Annual Energy Outlook 2025: Case Descriptions

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Overview

Our *Annual Energy Outlook 2025* (AEO2025), with projections through 2050, considers factors such as economic growth, future oil prices, the ultimate size of domestic energy resources, and technological changes that are often uncertain. To illustrate some of these uncertainties, we run side cases, compared with our Reference case, to show how the model responds to changes in key input variables. This document describes the nine core cases and two new alternative policy cases in AEO2025:

- Reference
- High Economic Growth
- Low Economic Growth
- High Oil Price
- Low Oil Price
- High Oil and Gas Supply
- Low Oil and Gas Supply
- High Zero-Carbon Technology Cost
- Low Zero-Carbon Technology Cost
- Alternative Electricity
- Alternative Transportation

Table 1 provides the formal case names, scenario names, and datekeys. Results for all AEO2025 cases are available in the AEO table browser.

Summary of Cases

Table 1. Summary of *Annual Energy Outlook 2025* cases (released April 15, 2025)

Case name	Scenario name	Datekey
Reference	ref2025	d032025a
Low Economic Growth	lowmacro	d032425b
High Economic Growth	highmacro	d032025a
Low Oil Price	lowprice	d032125a
High Oil Price	highprice	d032525b
Low Oil and Gas Supply	lowogs	d032625c
High Oil and Gas Supply	highogs	d032425b
Low Zero-Carbon Technology Cost	lowZTC	d032425a
High Zero-Carbon Technology Cost	highZTC	d032125b
Alternative Electricity	NoCAA111	d032525c
Alternative Transportation	AltTrnp	d032125a

Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2025* (AEO2025)

Macroeconomic Growth Cases

We developed the Low Economic Growth case and High Economic Growth case to reflect the uncertainty in projections of economic growth. These cases show the effects of alternative economic growth assumptions that are lower than or higher than the Reference case. Changes in assumptions for growth in population and nonfarm labor productivity yield changes in the growth in nonfarm employment, real disposable income, and real GDP, among other macroeconomic concepts. Table 2 shows the average compound annual growth rates of these model parameters in the Reference case and in the macroeconomic side cases.

Table 2. Macroeconomic growth rates in the *Annual Energy Outlook 2025* Low Economic Growth, Reference, and High Economic Growth cases (2024–2050)

Model parameter	Low Economic Growth case	Reference case	High Economic Growth case
Population	0.1%	0.3%	0.5%
Nonfarm labor productivity	1.4%	1.9%	2.4%
Nonfarm employment	0.2%	0.3%	0.5%
Real disposable income per capita	1.6%	1.9%	2.0%
Real gross domestic product	1.2%	1.8%	2.1%

Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2025* (AEO2025), National Energy Modeling System runs: ref2025.d032025a, highmacro.d032025a, and lowmacro.d032425b
Note: Minor discrepancies with published data are a result of independent rounding.

Oil Price Cases

Different expectations about long-term future oil prices can significantly affect the energy system. AEO2025 considers three oil price cases (Reference, Low Oil Price, and High Oil Price) to assess the impacts of alternative possibilities on the future course of oil prices. We base the benchmark world crude oil price in AEO2025 on historical spot prices for North Sea Brent crude oil, which is an international standard for light, sweet crude oil prices. Data tables also include the West Texas Intermediate (WTI) price—a critical reference point for the value of crude oil production in the U.S. Midcontinent—as well as the refiner's acquisition cost for imported crude oil.

We base the Brent spot price path in the Reference case on an assumption that both global oil supply and demand will increase in the projection period and that crude oil prices will also rise steadily across the projection period starting in 2025. Economic growth is steady during the projection period.

The Low Oil Price and High Oil Price cases encompass a wide range of potential price paths, illustrating potential variation in global demand for and supply of petroleum and other liquid fuels. The Low Oil Price case assumes conditions under which global (worldwide, excluding the United States) liquid fuels demand is lower and supply is higher than in the Reference case. The High Oil Price case assumes the opposite. Note that, while the Low Oil Price and High Oil Price cases illustrate variation in global demand and supply for petroleum and other liquid fuels, assumptions about U.S. supply and demand remain the same across the cases, and U.S. liquid fuels production and consumption respond only to changes in price.

In the Low Oil Price case, relatively low global demand results from several assumptions:

- Economic growth that is relatively slow compared with historical trends, especially in the countries outside of the OECD
- Reduced consumption in developed countries as a result of adopting more efficient technologies, extending Corporate Average Fuel Economy (CAFE) standards, lowering travel demand, and increasing natural gas or electricity consumption
- Efficiency improvements in nonmanufacturing industries in non-OECD countries
- Industrial fuel switching from liquid fuels to natural gas feedstocks for methanol and ammonia production

The Low Oil Price case also assumes higher supply than the Reference case, and the higher supply results in lower production costs for both crude oil and other liquid fuels production technologies. With lower demand and higher supply, prices remain lower in the Low Oil Price case than in the Reference case throughout the projection period, but the impacts on global quantities produced and consumed are muted because the demand and supply effects somewhat offset each other at equilibrium.

In the High Oil Price case, these assumptions are largely reversed. Liquid fuel demand is higher in the High Oil Price case as a result of higher economic growth than in the Reference case. Consumers demand greater personal mobility and consume more goods. Fewer efficiency gains occur in the industrial sector, and growing demand for fuel in the nonmanufacturing sector continues to be met with

liquid fuels. Liquid fuels supply decreases due to a lack of global investment in the oil sector, which eventually leads to higher production in countries outside of OPEC relative to the Reference case. Higher prices stimulate increased production of more costly resources, including tight or shale oil and bitumen, and they also lead to significant increases in production of renewable liquid fuels, gas-to-liquids, and coal-to-liquids compared with the Reference case.

Table 3 shows starting assumptions of the Brent crude oil benchmark price in the most recent historical year and in the first and last years of the projection period for both oil price cases and the Reference case. The prices below will differ from the final Brent crude oil price because the values in Table 3 are simply a starting assumption for the Liquid Fuels Market Module (LFMM).

Table 3. Brent oil price in selected years in both oil price cases and the Reference case, *Annual Energy Outlook 2025*

2024 dollars per barrel

Case name	2024	2025	2050
High Oil Price case	$80.49	$121.00	$154.92
Reference case	$80.49	$72.10	$95.00
Low Oil Price case	$80.49	$46.24	$47.04

Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2025*, National Energy Modeling System runs: ref2025.d032025a, highprice.d032525b, lowprice.d032125a

Oil and Gas Supply Cases

Estimates of technically recoverable tight or shale oil and natural gas resources are particularly uncertain and change over time as new information is gained through drilling, production, and technology experimentation. During the past decade, as a greater number of tight or shale oil formations have gone into production, estimates of technically recoverable tight or shale oil and natural gas resources have generally increased. However, these increases in technically recoverable resources (TRR) are based on many assumptions that might not apply in the long term or for the entire tight or shale formation. For example, some resource estimates may assume that crude oil and natural gas production rates achieved in one part of the formation represent the entire formation, even though neighboring well production rates can vary greatly. In addition, the tight or shale formation can differ significantly across the petroleum basin with respect to depth, thickness, porosity, carbon content, pore pressure, clay content, thermal maturity, and water content. Technological improvements and innovations may also result in developing undiscovered crude oil and natural gas resources, but the Reference case does not include these resources (because they are currently unknown).

Two AEO2025 side cases examine our projections' sensitivity to changes in assumptions regarding domestic crude oil and natural gas resources and technological progress (Table 4). These side cases are included to provide a framework to examine the effects of higher and lower domestic supply on energy demand, imports, and prices.

In the Low Oil and Gas Supply case, the estimated ultimate recovery per well is assumed to be 50% lower than in the Reference case for:

- Tight oil, tight gas, and shale gas in the Lower 48 states
- Undiscovered resources in Alaska
- Offshore Lower 48 states

Rates of technological improvement that reduce costs and increase productivity in the United States are also 50% lower than in the Reference case. These assumptions increase the per-unit cost of crude oil and natural gas development in the United States.

In the High Oil and Gas Supply case, we assume the estimated ultimate recovery per well to be 50% higher than in the Reference case for:

- Tight oil, tight gas, and shale gas in the Lower 48 states
- Undiscovered resources in Alaska
- Offshore Lower 48 states

Rates of technological improvement that reduce costs and increase productivity in the United States are also 50% higher than in the Reference case. The LFMM assumes crude oil pipeline and export capacity increases in the projection period to accommodate higher levels of domestic oil production.

Table 4. Unproved technically recoverable resource assumptions at the start of 2022, *Annual Energy Outlook 2025*

Case	Oil (billion barrels)	Natural gas (trillion cubic feet)
High Oil and Gas Supply case	311	3,309
Reference case	207	2,206
Low Oil and Gas Supply case	104	1,103

Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2025*, National Energy Modeling System runs: ref2025.d032025a, lowogs.d032625c, highogs.d032425b

Zero-Carbon Technology Cost Cases

To address the uncertainty in the future costs of power generation technologies that produce zero emissions, AEO2025 provides two cases: one assuming technology costs that are higher than those in the Reference case and another assuming technology costs that are lower. We applied the changes in the cost assumptions to the following technologies:

- Electric power sector
  - Conventional hydropower
  - Geothermal
  - Biomass, with and without carbon capture and sequestration system
  - Solar photovoltaic, standalone and hybrid
  - Onshore and offshore wind
  - Diurnal storage
  - Advanced nuclear and small modular reactors
- End-use sector
  - Solar photovoltaic
  - Wind
- Other
  - Electrolyzers deployed in production of hydrogen

Beginning in AEO2025, we include hydrogen electrolyzers in the case definition because the eligibility for the 45V Clean Hydrogen Production Tax Credit as established by the Inflation Reduction Act (IRA) of August 2022 implies zero carbon emissions.

In the High Zero-Carbon Technology Cost case, the overnight capital cost is held constant at the 2025 level throughout the projection period for all of the technologies listed above. In the Low Zero-Carbon Technology Cost case, we assume overnight capital costs and fixed operating and maintenance (O&M) costs decline more rapidly than in the Reference case, falling 40% below their Reference case equivalents by 2050 for all of these technologies. Other assumptions within these two cases remain the same as in the Reference case.

Alternative Electricity

This case captures the major electricity policy differences between the regulations modeled in the AEO2023 Reference case and the AEO2025 Reference case.

The AEO2025 Reference case includes the implementation of the U.S. Environmental Protection Agency's (EPA) April 2024 revisions to standards set for Section 111 of the Clean Air Act (CAA) to regulate carbon dioxide emissions from existing coal, oil, and natural gas-fired steam generating units and new natural gas-fired combustion turbines. As a sensitivity case, the Alternative Electricity (No CAA111) case assumes that the requirements of the rules issued in April 2024 are not in place. The assumptions used in this alternative case should not be construed as EIA's assessment on how laws or regulations could be changed or on the likelihood of such a change. The Alternative Electricity case allows existing coal plants to continue operation throughout the projection period without any modifications to reduce emission levels. The Alternative Electricity case also allows new natural gas-fired combined-cycle units to be built and operated without restrictions on their operating hours and irrespective of any installed carbon capture equipment. Plants with carbon capture can still be built if economical, but new or existing power plants have no carbon capture requirements or federal emission standards. Any state or regional programs are modeled as they are in the Reference case.

Alternative Transportation

This case captures the major transportation policy differences between the regulations modeled in the AEO2023 Reference case and the AEO2025 Reference case.

Policies removed for the Alternative Transportation case:

- National Highway Traffic Safety Administration's (NHTSA) CAFE and EPA tailpipe greenhouse gas standards for light-duty vehicles in model year 2027+
- EPA Phase 3 tailpipe greenhouse gas standards for freight trucks and buses in model year 2027+
- EPA low nitrogen oxide requirements for freight trucks in model year 2027+
- California Air Resources Board's Advanced Clean Truck (ACT) rule (for both California and CAA Section 177 states)

Other behavioral response assumptions modified in the Alternative Transportation case:

- Passenger vehicle manufacturers introduce new electric vehicle (EV) nameplates endogenously based on growth in EV sales, rather than based on plans announced in 2024.
- Charging infrastructure buildout is coupled with growth in EV registrations, rather than being exogenously determined based on private- and public-sector announcements.
- Projected increase in eligibility for IRA Section 30D credits—in other words, manufacturer reshoring of EV and battery supply chains—is significantly slowed, rather than being based on assumptions in the NHTSA and EPA rulemaking in order to better align with AEO2023 assumptions.