
International Energy Module

The National Energy Modeling System International Energy Module (IEM) simulates the interaction between U.S. and global petroleum markets. It uses assumptions of economic growth and expectations of future U.S. and world crude-like liquids production and consumption to estimate the effects of changes in U.S. liquid fuels markets on the international petroleum market. For each year of the projection period, the IEM computes Brent crude oil prices, provides a supply curve of world crude-like liquids, and generates a worldwide oil supply-demand balance with regional detail. The IEM also provides, for each year of the projection period, endogenous assumptions for petroleum products for import and export in the United States.

Changes in the Brent oil price are computed in response to:

1. The difference between projected U.S. total crude-like liquids production and the expected U.S. total crude-like liquids production at the current oil price (estimated using the current oil price and the exogenous U.S. total crude-like liquids supply curve for each year).

and

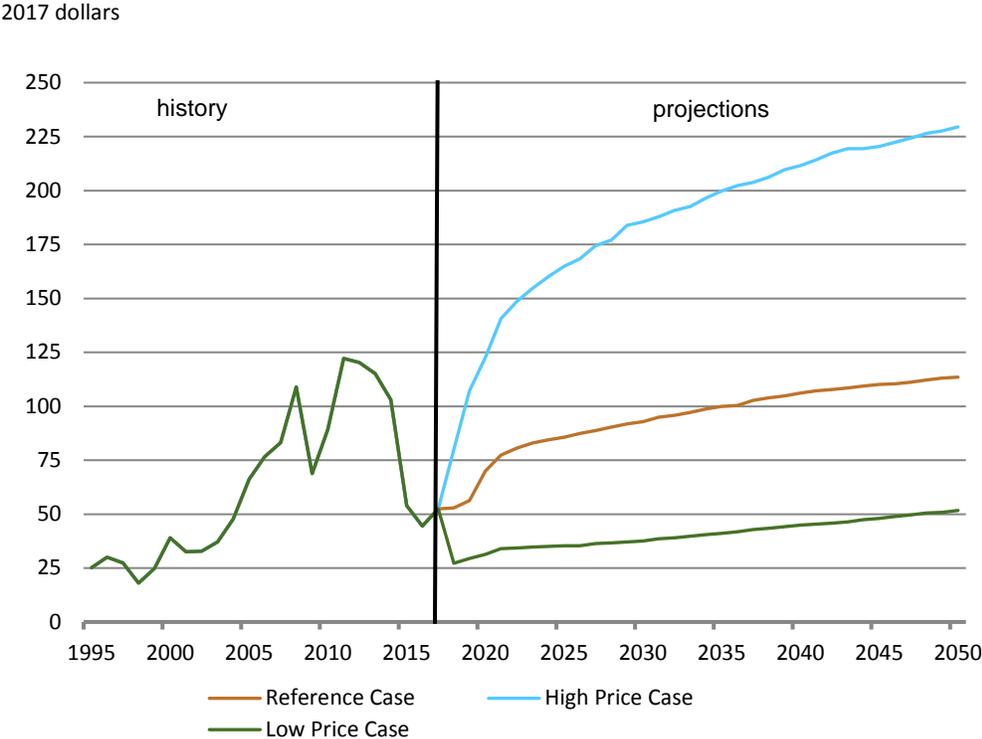
2. The difference between projected U.S. total crude-like liquids consumption and the expected U.S. total crude-like liquids consumption at the current oil price (estimated using the current oil price and the exogenous U.S. total crude-like liquids demand curve).

Key assumptions

AEO2018 considers a number of factors related to the uncertainty of future oil prices, including changes in worldwide demand for petroleum products, the Organization of the Petroleum Exporting Countries (OPEC) investment and production decisions, non-OPEC petroleum liquid fuels supply, and supplies of other liquid fuels. AEO2018 also has a representation of the International Maritime Organization (IMO) convention that limits sulfur in fuel oil used on ships over the 2020–2025 period.

In the AEO2018 Reference case, the small increase in U.S. crude oil production, combined with the increase in world oil prices, contributes to an increase in the oil price to \$53 per barrel (2017 dollars) in 2018. Oil prices rise steadily after 2018 in response to growth in demand from countries outside of the Organization for Economic Cooperation and Development (OECD), even if downward pressure from increases in U.S. oil production keeps the oil price below \$77 per barrel through 2020. Growth in demand from non-OECD countries pushes the oil price to \$114 per barrel in 2050 (Figure 1). The AEO2018 Reference case also assumes that the OPEC market share of liquids production will increase from 40% in 2018 to 43% in 2050.

Figure 1. World oil prices in three cases, 1995–2050



Source: U.S. Energy Information Administration, AEO2018, National Energy Modeling System runs REF2018.D121317A, HIGHPRICE.D122017A, LOWPRICE.D121317A

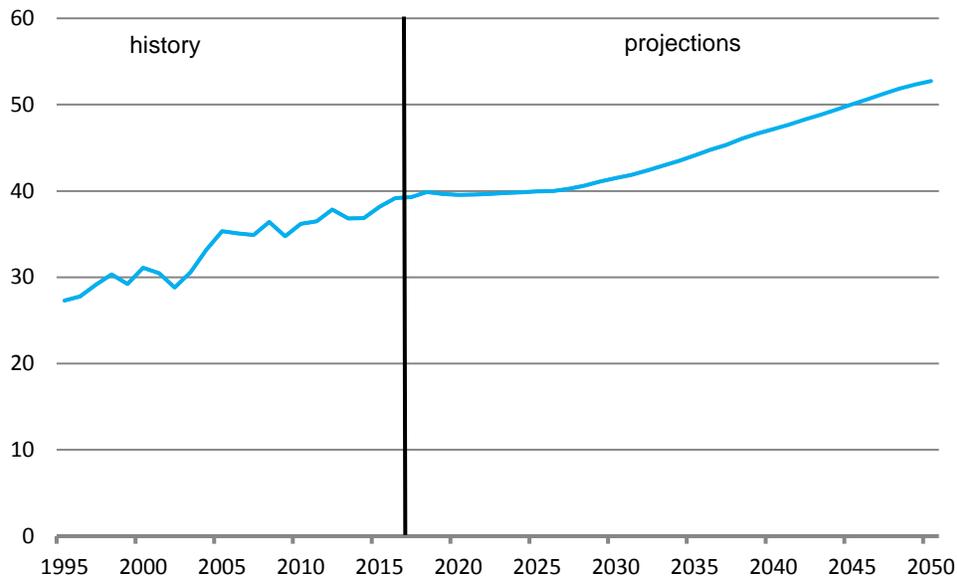
In the AEO2018 Low Oil Price case, the oil price drops to \$27 per barrel in 2018, followed by a gradual increase to \$52 per barrel in 2050. This is in response to higher upstream investment by OPEC and lower OECD demand. OPEC members increase their liquids production, and their market share increases from 41% in 2018 to 57% in 2050.

In the AEO2018 High Oil Price case, the oil price increases to \$80 per barrel in 2018 and \$229 per barrel in 2050. This is in response to significantly lower OPEC production and higher non-OECD demand, higher demand for petroleum products, and a more limited supply of other liquid fuels than in the Reference case. Also, U.S. production is significantly higher and U.S. domestic consumption is lower, which leads to lower U.S. net imports of crude oil through 2050. OPEC countries’ share of world liquids production slowly decreases to 33% by 2030 and then gradually increases to 36% by 2050.

OPEC petroleum and other liquids production in the AEO2018 Reference case is assumed to increase throughout the 2018–2050 projection period (Figure 2), at a rate that enables the organization to achieve a 43% market share of the world’s total petroleum and other liquids in 2050. OPEC is assumed to be an important source of additional production because its member-nations held at the end of 2017 a major portion of the world’s total proved oil reserves—approximately 1,218 billion barrels, about 74% of the world’s estimated total. [1]

Figure 2. OPEC total liquids production in the Reference case, 1995–2050

million barrels per day

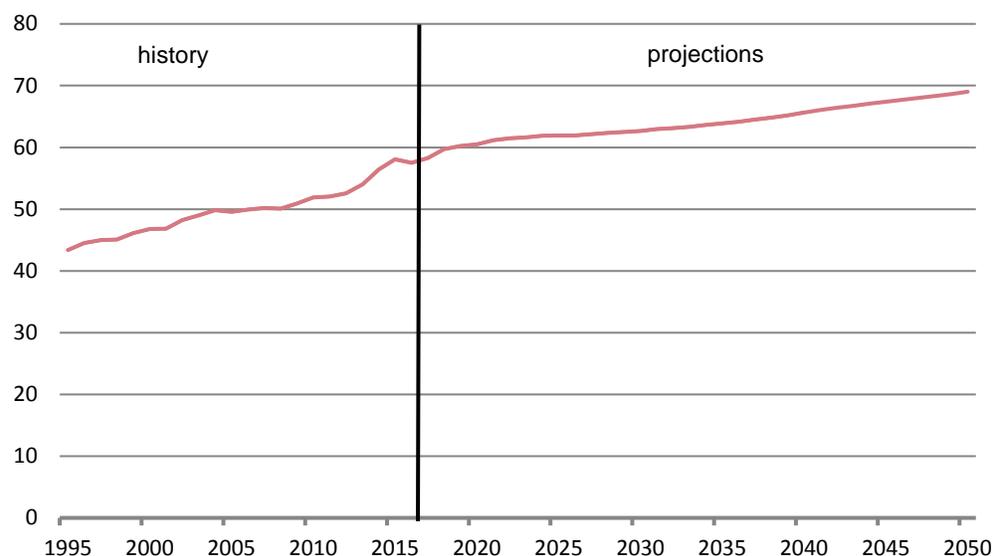


OPEC = Organization of the Petroleum Exporting Countries
 Source: U.S. Energy Information Administration, AEO2018 National Energy Modeling System run
 REF2018.D121317A

Non-U.S., non-OPEC oil production projections in AEO2018 are developed in two stages. Projections of liquids production before 2018 are based largely on project-by-project assessments of major fields, including volumes and expected schedules, with consideration given to the decline rates of producing projects, planned exploration and development activity, and country-specific geopolitical situations and fiscal regimes. Incremental production estimates from existing and new fields after 2018 are based on country-specific consideration of economics and ultimate technically recoverable resource estimates. Non-OPEC total liquids production in the AEO2018 Reference case is shown in Figure 3.

Figure 3. Non-OPEC total liquids production in the Reference case, 1995–2050

million barrels per day



OPEC = Organization of the Petroleum Exporting Countries
 Source: U.S. Energy Information Administration, AEO2018 National Energy Modeling System run REF2018.D121317A

The non-U.S. oil production projections in AEO2018 are limited by country-level assumptions regarding technically recoverable oil resources. Inputs to these resource estimates include the United States Geological Survey (USGS) *World Petroleum Assessment of 2012*, and oil reserves published in the *Oil & Gas Journal* by PennWell Publishing Company, a summary of which is shown in Table 1.

Table 1. Worldwide oil reserves as of January 1, 2018

billion barrels

Region	Proved Oil Reserves
Western Hemisphere	540.9
Western Europe	10.2
Asia-Pacific	45.6
Eastern Europe and Former Soviet Union (FSU)	120.0
Middle East	807.7
Africa	127.4
Total World	1,651.8
Total OPEC	1,217.9

Source: PennWell Corporation, *Oil & Gas Journal*, Vol 115. 12 (Dec. 4, 2017).

The AEO2018 Reference case growth rates for gross domestic product (GDP) for various regions in the world are shown in Table 2. The GDP growth rate assumptions for non-U.S. countries/regions are taken from Oxford Economic Model (March 2017).

Table 2. Average annual real gross domestic product rates, 2010–50

2010 purchasing power parity weights and prices

Region	Average Annual Percentage Change
OECD	1.6%
OECD Americas	2.1%
OECD Europe	1.4%
OECD Asia	1.2%
Non-OECD	3.6%
Non-OECD Europe and Eurasia	1.6%
Non-OECD Asia	4.2%
Middle East	2.8%
Africa	3.9%
Non-OECD Americas	2.1%
Total World	2.8%

Source: U.S. Energy Information Administration, derived from Oxford Economic Model (March 2017).

The values for growth in total liquids demand in the International Energy Module, which depend on oil price levels and GDP growth rates, are shown by region in Table 3 for the Reference case.

Table 3. Average annual growth rates for total liquids demand in the Reference case, 2010–50

percent per year

Region	Demand Growth
OECD	-0.08%
OECD Americas	0.12%
OECD Europe	-0.48%
OECD Asia	0.00%
Non-OECD	1.50%
Non-OECD Europe and Eurasia	0.09%
Non-OECD Asia	1.96%
Middle East	1.08%
Africa	1.94%
Non-OECD Americas	0.90%
Total World	0.78%

Source: U.S. Energy Information Administration, National Energy Modeling System run REF2018.D121317A.

Notes and sources

[1] PennWell Corporation, Oil and Gas Journal, Vol. 115.12 (December 4, 2017).