Harmonizing Emissions Estimates from EIA and EPA

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Introduction

Both the U.S. Energy Information Administration (EIA) and the U.S. Environmental Protection Agency (EPA) publish estimates of greenhouse gas (GHG) emissions. The Infrastructure Investment and Jobs Act of 2021 required the EIA Administrator to establish a "system to harmonize the operating data on electricity generation collected" by EIA with "measurements of greenhouse gases and other pollutant emissions collected" by EPA, among other sources. Because of different agency missions and activities, EIA and EPA GHG emissions estimates differ in scope and estimation method and may not always match. When we adjusted for the differences, however, we found that the EIA and EPA estimates are very close at aggregate levels.

This document summarizes the initial findings of the emissions harmonization effort, including the general differences in emissions accounting and scope for both agencies, differences in emissions estimation methods, and considerations when comparing emissions estimates between agencies. All findings presented below are preliminary. EIA and EPA staff continue to collaborate to understand the differences in our respective emissions estimation approaches and results. We are currently trying to better understand differences in historical emissions estimates and to deepen our understanding of emissions intensity at load-serving entities.

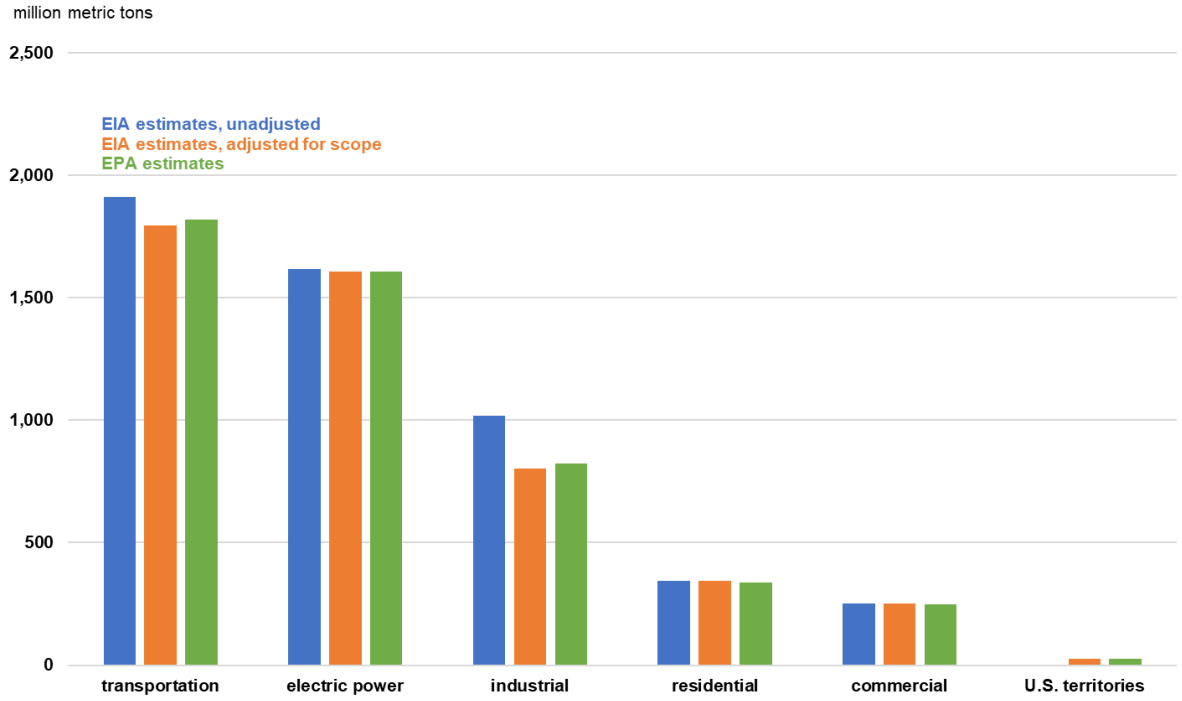
Scope of Reported Greenhouse Gas Emissions

Differences in scope often cause major differences in GHG emissions estimates between EIA and EPA. The scope of emissions coverage across both agencies varies on several dimensions, including economic sectors, emissions-producing facilities, and emissions sources. With respect to GHG emissions reporting, EIA and EPA overlap in their reporting of energy-related CO_2 emissions for the residential, commercial, industrial, transportation, and electric power sectors. EPA reports emissions from U.S. territories, which EIA typically excludes. The other most common differences in emissions accounting between the two agencies relate to four emissions categories that EPA classifies as separate from total fossil fuel emissions:

- Bunker fuels
- Industrial processes
- Municipal solid waste
- Non-energy use (NEU)

Accounting for these differences reduced the discrepancy in total energy-related CO_2 emissions in 2019 from about 6% (5,146 million metric tons [MMmt] estimated by EIA compared to 4,857 MMmt estimated by EPA) to less than 1% (4,827 MMmt estimated by EIA compared to 4,857 MMmt estimated by EPA). The graph displays the results of these adjustments.

Figure B-1. EIA and EPA total U.S. energy-related CO_2 emissions data, 2019



Data source: U.S. Energy Information Administration, *Monthly Energy Review*, November 2020, Tables 11.1–11.6; U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2019*
Note: U.S. territory emissions are reported in EIA's *International Energy Statistics*, but they are not included in EIA's national total in the *Monthly Energy Review* and so are excluded from the unadjusted calculations.

Different Methods Used to Estimate Electric Power Sector Emissions

EIA only calculates and reports energy-related emissions of nitrogen monoxide (NO) and nitrogen dioxide (NO_2), jointly denoted by NO_x, and sulfur dioxide (SO_2) for the electric power sector. For energy end-use sectors, EIA estimates *only* carbon dioxide (CO_2) emissions (not NO_x or SO_2), and EIA's CO_2 emissions estimates include emissions from non-combustion use of fossil fuels. EPA reports CO_2 emissions as well as emissions from other greenhouse gases, such as methane (CH_4) and nitrous oxide (N_2O). EIA's emissions estimates exclude all energy-related emissions that do not directly enter the economy (for example, flared gas).

To calculate emissions, we multiply a quantity of consumed fuel from EIA survey data by an *emissions factor*,[1] which represents the average quantity of a pollutant released when a unit of fuel is burned. The fuel units can be either physical units (for example, tons of coal) or British thermal units, which represent heat content. EIA uses physical units for calculating NO_x and SO_2 emissions and British thermal

[1] EIA uses EPA's emission factors for NO_x, SO_2, and CO_2. Factors for SO_2 and NO_x are from EPA's *Compilation of Air Pollutant Emissions Factors* report, supplemented by some external sources. Factors for CO_2 are from EPA's *Inventory of U.S. Greenhouse Gases Emissions and Sinks* [3].

units for calculating CO_2 emissions. For some fuels, EIA applies different emissions factors where combustion systems differ.

We may apply an adjustment factor to account for some capture technologies used to reduce emissions. Also, when fuels are used for non-combustive purposes (for example, as petrochemical feedstocks), some portion of the carbon contained within the fuel can be retained (sequestered) within final products instead of being released into the atmosphere. For these cases, we estimate emissions for the combusted and non-combusted portions of the fuel separately, applying an additional factor to the non-combusted quantity to account for the proportion of carbon sequestered. Slight differences in estimated emissions factors, along with differences in adjustment factors for non-combusted fuels, lead to minor differences in emissions estimated by EIA and EPA.

A variation of this method involves applying a fuel-specific emissions factor denoted in pounds of pollutant (typically CO_2) per megawatthour, which we then apply to estimates of generation. We estimate the emissions associated with electricity when direct fuel consumption estimates are not available in this way, for example, in the *Hourly Electric Grid Monitor*, which is based on electricity generation data collected in Form EIA-930.

At large electric power plants, EPA estimates emissions from a sample of the effluent stream using Continuous Emissions Monitoring System (CEMS) equipment installed at the plants, primarily for regulatory purposes. EPA's Clean Air Markets Division (CAMD) collects the CEMS data. For individual power plants, the CEMS data may differ substantially from the estimates obtained by EIA's emissions factor method described previously, explaining some of the differences between EIA and EPA emissions estimates. However, when plant results are aggregated, the two methods provide similar results.

EIA will continue to assess causes of plant-level inconsistencies between CO_2 levels as indicated by CEMS measurements and those estimated from fuel consumption estimates, although our previous efforts to identify, explain, and reduce the differences have not significantly improved the level of consistency.

Both EPA and EIA use a mix of the two methods for estimating emissions from the electric power sector:

- Estimating emissions based on samples drawn using CEMS equipment
- Estimating emissions by applying a chemical emissions factor to an estimated quantity of fuel consumed

EIA collects the fuel consumption data used in the latter method from a larger population of generators than those with CEMS equipment installed. EPA generally collects CEMS data for generators at or above 25 megawatts of nameplate capacity that burn fossil fuel to generate electricity for sale (about 1,300 power plants). EIA, in contrast, collects fuel consumption data for every power plant connected to the grid that has at least one megawatt in nameplate capacity (about 3,300 plants reporting fossil fuel consumption). The latter method is therefore the only method available for many generators.

EIA and EPA use each other's data to estimate emissions. EIA, for example, uses the EPA plant-level CEMS emissions estimates as inputs to the published values for SO_2 and NO_x emissions for the electric

power sector [1]. EPA uses EIA survey data, along with EPA emissions factors, to estimate emissions for its annual publication called the *U.S. Inventory of Greenhouse Gas Emissions and Sinks*.[2]

Comparing Electric Power Sector Emissions Estimates

Directly comparing estimates from the two methods is a complex task that involves time-consuming merges to account for the differences in both granularity and scope, as well as relational data about the power plants' operating configurations. EPA previously published a spreadsheet linking the CEMS datasets published by CAMD with EIA estimates computed using emissions factors. The spreadsheet matched 92% of the electric generating units at the generator level. EIA compared the emissions values for the year 2019 within the two datasets by computing the ratios of EIA CO_2 emissions to CAMD CO_2 emissions for the 1,392 power plants that matched [6]. Neither method consistently produced higher or lower emissions estimates than the other.

EIA is actively seeking to increase consistency between EIA and EPA emissions estimates. For example, EPA's Clear Air Markets Program collects hourly fuel consumption data from about 1,300 electric power facilities. About 1,260 of these facilities also report data to EIA in the *Power Plant Operations Report*. Although most of these facilities report monthly consumption, about 540 of them report only annual consumption. For the facilities that report annually, EIA allocates the reported annual consumption values to the months of the year by using monthly EPA consumption estimates for this allocation and by applying monthly proportions estimated from the EPA data to the annual totals reported to EIA. Beyond using the smaller time intervals of the EPA data to improve EIA's monthly allocation of plant-level fuel consumption, EIA survey methodologists are researching the root causes of the differences between EPA's CEMS data and EIA's electric power fuel consumption data. Both agencies continue to seek opportunities to improve the accuracy and consistency of their data products.

References

[1] U.S. Energy Information Administration (2022). Technical Notes from the *Electric Power Annual,* available at https://www.eia.gov/electricity/annual/pdf/tech_notes.pdf

[2] U.S. Environmental Protection Agency, Office of Atmospheric Programs, Clean Air Markets Division (2022). "The Emissions and Generation Resource Integrated Database Technical Guide with Year 2020 Data."

[3] U.S. Environmental Protection Agency (2021). *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2019*.

[4] U.S. Environmental Protection Agency (2022), "ANNEX 2 Methodology and Data for Estimating CO_2 Emissions from Fossil Fuel Combustion"

[2] *Sources* are the sources of GHG emissions, and *sinks* are mechanisms that remove GHG from the atmosphere, for example, plants. The harmonization effort does not involve data on GHG sinks because EIA does not collect data or publish estimates for GHG sinks.

[5] Geothermal Energy Association (2007). Alyssa Kagel, Diana Bates, and Karl Gawell. “A Guide to Geothermal Energy and the Environment”, Washington, D.C., April 2007. https://www.osti.gov/servlets/purl/897425-q5NDer/

[6] Huetteman, J., Tafoya, J., Johnson, T., and Schreifels, J. (2021). EPA-EIA Power Sector Data Crosswalk. Accessible at www.epa.gov/airmarkets/power-sector-data-crosswalk