Quality Assurance and Estimation of Emissions Activity Data in the National Emissions Inventory

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PURPOSE

- Investigate emissions activity data for U.S. greenhouse gas emissions inventory
- Initial focus on industrial boiler/internal combustion (IC) engine fossil fuel categories

NATIONAL EMISSIONS INVENTORY (NEI)

- Annual compilation
- Emission trends
- Modeling & regulatory analysis
- Combination of State/Local/Tribal (S/L/T) agency estimates and EPA estimates
- Emissions activity data often not reported
  - Not mandatory
  - Confidentiality concerns

WHY ARE ACTIVITY DATA IMPORTANT?

- Calculate emissions for pollutants not reported by S/L/T agencies
- Calculate area source emissions
- Quality assurance (QA)

OVERVIEW

- Prepare "decision tree" of methods for:
  - Quality assuring NEI 2.0 activity data
  - Replacing questionable NEI activity data with more reasonable values
  - Estimating missing activity values
- Implement "decision tree"
- Compare pre- and post-augmentation NEI-based fossil fuel consumption with Department of Energy (DOE) estimates

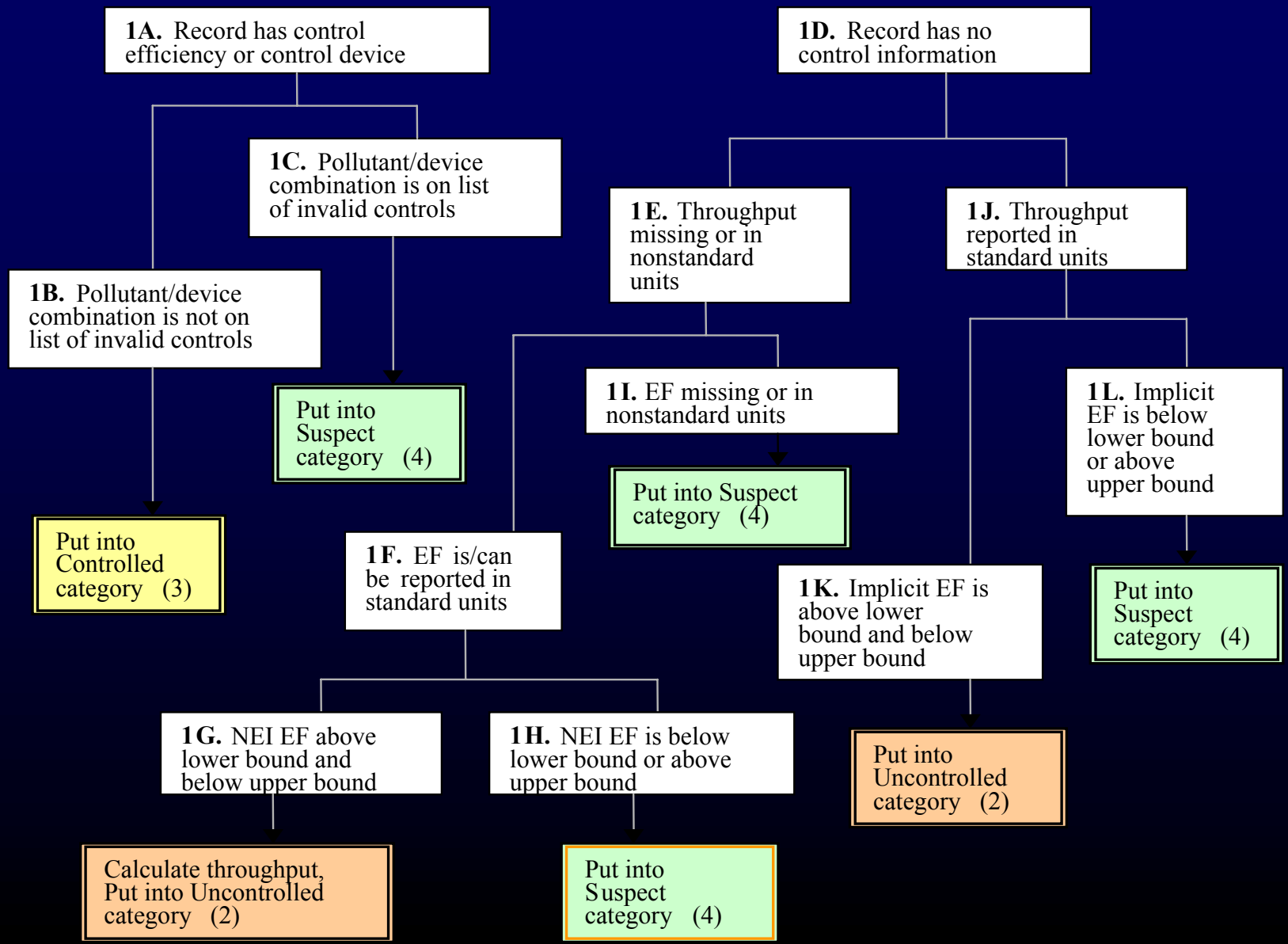
DECISION TREE DEVELOPMENT

- Focus on uncontrolled records to reduce reliance on additional data
- Convert NEI values to standard SCC units (e.g., from pounds to tons)
  - Throughput
  - Emission factor

DECISION TREE CATEGORIES

- Uncontrolled records
- Controlled records
- Suspect records
  - Suspect control device/pollutant combinations
  - Missing or invalid throughput values (e.g., natural gas consumption in acre-years)
  - Implicit emission factors (EFs) not within assumed lower and upper EF bounds

DECISION TREE CATEGORIES (cont'd)

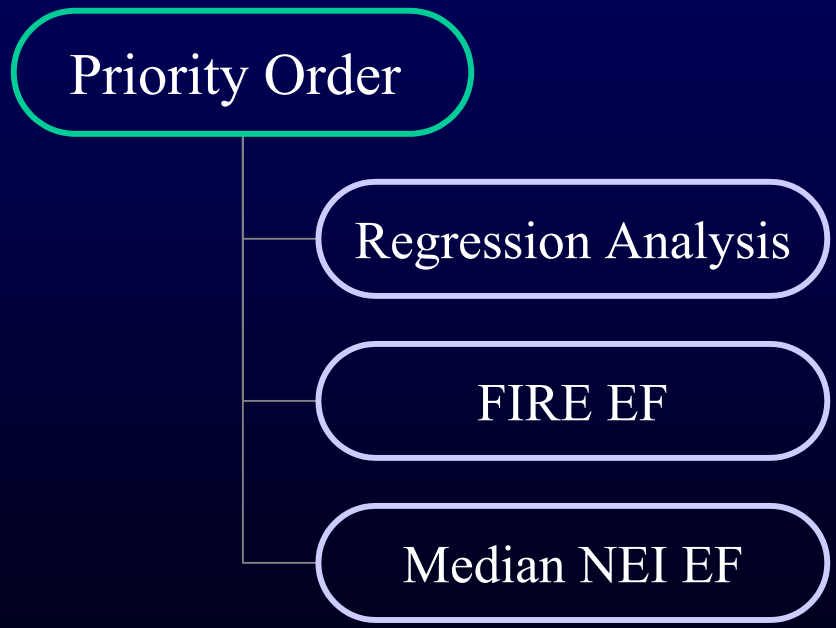


FACTORS FOR CALCULATING LOWER AND UPPER BOUND EFs

FIRE EF Quality Rating	Lower Bound	Upper Bound
A and B	0.75	1.25
C and D	0.50	1.50
Below D	0.25	1.75

UNCONTROLLED RECORDS

Develop Average EF for Each SCC/Pollutant



Remaining SCC/pollutant combinations use EF for a similar SCC, which was developed using one of the above methods

REGRESSION RESULTS

r^2 Value	# of EF Equations
< 0.90	4
0.90 to < 0.95	7
0.95 to < 0.99	29
> 0.99	101

CONTROLLED RECORDS

- Throughput not reported in NEI
  - Capture and control efficiency or primary control efficiency reported
    - Calculate uncontrolled emissions using reported control data and then divide uncontrolled emissions by EF computed from Uncontrolled records
  - No control efficiency reported
    - Calculate uncontrolled emissions using a default control efficiency and then divide uncontrolled emissions by EF computed from Uncontrolled records
    - Default control efficiencies identified from ControlNET, *AP-42*, and ARB point source emission control report

CONTROLLED RECORDS (cont'd)

- Throughput reported in NEI
  - Records with an implied EF between the lower and upper bound uncontrolled EF
    - Retain NEI throughput
  - Records with an implicit EF above the upper bound uncontrolled EF
    - Revise throughput using NEI controlled emissions, appropriate control efficiency, and upper bound uncontrolled EF
  - Records with an implied EF below lower bound uncontrolled EF
    - Revise throughput using NEI controlled emissions, appropriate control efficiency, and lower bound uncontrolled EF

SUSPECT RECORDS

- Throughput reported in NEI
  - Retained NEI throughput when following met
    - NEI implicit EF within 10% of NEI EF
    - NEI implicit EF not within 10% of NEI EF, but implicit EF is between lower bound controlled EF and upper bound uncontrolled EF
    - NEI implicit EF between lower bound controlled EF and upper bound uncontrolled EF and NEI EF is missing or reported using invalid units for SCC

SUSPECT RECORDS (cont'd)

- Throughput not reported in NEI
  - Estimated throughput:
    - From NEI emissions and NEI EF if the NEI EF was between the lower bound controlled EF and the upper bound uncontrolled EF
    - From NEI emissions and the lower bound controlled EF if the NEI EF value was below the lower bound controlled EF
    - From NEI emissions and the upper bound uncontrolled EF if the NEI EF was above the upper bound uncontrolled EF

SUSPECT RECORDS (cont'd)

- Throughput reported in NEI and NEI EF is not within 10 percent of implicit EF, replaced NEI throughput with value calculated
  - From NEI emissions and the uncontrolled EF (for records with both the implicit EF and the NEI EF outside the range of reasonable EFs)
  - By dividing NEI emissions by the lower bound controlled EF (for records with both the implicit EF and the NEI EF below the lower bound controlled EF)
  - By dividing NEI emissions by the upper bound uncontrolled EF (for records with both the implicit EF and the NEI EF above the upper bound uncontrolled EF)
  - By dividing NEI emissions by the NEI EF (for records with implicit EF outside the range of reasonable EFs and the NEI EF within the range of acceptable EFs)

SUSPECT RECORDS (cont'd.)

- Throughput reported in NEI and NEI EF is not available, replaced NEI throughput with value calculated
  - By dividing NEI emissions by the lower bound controlled EF (for records with an implicit EF below the lower bound controlled EF)
  - By dividing NEI emissions by the upper bound uncontrolled EF (for records with an implicit EF above the upper bound uncontrolled EF)

Comparison of DOE Energy Consumption with 1999 NEI Activity Estimates

			SIC Codes 01 - 39		SIC Codes 20 - 39	
Fuel	Units	1999 NEI Total	1999 NEI	1999 SEDR	1999 NEI	1998 MECS
Natural Gas	billion cu ft	28,528	13,638	10,067	9,356	6,481
Coal & Coke	million tons	21	13	96	11	78
Residual Oil	million bbl	139	138	40	138	57
Distillate Oil	million bbl	90	76	185	65	26
LPG	million bbl	23	4	624	4	38
Gasoline	million bbl	0.03	0.01	29	0.01	N/A

SEDR – State Energy Data Report
MECS – Manufacturing Energy Consumption Survey

RESULTS FROM IMPLEMENTING DECISION TREE

			SIC Codes 01 - 39		SIC Codes 20 - 39	
Fuel	Units	1999 NEI Total	1999 NEI	1999 SEDR	1999 NEI	1998 MECS
Natural Gas	billion cu ft	60,340	57,092	10,067	57,087	6,481
Coal & Coke	million tons	85	62	96	62	78
Residual Oil	million bbl	3,618	3,541	40	3,541	57
Distillate Oil	million bbl	3,854	3,414	185	3,414	26
LPG	million bbl	138	10	624	10	38
Gasoline	million bbl	0.05	0.02	29	0.02	N/A

SEDR – State Energy Data Report
MECS – Manufacturing Energy Consumption Survey

RESULTS (EXCLUDING MASSACHUSETTS RECORDS)

			SIC Codes 01 - 39		SIC Codes 20 - 39	
Fuel	Units	1999 NEI Total	1999 NEI	1999 SEDR	1999 NEI	1998 MECS
Natural Gas	billion cu ft	13,023	10,210	10,067	8,467	6,481
Coal & Coke	million tons	85	62	96	59	78
Residual Oil	million bbl	124	107	40	107	57
Distillate Oil	million bbl	187	145	185	137	26
LPG	million bbl	136	8	624	8	38
Gasoline	million bbl	0.05	0.02	29	0.02	N/A

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NEI QA ISSUES

- EF and throughput values reported using inappropriate units
- NEI reported EF values that differ significantly from implicit EF values
- Emission processes with same control device listed for every pollutant
- Atypically high control efficiencies
- Emissions and throughput values that imply that emissions are controlled although NEI does not report any control

RECOMMENDATIONS

- Refinement of emissions activity estimation procedures
  - Comparisons of uncontrolled EFs developed in this study with FIRE EFs
  - Methods applied to other point source categories
- Development/use of additional NEI QA procedures
  - Comprehensive lists of valid control device/pollutant combinations
  - Comprehensive lists of valid throughput units and emission factor units by SCC
- Education on importance of activity and related fields