How Mobile Source Emission Inventories Fit into Policy Making

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Overview

- Policy Applications
  - New vehicle emission standards
  - NAAQS
    - State implementation plans
  - Conformity
  - National Environmental Policy Act
- Inventory development

Policy Applications

New Vehicle Emission Standards

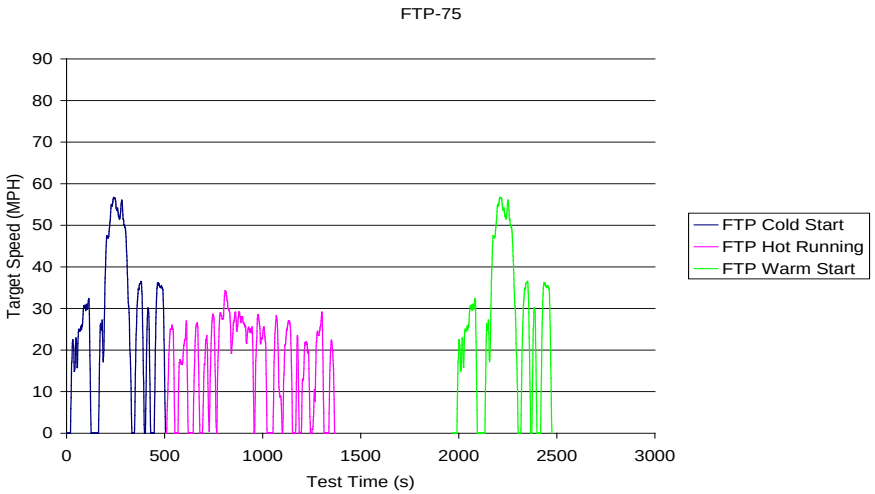
New Vehicle Standards

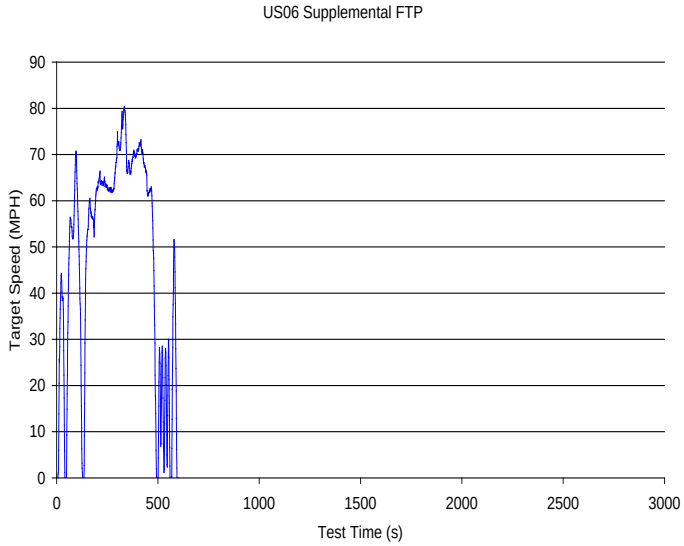
- EPA is authorized under the Clean Air Act to set emission standards for every motor vehicle and engine sold in the U.S.
  - Greatest degree of emission reduction achievable through application of technology
  - Applies to useful life of vehicle and engines
  - Pre-production and in-use testing by manufacturers and EPA
  - Revise standards from time to time
- Regulatory impact analyses use inventories and air quality models to assess effects of rule

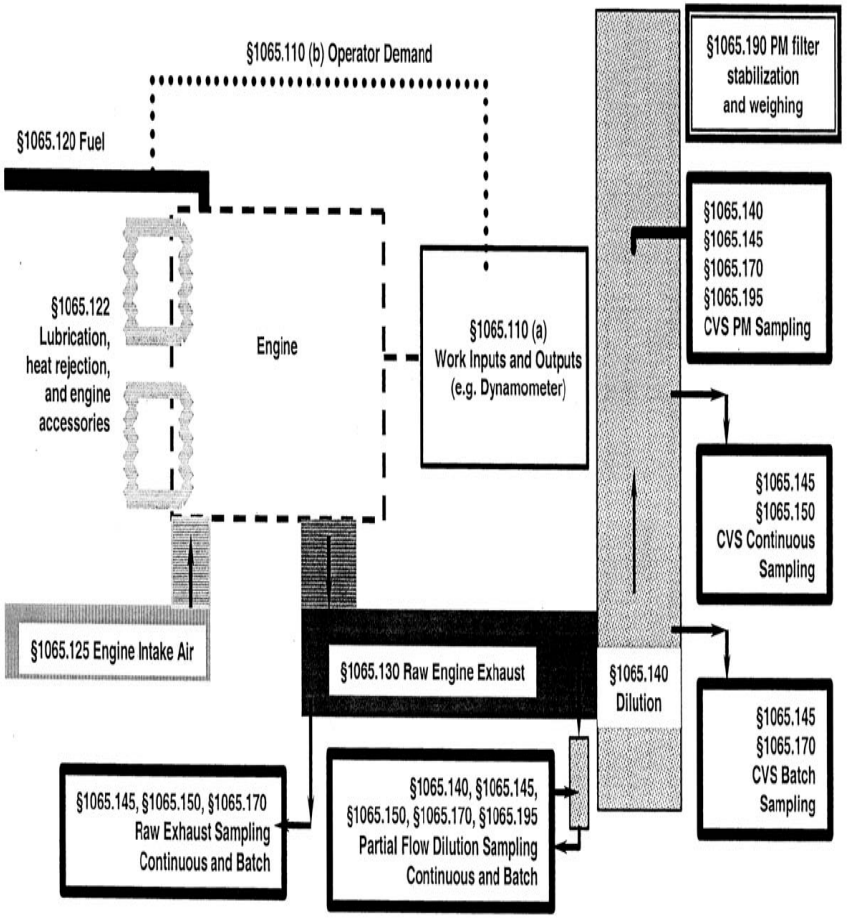
Exhaust Test Methods

- EPA publishes test procedures in 40 CFR Part 1065
- Factors include:
  - Engine selection and preparation
  - Vehicle conditioning
  - Transient vehicle “drive cycles” or engine “duty cycles” typical of “real world” operation using dynamometers (control of work and speed)
    - Federal Test Procedures (FTP)
    - Supplemental FTP cycles
  - Engine fluids, test fuels, analytical gas specifications
  - Engine intake air
  - Post-combustion dilution sampling
    - Dilution system design
    - Temperature control at sampling point (e.g. PM filter face)
    - Sampling during transient cycles
    - Pollutant/precursor concentrations and humidity in dilution air
  - Instrumentation, sampling media, and analysis techniques
  - Calibration and data verification

Elements of Test Procedure







Laboratory-roadway differences

- Dilution ratios
  - Laboratory: dilution ratios ~10x
  - Roadway: tailpipe dilution ≥1,000x within ~3 seconds prior to moving downwind
- Dilution air temperatures
  - Laboratory: FRM requires filter face at ~47 C, controlled by adiabatic dilution
  - Roadway: Generally small changes from roadside temperatures (-20 to 50 C)
- Background concentrations
  - Laboratory: HEPA-cleaned air to minimize noise, particularly for low-emission vehicles, but low dilution can maintain high concentrations
  - Roadway: Many gases, particles, and semivolatile species elevated above background levels, with oxidants entrained by turbulence
- Transport time
  - Laboratory: Seconds or less
  - Roadway: Receptor-dependent
- Drivers
  - Laboratory: Generally expert drivers who can follow cycle
  - Roadway: Wide variety of driving behaviors

Inventories presently treat the phase distribution of species measured in diluted sample as representative of ambient air.

Rule Analyses

- Dynamometer emission tests are critical to establishing standards and understanding emission changes associated with standards
  - Feasibility of new emission standards demonstrated in laboratory
  - Test methods constrain variability and ensure repeatability
- Models used to describe the impacts of those changes on emissions and air quality
  - Inventories express emissions data as measured
  - Chemical transport models used to assess national impacts

NAAQS and State Implementation Plans

National Ambient Air Quality Standards (NAAQS)

- Identify and list air pollutants that
  - "reasonably be anticipated to endanger public health and welfare";
  - "from numerous or diverse mobile or stationary sources"
- Administrator to establish "air quality criteria" that reflect the latest scientific knowledge about public health and welfare impacts
- Establish NAAQS based on those criteria
  - Primary: "allowing an adequate margin of safety to protect the public health"
  - Secondary: "..protect the public welfare from any known or anticipated adverse effects"
- Monitoring networks in place to measure ambient air

Implementation

- Areas designated as “nonattainment” develop *s*tate *i*mplementation *p*lans (SIPs) and after a nonattainment area attains the standard it develops a maintenance plan.
  - Identify emission control requirements to attain or maintain the NAAQS
- States use emission inventories to identify emission controls needed to attain/maintain
  - Establish “budgets” for source sectors
- CAA includes specific requirements for some pollutants and regions

Mobile Source SIP Components

- Emission inventories need to reflect the controls used to attain NAAQS
  - National emission standards
    - Vehicle turnover
  - Inspection & maintenance types
    - On-board diagnostic (OBD-2) checks
    - Tailpipe testing for pre-1996 vehicles
    - Evaporative emission testing (e.g., gas cap pressure tests)
  - Fuels
    - Reformulated gasoline (RFG) (O3)
    - Volatility (RVP) controls (O_3) (Federal program or state program if CAA criteria are met)
    - Winter fuels (CO)
    - Renewable fuels
  - Transportation control measures (activity-focused)
    - High-occupancy vehicle (HOV) lanes
    - Employer-based transit incentives
    - Accelerated retirement of vehicles
    - Extreme cold temperature starts
    - Etc.
  - Diesel-focused controls
    - Idling reduction
    - Retrofits
  - State rules

Conformity

Conformity

(Applies in Nonattainment/Maintenance Areas)

- General conformity (all criteria pollutants)
  - Ensures that actions taken by Federal agencies in nonattainment and maintenance areas do not interfere with a SIP
    - Airport emissions modeled in FAA's EDMS model
    - Numerous other sources covered by stationary source regulations (NSR / PSD)
- Transportation conformity (O_3, CO, PM &NO_2)
  - Ensures that highway and transit projects funded by FHWA or FTA do not interfere with a SIP
    - Regional analysis
      - Emissions from planned transportation system compared to SIP-based motor vehicle emissions budget
    - Project-level analysis
      - Air quality impacts of a planned project compared to the relevant NAAQS and current air quality (CO and PM only)

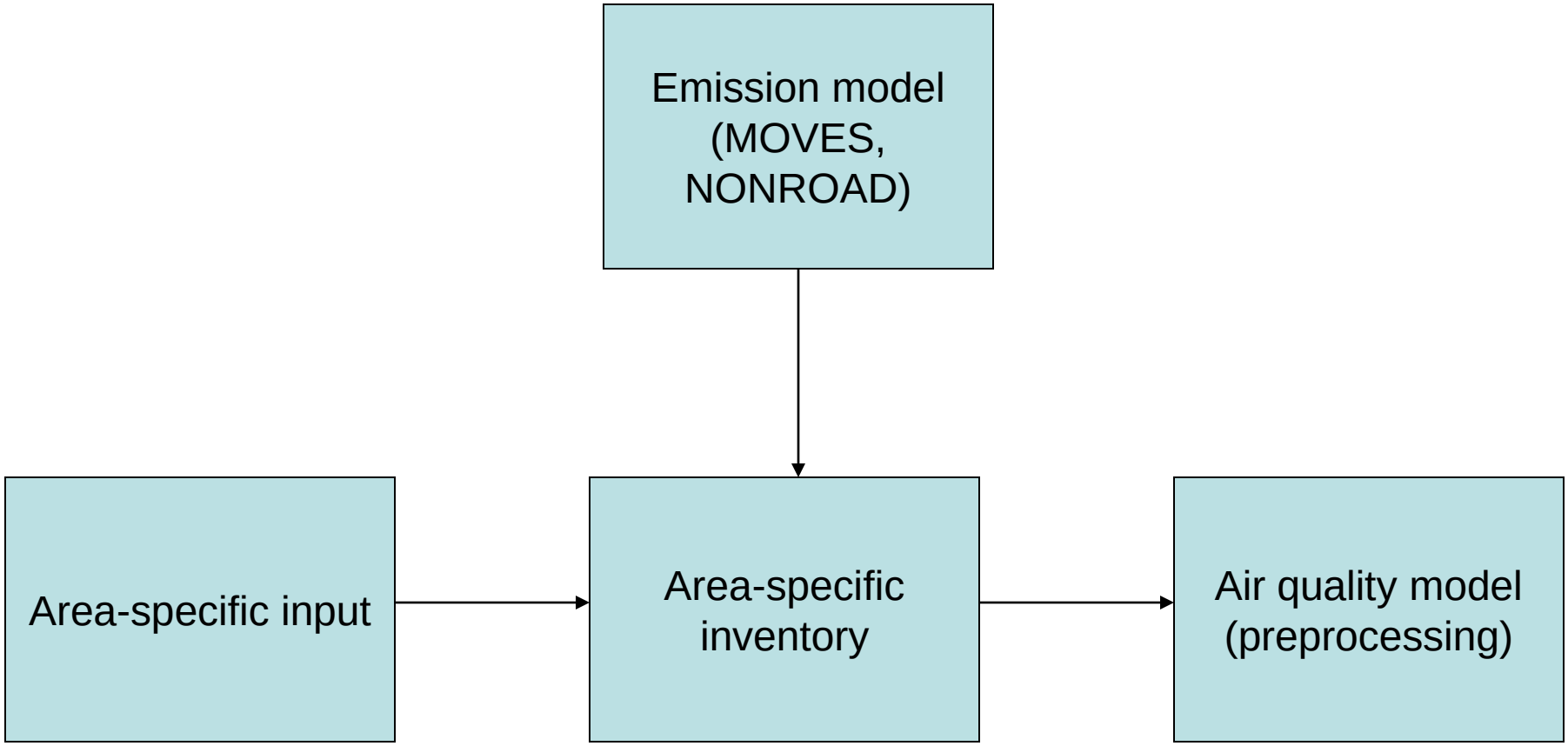
National Environmental Policy Act

NEPA

- Requires Federal agencies to consider environmental impacts in planning and decision-making
- Develop detailed statements of impacts of and alternatives to major Federal actions significantly affecting the environment
- Multiple pollutants may be considered, depending on the agency
  - Criteria pollutants
  - Air toxics
  - Greenhouse gases

Inventory Development

General Information Flow



Development of Models

- Models describe emissions, dependent on
  - Vehicle or engine characteristics
    - Source type (passenger car, combination truck, etc.)
    - Model year
    - Age
    - Fuel type
  - Activity
    - Start vs. running
    - Driving or operating cycle
  - Fuel properties
    - For example, ethanol and aromatic content, RVP
  - Meteorology
    - Ambient temperature
    - Relative humidity
  - Inspection & maintenance status
  - Retrofits

Current EPA Models

- Mandated by Clean Air Act
  - EPA must maintain & update emission factors every 3 years
  - EPA must provide tools for state and local air agencies
- Motor Vehicle Emission Simulator (MOVES) http://www.epa.gov/otaq/moves.htm
- NONROAD http://www.epa.gov/oms/nonrdmdl.htm

Inventory for a Place and Time

- Users develop inputs for models, describing local conditions
  - Fleet characteristics, such as
    - Source type distribution
    - Age distribution
  - Activity, such as
    - Vehicle miles traveled (VMT) by source type and road link type
    - Starts per day
    - Off-network activity (e.g., extended idling)
  - Meteorology
    - Ambient temperature
    - Relative humidity
  - Fuel supply and formulation, such as
    - Ethanol content
    - Reid vapor pressure
  - Local policies, such as
    - Inspection & maintenance
    - Retrofit and idle restrictions
    - Transportation control measures
- Inventories must reflect the range of policy options available

Conclusions

- Inventories inform a wide number of policy decisions at multiple levels
- Emission controls are source-specific, requiring inventories to be as well
- Test procedures aim to minimize testing-related variability to ensure repeatability
  - Inventories project these tests to ambient air
- Inventories and ambient measurements are different, but related
  - Research helps link the two