# Current Representative Baseline and 2028 Future Year EGU Emissions for WRAP Regional Haze Planning using the 2014 Modeling Platform

Draft

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## Introduction

The Western Regional Air Partnership (WRAP) has developed current Representative Baseline and 2018 future year Electrical Generating Unit (EGU) SO2 and NOX emissions for the 13 western WRAP states. The WRAP EGU Representative Baseline and 2028 SO2 and NOX emissions will be used with the WRAP 2014 Photochemical Grid Model (PGM) Modeling Platform to make 2028 future year visibility projections for use in western state’s regional haze State Implementation Plans (SIPs). This document addresses the following three additional aspects needed for the EGU Representative Baseline and 2028 EGU emissions:

1. Approach for adding other EGU precursor emissions (i.e., VOC, CO, PM and NH3) with the SO2 and NOX emissions.
2. Approach for defining stack parameters for the EGUs.
3. Temporal allocation factors to be used for allocating the annual EGU emissions to hour of day during the 2014 meteorological modeling year.

The WRAP EGU Emissions Analysis Study[[1]](#footnote-2) analyzed EGU emissions in the western states and found the 2018 year was most representative of current conditions so the current Representative Baseline EGU emissions are based on annual 2018 emissions based on actual measured hourly emissions from Continuous Emissions Monitoring (CEM) devices for those EGUs with CEMs. The addition of other precursor pollutants and selection of stack parameters was done to be consistent with the WRAP EGU Emissions Analysis Study selection of the 2018 year as most representative.

EGU hourly emissions depend on meteorological conditions. Thus, the hourly temporal profiles used to allocate annual EGU emissions to hourly of year will be based on 2014 activity data since the WRAP is using a 2014 base meteorological modeling year for their modeling.

**Overview of Approach**

The 2016 modeling platform is the closest year to 2018 with EGU emissions available for all pollutant so will be used to add the other precursors with the Representative Baseline EGU SO2 and NOX emissions.

* The current Representative Baseline EGU VOC, CO, NH3 and PM emissions will be based on the 2016 beta (or 2016v1 if available) annual EGU emissions adjusted to 2018 using the changes in gross load (MW-hr) for each EGU between 2016 and 2018. The 2016 to 2018 adjustment approach will take into account know special circumstances that occurred to EGUs between 2016 and 2018, such as fuel switching and shut downs.
* The stack characteristics for the EGU sources in the current Representative Baseline and 2028 future year will also be based on those in the 2016 modeling platform.
* The current Representative Baseline EGU VOC, CO, NH3 and PM emissions will be projected to the 2028 future year using the same approach as used for SO2 and NOX emissions from the WRAP EGU Analysis Project that uses changes in gross load (MW-hr) for two scenarios:
	+ Scenario 1: highest annual gross load over last three years (2016-2018).
	+ Scenario 2: the average gross load over the last three years (2016-2018).
* The temporal allocation factors that adjust the EGU emissions from annual to day-specific hourly emissions will be based on those used in EPA’s 2014 modeling platform that are consistent with the 2014 meteorology.

## WRAP EGU Emissions Analysis Project

The Center for the New Energy Economy (CNEE) at Colorado State University conducted an analysis of current and future air emissions from fossil-fueled electricity generating units (EGUs) in 13 western states for the Western States Air Resources Council (WESTAR) and Western Regional Air Partnership (WRAP). WESTAR and WRAP representatives have participated in discussions with WEST Associates, a group comprised of major Western electric utilities, to develop parameters for this study, including information needed for western regional air quality analyses and planning under the federal Clean Air Act.

The current Phase of the project had two major objectives and deliverables:

1. Develop a comprehensive database of information on the fleet of fossil-fired EGUs in 13-Western states that contains information on the plants current operating characteristics and emissions (i.e., current Representative Baseline); and
2. Project 2028 future year plant utilization and emissions based on expected plant closures, re-powering plans, and additional controls required under a “rules on the books” scenario that includes any controls required by permit or consent decree between current to 2028 future year.

The results from the WRAP EGU Emissions Analysis Project are available on its website[[2]](#footnote-3) with details on the development of the Representative Baseline and 2028 future year EGU SO2 and NOX emissions projections available in the CNEE final report[[3]](#footnote-4) dated June 14, 2019. The study determined that 2018 had the most representative emissions for western EGUs so the current Representative Baseline EGU SO2 and NOX emissions were based on 2018 Continuous Emissions Monitoring (CEM) data.

## WRAP Representative Baseline and 2028 Future Year EGU Emissions Processing Assumptions

There are three steps in processing of the WRAP Emissions Analysis Project Representative Baseline EGU SO2 and NOX emissions for the 13 western states so that they can be used in Photochemical Grid Model (PGM) modeling using the WRAP 2014 Shake-Out modeling platform.

1. Addition of other emissions species emitted by EGUS in addition to SO2 and NOX;
2. Addition of Stack Parameters and Characteristics; and
3. Develop of temporal allocation profiles to convert annual emissions to hourly emissions.

### Addition of Other Emitted Species and Stack Parameters

The stack parameters and other emitted species (i.e., PM, VOC, NH3 and CO) besides SO2 and NOX will be obtained from the 2016 Beta (or 2016v1 if available) emissions inventory prepared as part of the MJO-EPA 2016 Emissions Collaborative Project[[4]](#footnote-5) that are available from the Intermountain West Data Warehouse (IWDW[[5]](#footnote-6)). The WRAP Emissions Analysis Project SO2 and NOX emissions for each EGU will replace the corresponding emissions in the 2016 Beta EGU emissions inventories. The EGU VOC, CO, NH3 and PM emissions will be adjusted from 2016 to 2018 using changes in gross load (MW-hr) between the two years to be consistent with the SO2 and NOX emissions.

### Development of EGU Annual to Hourly Temporal Allocation Profiles

It is important that the emissions in the Representative Baseline and Future Year have consistent temporal allocation profiles since the relative changes in the modeling results are used to project the observed Baseline visibility conditions to the future year. It is also important that the temporal allocations for the EGU emissions be consistent with the base meteorological year conditions (2014 in this case) because EGU emissions rates are connected to meteorological conditions (e.g., during the summer are higher on hotter days). Two approaches will be used to develop the EGU temporal allocation profiles, one for units with measured hourly CEM data, the other for units without CEM data.

Hourly Temporal Profiles Based on EGU 2014 CEM Data

The observed 2014 EGU CEM data will be used to develop unit-specific temporal allocation profiles for SO2 and NOx emissions and heat input for those EGUs with CEM data. The hourly 2014 CEM data will first be processed to refill hours with missing hourly CEM data using the CEMCorrect tool. The CEMCorrect tool is based in part on procedures originally developed by Adelman and co-workers (2012[[6]](#footnote-7)) and has been used by EPA for the 2014 National Emissions Inventory (NEI), which is described in Section 3.2.2 of the 2014NEI emissions Technical Support Document (TSD[[7]](#footnote-8)), with the procedures also described in Section 4 of the documentation for the EGU emissions in the 2016 Beta inventory.[[8]](#footnote-9) Hourly CEM data are used to show compliance with EGU emission budgets (e.g., Title IV acid rain controls). Thus, when the CEM data are missing, they are replaced with high maximum values to provide a conservative (overstated) estimate of the total annual/seasonal emissions to assure that the EGU emission are complying with their emissions cap. The CEMCorrect tool uses the CEM data flags and spikes in the hourly emissions to determine hours when the CEM data are missing and were replaced with high values and the high values are replaced with more typical average values. There are also procedures for replacing CEM data when only partial years are available. The results of this processing will be estimates of actual hourly 2014 SO2 and NOX emissions and heat input for each EGU with CEM data in the 13 western states. These estimates of 2018 actual hourly SO2, NOX and heat input data will be first examined to eliminate days with hours the EGU was shut down for maintenance or other reason and emissions replaced with typical hourly emissions for that month.

Hourly Temporal Profiles Based on EGUs Without CEM Data

For EGUs without CEM data, we will use the temporal profiles in the 2014 modeling platform[[9]](#footnote-10) and 2016 Beta emissions inventory whose development are described in Section 4 for of its 2016 Beta inventory EGU documentation.[[10]](#footnote-11) These temporal EGU emissions allocation profiles are for smaller EGUs (< 25 MW) and vary by geographic region in the 13 western states (e.g., Northwest, West North Central, West, Southwest, see Figure 2 in 2016 Beta EGU documentation).

Implementation of Hourly Temporal Allocation Profiles

The EGU temporal hourly allocation factors using CEMCorrect for EGUs with CEMs and those for EGU without CEMs has already been performed and are available with the 2014 modeling platform. So the development of the EGU hourly temporal allocation profiles for the current Representative Baseline and 2028 future year is actually much simpler than described above as they will be obtained by processing the EGU hourly emissions in the 2014 modeling platform to generate annual to hourly allocation factors. Cases where an EGU is shut down during 2014 will need to be considered and potentially the shut down period will be replaced by monthly average diurnally varying hourly profiles for when the EGU is operating.

### California Representative Baseline and Future Year EGU Emissions

The Representative Baseline and Future Year emissions for EGUs in California will be provided by the California Air Resources Board (ARB). WRAP is in the process of working with the California ARB in developing and implementing their EGU emissions.

1. https://www.wrapair2.org/EGU.aspx [↑](#footnote-ref-2)
2. https://www.wrapair2.org/EGU.aspx [↑](#footnote-ref-3)
3. https://www.wrapair2.org/pdf/Final%20EGU%20Emissions%20Analysis%20Report.pdf [↑](#footnote-ref-4)
4. http://views.cira.colostate.edu/wiki/wiki/9169 [↑](#footnote-ref-5)
5. https://views.cira.colostate.edu/iwdw/ [↑](#footnote-ref-6)
6. https://www3.epa.gov/ttn/chief/conference/ei20/session5/zadelman\_pres.pdf [↑](#footnote-ref-7)
7. https://www.epa.gov/sites/production/files/2018-08/documents/2014v7.0\_2014\_emismod\_tsdv1.pdf [↑](#footnote-ref-8)
8. http://views.cira.colostate.edu/wiki/Attachments/Inventory%20Collaborative/Documentation/2016beta\_0311/National-Emissions-Collaborative\_2016beta\_point-egu-ipm\_11Mar2019.pdf [↑](#footnote-ref-9)
9. https://www.epa.gov/sites/production/files/2018-08/documents/2014v7.1\_2014\_emismod\_tsd.pdf [↑](#footnote-ref-10)
10. http://views.cira.colostate.edu/wiki/Attachments/Inventory%20Collaborative/Documentation/2016beta\_0311/National-Emissions-Collaborative\_2016beta\_point-egu-ipm\_11Mar2019.pdf [↑](#footnote-ref-11)