

## Documentation for Estimates of State Energy-Related Carbon Dioxide Emissions

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EIA emissions estimates for energy-related CO<sub>2</sub> at the state level are based on data in the [State Energy Data System](#) (SEDS). In particular, these estimates are based on energy consumption data for the following fuel types:

- Coal
  - Residential and commercial sector
  - Industrial sector coking
  - Industrial sector
  - Electric power sector
- Natural gas
- Petroleum products
  - Asphalt and road oil
  - Aviation gasoline
  - Distillate fuel
  - Jet fuel
  - Kerosene
  - Hydrocarbon gas liquids (HGL)
  - Lubricants
  - Motor gasoline
  - Petrochemical feedstocks
  - Petroleum coke
  - Residual fuel oil
  - Waxes
  - Special naphtha
  - Still gas
  - Unfinished oils
  - Miscellaneous products
  - Pentanes plus
  - Other petroleum products

## Methodology

For each fuel in each sector, emissions are calculated as:

$$\text{Total Emissions} = \text{Combustion Emissions} + \text{Non-Combustion Emissions}$$

Combustion emissions represent CO<sub>2</sub> emissions from burning fossil fuels for energy. We calculate combustion emissions by multiplying the quantity of fuel consumed, as provided by SEDS, by each fuel's CO<sub>2</sub> emissions factor (the amount of CO<sub>2</sub> that is released from a fuel per unit of energy consumed). We estimate the percentage of fuel used for combustion based on our survey data<sup>1</sup> and external data sources.<sup>2</sup> For a given proportion  $p_1$  of a fuel used in combustion, the formula for combustion emissions is:

$$\text{Combustion Emissions} = p_1 \times \text{Quantity of Fuel Consumed} \times \text{Emissions Factor}$$

For some fuels, particularly those used in the U.S. industrial sector, a portion of energy consumed is not combusted and is instead used for nonfuel purposes. In these instances, some of the carbon content of the fuel is captured (sequestered) in the final products instead of being released into the atmosphere. Non-combustion emissions are represented by the remaining amount of fuel consumed,  $1 - p_1$ . Of this nonfuel consumption, some percentage is sequestered in products.<sup>3</sup> For a given proportion  $p_2$  of non-combustion fuel use sequestered in products, non-combustion emissions are given by:

$$\text{Non-Combustion Emissions} = (1 - p_1) \times (1 - p_2) \times \text{Quantity of Fuel Consumed} \times \text{Emissions Factor}.$$

We use the U.S. Environmental Protection Agency's CO<sub>2</sub> emissions factors from its *Inventory of U.S. Greenhouse Gases and Sinks*. For the residential, commercial, and electric power sectors, we assume that all fuel consumed is combusted ( $p_1 = 1$ ). We assume the same for the transportation sector except for transportation lubricants, for which we assume 50% of CO<sub>2</sub> emissions are sequestered.

## HGL estimation

Hydrocarbon gas liquids (HGL) consist of several fuels:

- Ethane
- Ethylene
- Propane
- Propylene
- Normal butane
- Butylene
- Isobutane
- Isobutylene

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<sup>1</sup> Data come from our coal supply surveys, natural gas supply surveys, petroleum products supplied surveys, electricity supply surveys, some *Annual Energy Outlook* (AEO) assumptions, and the *Manufacturing Energy Consumption Survey* (MECS).

<sup>2</sup> External data come from the U.S. International Trade Commission; the American Petroleum Institute and Propane Education & Research Council; and the Bureau of Mines, *Petroleum Statement Annual*.

<sup>3</sup> We estimate this share is based on our survey data and on Intergovernmental Panel on Climate Change (IPCC) assumptions. We also consult our subject matter experts.

- Pentanes plus<sup>4</sup>

Each of these liquids has its own CO<sub>2</sub> emissions factor and assumed nonfuel and sequestration shares. Starting in 2010, SEDS began publishing state- and sector-level consumption of each of these individual fuels. Prior to 2010, energy consumption estimates were presented at the aggregate HGL level.

For years prior to 2010 (when disaggregated consumption estimates of each HGL component is unavailable), each liquid's share of total HGL consumption in 2010 (in British thermal units) is calculated and applied to each preceding year in the sample. For example, if 50% of a state's total HGL consumption in 2010 (in British thermal units) comes from ethane, we assume that 50% of the aggregate HGL total in all previous years is also ethane. After estimating consumption for each HGL product, we calculate product-level emissions and total HGL emissions using the same methodology for other fossil fuels.

## Output tables

The *Introduction and Key Concepts: State Energy-Related Carbon Dioxide Emissions Tables* describes the output tables.

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<sup>4</sup> For years prior to 1983, pentanes plus was referred to as natural gasoline.