Assumptions to the Annual Energy Outlook 2026: Emissions Policy Module

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Energy-Related Carbon Dioxide Emissions

Overview

The *Annual Energy Outlook 2026* (AEO2026) projects carbon dioxide (CO_2) emissions by fuel and by sector for three energy-related activities:

- Fossil fuel combustion
- Nonfuel use of fossil fuels (for example, in industrial activities such as manufacturing plastics)
- Naturally occurring CO_2 vented during energy consumption or production (for example, geothermal or natural gas processing)

For each activity, we estimate projected CO_2 emissions by multiplying associated energy consumption of each fuel by a CO_2 emission factor. Emissions factors reflect the amount of CO_2 emitted per unit of energy consumed and are expressed as millions of metric tons (MMmt) of CO_2 per quadrillion British thermal units (quads) of energy use.

To calculate CO_2 emissions factors, we start with CO_2 coefficients at full combustion for each fuel type. We adjust each coefficient by multiplying it with a combustion fraction between 0.0 and 1.0, arriving at an adjusted CO_2 emission factor for each fossil fuel. We assume all fuels are fully emissive when combusted (that is, a combustion fraction of 1.0). For nonfuel uses, the combustion fraction reflects our estimates of how much carbon remains in the product instead of being released into the atmosphere. We assume some nonfuel uses of fossil fuels capture all carbon inputs but other nonfuel uses emit some CO_2 during production.

Emissions factors and combustion fractions for all fossil fuel categories are listed in Table 1.

Fossil fuel combustion

CO_2 emissions from fuel use vary based on the:

- Carbon content of the fossil fuel
- Fraction of the fuel combusted
- Amount of the fuel consumed

The chemical composition of most fossil fuels is relatively consistent over time, resulting in little to no change in their carbon factors over our AEO projections. However, some fuel categories have greater variability. For example, coal is reported as a single fuel type, but if the underlying coal ranks that make up the coal category change, the carbon factor can change over time.

For fuel uses of energy, we assume all of the carbon is oxidized, so the combustion fraction is equal to 1.0 (in keeping with international convention). Some products, such as petroleum coke, have both fuel and nonfuel uses, and we adjust the combustion fraction accordingly. Lubricants are not used for their energy value, but we assume that half of the lubricants consumed are combusted (therefore, emitted) and half are not.

Nonfuel use (Fuel-dependent processes)

CO_2 emitted during nonfuel energy use varies widely across energy products. For some products, such as asphalt and road oil, we assume that all CO_2 is captured during nonfuel uses. As a result, the adjusted CO_2 emission factor is zero. For other fossil fuel inputs, such as those for petrochemical feedstocks, some CO_2 is emitted during production, and some carbon is stored in a final product (and not emitted into the atmosphere), reducing the fuel's CO_2 emissions relative to full combustion.

Biomass combustion

By convention, we assume biomass combustion results in net-zero CO_2 emissions. Specifically, we consider any CO_2 emitted by biogenic energy sources, such as biomass and alcohols, to be balanced by the CO_2 sequestration that occurred during biomass production.

For fuels or fuel categories containing only biogenic fuels (such as woody biomass or biogenic municipal solid waste), CO_2 emissions are reported as zero. For fuels that contain both biogenic and non-biogenic components, such as ethanol blended with motor gasoline or biodiesel, biogenic components are excluded from emissions calculations. To illustrate the potential for these emissions in the absence of any offsetting sequestration—as might occur under related land-use changes, with CO_2 being sequestered in terrestrial carbon sinks—we calculate and report the CO_2 emissions from biogenic fuel use separately. However, these values are not included in total or sectoral emissions estimates.

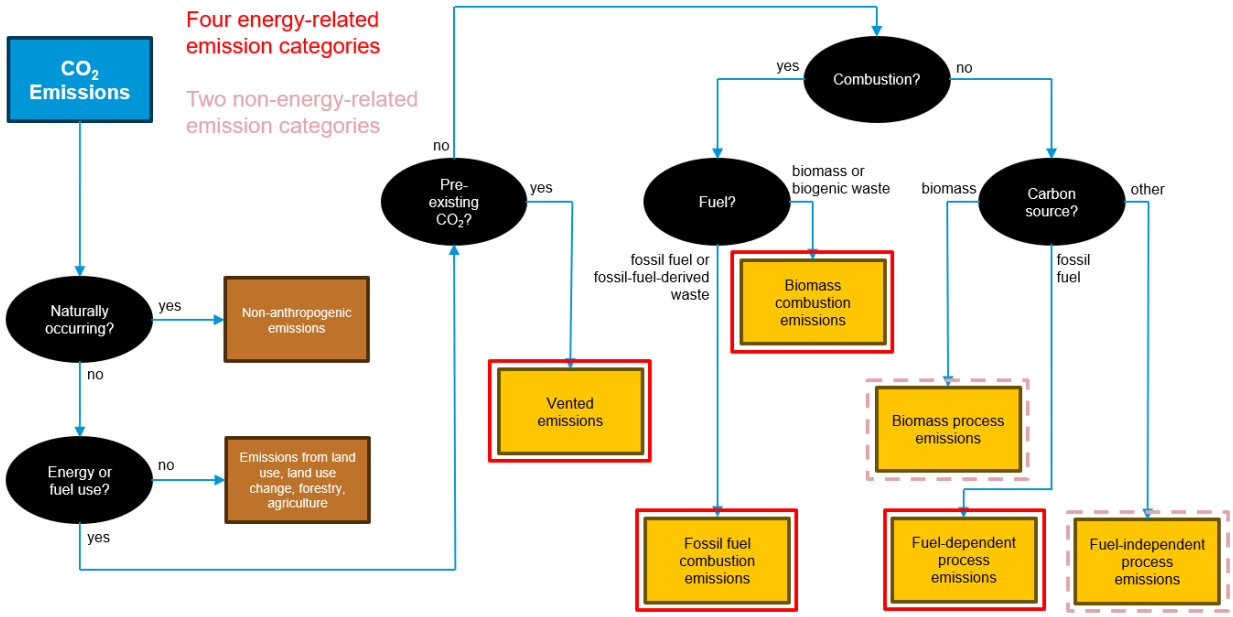
Fuel-independent processes

Some industrial processes release CO_2 as a result of natural chemical processes, rather than through the fuel or nonfuel use of energy products. One example is CO_2 released from limestone during cement production. Although these emissions contribute to an overall national total, they are outside the scope of what we consider to be *energy related*. As such, we calculate and report these CO_2 emissions separately, but we do not include these values in our total or sectoral energy-related emissions estimates.

Reporting

Figure 1 clarifies how we distinguish energy and non-energy CO_2 emissions in our published AEO tables.

Figure 1. Classifications of CO_2 emissions, energy vs. non-energy



Source: U.S. Energy Information Administration

The CO_2 emissions reported in AEO2026 Table 18 and Table 70 include all energy-related emissions from fossil fuel combustion, fuel-dependent processes, and venting. Table 18 groups these emissions by economic sector and fuel type, and Table 70 groups them by economic sector and end use. Table 71 reports CO_2 emissions by all categories shown in Figure 1, with subtotals for energy and non-energy CO_2 emissions.

Table 1. CO_2 emissions factors

million metric tons of CO_2 per quadrillion British thermal units

Fuel type	CO_2 coefficient at full combustion	Combustion fraction[a]	Adjusted emission factor
Petroleum			
Propane used as fuel	62.88	1.0	62.88
Propane used as feedstock	62.88	0.2	12.58
Ethane used as fuel	59.58	1.0	59.58
Ethane used as feedstock	59.58	0.2	11.92
Butane used as fuel	64.75	1.0	64.75
Butane used as feedstock	64.75	0.2	12.95
Isobutane used as fuel	64.94	1.0	64.94
Isobutane used as feedstock	64.94	0.2	12.99
Natural gasoline (pentanes plus) used as fuel	66.88	1.0	66.88
Natural gasoline (pentanes plus) used as feedstock	66.88	0.2	13.38
Motor gasoline (not including ethanol)	70.66	1.0	70.66
Jet fuel	72.23	1.0	72.23
Distillate fuel (not including biodiesel)	74.14	1.0	74.14
Residual fuel	75.09	1.0	75.09
Asphalt and road oil	75.35	0.0	0.0
Lubricants	74.07	0.5	37.03
Petrochemical feedstocks	69.26	0.308	21.31
Kerosene	73.19	1.0	73.19
Petroleum coke (industrial)	102.12	0.956	97.59
Petroleum coke (electric power)	102.12	1.0	102.12
Petroleum still gas	66.73	1.0	66.73
Other industrial[b]	30.39	1.0	30.39
Coal			
Residential and commercial	95.99	1.0	95.99
Metallurgical	93.90	1.0	93.90
Coke	113.67	1.0	113.67
Industrial other[c]	95.70	1.0	95.70
Electric power[d]	95.81	1.0	95.81
Natural gas			
Used as fuel	52.91	1.0	52.91
Used as hydrogen production feedstock	52.91	1.0	52.91
Used as other industrial feedstock	52.91	0.366	19.37
Biogenic energy sources[e]			
Woody biomass	93.81	1.0	93.81
Biogenic waste	90.64	1.0	90.64
Biofuels heat and coproducts	93.81	1.0	93.81
Ethanol	68.42	1.0	68.42
Biodiesel	72.73	1.0	72.73
Renewable diesel and gasoline	73.15	1.0	73.15
Renewable natural gas	52.91	1.0	52.91
Biobutanol	70.58	1.0	70.58
Other biomass liquids	73.15	1.0	73.15

Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2026,* National Energy Modeling System run: cb2026.d021826b, and Appendix tables A-20, A-32, and A-226, U.S. Environmental Protection Agency (EPA), *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2022*

Note: Emissions coefficients from EPA are converted from units of carbon to CO_2 by multiplying by a factor of (44/12).[a] For feedstocks, the combustion fraction includes fuel-dependent process emissions as well as inputs that might be combusted onsite.

[b] *Other industrial petroleum* includes industrial lubricants, special naphtha (solvents), waxes, and miscellaneous products such as sulfur.

[c] *Industrial other coal* is for process heat and qualitatively differs from coal used for steel production (metallurgical coal).

[d] The National Energy Modeling System specifies emissions factors for coal used for electric power generation by coal supply region and types of coal, so the average CO_2 content for coal varies throughout the projection period. The electric power value of 95.81 shown here illustrates a typical coal-fired emission factor.

[e] We include biogenic sources for informational purposes, but we do not count them in total energy-related CO_2 emissions.