represents numerous facilities or activities with small amounts of a given pollutant
- Usually do not use same method as point source

Key Steps in Preparing Area Source Inventory

Existing inventories

- State/local/tribe inventories
- NEI
- Other

Key Resources

- EIIP Area Source Document Series
  - http://www.epa.gov/ttn/chief/eiip/techreport/volume03/index.html
- NEI Documentation
  - http://www.epa.gov/ttn/chief/net/index.html#doc

Area Source SCC's

- Ten digit Source Classification Codes
- Available on EPA's website
  - http://www.epa.gov/ttn/chief/codes/index.html#scc

At What Level of Detail Are Area Source Inventories Compiled?

- State
- County level
- Other jurisdictions for which activity surrogates are available

What Area Source Categories Does EPA Inventory?

- See NEI Documentation

Where Do I Find Applicable Activity Parameters ?

- Sources of Area Source Activity Data
  - US Dept of Commerce
    - County Business Patterns
    - Census of Population
    - Census of Manufacturers
    - Census of Agriculture
    - County and City Data Book
    - Current Industrial Reports
    - Census of Retail Trade

Where Do I Find Applicable Activity Parameters ?

- Sources of Area Source Activity Data
  - Regional planning commissions
  - Agency-sponsored surveys
  - State Depts. of Transportation and State Energy Offices
  - US DOE
    - State Energy Reports
    - Petroleum Marketing Annual
    - Natural Gas Annual

Where Do I Find Applicable Activity Parameters ?

- Sources of Area Source Activity Data
  - State Departments Of Labor
  - State Agriculture Offices and USDA
  - State Solid Waste Management agencies
  - Fire marshals
  - Port Authority
  - State Health Departments
  - Miscellaneous statistical government & trade publications

Where Do I Find Applicable Area Source Emission Factors ?

- EIIP
- AP-42
- L&Es
- FIRE
- NTI area source documentation
- AIR CHIEF CD-ROM

What Methods Are Used to Collect Data for Area Sources?

- Surveys
- Examination of Local, State and Federal documents and databases
- Examination of trade association reports, journals, and databases

What Emissions Estimation Methods Should I Use?

- Applying point source methods to area sources (bottom-up)
- Conducting local activity level surveys (bottom-up)
- Applying a top-down approach

Applying The Top-Down Approach

- Applying source test or national (or regional) derived emission factor to the local level
- Allocating national, regional, or state level emission estimates to the local level

Special Issues to Resolve

- Double counting between point source and area source inventories
- Overlap between two area source categories
- Spatial allocation of emissions

Incorporating Area Source Inv Into NEI

Area Source Inventories

- Review S/L/A data before Incorporation
- QA inventory
- Gap Fill data
- EPA grows emissions from some SCC's from some baseline year

Example – Open Burning

- Residential MSW Burning
  - 2610030000
- Residential Leaf Burning
  - 2610000100
- Residential Brush Burning
  - 2610000400

Residential MSW Burning

- Estimate Total MSW generated using national average per capita waste generation factor (3.31 lbs/person/day)
  - EPA's Office of Solid Waste
- Assume 28% of MSW burned
  - Apply only to rural population
  - Zero out counties where urban/total >80%
  - US Dept of Census
- Use Emission Factors to calculate emissions

Residential Leaf/Brush Burning

- Estimate total waste generated using national average per capita generation factor (0.56 lbs yard waste/person/day)
  - Ignore grass (50%)
- Assume 28% burned
  - Apply only to rural population
  - Zero out counties where urban/total >80%
  - Adjust for variations in vegetation by county
    - BELD2 database, percent forested
    - <10%, zero; 10-50%, one half; >50%, all

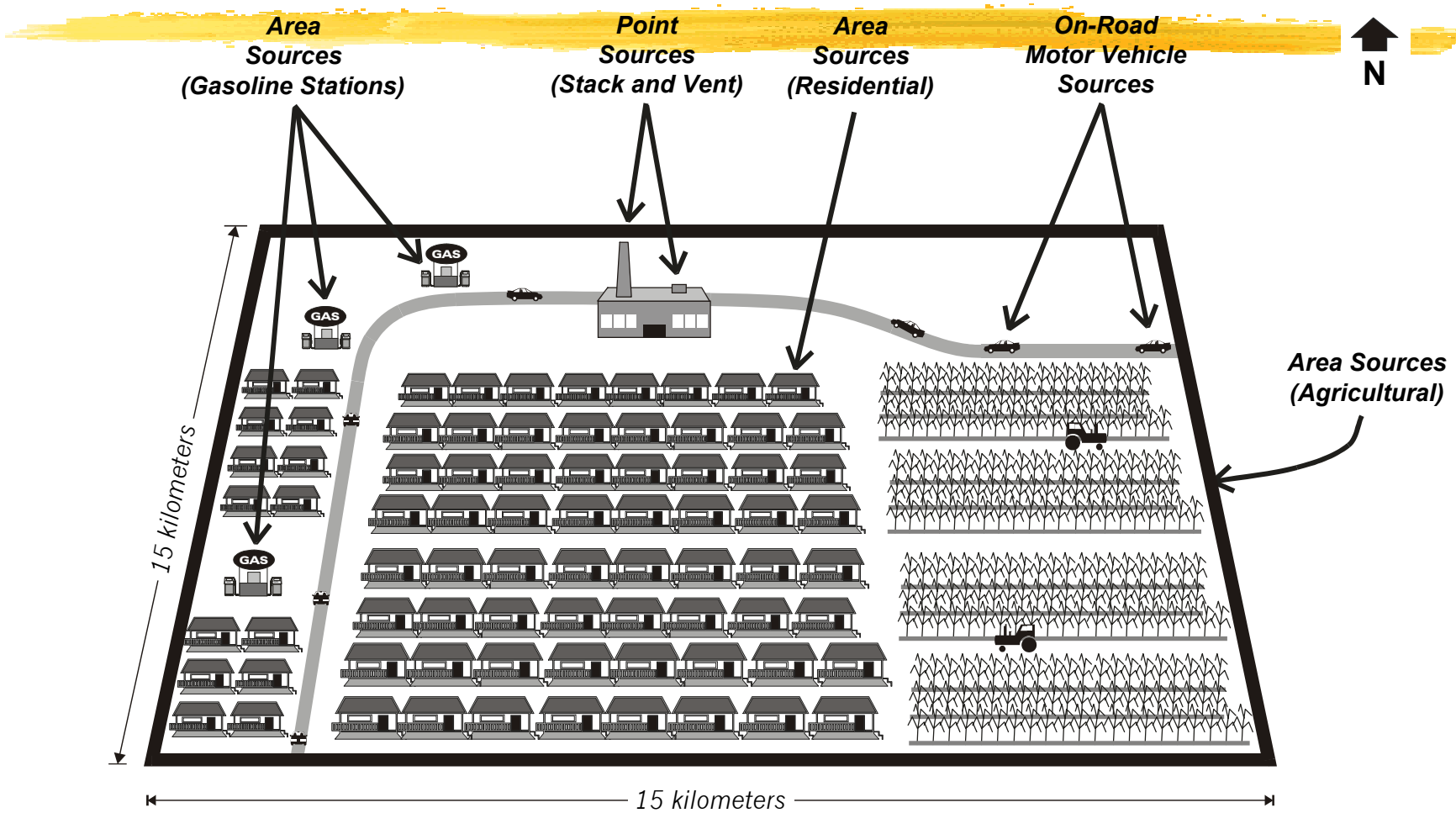
Mobile Sources

Mobile Sources

Mobile Sources

What is a Mobile Source?

- Source is Mobile and Portable
- Source is Generally Internal Combustion Powered
- Licensed or Certified for Highway Use
  - Automobiles, Trucks, Buses, Motorcycles
- Not Licensed or Certified for Highway Use
  - Planes, Trains, Boats, Farm Equipment, Lawn & Garden Equipment, Construction Equipment


Area Sources (Gasoline Stations)
Point Sources (Stack and Vent)
Area Sources (Residential)
On-Road Motor Vehicle Sources
N
GAS
GAS
GAS
Area Sources (Agricultural)
15 kilometers
15 kilometers

Mobile Source Documentation for 1999 NEI

- On EPA's ftp site.
  - ftp://ftp.epa.gov/EmisInventory/draftnei99ver2/criteria/documentation/

Key Points

- EPA uses a model to estimate most mobile source emissions
- EPA does top-down determination of Mobile source emissions
- Most S/L/T do not submit data
- There is a potential for S/L/T to improve Mobile emission estimates

Mobile Source Categories

- Nonroad
  - 2,4-stroke & diesel engines
  - Aircraft
  - Locomotives
  - Commercial marine vessels
- Onroad
  - Gasoline
  - Diesel

NONROAD SOURCE DEFINITION

- Mobile and Portable
- Internal Combustion Powered
- Not Generally Licensed or Certified for Highway Use.
- Examples - agricultural, construction, lawn and garden, industrial/commercial (e.g, airport service vehicles), recreation

EPA's NONROAD MODEL

(2-stroke, 4-stroke and Diesel Engines)

EPA's NONROAD Model

- Estimates Emissions from
  - 2-Stroke Gasoline Engines
  - 4-Stroke Gasoline Engines
  - Diesel Engines
- Includes Default Data

2- & 4- Stroke Engines

Fuels

- Baseline gasoline, conventional lead-free
- Reformulated fuels with MTBE or TAME
- Reformulated fuels with ethanol
- Winter oxygenated gasoline with MTBE or TAME
- Winter oxygenated gasoline with ethanol
- Diesel fuel

Nonroad Model

- Model covers more than 80 types of nonroad engine categories
- Estimates mass emissions of VOC, CO, NO_x, SO_2, PM10 and PM2.5, and CO_2
- Can report emissions down to county level (sub-county with user-supplied data)

Equipment Types Covered

- Airport ground support
- Agricultural
- Construction
- Industrial
- Commercial
- Recreational vehicles
- Logging
- Residential/ commercial lawn and garden
- Recreational marine vessels
- Oil field
- Underground mining
- Railway Maintenance

Estimating Aircraft Emissions

- Not obtained from model
- Aircraft fleet mix obtained from your local airport authority
- Emissions model obtained through FAA:
  - http://www.aee.faa.gov/emission/

Aircraft

- Types
  - Commercial - jet
  - Air taxis - jet and prop
  - General aviation - prop
  - Military

Estimating Locomotive Emissions

- Not obtained from model
- Estimate Fuel Use
  - Contact Local Railroads
  - Contact State DOT
- OTAQ Locomotive Emissions Page
  - http://www.epa.gov/otaq/locomotv.htm

Commercial Marine Vessels

- Not obtained from model
- For more information see OMS Marine Engine Emissions website

http://www.epa.gov/otaq/marine.htm

Commercial Marine Vessels

- All boats and ships used either for commerce or military activity; usually > 100 ft in length
- Types
  - diesel engines - distillate fuel oil
  - steam turbines - residual fuel oil

Onroad Mobile Emission Inventories

Vehicle Miles Traveled

- EPA's Emission Model (Mobile6)
- Needs
  - County level
  - Vehicle type
  - Functional road class

Vehicle Miles Traveled

- Data Sources
  - State Department of Transportation
  - Federal Highway Administration
    - Highway Performance Monitoring System (HPMS)
  - EPA's National Emission Inventory (NEI)
- Data Format
  - EPA AMS SCCs
  - Single code contains information on vehicle type and road class

Emission Factors
Ozone Precursors

- EPA's MOBILE model
  - Developed and maintained by EPA's Office Transportation and Air Quality
  - Current version is MOBILE6
  - Models and documentation available at http://www.epa.gov/otaq/models.htm

Mobile Model Important Inputs

- Vehicle Speed
- Ambient Temperature
- Gasoline Volatility (RVP)
- Control Programs
  - Inspection/Maintenance
  - Reformulated gasoline
  - Oxygenated Fuels
  - New Vehicle Standards
- Registration Distributions

EPA Office of Transportation and Air Quality (OTAQ)

- Web site: http://www.epa.gov/otaq/
- MOBILE List Server
- E-mail: otaqpublicweb@epa.gov

The End

Don’t Forget to Fill Out the Course Evaluation