Stationary Fuel Combustion - Industrial Area Source Category Calculation Methodology Sheet

I. Source Category: Stationary Fuel Combustion - Industrial

II. Pollutants: SO_x, NO_x, CO, PM_F

III. SCC:

2102011000 Stationary Source Fuel Combustion – Industrial - Kerosene
2102004000 Stationary Source Fuel Combustion – Industrial - Distillate oil
2102005000 Stationary Source Fuel Combustion – Industrial - Residual oil
2102006000 Stationary Source Fuel Combustion – Industrial - Natural Gas
2102007000 Stationary Source Fuel Combustion – Industrial - Liquefied Petroleum Gas (LPG)

IV. Description:

This category includes industrial emissions from fuel oil, natural gas, and LPG. LPG includes propane, propylene, butane, and butylenes. These emissions can be from large and small boilers, furnaces, heaters, and other heating units that are inventoried as point sources or area sources.

V. Current Methodology:

The methodology that was developed to estimate industrial fuel combustion for this project uses fuel consumption data from the U.S. Department of Energy's (DOE) Energy Information Administration (EIA).

VI. Emission Calculation:

A. Annual Emissions

Emissions were calculated in tons/year for industrial categories from each type of fuel combustion using following equation.

$$EM_I = \sum((F_{I,i} \times EF_{I,i}) / 2000)$$

Where:
EM_I = Emissions from industrial category.
$F_{I,i}$ = Total annual industrial sales of fuel i.
$EF_{I,i}$ = Industrial emission factor for fuel i from AP-42

1. Fuel Oil (Distillate Oil and Residual Oil)

Emissions from fuel oil combustion depend on the grade and composition of the fuel, the type and size of the boiler, the firing and loading practices used, and the level of equipment maintenance.

Activity Data Resources:

- Total amount of fuel consumed in the state.
    - Total sales statistics of kerosene, distillate oil, and residual oil can be obtained from the Annual Report on Sales of Fuel Oil and

Kerosene, 1999, published by Energy Information Administration, U.S. Department of Energy.
    - Local distributors can be contacted to obtain estimates for the industrial portions of delivery.
- Number of heat degree days per county per month for the year of the inventory. Heating degree data is available from the National Oceanographic and Atmospheric Administration (NOAA).
- Emission Factors:
    - Emission factors are available in AP-42. Additional emission factors for 7-PAH and 16-PAH are available in the EPA document *Locating and Estimating Air Emissions for sources of Polycyclic Organic Matter* (EPA, 1998b) and for 2,3,7,8-TCDD, 2,3,7,8-TCDD TEQ, CDD, CDF and EOM from *1990 Emission Inventory of Section 112(c)(6) Pollutants* (EPA, 1998a).

AP-42 Fuel Oil Combustion Emission Factors				
	SOx ($lbs/10^3$ gal)	**NOx ($lbs/10^3$ gal)**	**CO ($lbs/10^3$ gal)**	**PM_F ($lbs/10^3$ gal)**
Residual Boilers > 100 MMBTU/Hr	162.7(S)	47	5	9.19(S)+3.22
Residual Boilers < 100 MMBTU/Hr	159(S)	55	5	9.19(S)+3.22
Distillate Boilers > 100 MMBTU/Hr	147.7(S)	24	5	2
Distillate Boilers < 100 MMBTU/Hr	144(S)	20	5	2

Note: S indicates the sulfur content in %

2. Natural Gas

Activity Data Resources:

- Total amount of natural gas consumed in the state.
    - The preferred source of activity information is local distributors, who can be contacted to obtain estimates for the industrial portions of delivery.
    - The number of industrial units using natural gas for space heating for 1999 can be obtained from 1990 Census Profile Series, Social and Economic Characteristics of Population and Housing.
    - Department of Energy (DOE) Energy Information Administration (EIA) publishes a document titled *State Energy Data Report*, which provides state-level fuel consumption separately for industrial sectors.
- Number of heat degree days per county per month for the year of the inventory. Heating degree data is available from the National Oceanographic and Atmospheric Administration (NOAA).

- Emission factors:

Industrial AP-42 Natural Gas Combustion Emission Factors					
	VOC ($lb/10^6$ scf)	**SOx ($lb/10^6$ scf)**	**NOx ($lb/10^6$ scf)**	**CO ($lb/10^6$ scf)**	**PM_F ($lb/10^6$ scf)**
Boilers > 100 MMBTU/Hr	5.5	0.6	100-280	84	1.9
Boilers < 100 MMBTU/Hr	5.5	0.6	32-100	84	1.9
Tangential-fired Boilers	5.5	0.6	76-170	24-98	1.9

3. Liquefied Petroleum Gas (LPG)

Activity Data Resources:

- Total amount of LPG consumed in the state.
  - The number of industrial units using LPG for space heating for 1999 was obtained from 1990 Census Profile Series, Social and Economic Characteristics of Population and Housing.
  - Department of Energy (DOE) Energy Information Administration (EIA) publishes a document titled *State Energy Data Report*, which provides state-level fuel consumption separately for industrial sectors.
  - Local distributors can be contacted to obtain estimates for the industrial portions of delivery.
- Number of heat degree days per county per month for the year of the inventory. Heating degree data is available from the National Oceanographic and Atmospheric Administration (NOAA).
- Emission factors:

Industrial AP-42 Butane Combustion Emission Factors					
	VOC ($lb/10^3$ gal)	**SOx ($lb/10^3$ gal)**	**NOx ($lb/10^3$ gal)**	**CO ($lb/10^3$ gal)**	**PM_F ($lb/10^3$ gal)**
Industrial Boiler	0.4	0.09S	21	3.6	0.6

Industrial AP-42 Propane Combustion Emission Factors					
	VOC ($lb/10^3$ gal)	**SOx ($lb/10^3$ gal)**	**NOx ($lb/10^3$ gal)**	**CO ($lb/10^3$ gal)**	**PM_F ($lb/10^3$ gal)**
Industrial Boiler	0.3	0.10S	19	3.2	0.6

Note: S indicates the sulfur content in gr/100 ft^3

4. Sample Calculation

Commercial and industrial emissions from this source category are calculated in a similar manner as residential fuel combustion (see example in Stationary Fuel Combustion Residential Area Source Category Calculation Methodology Sheet) with the exception that the number of days in an ozone season changes from 214 for residential to 168 for commercial and industrial. Residential ozone season days are based on 7 days per week activity and commercial and industrial ozone season days are based on 6 days per week activity.

VII. Point Source Adjustments:

A large portion of the activity data may represent deliveries to industrial facilities will be inventoried as point sources. Estimated area source activity of emissions should be adjusted by subtracting the activity or emissions attributable to point sources. See EIIP Volume III, Chapter 1, Section 4 for methodology to account for point sources in an area source emissions inventory.

VIII. Adjustments for Controls:

Regulations for emissions from fuel combustion rarely apply to the area.

IX. Spatial Adjustments:

Industrial activity may be spatially allocated based on employment data for SICs 20-39. Employment information may be obtained from the state department of labor or from the U.S. Census Bureau data. Emissions from commercial/institutional sources that are combusting predominantly for heating purposes may be apportioned based on employment data for SICs 20-39 :

$$SAF_{InventoryCounty} = \frac{SE_{InventoryCounty}}{\sum AllCountiesInState(SE_{County})}$$

Where:

$SAF_{InventoryCounty}$ = Industrial Spatial Apportioning Factor

$SE_{InventoryCounty}$ = SIC 20-39 employment numbers for inventory county

SE_{county} = SIC 20-39 employment for each county in the state

X. Temporal Adjustments:

Some consumption for water heating purposes may be assumed to be constant through the year, but fuel for space heating must be apportioned according to heating needs. To separate industrial space heating usage from water heating, contact one representative fuel oil distributor to obtain commercial annual deliveries and lowest monthly deliveries. The deliveries for the month with the lowest deliveries can be assumed to be only for water heating. Calculate the percentage of fuel oil consumption for water heating separately. Temporal adjustments can be applied to the inventory for home heating using the following equations:

$$HP_{npannual} = 100 * \frac{12 * F_{LM}}{Fannual}$$

Where:

$HP_{npannual}$ = Annual non-space heating percent
F_{LM} = Lowest monthly fuel use
F_{annual} = Annual fuel use

and

$$Fuel_{month} = Fuel_{annual} * \frac{HDD_{month}}{HDD_{annual}}$$

Where:

$Fuel_{month}$ = Fuel use for inventory month
$Fuel_{annual}$ = Fuel use for inventory year
HDD_{month} = Heating degree days for inventory month
HDD_{annual} = Heating degree days for inventory year]

XI. Assumptions:

1. Combustion estimates are corrected for the number of units burning each fuel type.

XII. Rule Effectiveness:

Not applicable.

XIII. Recommendations to Improve Methods/Data

Estimates for fuel use can be improved by the state by contacting suppliers or performing a survey.

XIV. References:

Maryland Department of the Environment, *Calculation Methodologies (draft)*, June 2002.
U.S. Environmental Protection Agency, *AP-42 Fuel Oil Combustion Chapter 1.3,* September 1998.

U.S. Environmental Protection Agency, *AP-42 Natural Gas Combustion Chapter 1.4,* July 1998.

U.S. Environmental Protection Agency, *AP-42 Liquefied Petroleum Gas Combustion Chapter 1.5,* October 1996.

U.S. Environmental Protection Agency, *Area Source Category Abstract – Fuel oil and Kerosene Combustion*, April, 1999.

U.S. Environmental Protection *Agency, Area Source Category Abstract – Natural Gas and LPG Combustion*, April, 1999.

U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors – Volume I: Stationary Point and Area Sources. Fifth Edition, AP-42*, *1998.*