Short-Term Energy Outlook: Energy-Related Carbon Dioxide Forecasts

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Introduction

Energy use continues to be the largest source of carbon dioxide (CO_2) emissions in the United States, accounting for about 93% of U.S. CO_2 emissions in 2024.[1] The majority of energy-related CO_2 emissions come from fossil fuel (coal, natural gas, and petroleum) combustion, with small amounts from the nonfuel use of energy inputs, such as for industrial feedstocks, and emissions from non-biogenic municipal solid waste and steam geothermal electricity generation. Non-energy CO_2 emissions, such as those from agricultural use or some industrial processes, are outside the scope of EIA analysis.

The Short-Term Energy Outlook (STEO) provides historical CO_2 emissions estimates (starting in 1998), as well as CO_2 emissions forecasts, for three major fossil fuel categories: coal, natural gas, and petroleum. The historical and forecast CO_2 emissions are available as monthly, quarterly, and annual data series from STEO Table 9a. Short-term forecasts of CO_2 emissions are calculated using STEO forecast of fossil fuel consumption and applying estimated conversion factors of CO_2 emissions per unit of fuel consumed, which are taken or calculated from the EIA *Monthly Energy Review* (MER) database.[2]

Carbon Dioxide Model Outputs

The STEO publishes CO_2 emissions estimates for three primary fossil fuel categories:

- Coal
- Natural gas
- Petroleum

Coal and petroleum are both aggregate categories, consisting of distinct subcomponents:

- Coal
  - Total U.S. coal consumption
  - Coal coke net imports
- Petroleum
  - Asphalt and road oil
  - Aviation gasoline
  - Jet fuel
  - Distillate fuel oil[3]
  - Kerosene
  - Liquified petroleum gases[4]
  - Lubricants
  - Motor gasoline[5]
  - Petroleum coke
  - Residual fuel oil

[1] https://www.epa.gov/system/files/documents/2024-04/us-ghg-inventory-2024-chapter-executive-summary_04-16-2024.pdf

[2] The historical monthly CO_2 emissions provided in the STEO tables are from the MER. The emissions factors used there, as well as in the STEO, are sourced primarily from EPA's *Inventory of Greenhouse Gas Emissions and Sinks*.

[3] Not including renewable diesel or biodiesel

[4] Propane, ethane, butane, and isobutane

[5] Excluding blended fuel ethanol

- Other petroleum[6]

Data Sources and Aggregations

STEO CO_2 emission forecasts are based on STEO forecasts of fossil fuel consumption, established CO_2 emissions factors, and calculated emissive shares of energy products. The CO_2 emissions factors used are standardized across most EIA products, based on the latest available data from EPA's *Inventory of Greenhouse Gas Emissions and Sinks*. The emissive share for each fuel is calculated using MER emissions estimates, as the MER more explicitly accounts for non-combustion uses of energy products. By taking the ratio of the MER CO_2 emissions estimate, which takes into account sequestration from non-combustion fuel use, to a hypothetical CO_2 estimate assuming full combustion, we calculate effective emissions shares for each fuel. Additional details on the calculation of these emissions shares are available in Step 2 of the Methodology section.

CO_2 factors and emissive shares of each fuel are provided in Table 1.

[6] Includes aviation gasoline blending components, motor gasoline blending components, crude oil, petroleum feedstocks, still gas, special naphtha, pentanes plus, unfinished oils, waxes, and miscellaneous petroleum products

Table 1. STEO CO_2 Emission Factors and Emissive Shares

Fuel	CO_2 emissions factor (million metric tons CO_2 per quadrillion British thermal units)	Emissive share
Natural gas	52.91	1.00
Coal	95.70[a]	1.00
Coal coke net imports	113.67	1.00
Aviation gasoline blending components	69.19	1.00
Aviation gasoline	69.15	1.00
Liquified Petroleum Gases	61.38[a]	0.43[a]
Crude oil	74.47	1.00
Distillate fuel oil	74.14	1.00
Jet fuel	72.23	1.00
Kerosene	73.19	1.00
Lubricants	74.07	0.5
Motor gasoline blending components	71.35	1.00
Finished motor gasoline	70.66	1.00
Petroleum coke	102.12	0.94
Residual fuel oil	75.09	1.00
Still gas	66.73	0.93
Special naphtha	72.38	1.00
Asphalt and road oil	75.35	0.00
Unfinished oils	74.47	1.00

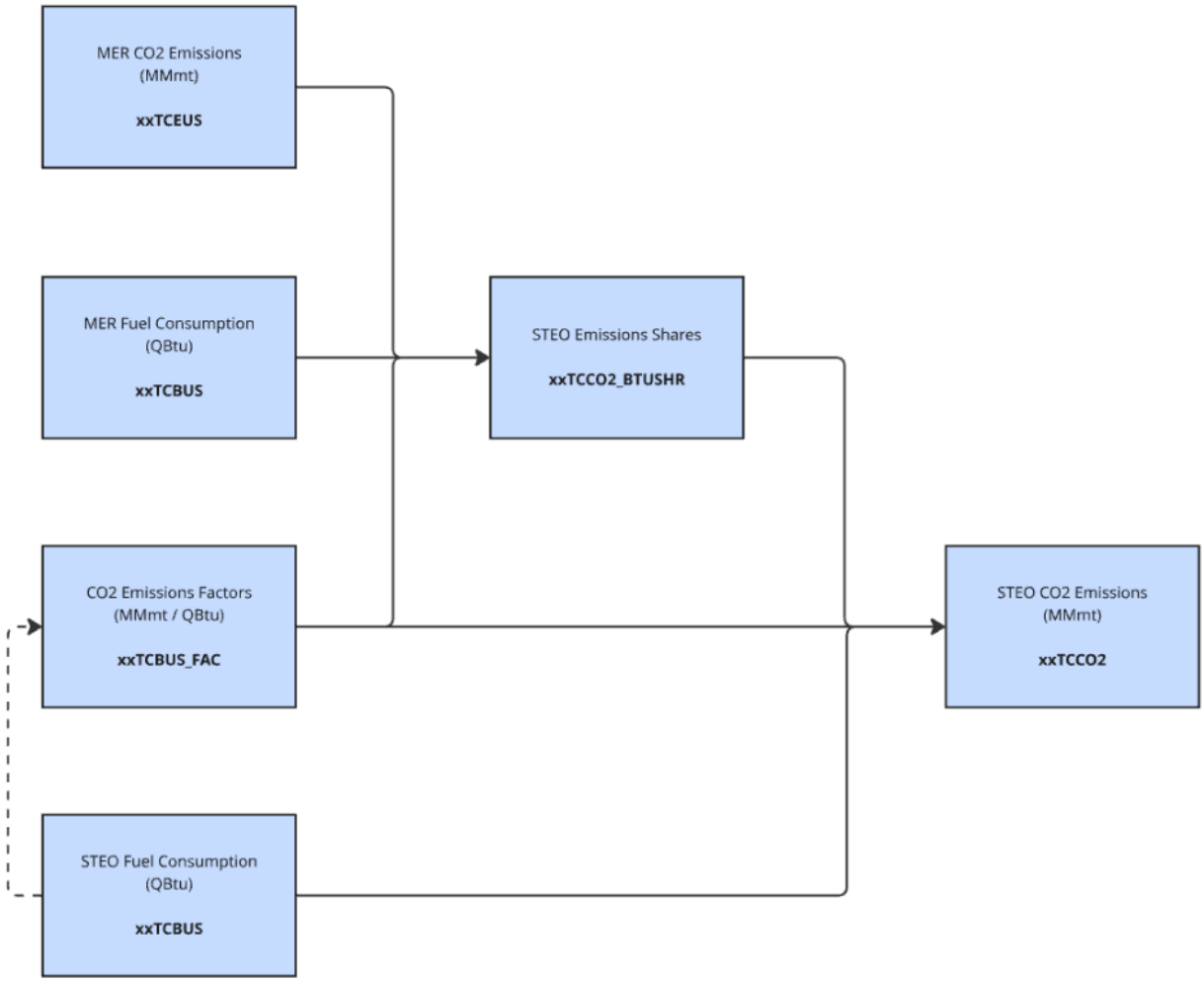
Data source: U.S. Energy Information Administration, *Short-Term Energy Outlook* and *Monthly Energy Review*, February 2026

[a] This value shown here is a weighted average, and may not be exact for each STEO publication

Methodology

A flow chart of the STEO methodology for calculating CO_2 emissions is shown in Figure 1, followed by detailed steps in the calculation procedure.

Figure 1. STEO CO_2 Emission Calculation Flow Diagram



Note: For some aggregate fuel categories, such as liquified petroleum gases, the emissions factor used is based on a weighted average of consumption across underlying products (indicated by the dashed line). MMmt=Million metric tons; QBtu=Quadrillion British thermal units.

Step 1: Download CO_2 emissions and MER fuel consumption

We start by downloading the relevant CO_2 emissions and fuel consumption variables. The MER CO_2 emissions and fuel consumption series use the following naming conventions:

*xx*TCEUS = CO_2 emissions from fuel *xx* (MMmt)

*xx*TCBUS = Total consumption of fuel *xx* (QBtu)

Where *xx* is the 2-character MER code to represent each fuel. For calculating CO_2 emissions in the STEO, 23 MER emissions and consumption series are required. The character codes for each of these required fuels are listed in Table 2.

Table 2. MER fuel codes and descriptions

Fuel character code	Fuel description
AB	Aviation gasoline blending components
AR	Asphalt and road oil
AV	Aviation gasoline blending components
CL	Coal
CO	Crude oil
DM	Distillate fuel oil, excluding biofuels
FN	Naphthas for petrochemical feedstock use
FO	Other oils for petrochemical feedstock use
JF	Jet fuel
KS	Kerosene
LG	Liquified petroleum gases
LU	Lubricants
MB	Motor gasoline blending components
MM	Motor gasoline, excluding ethanol
MS	Miscellaneous petroleum products
NN	Natural gas, excluding supplemental gaseous fuels
PC	Petroleum coke
PO	Other petroleum products
RF	Residual Fuel Oil
SG	Still Gas
UO	Unfinished Oils
WX	Waxes

The exceptions to this convention are the series for net imports of coal coke, which are *CCNIEUS* and *CCNIBUS*. These series can be downloaded from the "Total Energy" category of the EIA Open Data portal.

Step 2: Calculate emissive shares for fuels

Using the MER emissions and fuel consumption series downloaded in Step 1, we estimate emissive shares of each fuel. The MER CO_2 emissions estimates (*xx*TCEUS) account for both combustion as well as non-combustion uses of each fuel (such as in the form of industrial feedstocks). In cases where a fuel is used for non-combustion purposes, some amount of CO_2 is assumed to be sequestered (or stored) in final industrial products and not emitted into the atmosphere. By taking the ratio of emissions estimate to a theoretical full-combustion emissions estimate, using total consumption (*xx*TCBUS) and emissions factors (*xx*TCBUS_FAC), we derive an effective emissive share (*xx*TCCO2_BTUSHR).

$$xxTCCO2\_BTUSHR = \frac{xxTCEUS}{(xxTCBUS \cdot xxTCBUS\_FAC)}$$

Step 3: Forecast STEO CO_2 emissions

Using STEO fuel consumption estimates, emissions factors, and calculated emissive shares (from Step 2), we calculate CO_2 emissions estimates (*xx*TCCO2) over the STEO forecast.

$$xxTCCO2 = xxTCBUS \cdot xxTCBUS\_FAC \cdot xxTCCO2\_BTUSHR$$

Note that some of emissions factors and emissive shares used are weighted averages across multiple fuels (as indicated in the Table 1 notes and the dashed line in Figure 1), and that some individual fuels are aggregated for presentation in STEO tables (as shown in Carbon Dioxide Model Outputs).