August 24th, 2021

California Air Resources Board

1001 I Street

Sacramento, CA 95812

To whom it may concern,

Chevron appreciates the opportunity to respond to the Air Resources Board’s presentation “Updates to OPGEE v3.0a Candidate Model” presented on August 10, 2021, by Professor Adam Brandt. The new version of the model introduces changes that we believe are a valuable contribution to improving how greenhouse gases from the oil and gas extraction and processing operations in California are represented.

Chevron has been collaborating with Professor Brandt and his graduate student Wennan Long to analyze in detail six Chevron oil fields in the San Joaquin Valley (SJV) of California. As part of this effort, Chevron has provided detailed operating data and characteristics of the fields so that accurate comparisons of OPGEE’s engineering estimates can be performed.

As part of this effort, we have developed the following suggestions for improving OPGEE v3.0.

**Suggestion 1: Regionalization of inputs to allow for California specific values**

A number of the inputs to the OPGEE model are set by default to national averages, often derived from the Argonne National Lab GREET model or a similar national data source. These inputs may be unrepresentative of California conditions, and a setting in OPGEE 3.0 to automatically select more accurate California regional values would be very useful. In particular, the setting should include:

1. Electricity carbon intensity: Imported power has a CI of 206 kgCO2/MWh. EPA E-Grid or a similar resource could be used to generate grid-specific values for CA-ISO, CAMX/WECC, or other regional grid mixes.
2. Imported natural gas: Upstream CI has a value of 15,044 gCO2/MMBtu, obtained from the GREET model. This value may not be representative of the gas imported into California. Additional work to generate a regional gas CI would improve the accuracy of modeling steam injection fields. This value can have a large impact on steam injection fields because of the large amount of natural gas used for steam generation.
3. Fugitive emissions: Fugitives rely on a national model developed as part of the work presented in **Rutherford et al. (2021)[[1]](#footnote-2)**. These data do not reflect the conditions on the ground in California due to the more stringent LDAR and equipment requirements present in California. CARB staff should coordinate to better represent California fugitives in the model.
4. Imported gas composition: Gas composition may be different from the default and/or different from the produced gas composition. This should be chosen from a set of regional defaults or easily changeable.

Note that these regional values will likely change materially over time as California progresses its journey to lower GHG emissions. As such, a periodic (e.g., annual) update of these values would ensure that OPGEE is using the latest data for its CI calculations.

**Suggestion 2: Innovative crude oil provisions**

Although OPGEE allows for solar steam, it does not currently provide an easy way to introduce on-site solar power or other renewable power generation produced at the oilfield. An option to add this power generation stream and offset some otherwise imported power would enable an easier analysis of innovative crude oil production methods. In addition, options to model the other approved innovative crude pathways would be helpful, including:

* Carbon capture and sequestration with and without EOR (some companies may be exploring CCS separate from EOR as a potential GHG abatement opportunity)
* Wind power
* Solar heat (e.g., for hot water), and
* Ability to input CI for renewable natural gas with project- specific carbon intensity

**Suggestion 3: Improve steam generation modeling**

Steam generation is a key contributor to carbon emissions for California thermal crudes. Steam generation modeling can be improved by the following additions:

1. Add a secondary input for the pressure of steam leaving the steam generator. This is currently calculated in the model using the reservoir pressure as a proxy, but it is more useful to be able to specify the pressure directly. Because steam pressure strongly affects steam enthalpy, it is crucial that the steam pressure is modeled accurately.
2. Gas turbines in cogeneration systems are not always run at 100% load. In Chevron’s SJV operations some of the cogeneration system turbines are run at partial loads depending on power and steam demand, power prices, and other operational details. When running a turbine at partial load, the power generation efficiency tends to drop, and more energy leaves in the exhaust stream, changing the balance of power and steam generation in a cogeneration operation. We recommend adding a function to represent the partial load effect, such as those relationships presented in **Gobran (2013)[[2]](#footnote-3)** “Off-design performance of solar Centaur-40 gas turbine engine using Simulink”.
3. Add a user-defined option for turbines where turbine parameters can be specified to accommodate different turbine types.

**Suggestion 4: Allow for improved specificity of on-site equipment use and process design**

Onsite equipment is sometimes of a different configuration than assumed in OPGEE in the process modeling sheets and in fugitive emissions sheets. Two examples from Chevron‘s SJV operations include:

1. Acid gas removal (AGR) units do not have the option in OPGEE to use electric-powered reboilers, while Chevron’s operations do use electric reboilers.
2. Chevron generally does not use chemical injection pumps for gas streams and onsite heaters at well sites. The emissions from these sources in the fugitive emissions sheet are therefore not relevant for Chevron’s operations.

We recommend adding the option for AGR electrification and allowing the user to customize the set of onsite equipment and components with “on-off” options to deselect equipment that is not present at a given oil field.

Furthermore, there are cases in which produced gas is not processed on-site before being sold to a third party. In this case, gas clean up processes, such as acid gas removal and condensate recovery are carried out outside of the field boundary. As a result, emissions from those processes should be allocated to the third party and not to the gas producer. We recommend adding flexibility to the definition of facility boundary to account for these cases.

In addition, more work should be done to characterize what is included in small sources (miscellaneous) and how their emissions impact is quantified, since currently this category is not well-defined.

Should you have any questions or comments regarding our suggestions, please feel free to reach out to me directly at [Laurav@chevron.com](mailto:Laurav@chevron.com).

Sincerely,

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Laura E. Verduzco, D.Sc.

California Carbon Compliance

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1. Rutherford, J.S., Sherwin, E.D., Ravikumar, A.P. et al. Closing the methane gap in US oil and natural gas production emissions inventories. Nat Commun 12, 4715 (2021). <https://doi.org/10.1038/s41467-021-25017-4> [↑](#footnote-ref-2)
2. Gobran, M. H. (2013). Off-design performance of solar Centaur-40 gas turbine engine using Simulink. Ain Shams Engineering Journal, 4(2), 285–298. <https://doi.org/10.1016/j.asej.2012.08.007> [↑](#footnote-ref-3)