

# **International Energy Module**

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The NEMS 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 forecast, the NEMS IEM computes world oil prices, provides a supply curve of world crude-like liquids, generates a worldwide oil supply-demand balance with regional detail, and computes quantities of crude oil and light and heavy petroleum products imported into the United States by export region.

Changes in the world oil price (WOP), which is defined as the price of light, low sulfur crude oil delivered to Cushing, Oklahoma in PADD2, 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 WOP (estimated using the current WOP 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 WOP (estimated using the current WOP and the exogenous U.S. total crude-like liquids demand curve).

### Key assumptions

The level of oil production by OPEC is a key factor influencing the world oil price projections incorporated into *AEO2011*. Non-OPEC production, worldwide regional economic growth rates and the associated regional demand for oil are additional factors affecting the world oil price.

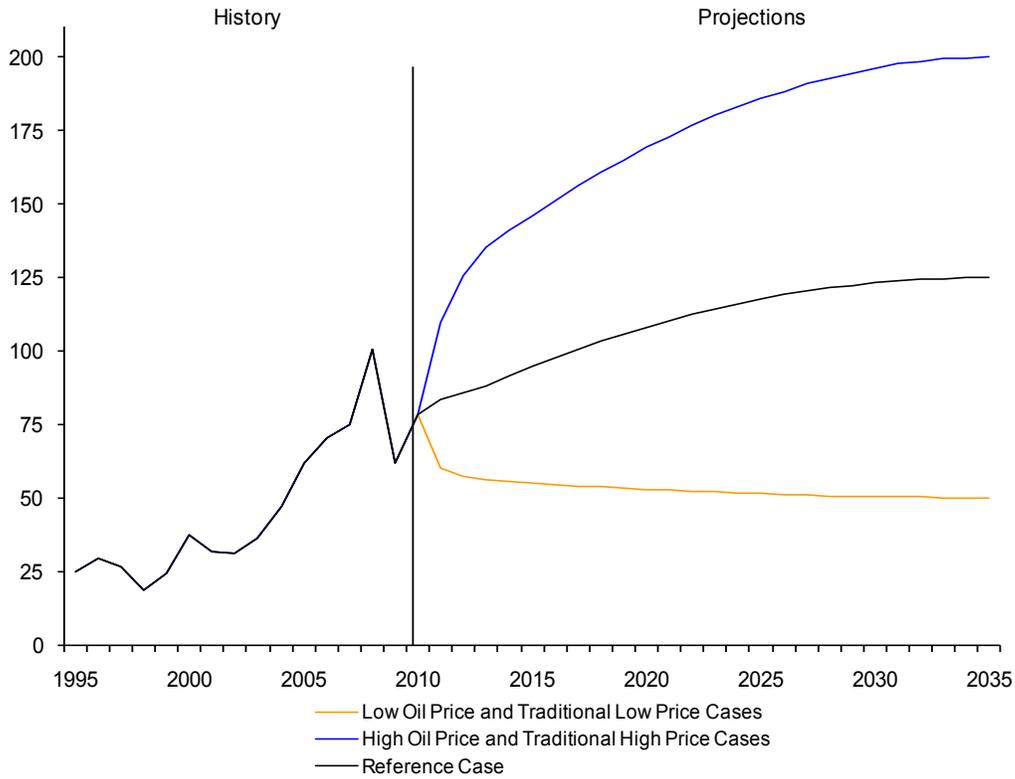
For the low, reference, and high oil price cases, the world oil price reaches \$50, \$125 and \$200 per barrel in 2035, respectively, in 2009 dollars. The Reference case assumes that OPEC producers will continue to demonstrate a disciplined production approach. The traditional low oil price case reflects a market where all oil production becomes more competitive and plentiful. For the low price case (LNO), low prices result from low demand for liquid fuels in the non-OECD nations. Lower demand is measured by lower economic growth relative to the Reference case. In this case, GDP growth in the non-OECD is reduced by 1.5 percentage points in each projection year from 2015 on relative to Reference case assumptions. The traditional high oil price cases could result from a more cohesive and market-assertive OPEC that reduces overall production volumes while resource rich non-OPEC producers restrict economic access to their oil reserves. For the high price case (HNO), high prices result from high demand for liquid fuels in the non-OECD nations. Higher demand is measured by higher economic growth relative to the Reference case. In this case, GDP growth in the non-OECD is raised by 1.0 percentage point in each projection year from 2015 relative to Reference case assumptions. The five price scenarios are shown in Figure 2.

OPEC oil production in the Reference case is assumed to increase throughout the projection (Figure 3), at a rate that enables the organization to maintain an approximately constant market share over the projection period. OPEC is assumed to be an important source of additional production because its member nations hold a major portion of the world's total reserves—exceeding 950 billion barrels, about 70 percent of the world's estimated total, at the beginning of 2010.[1] Despite investment from foreign sources, Iraq's oil production is not assumed to maintain steady growth until after 2015 as infrastructure limitations as well as security and legislative issues are assumed to slow development for the next five years.

Non-U.S., non-OPEC oil production projections in the *AEO2011* are developed in two stages. Projections of liquids production before 2015 are based largely on a project-by-project assessment of major fields, including volumes and expected schedules, with consideration given to the decline rates of active projects, planned exploration and development activity, and country-specific geopolitical situations and fiscal regimes. Incremental production estimates from existing and new fields after 2015 are estimated based on country specific consideration of economics and ultimate technically recoverable resource estimates. The non-OPEC production path for the Reference case is shown in Figure 4.

**Figure 2. World oil prices in five cases, 1995-2035**

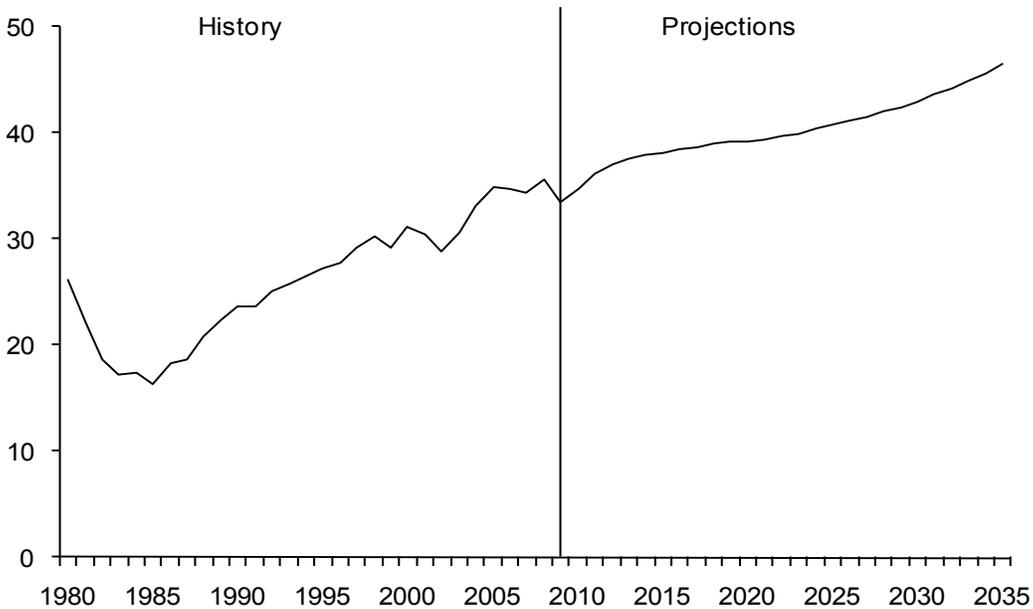
2008 dollars per barrel



Source: U.S. Energy Information Administration. AEO2011, National Energy Modeling System runs REF2011.D020911A, HP2011hno.D020911A LP2011/Ino.D020911A, HP2011mno.D020911A, and LP2011mno.D020911A.

**Figure 3. OPEC total liquids production in the Reference case, 1995-2035**

million barrels per day

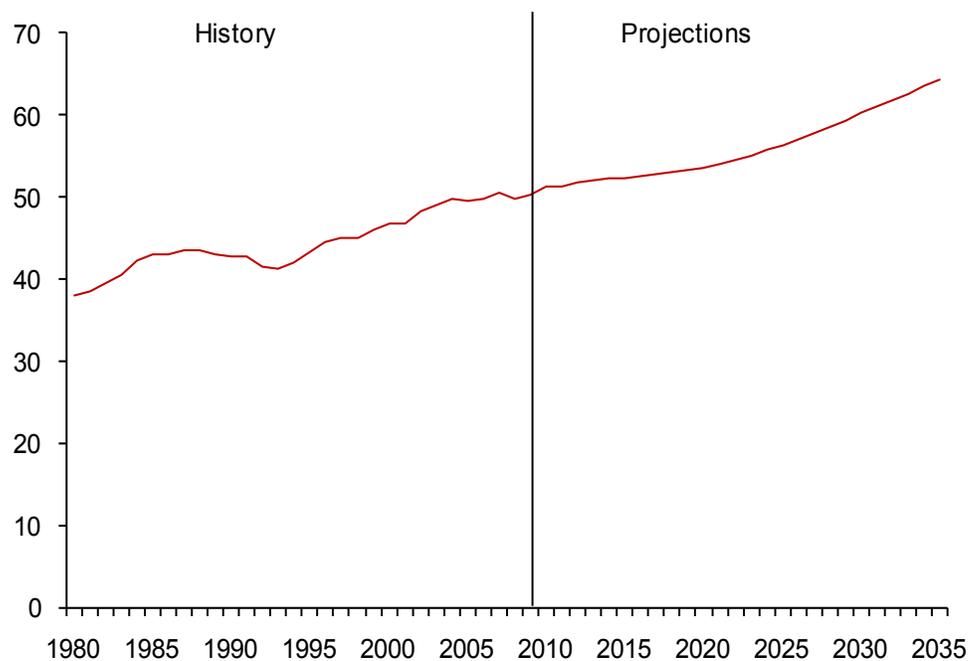


OPEC = Organization of Petroleum Exporting Countries.

Source: U.S. Energy Information Administration. AEO2011 National Energy Modeling System run REF2011.D020911A.

**Figure 4 Non-OPEC total liquids production in the Reference case, 1995-2035**

million barrels per day



OPEC = Organization of Petroleum Exporting Countries.

Source: U.S. Energy Information Administration. AEO2011 National Energy Modeling System run REF2011.D020911A.

The non-U.S. oil production projections in the AEO2011 are limited by country-level assumptions regarding technically recoverable oil resources. Inputs to these resource estimates include the USGS World Petroleum Assessment of 2000 and oil reserves published in the Oil and Gas Journal by PennWell Publishing Company, a summary of which is shown in Table 3.1.

The Reference case growth rates for GDP for various regions in the world are shown in Table 3.2. Except for the United States, the GDP growth rate assumptions for non U.S. country/regions are taken from HIS Global Insight, Inc., Global detailed forecast (November 23, 2009).

The values for growth in total liquids demand in the International Energy Module, which depend upon the oil price levels as well as GDP growth rates, are shown in Table 3.3 for the Reference case by regions.

**Table 3.1. Worldwide oil reserves as of January 1, 2010**

billion barrels

Region	Proved Oil Reserves
Western Hemisphere	329.4
Western Europe	12.2
Asia-Pacific	40.1
Eastern Europe and Former Soviet Union (F.S.U.)	100.0
Middle East	753.4
Africa	119.1
Total World	1,354.2
Total OPEC	951.3

Source: Pennwell Corporation, Oil and Gas Journal, Vol 106. 48 (Dec. 21, 2009).

**Table 3.2. Average annual real gross domestic product rates, 2007-2035**

2005 purchasing power parity weights and prices

Region	Average Annual Percentage Change
OECD	2.01%
OECD Americas	2.52%
OECD Europe	1.68%
OECD Asia	1.42%
Non-OECD	4.39%
Non-OECD Europe and Eurasia	2.69%
Non-OECD Asia	5.21%
Middle East	3.73%
Africa	3.58%
Central and South America	3.41%
Total World	3.21%

Source: U.S. Energy Information Administration, National Energy Modeling System run REF2011.D020911A.

**Table 3.3. Average annual growth rates for total liquids demand in the Reference case, 2007-2035**

billion barrels

Region	Oil Demand Growth
OECD	-0.06%
OECD Americas	0.24%
OECD Europe	-0.60%
OECD Asia	-0.09%
Non-OECD	1.92%
Non-OECD Europe and Eurasia	0.42%
Non-OECD Asia	2.62%
Middle East	1.96%
Africa	1.27%
Central and South America	1.10%
Total World	0.92%

Source: U.S. Energy Information Administration, National Energy Modeling System run REF2011.D020911A; and World Energy Projection system Plus (2010), run AEO2011-STECLB2-101310B.

**Notes and sources**

[1] PennWell Corporation, Oil and Gas Journal, Vol. 107.47 (December 21, 2009).