Estimating Nonpoint Source Emissions from Industrial, Commercial, and Institutional Fuel Combustion

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ALPINE GEOPHYSICS

Overview

- Methods Used for the National Emissions Inventory (NEI)
  - Emissions activity data sources
    - Background
    - Adjustments
      - Example calculations
  - Emission factors
    - Assumptions
  - Potential refinements

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Methods

- Emissions Estimation Equation

$$E_{s,f} = A_{s,f} * F_{s,f}$$

where

E = Emissions

A = Emissions Activity

F = Emission Factor

s = sector

f = fuel type

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Key Activity Data Inputs

- Annual Energy Consumption by State/Fuel Type
  - Total industrial
  - Total commercial/institutional
- Industrial Energy Consumption for Non-Fuel Purposes by State/Fuel Type
- Industrial and Commercial/Institutional (ICI) Fuel Consumption from Nonroad Mobile Sources
  - Distillate oil
  - Liquefied petroleum gas (LPG)

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Key Activity Data Inputs (cont'd)

- ICI Energy Consumption by Sector/State/Fuel Type for Point Sources
- County-level Employment by ICI Sector and State

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Activity Data Adjustments

- EIA's State Energy Data System (SEDS)
  - Use estimates for coal consumed by industrial users other than coke plants (CLOCP) rather than total industrial coal consumption (CLICP)

- *Example – 2008 PA: CLICP = 9,135; CLOCP = 2,641*

Activity Data Adjustments (cont'd)

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- EIA's State Energy Data System (SEDS)
  - Split coal estimates into anthracite vs. bituminous using EIA data identifying type of coal distributed into each state by sector
    - *Example – 2008 PA:*

      a) anthracite coal accounted for 202 thousand short tons of the total 2,404 thousand short tons of coal distributed for use in "Industrial plants excluding coke" (8.4%); and

      b) anthracite coal accounted for 85 thousand short tons of the total 214 thousand short tons of coal distributed for use in the "Commercial & Institutional" sector (39.7%)

Activity Data Adjustments (cont'd)

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- EIA's State Energy Data System (SEDS)
  - Nonroad mobile sources - LPG
    - Run NONROAD to obtain proportion of Industrial LPG consumption from agriculture, logging, mining, and construction source categories
      - *Example – National NMIM run for 2006: 9% of total Industrial LPG from nonroad mobile sources*
    - Run NONROAD for volume of Commercial sector nonroad mobile source LPG consumption and calculate proportion relative to total Commercial LPG consumption
      - *Example - National NMIM run for 2006: 18% of total Commercial LPG from nonroad mobile sources*




Activity Data Adjustments (cont'd)

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- Distillate Oil Consumption by Sector and State from EIA's *Fuel Oil and Kerosene Sales*
  - Source provides type of distillate oil detail not provided by SEDS
  - Proportion of total consumption by distillate fuel type from stationary sources largely based on assumptions from EPA's nonroad diesel emissions rulemaking

Activity Data Adjustments (cont'd)

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- Distillate Oil Consumption by Sector/State from EIA's *Fuel Oil and Kerosene Sales*

Sector	Distillate Fuel Type	% of Total Consumption from Stationary Sources
Commercial	No. 1 Distillate Fuel Oil	80
	No. 2 Distillate Fuel Oil	100
	Ultra-Low, Low, and High Sulfur Diesel	0[a]
	No. 4 Distillate Fuel Oil	100

[a] A very small portion of total commercial/institutional diesel is consumed by point sources (SCC 203001xx).

Activity Data Adjustments (cont'd)

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- Distillate Oil Consumption by Sector/State from EIA's *Fuel Oil and Kerosene Sales*
  - *Example – 2008 PA (values in 1000 gallons):*
    - *No. 1 Distillate = 1 (80% stationary source assumption)*
    - *No. 2 Distillate Fuel Oil = 128,836 (100% assumption)*
    - *Ultra Low/Low/High Sulfur Diesel = 55,519 +11,236 + 4,958 = 71,713 (0% assumption)*
    - *No. 4 Distillate Fuel Oil = 891 (100% assumption)*

*71,713 + [1 * (1-0.8)] = 71,713.2 thousand gallons out of 201,441 thousand gallons (35.6 percent) of total Commercial sector distillate oil consumption is estimated to be from nonroad mobile sources*

Activity Data Adjustments (cont'd)

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- Industrial Sector Non-Fuel Use
  - Eliminate data for fuels that EIA greenhouse gas (GHG) inventory treats as 100% non-fuel use
  - Fuel types in GHG Inventory for which non-fuel use>0% and <100% = distillate oil, LPG, natural gas, residual oil, non-coke coal
    - Calculate % of total energy consumption from non-fuel uses from regional data in EIA's *Manufacturing Energy Consumption Survey* (MECS)
      - *Example – 2006 Northeast region: Total LPG = 6 mil bbls; non-fuel (feedstock) LPG = 2 mil bbls; 33% of total LPG consumption estimated to be non-fuel use in Pennsylvania*
    - Non-coke coal data not reported in MECS (7% non-fuel estimate provided by EIA expert)

Activity Data Adjustments (cont'd)

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- Subtraction of Point Source Inventory Fuel Consumption

$$N_{s,f} = T_{s,f} - P_{s,f}$$

where

N = Nonpoint source fuel consumption

T = Total fuel consumption

P = Point source fuel consumption

s = sector

f = fuel type

Activity Data Adjustments (cont'd)

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- Subtract Point Source Inventory Fuel Consumption
  - Subtraction performed at state rather than county-level due to uncertainty of county-level estimates of total fuel consumption (county allocation procedure)
  - Crosswalk between each nonpoint source category and point source classification codes

Activity Data Adjustments (cont'd)

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- Industrial Wood Combustion Point SCCs

Point SCC	SCC1 DESC	SCC3 DESC	SCC6 DESC
10200901	External Combustion Boilers	Industrial	Wood/Bark Waste
10200902	External Combustion Boilers	Industrial	Wood/Bark Waste
10200903	External Combustion Boilers	Industrial	Wood/Bark Waste
10200904	External Combustion Boilers	Industrial	Wood/Bark Waste
10200905	External Combustion Boilers	Industrial	Wood/Bark Waste
10200906	External Combustion Boilers	Industrial	Wood/Bark Waste
10200907	External Combustion Boilers	Industrial	Wood/Bark Waste
10200908	External Combustion Boilers	Industrial	Wood/Bark Waste
10200910	External Combustion Boilers	Industrial	Wood/Bark Waste
10200911	External Combustion Boilers	Industrial	Wood/Bark Waste
10200912	External Combustion Boilers	Industrial	Wood/Bark Waste
39000989	Industrial Processes	In-Process Fuel Use	Wood
39000999	Industrial Processes	In-Process Fuel Use	Wood

Activity Data Adjustments (cont'd)

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- Natural Gas Consumption in Pipelines (e.g., compressor turbines/engines) Excluded from Subtraction unless not Completely Covered in Point Source Inventory (or other nonpoint category–e.g., oil and gas)
  - SEDS consumption data for "natural gas consumed as pipeline fuel" (NGPZP) is categorized by EIA as transportation sector use

Activity Data Adjustments (cont'd)

ALPINE GEOPHYSICS

- Subtraction of Point Source Inventory Fuel Consumption
  - *Example – 2008 PA: assuming Pennsylvania's 2008 point source inventory accounts for 2,000 thousand short tons of Industrial sector non-coke bituminous coal consumption*

$$Nonpoint_{\text{industrial coal}} = Total_{\text{industrial coal}} - Point_{\text{industrial coal}}$$

$$= 2{,}641 \text{ thousand tons} - 2{,}000 \text{ thousand tons}$$

$$= 641 \text{ thousand tons}$$

Activity Data Adjustments (cont'd)

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- County Allocation Procedure
  - Industrial - employment data for mfg. sector North American Industrial Classification System (NAICS) codes (31-33)
    - Source: Bureau of Census' *County Business Patterns*
  - Commercial/Institutional – employment data for Commercial & Public Administration sector NAICS codes (42 though 92, excluding 814)
    - Source for commercial sector: Bureau of Census' *County Business Patterns*
    - Source for public administration sector: Bureau of Census' *Census of Governments*

Activity Data Adjustments (cont'd)

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- County Allocation Procedure
  - *County Business Patterns* employment data often withheld to avoid disclosing information for individual facilities. Withheld data reported as a range (e.g., 50-99 employees)
    - Midpoint of range used as initial employment estimate
    - Initial employment estimates are then normalized to sum to total employment for all counties for which employment estimates are withheld

Activity Data Adjustments (cont'd)

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- *Example – 2006 Maine CBP data:*

FIPSSTATE	FIPSCTY	NAICS	EMPFLAG	EMP
23	001	31----		6,774
23	003	31----		3,124
23	005	31----		10,333
23	007	31----		1,786
23	009	31----		1,954
23	011	31----		2,535
23	013	31----		1,418
23	015	31----	F	0
23	017	31----		2,888
23	019	31----		4,522
23	021	31----		948
23	023	31----	I	0
23	025	31----		4,322
23	027	31----		1,434
23	029	31----		1,014
23	031	31----		9,749

Maine NAICS 31 employment = 59,322

Total NAICS 31 employment excluding counties 015 and 023 = 52,801. Difference = 6,521 employees

County 015 is assigned midpoint of 750 (EMPFLAG F = 500-999) and County 023 is assigned a midpoint of 7,500 (EMPFLAG I = 5,000-9,999)

Total initial employment estimate for these two counties = 8,250

6,521/8,250 = 0.79042

Final employment estimate for county 015 is 750 x 0.79042 = 593
Final employment estimate for county 023 is 7,500 x 0.79042 = 5,928

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Emission Factor Selection

- Is Fuel Being Combusted in Boilers or Engines, or Both? Method Assumes that all Combustion Takes Place in Boilers (expect that more fuel burned in boilers)
- Assumed that Nonpoint Sources are Uncontrolled (smaller sources less likely to be controlled)

Emission Factor Selection (cont'd)

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- Sulfur Content of Coal Important Input to SO_2 Emission Factors
  - Bituminous coal sulfur content by state/year obtained from EIA's *Quarterly Coal Report*
- PM Emission Factors for Natural Gas and LPG from 2002 NEI Identified as Too High (artifact formation during stack testing)
  - EPA applied SCC-specific adjustment factors to the 2002 NEI emission factors to better estimate PM emission rates for these fuels

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Method Refinements

- Review Emission Factors for Potential Revisions to Account for Recent ICI Boiler/Process Heater MACT Standards
- For Industrial Sector, Incorporate Allocation Procedure Based on County Estimates of Total Industrial Sector Energy Consumption
- Obtain More Geographic/Year-Specific Estimates of Nonpoint Source Fuel Consumption and Emission Factors

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