Emission Inventory

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Air Quality Analysis
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The Basics

Criteria Pollutants

TOG: Total Organic Gases

ROG: Reactive Organic Gases (used by ARB)

VOC: Volatile Organic Gases (used by EPA and SJV)

CO: Carbon Monoxide

NOX: Oxides of Nitrogen

SOX: Oxides of Sulfur

PM: Particulate Matter

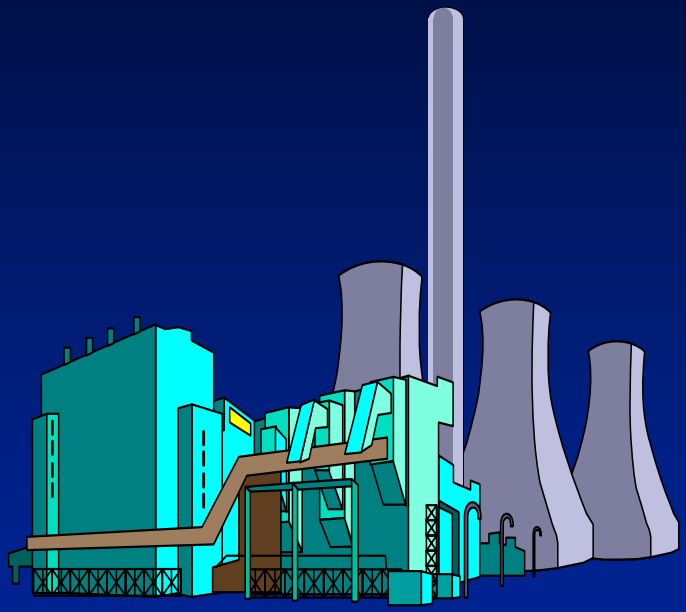
PM10: Particulate Matter < 10 Microns

PM2.5: Particulate Matter < 2.5 Microns

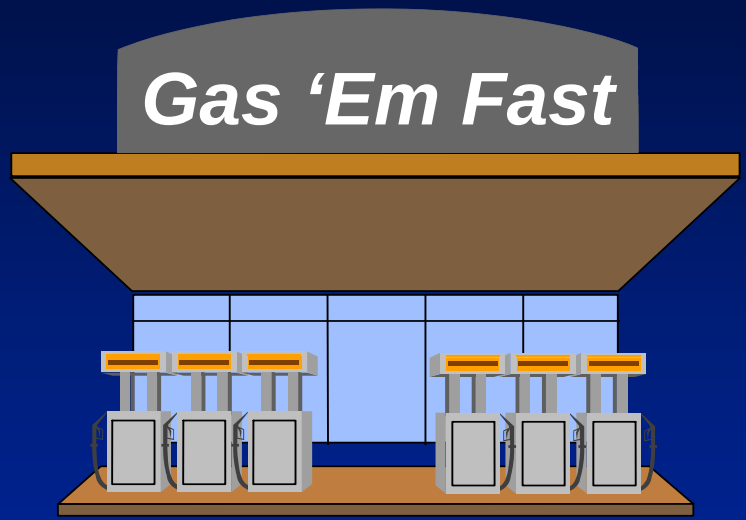
Types of Sources

- Stationary
- Area-Wide
- Mobile
- Non-Anthropogenic

Stationary Sources

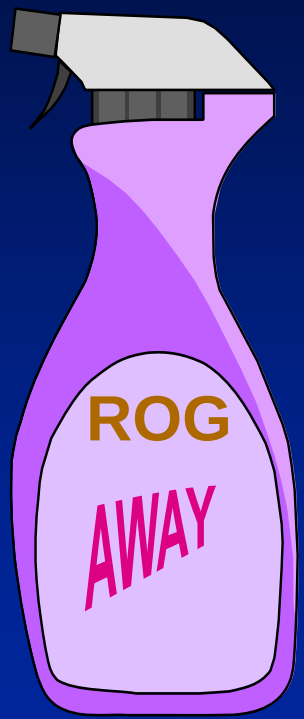


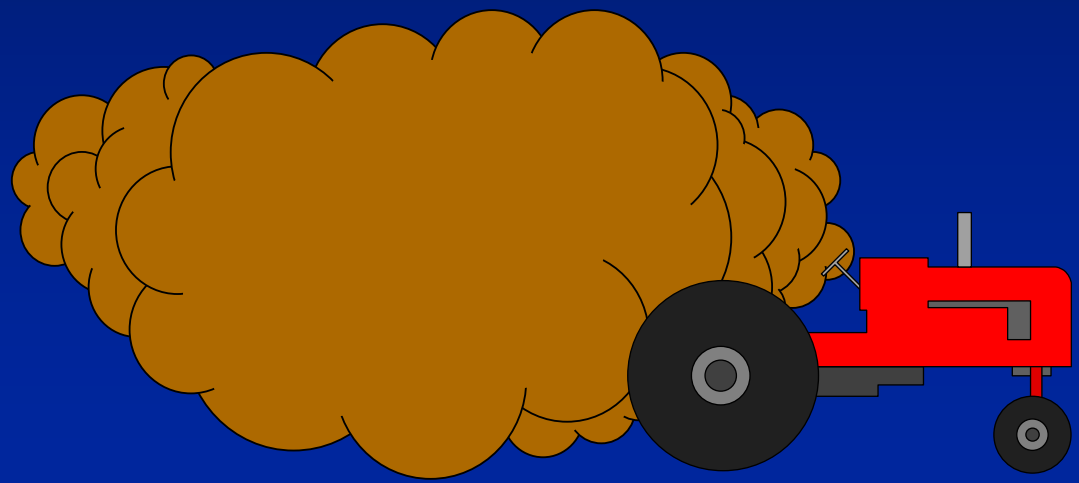
Point



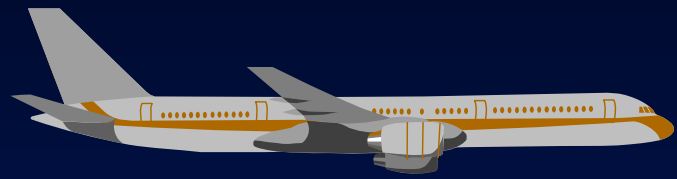
Aggregated Point

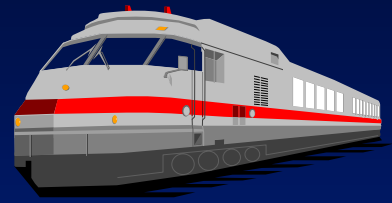
Area-Wide

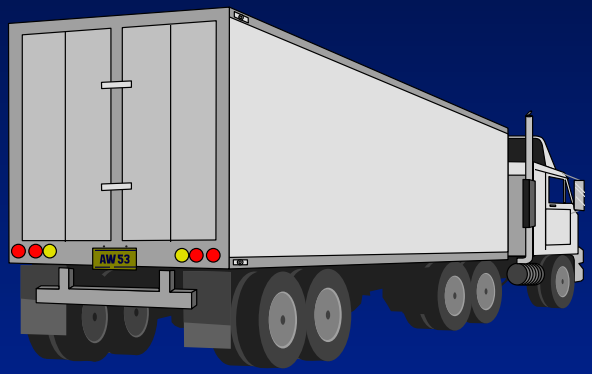




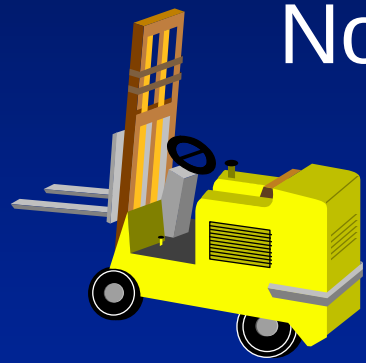
Mobile



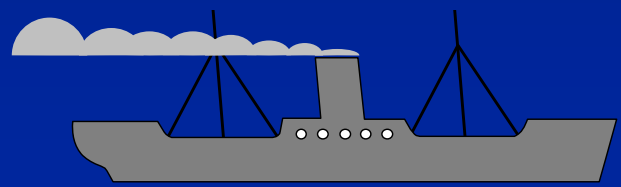




Non-Road



On-Road



Non-Anthropogenic

How Do We Identify and Categorize Sources?

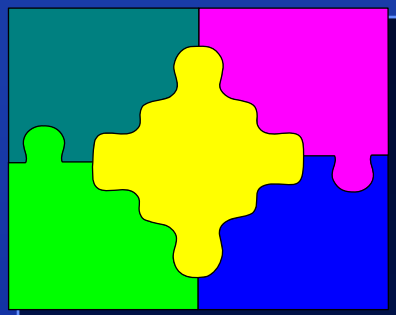
- Point Sources
  - Combination of SCC and SIC Codes
  - Each SCC/SIC Combination is Mapped to an EIC
- Area Sources
  - Each category is assigned a unique EIC

Emission Inventory Code (EIC)

- 14 Digit Code that Categorize Emission Sources
- Created and Maintained by ARB
- Each Valid SCC/SIC is Mapped to an EIC
- EICs can have many SCC/SIC assigned
- Each Area Source Category Identified by EIC

Use of EICs

- Categorize and Report Emissions
- Identify Each Area Source Category
- Provides Automatic Reconciliation of Point and Area Sources



Example of an EIC

- **040-005-0110-0000**
  - **040** Fuel Combustion Petroleum Refining
  - **005** Boiler *(Source Category)*
  - **0110** Natural Gas *(Material Type)*
  - **0000** Sub-category *(Sub-category User Defined)*

Source Classification Code (SCC)

- 8 Digit Code to Identify Emission Processes
- Created by U.S. EPA
- 9865 Valid SCCs Available
- Large NG Boiler = 1-03-006-03

Standard Industrial Classification (SIC)

- 4 Digit Code to Identify Business Activity
- Published by U.S. OMB
- 1700 valid SICs Available
- SIC 7011 = Hotel and Motels
- SIC 2911 = Petroleum Refining

Facility vs. Process SIC

- SICs are used in two places
- Facility SIC Identifies Primary Activity of Entire Facility
- Process SIC Identifies Type of Activity for a Specific Process
- Example of Facility vs. Process SIC:
  - *Wood Furniture Manufacturer 2511 with a Metal Parts Coating Operation 2514*

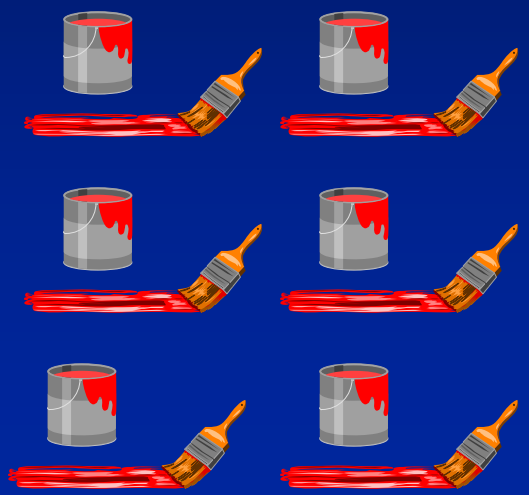
How Do We Estimate Emissions?

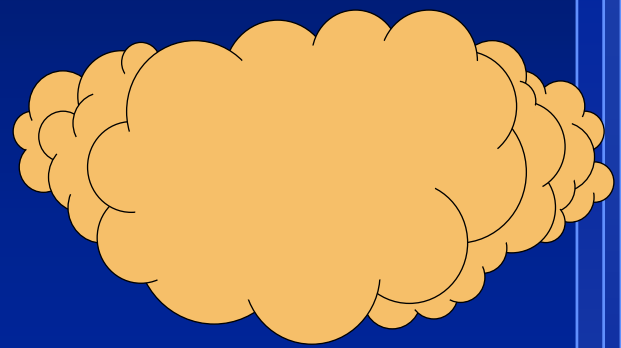
Emission Calculation

Process Rate (Activity)

Emission Factor

Number of Units **x** Emissions per Unit **=** **Total Emissions**



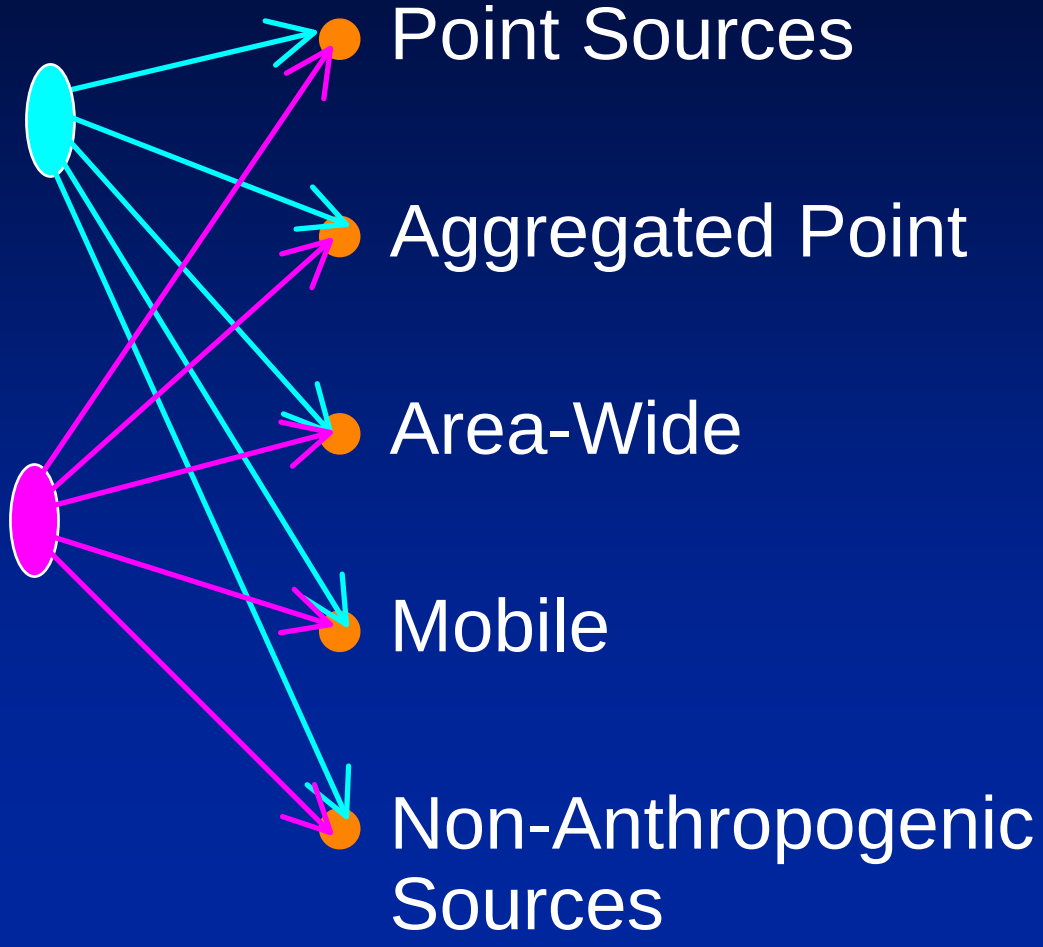


Calculations Methods

- Bottom-up (Typically Point Sources)
  - Number of Units * Emission Factor
  - Gallons of paint used in the facility
  - Point Source Method
- Top-down (Typically Area Sources)
  - Number of Units Sold * Emission Factor
  - Gallons of paint sold in the County
  - Area Source Method

Which Method Do I Use?

- Point Source Methods
- Area Source Methods



Mobile Emissions

- EMFAC 2002 Model
- Moving to EMFAC 2007 soon
- Most Off-Road categories are calculated with the Off-Road emissions model

Responsibilities

- Local Districts
  - Develop Local Point Source Inventory
  - Estimate Emissions for 1/3 of Area Source Categories
- ARB
  - Estimate Mobile Source Emissions
  - Estimate Emissions for 2/3 of Area Source Categories
  - Develop and Report Statewide Inventory

Types of Inventories

- Annual Average
- Planning
  - Summer Planning
  - Winter Planning
- Forecasted
- Gridded / Modeling

Important Points

- EI is a ‘live’ database
- Constantly changing (improved)
- Only Snapshots of the EI are used
- Snapshots may or may not be improved
- Can only compare EIs of the same snapshot and publishing date

Annual Average Inventories

Average Annual EI

- What is a Average Annual Inventory ?
  - Annual Emissions divided by 365
  - Most commonly seen
  - All criteria pollutants
  - Not detailed enough for technical use
  - Example: Fireplaces

Planning Inventories

Planning EI's

- What is a Planning Inventory ?
  - Planning Inventories are a refinement of annual emission inventories
  - Created only for non-attainment areas
  - Ozone or precursors (i.e. ROG and NOx), CO, SOx, and PM10 are the non-attainment pollutants considered at this time

Planning EIs
(continued)

- Purpose of Planning Inventories
  - To characterize emissions of a non-attainment pollutant (or its precursors) during air quality exceedance periods
  - A tool for air quality planners to assess what sources to target for emission reductions as required under the federal CAA

Planning EIs
(continued)

- Periods Analyzed
  - Ozone: summer operating period May-Oct (mainly concerned with ROG and NOx)
  - CO: winter operating period Nov-Apr
  - Other Periods: For the San Joaquin PM10 SIP, quarterly inventories were developed

Calculation Method

SEMS (t/d) = EMS (t/y) * TF

Where:

SEMS = Seasonal emissions (tons/seasonal day)

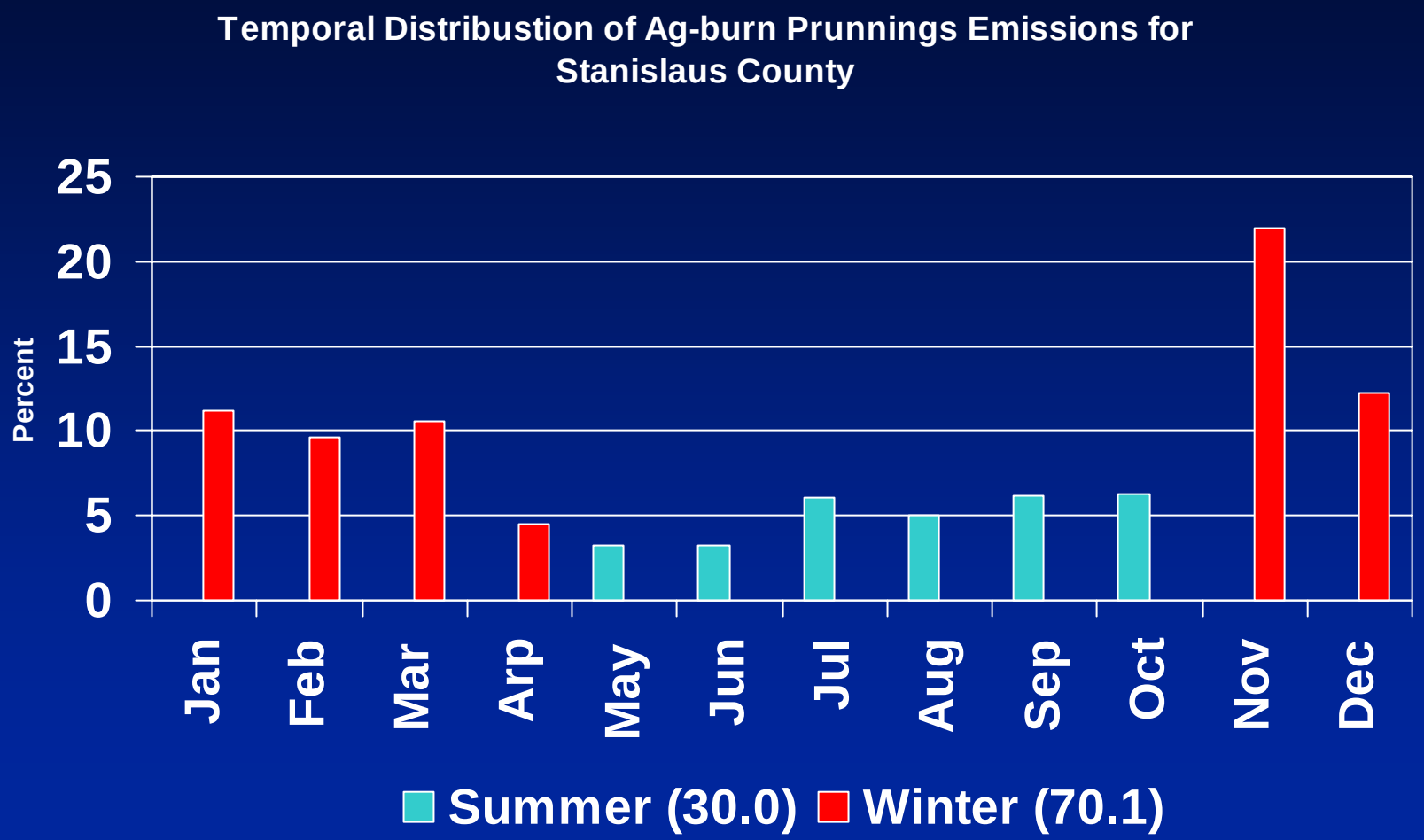
EMS = Annual Emissions (tons/year)

TF (Temporal Factor) = SEAS_FRAC / 182.5

SEAS_FRAC = (i) Sum of fractional monthly throughputs
Summer: May-October
Winter: November-April

or (ii) The ratio of the operating days in the season to the operating days in the year (intermittent sources)

Planning Inventories (cont.)



Forecasted Emission Inventories

Introduction

- Used to predict future emission levels based on expectations of future economic conditions, population growth, and emission controls
- Used to develop baseline emission inventory projections for SIP and local AQMPs

Introduction (continued)

- Also used to backcast emissions (for historical years) to account for improved inventory methodologies
- Air basin and county level emission trends calculated for period 1975-2030

Socioeconomic and Demographic Growth Activity

Growth Factors

- What are growth factors?
  - Derived from county-specific economic activity profiles, population forecasts, and other socio/demographic activity

Growth Factors (Continued)

- Sources of data
  - District supplied data based on information from COGs
  - Economic activity studies contracted by ARB (e.g. DRI/McGraw-Hill, CSU Fullerton, Pechan and Assoc.)
  - Demographic data (e.g. population estimates-DOF, VMT-Caltrans)

Growth Factors (Continued)

- How are growth factors linked to emissions?
  - **"Rule of Thumb"**: Growth profiles are typically associated with the type of industry and secondarily to the type of emission process.
    - **Point Sources**: Economic output profiles by industrial sector are linked to emission sources via SIC.

Growth Factors (Continued)

- **Area-wide and Aggregated Point Sources**: Other growth surrogates such as population, dwelling-units, fuel usage etc. may be used

  Example: Emissions from residential fuel combustion are generally linked to # of dwelling-units as a growth parameter

Control Factors

Control Factors

- What are control factors?
  - Control factors are derived from adopted ARB regulations or district rules which impose emission reductions or a technological change on a particular emission process

Control Factors (Continued)

- Sources of data
  - ARB Regulations:

    Control profiles are derived from adopted state regulations by ARB staff (e.g. consumer products, clean fuels, etc.)
  - District Rules:

    Control profiles are developed by district staff based on adopted district rules (e.g. IC engine rules)
  - Other regulatory agencies: DPR, U.S. EPA, etc.

Control Factors (Continued)

- How are control factors linked to emissions?
  - **"Rule of Thumb"**: Control data are closely linked to the type of emission process and secondarily to the type of industry
  - Control data are assigned to emission categories which are targeted by the rules

General Forecasting Equation

$E_{fy}(s,p) = E_{by}(s,p) * TF * GF * [CF(m_1,s,p) * CF(m_2,s,p) *...* CF(m_j,s,p)]$

where:

E_{fy} = Emissions in the future year
E_{by} = Emissions in the base year
where:
E_{by} = Process Rate * Emission Factor

TF = Temporal Factor
GF = Growth Factor (Growth Level FY / Growth Level BY)
CF = Control Factor (Control Level FY / Control Level BY)
s = The source category (SCC/SIC or EIC)
p = The pollutant
m = The control measure impacting the source category
j = The number of measures impacting the source category, s

Modeling Inventories

Modeling Inventories

- Day Specific
- Hourly Specific
- Location Specific
- Gridded
- Each EIC/SCC/SIC is speciated into component chemicals

Emission Inventory Resources

- California Air Resources Board (http://www.arb.ca.gov)
- EPA (http://www.epa.gov/ttn/chief/net/neidata.html)