Daily and Diurnal Temporalization of EGUs without CEMS Data for 2016 Beta Modeling Platform

Large electric generating unit (EGU) sources are temporalized for modeling using unit-level matches to the hourly CAMD continuous emissions monitoring (CEM) data. In previous modeling platforms small EGUs were temporalized using daily and diurnal profiles weighted by CEM values within an IPM region and by fuel type (coal, gas, and other). All unit types (peaking and non-peaking) were given the same profile within a region and fuel bin. Certain units, identified the creation of the 2011 platform, were identified as municipal waste combustors (MWC) or cogeneration (cogen) and given flat daily and diurnal profiles. For the 2016 beta modeling platform updates have been made to the small EGU temporalization process to improve on the previous approach.

Overview

Updates to the small EGU temporalization approach include changes to the grouping of sources with hourly CEM data for input into the profiles and the selection of each temporal profile for small EGU source. Changes have also been made to the identification of unit types.

- The region groupings have narrowed from many IPM regions to eight multi-state regions derived from MJO and climate region groups.
- The fuel groupings have expanded, moving units primarily operating on distillate and residual oil from the "other" category into a new "oil" category.
- Within each region and fuel grouping there are now separate profiles for peaking and non-peaking units.
- The list of units identified as MWC and/or cogen was updated using NEEDS v6 information.
- Temporal profiles are assigned at the unit level rather than the process level.

Selection of Input Units

The region, fuel, and type (peaking or non-peaking) must be identified for each input EGU with CEM data that is used for generating profiles. The identification of peaking units was done using hourly heat input data from the 2016 base year and the two previous years (2014 and 2015). The heat input was summed for each year. Equation 1 shows how the annual heat input value is converted from heat units (BTU/year) to power units (MW) using the NEEDS v6 derived unit-level heat rate (BTU/kWh). In equation 2 a capacity factor is calculated by dividing the annual unit MW value by the NEEDS v6 unit capacity value (MW) multiplied by the hours in the year. A peaking unit was defined as any unit that had a maximum capacity factor of less than 0.2 for every year (2014, 2015, and 2016) and a 3-year average capacity factor of less than 0.1.

Equation 1. Annual unit power output

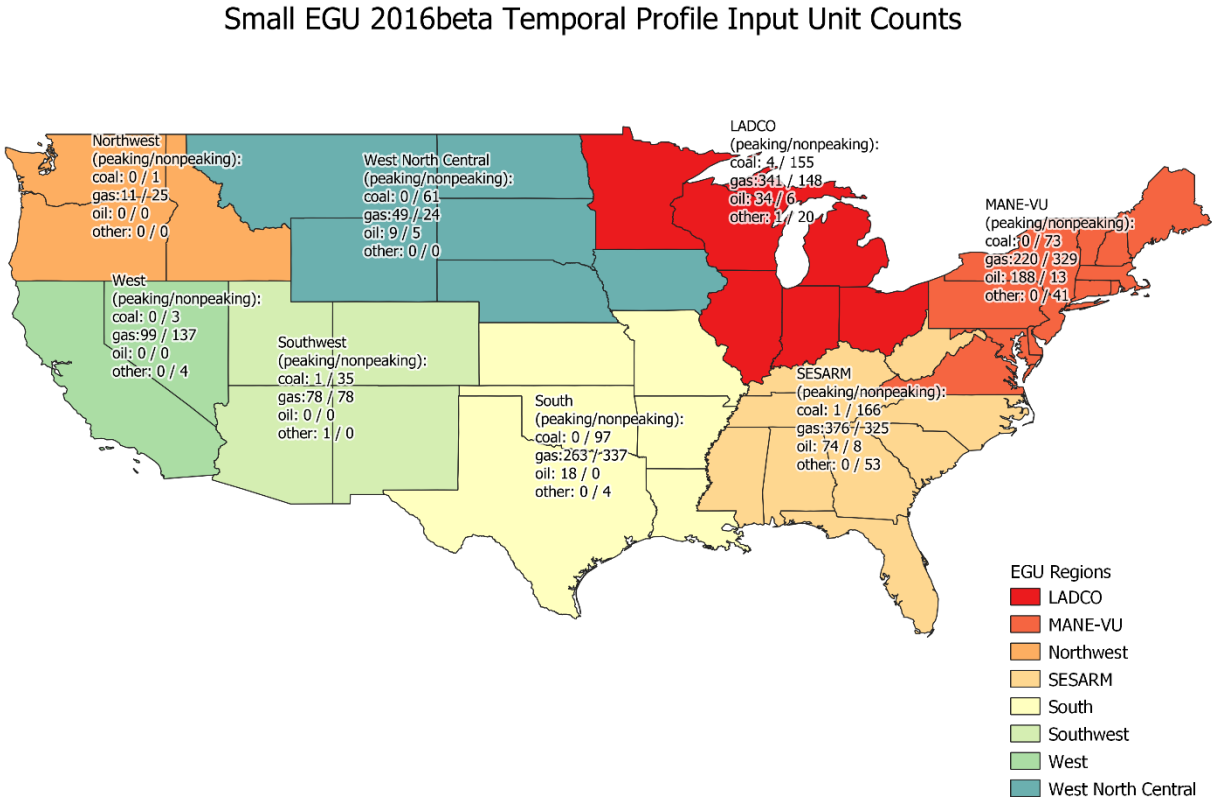
$$Annual\ Unit\ Output\ (MW) = \frac{\sum_{i=0}^{8760} Hourly\ HI\ (BTU) * 1000\left(\frac{MW}{kW}\right)}{NEEDS\ Heat\ Rate\left(\frac{BTU}{kWh}\right)}$$

Equation 2. Unit capacity factor

$$Capacity\ Factor = \frac{Annual\ Unit\ Output\ (MW)}{NEEDS\ Unit\ Capacity\left(\frac{MW}{h}\right) * 8760\ (h)}$$

Input regions are determined from one of the eight EGU modeling regions based on MJO and climate regions. Regions are used to group units with similar climate-based load demands. Region assignment is made on a state level, where all units within a state are assigned to the appropriate region. Unit fuel assignments are made using the primary NEEDS v6 fuel. Units fueled by bituminous, subbituminous, or lignite are assigned to the coal fuel type. Natural gas units are assigned to the gas fuel type. Distillate and residual fuel oil are assigned to the oil fuel type. Units with any other primary fuel are assigned the "other" fuel type. The number of units used to calculate the daily and diurnal EGU temporal profiles are shown in Figure 1 by region, fuel, and for peaking/non-peaking. Currently there is a possible region, fuel, and type group maximum of 64 based on 8 regions, 4 fuels, and two types (peaking and non-peaking).

Figure 1. Small EGU 2016beta Temporal Profile Input Unit Counts



Generation of SMOKE Ready Temporal Profiles

The daily and diurnal profiles are calculated for each region, fuel, and peaking type group from the 2016 CEM heat input values. The heat input values are summed for each input group to the annual level at each level of temporal resolution: monthly, month-of-day, and diurnal. The sum by temporal resolution value is then divided by the sum of annual heat input in that group to get a set of temporalization factors. Diurnal factors are created for both the summer and winter seasons to account for the variation in hourly load demands between the seasons. For example, the sum of all hour 1 heat input values in the group is divided by the sum of all heat inputs over all hours to get the hour 1 factor. For each grouping there are 12 monthly factors, up to 31 daily factors per month, and two sets of 24

hourly factors. The profiles are implicitly weighted by unit size where the units with more heat input have a greater influence on the shape of the profile. *Composite profiles are created for each region and type across all fuels as a way to provide profiles for a fuel type that does not have hourly CEM data in that region.* Figure 2 shows daily temporal profiles for the gas fuel type in the LADCO region, and Figure 3 shows diurnal temporal profiles in the MANE-VU region.

Figure 2. Example Daily Temporal Profiles for the LADCO region and Gas Fuel Type

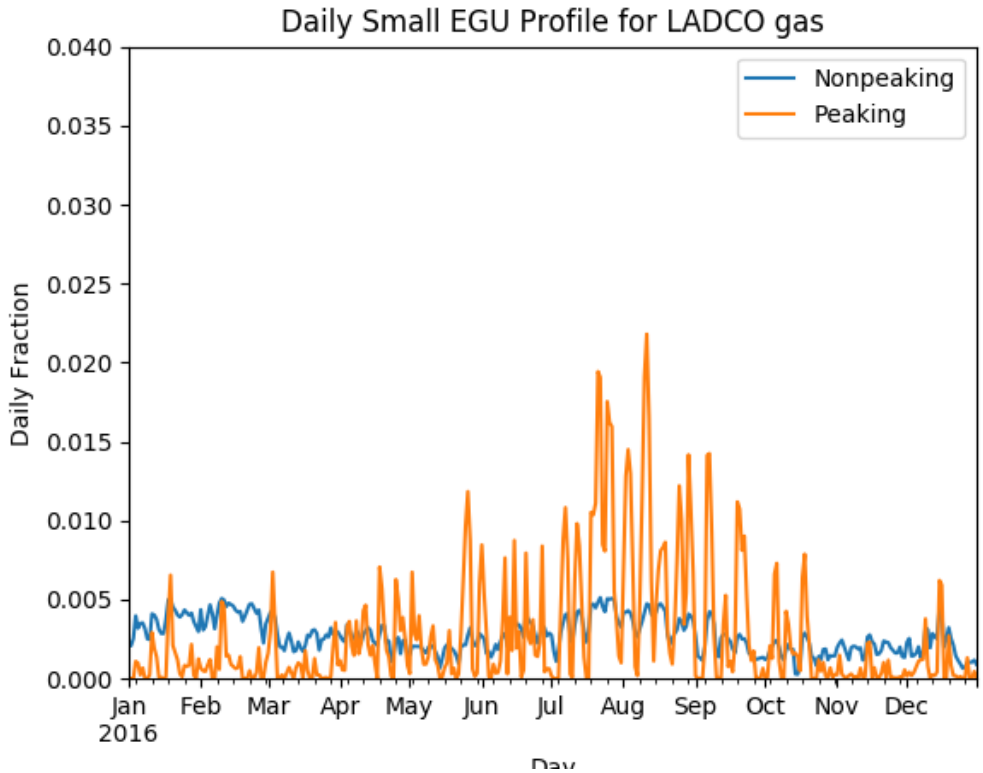
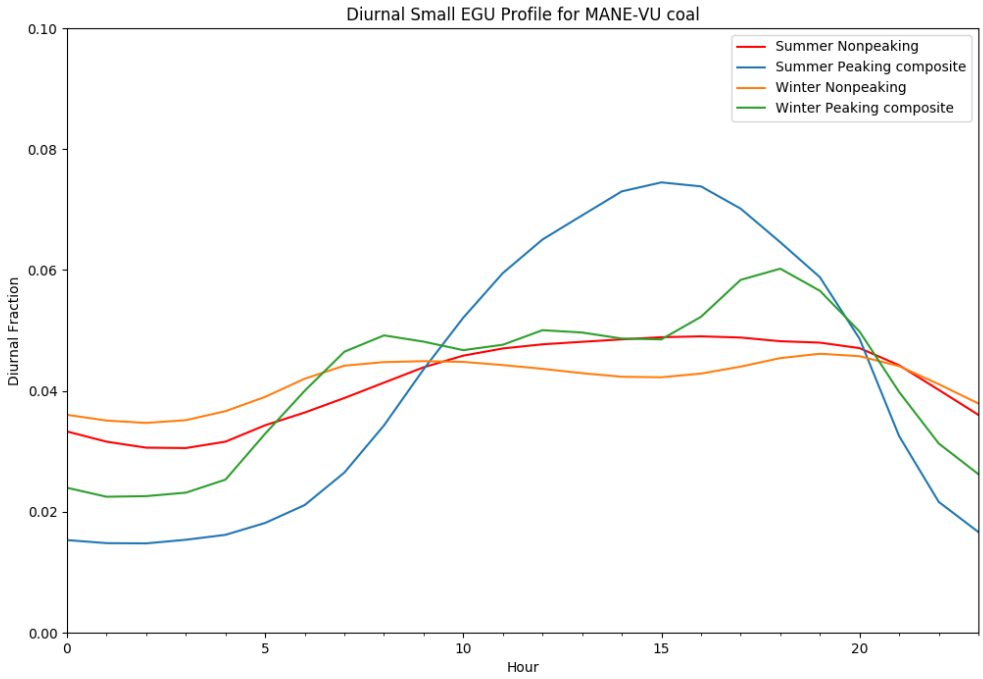


Figure 3. Example Diurnal Profile for MANE-VU Region and Coal Fuel Type



Assignment of Temporal Profiles

SMOKE uses a cross-reference file to select a monthly, daily, and diurnal profile for each source. The temporal profiles are assigned in the cross-reference at the unit level to EGU sources without hourly CEM data. An inventory of all EGU sources without CEM data is used to identify the region, fuel type, and type (peaking/non-peaking) of each source. As with the input unit the regions are assigned using the state from the unit FIPS. The fuel is assigned by SCC to one of the four fuel types: coal, gas, oil, and other. A fuel type unit assignment is made by summing the VOC, NOX, PM2.5, and SO2 for all SCCs in the unit. The SCC that contributes the highest total emissions to the unit for selected pollutants is used to assign the unit fuel type. Peaking units are identified as any unit with an oil, gas, or oil fuel type with a NAICS of 22111 or 221112. Some units may be assigned to a fuel type within a region and type that does not have an available input unit with a matching fuel type in that region. These units without an available profile for their group are assigned the regional composite profile for their type. MWC and cogen units are identified using the MWC NEEDS primary fuel type and cogeneration flag, respectively, from the NEEDS v6 database. The number of small EGUs assigned each profile group are shown by region in Figure 4.

Figure 4. Small EGU Temporal Profile Application Counts