BOEM BUREAU OF OCEAN ENERGY MANAGEMENT

The Greenhouse Gas Life Cycle Energy Emissions Model (GLEEM) Readme File

This readme file describes how to use the 2024 version of GLEEM. To learn about the model, its inputs, and its assumptions, go to https://www.boem.gov/environment/GLEEM to download the Technical Report.

The model is in Microsoft® Excel. To run the model for a particular scenario, the user must update the values in several cells:

- A minimum of two cells must be updated for each project (**Section 1**).
- Six additional cells must be updated if calculating emissions for substituted fuels (**Section 2**).
- Multiple cells across three tabs must be updated annually (**Section 3**).

See **Section 3.2** if only certain types of fuel (motor gasoline, aviation fuel, etc.) are expected to be produced for a particular scenario.

See **Section 4** for a description of the output data.

1 Updates for Each Model Run

Two cells must be updated for each model run under the Overview tab:

- **C3:** Expected oil production (in barrels of oil)
- **C4:** Expected natural gas production (in thousands of cubic feet)

As additional option, update these cells to include self-calculated upstream emissions:

- **D3, E3, F3:** CO_2, CH_4, N_2O (metric tons) to be released onsite, respectively
- **D4, E4, F4:** CO_2, CH_4, N_2O (metric tons) to be released onsite, respectively

BOEM does not recommend using these cells for self-calculated upstream emissions if onsite facilities will be processing multiple fuels.

If you have individual years of production data, individual years of midstream and downstream emissions can be calculated using the Annualized Emissions tab. Note that this calculation is optional and has no effect on the results presented in the Overview tab.

- **Column B:** Oil production (in barrels of oil)
- **Column C:** Natural gas production in (thousands of cubic feet)

2 Updates for Each Model Run With Substitutions

To use GLEEM for substitutions, enter the following data on the Substitution Rates tab:

- **C3, C4, C5:** Percentage of oil production to be replaced by other oil production, natural gas, and coal, respectively
- **D3, D4, D5:** Percentage of natural gas production to be replaced by other natural gas production, natural gas, and coal, respectively

If you know the volumes but not percentages, you may overwrite the following cells (which have formulas):

- **C3, C4, C5:** Volume of oil production to be replaced by other oil production, natural gas, and coal, respectively
- **D3, D4, D5:** Volume of natural gas production to be replaced by other natural gas production, natural gas, and coal, respectively

Note that oil should be in barrels, natural gas should be in thousands of cubic feet, and coal should be in short tons.

3 Annual Updates

The cells described in this section are updated annually. These updates provide the model with the most recent consumption and emission rates for fuels. As an alternative to manually updating these cells, download the most recent version of the model, which includes the most recent consumption and emissions rates. See model documentation for information about 'zero' midstream carbon dioxide and nitrous oxide emissions for coal, and production gain only applying to oil.

3.1 Industry Data

This data describes the US energy market. The following cells must be updated yearly:

- **B3, B4, B5:** Midstream carbon dioxide for oil, natural gas, and coal, respectively (in millions of metric tons)
- **C3, C4, C5:** Midstream methane for oil, natural gas, and coal, respectively (in millions of metric tons)
- **D3, D4, D5:** Midstream nitrous oxide for oil, natural gas, and coal, respectively (in millions of metric tons)
- **E3, E4, E5:** Resources not combusted for oil, natural gas, and coal, respectively
- **F3:** Production gain as a ratio
- **G3, G4, G5:** National oil refinery inputs (in thousands of barrels of oil), national natural gas systems inputs (in millions of cubic feet), and national coal production (in thousands of short tons)

Data comes from the following websites:

- Oil, natural gas, and coal facility emissions: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021 – Main Report (epa.gov)
- Midstream processing and not combusted oil, natural gas, and coal inputs: https://www.eia.gov/totalenergy/data/monthly/archive/00352303.pdf

3.2 Downstream Emission Factors (EFs) and Multitype Fuels

Updates here require entering data on two tabs, Downstream EFs and Multitype Fuels. On both tabs, the data is formatted the same way. The only rows that do not need to be updated are ones labeled "Average." The columns that need to be updated are as follows:

- **Column B:** National production of oil (in thousands of barrels per day), natural gas (in thousands of cubic feet), and coal (in thousands of short tons)
- **Column C:** CO_2 per gallon of oil, per thousand cubic feet, per short ton
- **Column D:** CH_4 per gallon of oil, per thousand cubic feet, per short ton
- **Column E:** N_2O per gallon of oil, per thousand cubic feet, per short ton

If an individual fuel type will not be used, zeros can be inserted for that row. Note that, for example, if there is no natural gas production expected, then there is no need to put zeros into the cells. Also note that these values are used for both production and substitution.

Data comes from the following websites:

- Oil, natural gas, and coal consumption: https://www.eia.gov/totalenergy/data/monthly/archive/00352303.pdf
- EFs: https://www.epa.gov/system/files/documents/2022-04/ghg_emission_factors_hub.pdf

4 Model Output

Model output can be found in the Overview tab. All values are provided in metric tons. If you have entered individual years of oil and natural gas production, the annual emissions can be found in the Annualized Emissions tab.