Emissions Quantification Tools Overview

According to the U.S. Energy Information Administration, the electric power sector produced 33% of the country's total carbon dioxide emissions in 2018. Carbon dioxide and other greenhouse gas (GHG) emissions can affect the environment, health and quality of life, and there is growing interest — among communities, industries and governing bodies — in quantifying and tracking them. The electric power sector in particular is making commitments to reduce carbon emissions, with many utilities setting targets for 2030 or 2050.

Here, we consolidate information on various emissions quantification tools. The appropriate tool for a given organization depends on its type and size and the category of processes being tracked. A list of standard tools and databases used in the energy arena is provided below, including both open-source and licensed software. This list is not exhaustive, however, as there are many government-sponsored and private-sector emissions calculators that provide insights into the carbon footprints of industries, residential/commercial buildings, small-scale businesses, transportation and more.

Emissions Quantification Tools

If you are a small business trying to get started on your carbon reduction plan -

• EPA Simplified GHG Emissions Calculator (SGEC): The U.S. Environmental Protection Agency (EPA) SGEC helps small businesses and low-emitter organizations estimate and inventory their annual GHG emissions. The calculator will determine the direct and indirect emissions for one annual period from all sources at a company when activity data is entered into the various sections of the workbook.

If you are looking to convert your fleet to electric vehicles -

• Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) Model by Argonne National Laboratory: GREET was developed to evaluate energy and emissions impacts of advanced vehicle technologies and new transportation fuels. It includes the fuel cycle from wells to wheels (covering the energy and emissions necessary for fuel production and associated with vehicle operation) and the vehicle cycle through material recovery and vehicle disposal. A variation of the GREET model is the Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool.

• MOtor Vehicle Emission Simulator (MOVES) by EPA: This modeling system estimates emissions for mobile sources at the national, county and project level for criteria air pollutants, GHGs and air toxics. The tool is typically used at the fleet level (i.e., not for a single vehicle), unlike GREET (though AFLEET can perform fleet-level analyses), and is for pump to wheel emissions, which cover when energy is absorbed at a charging point or fuel pump to when it is discharged on the move.

If you need to evaluate the impact of broad energy efficiency, renewable energy or electric transportation programs that have specific targets -

• AVoided Emissions and geneRation Tool (AVERT) by EPA: This model applies to the electric power sector. AVERT may be used to assess county, state and regional emissions displaced at power plants by energy efficiency and renewable energy policies and programs. It is designed to use accessible and auditable public data.

If you have highly specialized needs for the electric power grid beyond just emissions -

• PLEXOS: Unlike the other tools, PLEXOS must be purchased, and unlike open-source tools, it does not just provide emissions but can also perform complex engineering and statistical analyses, like load flow analytics, load forecasting and operation planning. Users can create any kind of emission (e.g., carbon dioxide, nitrogen oxide, sulfur oxide, solid particle) using its specialized emission class. Emissions are associated with generation and fuel offtake by defining the functional relationship between megawatt generation and emissions and the functional relationship between fuel usage and emissions.

If you are a utility or governmental organization evaluating a city-wide project -

• Pacific Northwest National Laboratory Emissions Quantification Tool: This calculator estimates the impacts of specific smart grid infrastructure projects on load profile and criteria pollutant emissions (e.g., sulfur dioxide, nitrogen oxide, carbon dioxide). Although ideal for smart grids, this model covers electric vehicle transportation to an extent as well, so it can be classified as a multi-sector tool.

Emissions Databases

Below is a short list of common databases that can be leveraged for customizing analyses. The databases give a big-picture overview of the type of emissions (life-cycle vs. local, facility-level vs. city-level, pollutants being reported, etc.). Occasionally, the quantification tools distributed by the government and national labs are added to the databases. For example, methane and nitrous oxide emissions factors for alternative fuel vehicles developed based on the GREET model were incorporated into the EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks (searchable through the Greenhouse Gas Inventory Data Explorer).

• Facility Level Information on GreenHouse gases Tool (FLIGHT): This interactive website allows users to review information by filtering GHG data in a variety of ways, including by facility, industry, location or gas. Significant post-processing of results may be required to arrive at consolidated deliverables.

• Greenhouse Gas Inventory Data Explorer by EPA: This interactive tool provides access to data from the EPA's annual Inventory of U.S. Greenhouse Gas Emissions and Sinks.