

## RESIDENTIAL AND COMMERCIAL/INSTITUTIONAL FUEL OIL AND KEROSENE COMBUSTION

### DESCRIPTION

This emission guidance abstract covers air emissions from the combustion of distillate fuel oils and kerosene by the residential and commercial/institutional sectors for space heating or water heating. This category includes small boilers, furnaces, heaters, and other heating units that are not inventoried as point sources. Residential and commercial fuel oil and kerosene combustion sectors include housing units; wholesale and retail businesses; health institutions; social and educational institutions; and Federal, state and local government institutions (e.g., military installations, prisons, office buildings).

### POLLUTANTS

Particulate matter (PM), sulfur dioxide (SO<sub>2</sub>), sulfur trioxide (SO<sub>3</sub>), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), nitrous oxide (N<sub>2</sub>O), methane and non-methane total organic carbon (TOC), volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (7-PAH and 16-PAH), extractable organic matter (EOM), polycyclic organic matter (POM), formaldehyde (HCOH), 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), 2,3,7,8-tetrachlorodibenzofuran (TCDF), 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalent quantity (TCDD TEQ), dioxins (CDD), furans (CDF), speciated metals, and organic compounds.

### AVAILABLE METHODS

**Activity:** The preferred source for fuel oil and kerosene consumption information is the state energy office. If an assumption is required to separate residential and commercial consumption, the following resources may be used:

- Contact a small number of local distributors to obtain estimates for the residential and commercial portions of deliveries; or
- The U.S. Census Bureau<sup>1</sup> reports the number of households at state and county levels that use fuel oil and kerosene as their primary space heating fuel. Household data are available from the 1990 census.

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<sup>1</sup> <http://venus.census.gov/cdrom/lookup/CMD=LIST/DB=C90STF3A/LEV=STATE>

If very few households use fuel oil or kerosene, then deliveries can be assumed to be entirely to the commercial sector.

An alternative information source for activity data is the Department of Energy (DOE) Energy Information Administration (EIA) annual publication titled *State Energy Data Report* which provides total fuel oil and kerosene consumption from the annual EIA report *Fuel Oil and Kerosene Sales*.<sup>2</sup> The EIA determines consumption by applying statistical methods to survey data of deliveries of a sample of companies that sell fuel oil and kerosene to end users. The assumptions used by EIA to disaggregate the data into residential and commercial/institutional consumption are applicable to the national level and may not be correct for the inventory area. Also note that sales to farm houses are reported under farm use and included in the industrial sector. To separate *State Energy Data Report* information into residential and commercial/institutional consumption, the following resources may be used:

- Use the EIA data as reported;
- Contact a small number of local distributors to obtain estimates for the residential and commercial portions of deliveries; or
- The U.S. Census Bureau<sup>1</sup> reports the number of households at state and county levels that use fuel oil or kerosene as their primary space heating fuel. Household data are available from the 1990 census.

If very few households use fuel oil or kerosene, then deliveries can be assumed to be entirely to the commercial sector.

**Emission Factors:** Emission factors are available from *AP-42*, Chapter 1: External Combustion Sources (EPA, 1996). *AP-42* provides fuel oil combustion factors for residential furnaces, as well as distillate oil-fired commercial/institutional combustion (Tables 1.3-1, 1.3-2, 1.3-3, 1.3-7, 1.3-8, 1.3-9 and 1.3-10). Distillate fuel emission factors may also be used for kerosene. Emission factors for No. 6, No. 5 and No. 4 oil-fired combustors may be used when activity is separated into these fuel oil types. A particulate matter size distribution is given for commercial combustion sources (Figure 1.3-6 in *AP-42*).

Additional fuel oil combustion emission factors are available for 7-PAH and 16-PAH from the EPA document *Locating and Estimating Air Emissions from Sources of Polycyclic Organic*

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<sup>2</sup> <http://www.eia.doe.gov>

Matter (EPA, 1998b) and for 2,3,7,8-TCDD, 2,3,7,8-TCDF, 2,3,7,8-TCDD TEQ, CDD, CDF and EOM from 1990 Emission Inventory of Section 112(c)(6) Pollutants (EPA, 1998a).<sup>3</sup>

## POINT SOURCE ADJUSTMENTS

A portion of the activity data may represent deliveries to larger commercial, institutional, or multi-family facilities that may be inventoried as point sources. Estimated area source activity or emissions should be adjusted by subtracting the activity or emissions attributable to point sources. It is preferable to use activity data when making point source adjustments because emission estimates are not easily comparable due to differences in emission estimation methods and the use of controls. If only emissions are available, then it is preferable to subtract pre-control emission estimates for point sources. See the EIIP Volume III, Chapter 1, Section 4 for methodology to account for point sources in an area source emission inventory.<sup>4</sup>

## ADJUSTMENTS FOR CONTROLS

Regulations for emissions from fuel oil combustion are generally applicable to point sources and do not apply to the area sources in this category. Inventory preparers should research rules applying to this source category. If some controls are being used, then refer to EIIP Volume III, Chapter 1, Section 4.2.

## SPATIAL AND TEMPORAL ALLOCATIONS

Inventory preparers should first develop a preliminary state-wide estimate of emissions from fuel oil and kerosene combustion sources and then decide if emission levels justify the effort required to collect data for spatial and temporal apportioning. If this category is not expected to be a significant contributor during the inventory time period, then apportioning methods that require less effort may be used.

**Residential Spatial Allocation:** For residential use of fuel oil and kerosene, the preferred method to allocate state data to the county level is to proportion fuel use by the number of households heating with fuel oil or kerosene and heating degree days. A "heating degree day" is a unit of measure used to indicate how cold it has been over a 24-hour period. Daily heating degree days are calculated as the difference between the base value of 65°F and the mean

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<sup>3</sup> See reference section of this abstract for websites.

<sup>4</sup> <http://www.epa.gov/ttn/chief/eiip/techrep.htm#areasrc>

temperature for the day (mean of the high and low temperatures for the day). Annual heating degree days are the sum of the daily heating degree days. Heating degree data is available from the National Oceanographic and Atmospheric Administration (NOAA).<sup>5</sup>

Residential Spatial Apportioning Factor =

$$\frac{HDD_{Inventory\ County} * FHU_{Inventory\ County}}{\left[ \sum_{\substack{all\ counties \\ in\ state}} (HDD_{county} * FHU_{county}) \right]}$$

Where:

$HDD_{Inventory\ County}$	=	Annual heating degree days for inventory county
$FHU_{Inventory\ County}$	=	Housing units using fuel oil or kerosene for inventory county
$HDD_{county}$	=	Annual heating degree days for each county in the state
$FHU_{county}$	=	Housing units using fuel oil or kerosene for each county in the state

The U.S. Census Bureau reports the number of households using each fuel as their primary household space heating fuel by state and county. Household data is available from the 1990 Census.<sup>6</sup>

Alternative spatial apportioning factors for residential emissions include primary household heating fuel data, population data, or number of households.

**Commercial/Institutional Spatial Allocation:** Commercial/institutional activity may be spatially allocated based on employment data for SICs 50-99. Employment information may be obtained from the state department of labor or from U.S. Census Bureau data.<sup>7</sup> Emissions from

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<sup>5</sup> <http://www.noaa.gov> (homepage) or <http://www.ncdc.noaa.gov/ol/climate/climateproducts.html#PUBS> (for a list of available data)

<sup>6</sup> <http://venus.census.gov/cdrom/lookup/CMD=LIST/DB=C90STF3A/LEV=STATE>

<sup>7</sup> <http://govinfo.kerr.orst.edu/index.html>

commercial/institutional sources that are combusting predominantly for heating purposes may be apportioned based on employment data for SICs 50-99 and heating degree days:

Commercial/Institutional Spatial Apportioning Factor =

$$\frac{HDD_{InventoryCounty} * SE_{InventoryCounty}}{\left[ \sum_{\substack{\text{allcounties} \\ \text{instate}}} (HDD_{county} * SE_{county}) \right]}$$

Where:

$HDD_{InventoryCounty}$	=	Annual heating degree days for inventory county
$SE_{InventoryCounty}$	=	SIC 50-99 employment numbers for inventory county
$HDD_{county}$	=	Annual heating degree days for each county in the state
$SE_{county}$	=	SIC 50-99 employment for each county in the state

See the temporal section below for guidance on separating heating and non-heating usage. An alternative method is to spatially apportion emissions from commercial/institutional sources based on population data.

**Temporal Allocation:** Kerosene consumption may be assumed to be exclusively for space heating. For fuel oil, research the consumption for water heating in the inventory area. The U.S. Census reports fuel used for space heating and water heating for selected metropolitan areas in the *American Housing Survey for Selected Metropolitan Areas*<sup>8</sup> and national regions as reported in the *American Housing Survey*.<sup>9</sup>

Consumption for water heating purposes may be assumed to be constant through the year, but fuel used for space heating must be apportioned according to heating needs. To separate commercial/institutional space heating usage from water heating, contact one representative fuel oil distributor to obtain commercial/institutional annual deliveries and lowest monthly deliveries. Similar information should also be obtained for residential consumption. Deliveries can be in gallons, Btus, or dollars. 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 for each sector:

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<sup>8</sup> <http://www.census.gov/prod/www/abs/h170sma.html>

<sup>9</sup> <http://www.census.gov/prod/www/titles.html#house>

Annual Non-Space Heating Percent =

$$\frac{12 * \text{Lowest Monthly Fuel Use}}{\text{Annual Fuel Use}} * 100$$

This percentage may be applied to the inventory area's fuel oil consumption for a given sector to calculate the water heating portion of usage. This portion can be subtracted from the annual total and the remaining consumption, which is being used for space heating, can be allocated by month using proportions of annual and monthly heating degree days:

$$\text{Fuel}_{\text{month}} = \text{Fuel}_{\text{annual}} * \frac{\text{Heating Degree Days}_{\text{month}}}{\text{Heating Degree Days}_{\text{annual}}}$$

Where:

Fuel <sub>month</sub>	=	Space heating fuel use for inventory month
Fuel <sub>annual</sub>	=	Space heating fuel use for inventory year
Heating Degree Days <sub>month</sub>	=	Heating degree days for inventory month
Heating Degree Days <sub>annual</sub>	=	Heating degree days for inventory year

## OTHER EMISSION CALCULATION ISSUES

None.

## REFERENCES

EPA. 1998a. *Compilation of Air Pollutant Emission Factors--Volume I: Stationary Point and Area Sources. Fifth Edition, AP-42*. U. S. Environmental Protection Agency, Office of Air Quality Planning and Standards. (GPO 055-000-00251-7). Research Triangle Park, North Carolina.

EPA. 1998b. *Locating and Estimating Air Emissions from Sources of Polycyclic Organic Matter (EPA-454/R-98-014)*. U. S. Environmental Protection Agency, Air Quality Strategies and Standards Division. Research Triangle Park, North Carolina (<http://www.epa.gov/ttn/chief/pom.html>).

EPA. 1998c. *1990 Emission Inventory of Section 112(c)(6) Pollutants: Polycyclic Organic Matter (POM), 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TDCC), 2,3,7,8-Tetrachlorodibenzofuran (TDCF), Polychlorinated Biphenyl Compounds (PCBs), Hexachlorobenzene, Mercury and Alkylated*

*Lead.* U. S. Environmental Protection Agency, Air Quality Strategies and Standards Division. Research Triangle Park, North Carolina (<http://www.epa.gov/ttncaaa1/t3/meta/m23804.html>).