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

This readme file describes how to use the 2023 version of GLEEM. To learn about the model, its inputs, and its assumptions, go to www.boem.gov/environment/GLEEM download the Technical Report.

This model is in Micosoft® Excel format. To run the model for a particular scenario, the user must update the values in several cells.

- At least two cells that must be updated for each project (see **Section 1**).
- If calculating emissions for substituted fuels, six additional cells must be updated (see **Section 2**).
- Multiple cells across three tabs must be updated annually (see **Section 3**)

Note: See **Section 3.2** when only certain types of fuel (e.g., motor gasoline, aviation fuel) 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. In the **Overview** tab, enter the following data:

- **B2** (cell in column B, row 2): Expected production for oil (in barrels)
- **B3:** Expected production of natural gas (in thousands of cubic feet)

Additionally, to self-calculate upstream emissions, enter the following data:

- **C2, D2, E2:** Amount of CO_2, CH_4, and N_2O to be released onsite for oil production, respectively (in metric tons)
- **C3, D3, E3:** Amount of CO_2, CH_4, and N_2O to be released onsite for gas production, respectively (in metric tons)

BOEM does not recommend using this functionality if onsite facilities will be processing multiple fuels.

2 Updates for Each Model Run with Substitutions

To use GLEEM for substitutions, go to the **Substitution Rates** tab and enter the following data:

- **B2, B3, B4:** Percentage of oil production to be replaced by other oil, natural gas, and coal production, respectively
- **C2, C3, C4:** Percentage of natural gas production to be replaced by other oil, natural gas, and coal production, respectively

If the user knows volumes, but not percentages, they may enter replacement fuel volumes in the following cells, which have formulas:

- **B2, B3, B4:** Volume of oil production to be replaced by other oil, natural gas, and coal production, respectively
- **C2, C3, C4:** Volume of natural gas to be replaced by other natural gas production, natural gas, and coal production, respectively

Note that oil should be in barrels, natural gas should be in 1,000s of cubic feet (mcf), and coal should be in short tons.

3 Annual Update

The files 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 the files, download the most recent version of the model, which will include the most recent consumption and emissions rates. See the model documentation for information about the 'zero' midstream carbon dioxide and nitrous oxide emissions for coal, as well as production gain only applying to oil.

3.1 Industry Data

In the **Industry Data** tab, enter the following data (describing the US energy market) for each year:

- **B2, B3, B4:** Midstream CO_2 for oil, natural gas, and coal, respectively (in millions of metric tons)
- **C2, C3, C4:** Midstream CH_4 for oil, natural gas, coal, respectively (in millions of metric tons)
- **D2, D3, D4:** Midstream N_2O for oil, natural gas, coal, respectively (in millions of metric tons)
- **E2, E3, E4:** Resources not combusted for oil, natural gas, and coal, respectively
- **F2:** Production gain as a ratio
- **G2, G3, G4:** 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)

The above data is available on the following websites:

- Oil, Natural Gas, and Coal facility Emissions: Inventory of U.S. Greenhouse Gas Emissions and Sinks | US EPA
- Midstream processing and not combusted Oil, Natural Gas, and Coal Inputs: Total Energy Monthly Data - U.S. Energy Information Administration (EIA)

3.2 Downstream Emission Factors (EFs) and Multitype Fuels

Updates here require entering data under two tabs, **Downstream EFs** and **Multitype Fuels**. For both tabs, the data is formatted the same way. The only rows that do not need to be updated are rows with labels ending in "Average" (i.e., Weighted Average, Distillate Fuel Oil Average, and Residual Fuel Oil Average). Update the following columns in both tabs:

- **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 1,000 cubic feet, per short ton
- **Column D**: CH_4 per gallon of oil, per 1,000 cubic feet, per short ton
- **Column E**: N_2O per gallon of oil, per 1,000 cubic feet, per short ton

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

Data comes from the following websites:

- Oil, Natural Gas, and Coal Consumption: Total Energy Monthly Data - U.S. Energy Information Administration (EIA)
- Emission factors come from: GHG Emission Factors Hub | US EPA

4 Model Output

After the data has been entered, go to the **Overview** tab to see the model output. All values are provided in metric tons.