Attachment B:


November 2018
I. Purpose
This staff paper outlines initial proposed changes to the 2017-2018 IRP criteria pollutant estimation process, for use in the 2019-2020 IRP cycle, and proposes key assumptions for calculating pollutant emissions: emission factors. Additionally, it explains the role of the Commission’s IRP criteria pollutant work as it relates to other agencies and stakeholders that are a part of California’s air quality landscape. Although not a direct output of the RESOLVE model, criteria pollutant emissions are estimated through the post-processing of RESOLVE results.  

II. Background
One of the many statutory goals of IRP is to “minimize localized air pollution and other GHG emissions, with early priority on disadvantaged communities.” To inform the selection of the 2017-2018 Reference System Plan (RSP) and comply with the two parts of this requirement, 1) minimizing emissions across the state and 2) prioritizing this minimization in disadvantaged communities (DACs), staff estimated criteria pollutant amounts of nitrogen oxides (NOx) and particulate matter less than 2.5 micrometers in size (PM2.5) as a proxy for air pollution. This was done in two phases. The first phase was based on outputs of the RESOLVE simulation of portfolios modeled to develop the 2017-2018 RSP and only included emissions from steady-state operation of generators. The second phase was based on outputs of the SERVM Production Cost Modeling of the RSP using 2017 Integrated Energy Policy Report (IEPR) assumptions and included emissions for steady-state operations along with hot, warm, and cold starts.

Commission staff approximated system-wide criteria pollutant emissions for different resource portfolios (developed under different greenhouse gas (GHG) constraints and sensitivities) through 2030 and found that the GHG constraint had a greater impact on criteria pollutant emissions than the various sensitivities examined. Staff concluded that the more stringent the GHG constraint, the greater the reductions in criteria pollutants. Between sensitivity cases, those resulting in higher load were associated with higher emission amounts and those resulting in lower load were associated with lower emission amounts. Additionally, although staff found that power plants are a small contributor to statewide NOx and PM2.5 levels relative to other sources of pollution (e.g., the transportation sector), staff concluded that fuel consumption and thus emissions changes within the combined cycle gas turbine (CCGT) class of power plants greatly outweighed those from other classes, even Peakers. Thus, reducing CCGT usage would result in the greatest decrease in quantities of emissions from the electric sector.

Limitations of the 2017-2018 approach were that the approach considered only two criteria pollutants and approximated their emissions at the system level, as a proxy for evaluating localized air pollution. This approximation did not properly account for the actual air pollution impacts of conventional

---

1 RESOLVE provides annual production (MWh) and fuel consumption (MMBtu) for each natural gas plant type category.
2 Normal operations of a plant include steady state, partial load, cold/warm/hot startup, and shutdown. Staff only accounted for the portion of emissions resulting from plants running at steady state.
3 D.18-02-018, pg. 60.
4 See Reference System Plan Analysis: Impacts on Disadvantaged Communities starting on Slide 149.
generation on local communities, which are difficult to accurately quantify accurately. In addition, because of the compressed schedule in the first cycle of IRP, stakeholders had limited opportunity to vet the emissions factors used to estimate criteria pollutant amounts before the analysis was conducted. In order to analyze the IRP portfolios’ impacts on localized air pollution in DACs, staff used the distinction of whether a generator was located inside or outside of a DAC to begin to evaluate the generator’s potential pollution impact. This approach relied upon the assumption that emissions would stay where they were produced. Even with these limitations, the 2017-2018 IRP cycle methodology provided insight into the amounts of pollutants emitted by California’s thermal fleet that had not previously been known. During the development of the 2019-2020 RSP, Commission staff plans to work with stakeholders to address the previous cycle’s limitations and improve upon the analysis.

III. Agency-Stakeholder Interactions

Because several agencies both at the local and federal level develop and manage programs to monitor and decrease criteria pollutant emissions to improve air quality, some parties voiced concerns in the 2017-2018 IRP cycle that the Commission’s work on criteria pollutants would risk duplicating efforts. The role of the Commission’s IRP criteria pollutant work in the context of these other agency and stakeholder activities is described below.  

Figure 1  Agency-stakeholder interactions as related to electric generator criteria pollutant emissions.

1. CAISO
   CAISO dispatches individual power generators and can award RMR contracts to facilities needed for system reliability.

2. Generators
   Generators run as needed and emit criteria pollutants. The amounts emitted are reported to the EPA and monitored by the air district the generator belongs to.

3. EPA
   EPA aggregates emissions data from generators and makes it publicly available in various databases (e.g. eGRID, AMPD). Also requires CARB to develop State Implementation Plan.

4. Air Districts
   Air districts prepare emissions inventory and report it to CARB. They also adopt control regulations for stationary sources.

5. CARB
   As part of AB 617, CARB develops statewide 5-yr emissions reduction plan with focus on local communities and air districts in non attainment and develops a consistent approach to quantifying emissions.

6. CPUC
   CPUC’s long term modeling of the electric system provides insight into how generators will run. Also directs LSE procurement and sends CAISO a resource portfolio for their Transmission Planning Process.

---

5 Should not be interpreted as a comprehensive summary of all agency and stakeholder air pollutant activities.
Figure 1 graphically represents high-level linkages between other agency activities that impact electric generator emissions. At the local level, air districts monitor emissions and issue air permits to individual generators. They also conduct emissions inventories for their districts which are then aggregated by the California Air Resources Board (CARB). CARB uses these emissions inventories to prepare the State Implementation Plan that details the state’s strategy for meeting federal air standards. This plan is reported to the U.S. Environmental Protection Agency (EPA). Because the CAISO runs the daily operations of California’s electric grid it has an immediate short-term impact on how often individual generators are dispatched. The Commission’s IRP process looks at the long-term needs of California’s electric grid and determines the optimal portfolio of resources to meet the state’s goals. It also informs the procurement of existing resources and can authorize the procurement of new resources. This resource determination sets the long-term resource policy that impacts future thermal generator usage.

The purpose of forecasting electric sector criteria pollutants each cycle of IRP is to ensure that the portfolio of resources selected to meet California’s electric sector GHG target also decreases criteria pollutants as is required by statute, while considering the short- and long-term cost and reliability impacts. The Commission’s resource portfolio determination has an impact on individual generators in two distinct ways. First, the Preferred System Plan is transmitted to the CAISO to ensure that the resource portfolio meets reliability needs, to avoid emergency procurement or operation of polluting sources of energy. Second, the approval (or non-approval) of individual IRP plans that LSEs are required to file with the Commission may directly impact contracting with individual generators.\(^6\)

IV. Overview of Approach for 2019-2020 Emissions Calculations

As part of the 2017-2018 IRP cycle, only NOx and PM2.5 emissions from the selected resource portfolio were estimated by applying emissions factors to forecast fuel usage amounts for all the conventional generators in the fleet. For the 2019-2020 IRP cycle, Commission staff is proposing to continue to use an emissions factor methodology but to refine the emissions factors used and to forecast SO2 emissions along with emissions from biomass, diesel, and geothermal.

In addition, in the 2017-2018 IRP cycle, Commission staff conducted SERVM Production Cost Modeling (PCM) after RESOLVE modeling and the selection of the RSP. For the 2019-2020 IRP cycle, staff proposes that SERVM PCM be conducted in parallel with RESOLVE modeling, before the selection of the RSP. Because SERVM can report individual unit emissions, it can provide a more detailed view of how often individual generators are running, starting, stopping, and contributing to total system emissions. This will allow better estimation of system emissions before the RSP is selected.

Staff proposes to improve emissions reporting from SERVM as follows:

- Where feasible, staff plans to estimate plant-specific emissions curves from EPA emissions data (available here: ftp://newftp.epa.gov/DMDnLoad/emissions/hourly/monthly/2018/) and apply those curves to the plants’ hourly dispatch data from the PCM runs, in order to estimate plant-

\(^6\) Ordering Paragraph 8 of D. 18-02-018 requires any load serving entity proposing to develop new natural gas resources or re-contract with existing natural gas resources for a period of five years or more to show justification for why another lower or zero emitting resources could not reasonably meet any identified resource need.
specific emissions. This will better reflect the range of difference in emissions factors depending on a plant’s operating state and output level.

- If data is not available, staff will use the steady-state/hot start/warm start/cold start emissions factors presented in Table 1.
- Where appropriate, staff will aggregate unit-specific results to preserve confidential information and summarize results.

While SERVM can provide a view into individual plant emissions, SERVM does not attribute individual plant emissions to a region’s air pollution or account for non-thermal factors that contribute to smog. Furthermore, there are limitations to forecasting individual plant emissions over IRP’s long planning horizon since individual gas plant costs, efficiency, and bidding behavior are difficult to capture in a long-term simulation. The reporting of individual unit usage in SERVM does not necessarily give actionable information about exactly how an individual plant is going to be used ten years into the future, but rather provides insight into the overall trends.

V. Local Emissions

In the 2017-2018 IRP cycle, beyond a basic geographic distribution of forecasted emissions based on the installed capacity of generators inside and outside of DACs, staff did not calculate local criteria pollutant emissions or attempt to quantify their impact on local communities. This was because industry standard air quality models to conduct the proper quantification of impacts were not available, due to the compressed schedule.

SERVM’s capability to dispatch individual generators will allow examination of how individual generators are expected to run while considering the locations of the generators. Staff plans to use the geographic information of each individual generator (latitude and longitude) to report aggregate emissions from different classes of generators in different regions. However, knowing the locations of specific generators does not provide full insight into the impacts of a specific generator’s emissions on the ambient pollutant levels of the community in which it is located. This is because criteria pollutants emitted from generator stacks disperse and diffuse into the atmosphere and end up impacting communities several miles downwind from where the plant is located. Commission staff seeks feedback from stakeholders to determine a method to allocate and understand the impact of system level emissions on local communities.

VI. Emission Factors

Tables 1 and 2 below specify the emissions factors staff have proposed to use to estimate criteria pollutant amounts. Source documentation can be found in Attachment B of the September 24, 2018 Ruling Seeking Comment on Production Cost Modeling, pg. 55. Table 3 proposes emissions factors based on EPA’s AP-42: Compilation of Air Emissions Factors. Staff also acknowledges recent party comments on SERVM production cost modeling that recommend using actual unit performance of existing emitting

---

7 See Comments of California Environmental Justice Alliance and Sierra Club on Production Cost Modeling, October 10, 2018.
generators as the basis for emissions factors, as well as available data differentiating emissions factors when a unit operates at Pmin, Pmax, or ranges in between.

**Table 1** NOx (tons/MWh) emissions factors for 2019-2020 RSP

<table>
<thead>
<tr>
<th>Type</th>
<th>Steady-state</th>
<th>Hot</th>
<th>Warm</th>
<th>Cold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined Cycle (Industrial)</td>
<td>3.45E-05</td>
<td>5.0E-04</td>
<td>4.0E-04</td>
<td>2.25E-04</td>
</tr>
<tr>
<td>Combined Cycle (Aero)</td>
<td>3.18E-05</td>
<td>7.0E-05</td>
<td>7.0E-05</td>
<td>7.0E-05</td>
</tr>
<tr>
<td>Combined Cycle (Single Shaft)</td>
<td>3.18E-05</td>
<td>5.0E-04</td>
<td>4.0E-04</td>
<td>2.25E-04</td>
</tr>
<tr>
<td>Combustion Turbine (Aero)</td>
<td>4.49E-05</td>
<td>7.0E-05</td>
<td>7.0E-05</td>
<td>7.0E-05</td>
</tr>
<tr>
<td>Combustion Turbine (Industrial)</td>
<td>1.27E-04</td>
<td>7.0E-05</td>
<td>6.0E-04</td>
<td>3.35E-04</td>
</tr>
<tr>
<td>Internal Combustion Engine</td>
<td>2.27E-04</td>
<td>7.0E-05</td>
<td>6.0E-04</td>
<td>3.35E-04</td>
</tr>
<tr>
<td>Steam Turbine, Boiler</td>
<td>6.8E-05</td>
<td>7.0E-05</td>
<td>6.0E-04</td>
<td>3.35E-04</td>
</tr>
<tr>
<td>Steam Turbine, Boiler with Combined Cycle Single Shaft</td>
<td>4.99E-05</td>
<td>5.0E-05</td>
<td>4.00E-04</td>
<td>2.25E-04</td>
</tr>
</tbody>
</table>

**Table 2** PM2.5 and SO2 emissions factors for 2019-2020 RSP

<table>
<thead>
<tr>
<th>Type</th>
<th>PM2.5 (tons/mmbtu)</th>
<th>SO2 (tons/mmbtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined Cycle</td>
<td>2.99E-06</td>
<td>3.18E-07</td>
</tr>
<tr>
<td>Steam</td>
<td>3.40E-06</td>
<td>3.18E-07</td>
</tr>
<tr>
<td>Cogen</td>
<td>2.99E-06</td>
<td>3.18E-07</td>
</tr>
<tr>
<td>Combustion Turbine</td>
<td>2.99E-06</td>
<td>3.18E-07</td>
</tr>
<tr>
<td>Internal Combustion Engine</td>
<td>4.54E-06</td>
<td>3.18E-07</td>
</tr>
</tbody>
</table>

**Table 3** Biomass and diesel emissions factors for 2019-2020 RSP

<table>
<thead>
<tr>
<th>Type</th>
<th>NOX (tons/mmbtu)</th>
<th>PM2.5 (tons/mmbtu)</th>
<th>SO2 (tons/mmbtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass</td>
<td>1.1E-04</td>
<td>3.25E-05</td>
<td>1.25E-05</td>
</tr>
<tr>
<td>Diesel</td>
<td>9.5E-04</td>
<td>2.39E-05</td>
<td>5.05E-04</td>
</tr>
</tbody>
</table>
(End of Attachment B)