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US Oil and Gas Import Dependence: Department of Energy Projections in 2011

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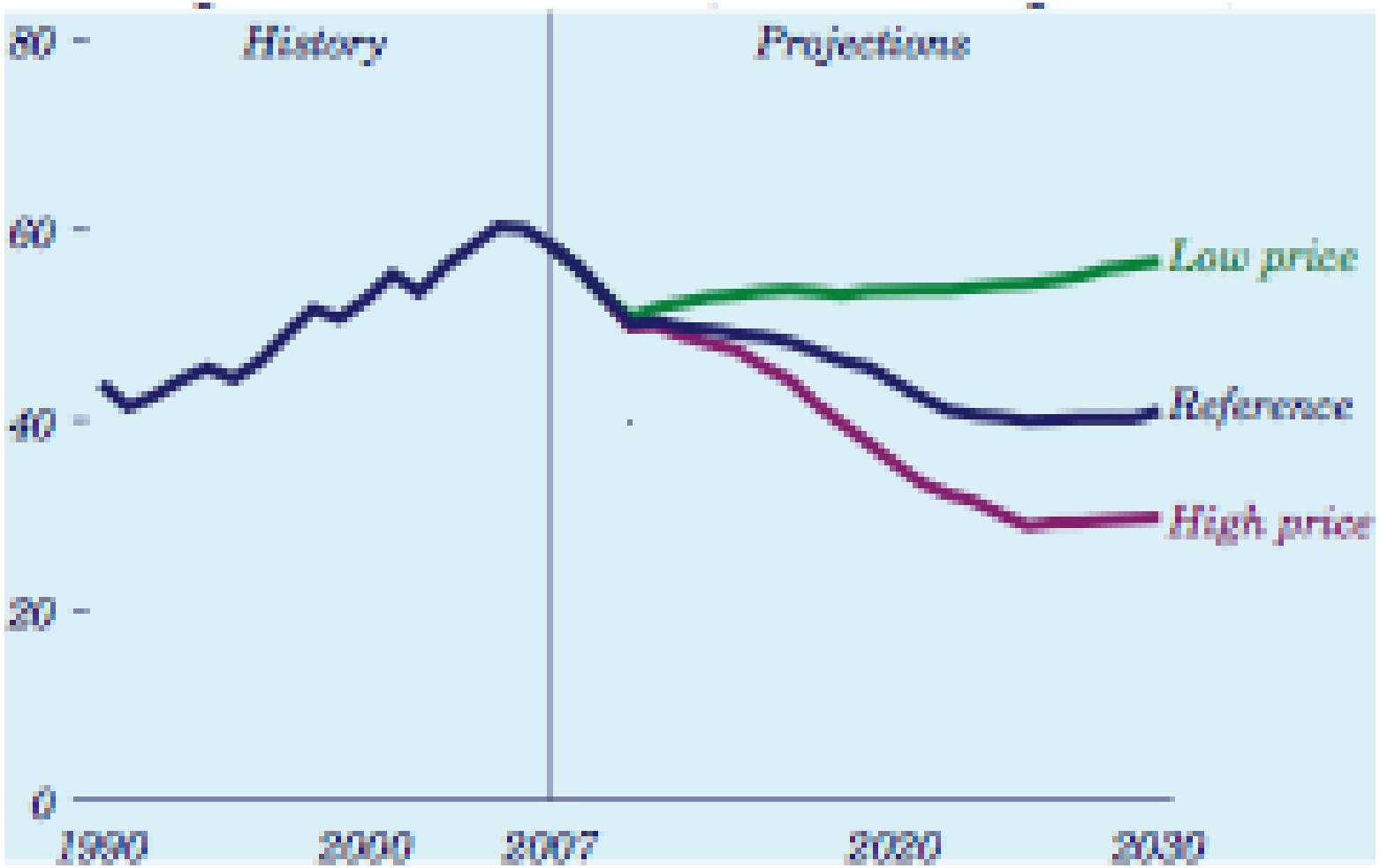
US Petroleum Imports Remain High Through 2025 In Spite of Increased Prices and Increase Domestic Production of Oil and Alternative Fuels

Net Import Share of U.S. Liquid Fuels Consumption, 1990-2030 in Percent (2009 Estimate)

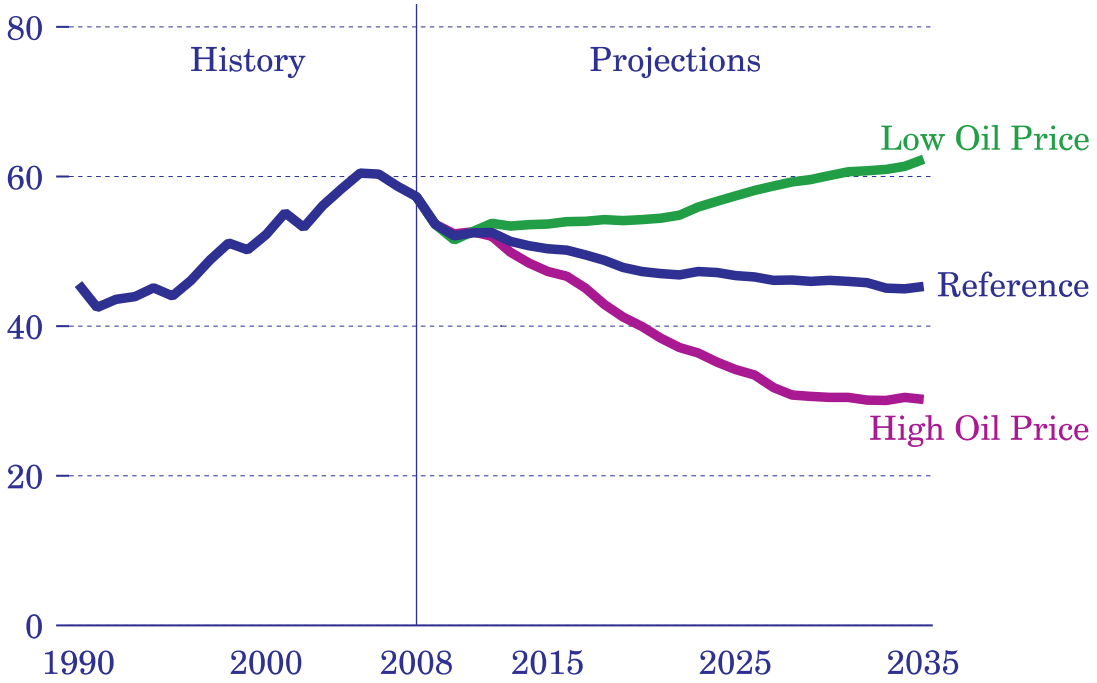


DOE-IEA, Annual Energy Outlook 2009, p. 82

Net Import Share of U.S. Liquid Fuels Consumption, 1990-2030 in Percent (2010 Estimate)

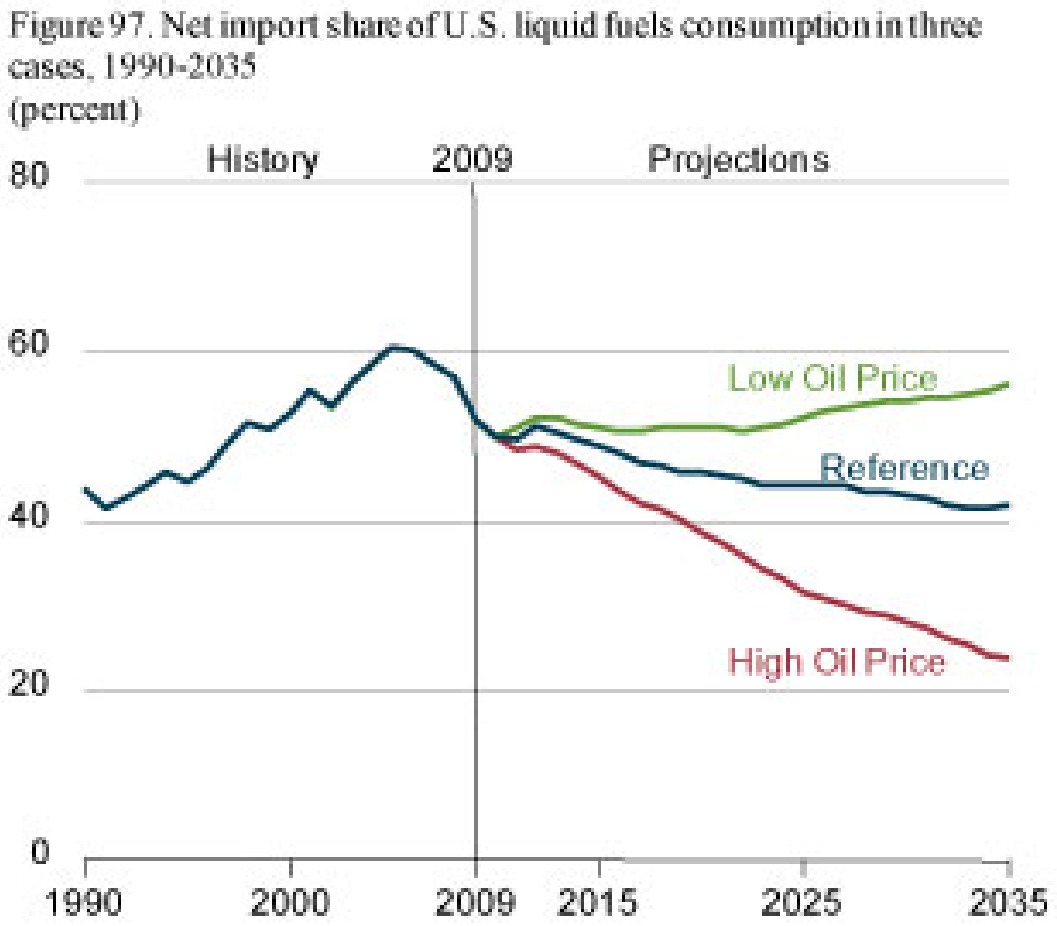
Imports of liquid fuels vary with world oil price assumptions

Figure 83. Net import share of U.S. liquid fuels consumption in three cases, 1990-2035 (percent)



DOE-IEA, Annual Energy Outlook 2010, p. 77

US Petroleum Import Dependence Varies with Price (2011 Estimate)



In the *AEO2011* Reference and High Oil Price cases, imports of liquid fuels continue to decline from 2009 to 2035, although they provide a major part of total U.S. liquids supply over the period.

Tighter fuel efficiency standards and higher prices for liquid fuels moderate the growth in liquids demand, even as the combination of higher prices and renewable fuel mandates leads to increased domestic production of both oil and biofuels. Consequently, while consumption of liquid fuels increases steadily in the Reference case from 2009 to 2035, the growth in demand is met by domestic production.

The net import share of U.S. liquid fuels consumption fell from 60 percent in 2005 to 52 percent in 2009. The net import share continues to decline in the Reference case, to 42 percent in 2035 (Figure 97). In the High Oil Price case, the net import share falls to an even lower 24 percent in 2035. Increased penetration of biofuels in the liquids market reduces the need for imports of crude oil and petroleum products in the High Oil Price case. In the Low Oil Price case, the net import share remains flat in the near term, then rises to 56 percent in 2035 as demand increases and imports become cheaper than crude oil produced domestically.

EIA, Annual Energy Outlook, 2011, http://www.eia.doe.gov/forecasts/aeo/MT_liquidfuels.cfm

Net Import Share of U.S. Liquid Fuels and Gas Supply, 1970-2035 in MMBD and TCF (2010 Estimate)

Figure 2. U.S. liquid fuels supply, 1970-2035 (million barrels per day)

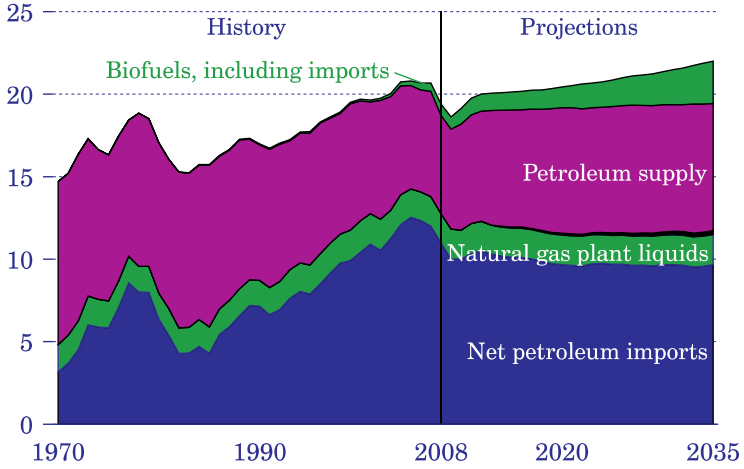
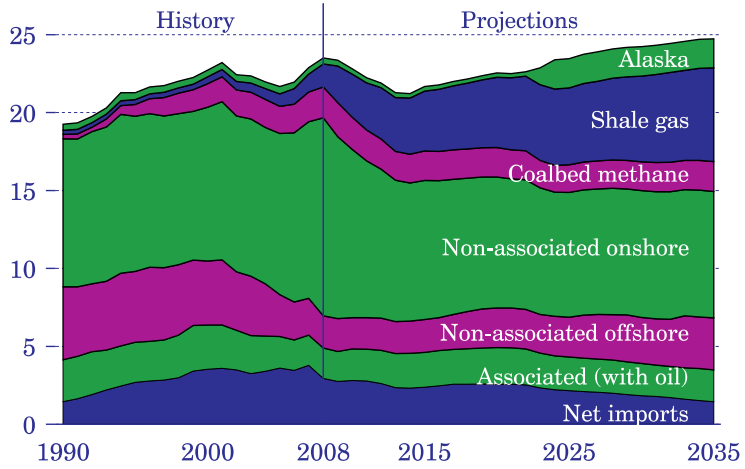


Figure 3. U.S. natural gas supply, 1990-2035 (trillion cubic feet)



Although U.S. consumption of liquid fuels continues to grow over the next 25 years in the AEO2010 Reference case, reliance on petroleum imports decreases (Figure 2). With government policies and rising oil prices providing incentives for the continued development and use of alternatives to fossil fuels, biofuels account for all the growth in liquid fuel consumption in the United States over the next 25 years, while consumption of petroleum-based liquids is essentially flat. Total U.S. consumption of liquid fuels, including both fossil fuels and biofuels, rises from about 20 mil- lion barrels per day in 2008 to 22 million barrels per day in 2035 in the Reference case.

In the Reference case, total domestic natural gas production grows from 20.6 trillion cubic feet in 2008 to 23.3 trillion cubic feet in 2035. With technology improvements and rising natural gas prices, natural gas production from shale formations grows to 6 tril- lion cubic feet in 2035, more than offsetting declines in other production. In 2035, shale gas provides 24 percent of the natural gas consumed in the United States, up from 6 percent in 2008 (Figure 3).

DOE-IEA, Annual Energy Outlook 2010, p. 3

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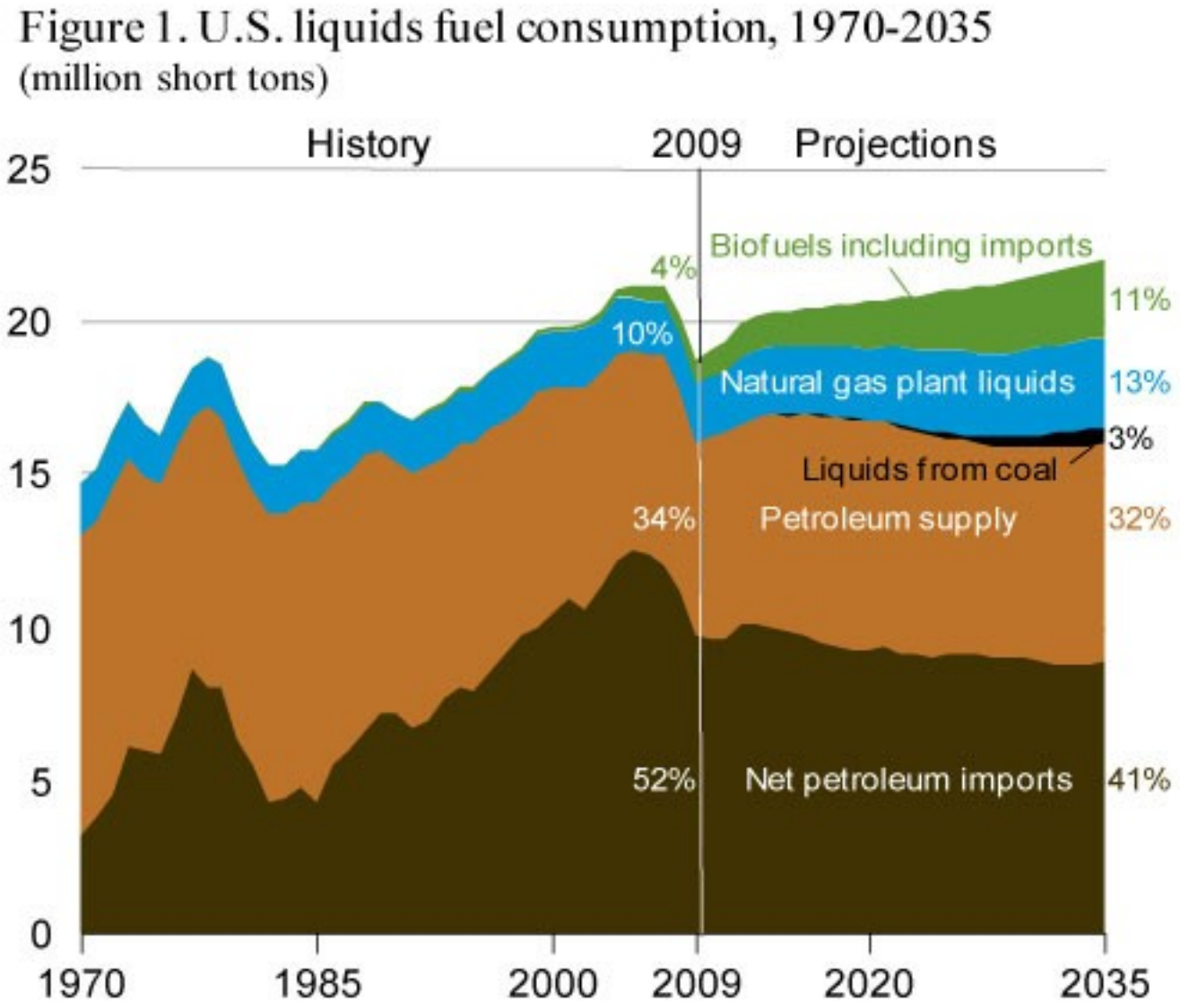
US Petroleum Imports Drop Slightly But Remains High Thru 2035 (2011 Estimate)



The net import share of total U.S. energy consumption in 2035 is 17 percent, compared with 24 percent in 2009. (The share was 29 percent in 2007, but it dropped considerably during the 2008-2009 recession.)

Much of the projected decline in the net import share of energy supply is accounted for by liquids.

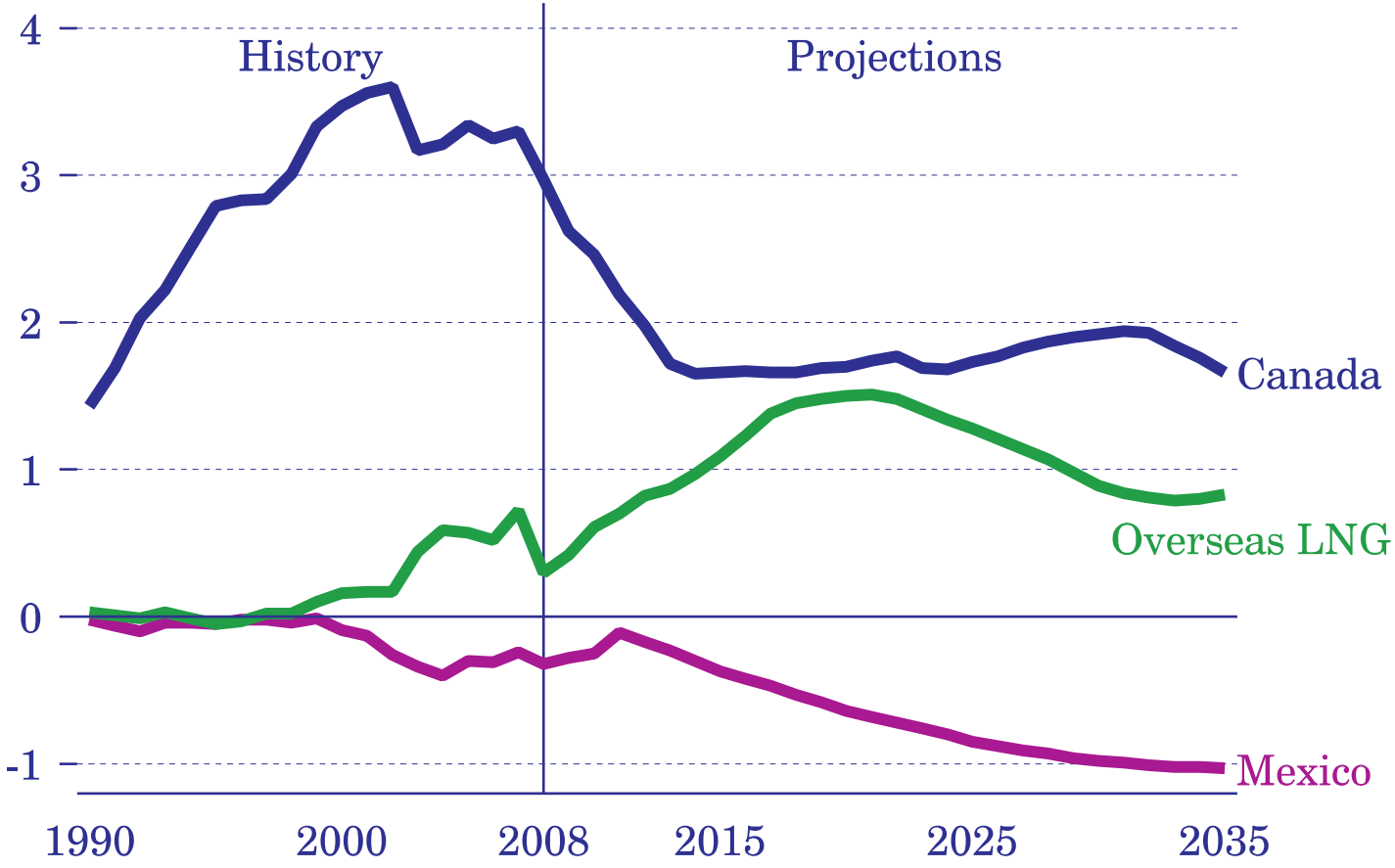
Although U.S. consumption of liquid fuels continues to grow through 2035 in the Reference case, reliance on petroleum imports as a share of total liquids consumption decreases. Total U.S. consumption of liquid fuels, including both fossil fuels and biofuels, rises from about 18.8 million barrels per day in 2009 to 21.9 million barrels per day in 2035 in the Reference case.
The import share, which reached 60 percent in 2005 and 2006 before falling to 51 percent in 2009, falls to 42 percent in 2035

EIA, Annual Energy Outlook, 2011, http://www.eia.gov/forecasts/aeo/chapter_executive_summary.cfm#imports

US Gas Imports Drop and Increases Gas Production Reduces Potential Demand for Oil

EIA Estimates of Future Gas Imports (2010 Estimate)

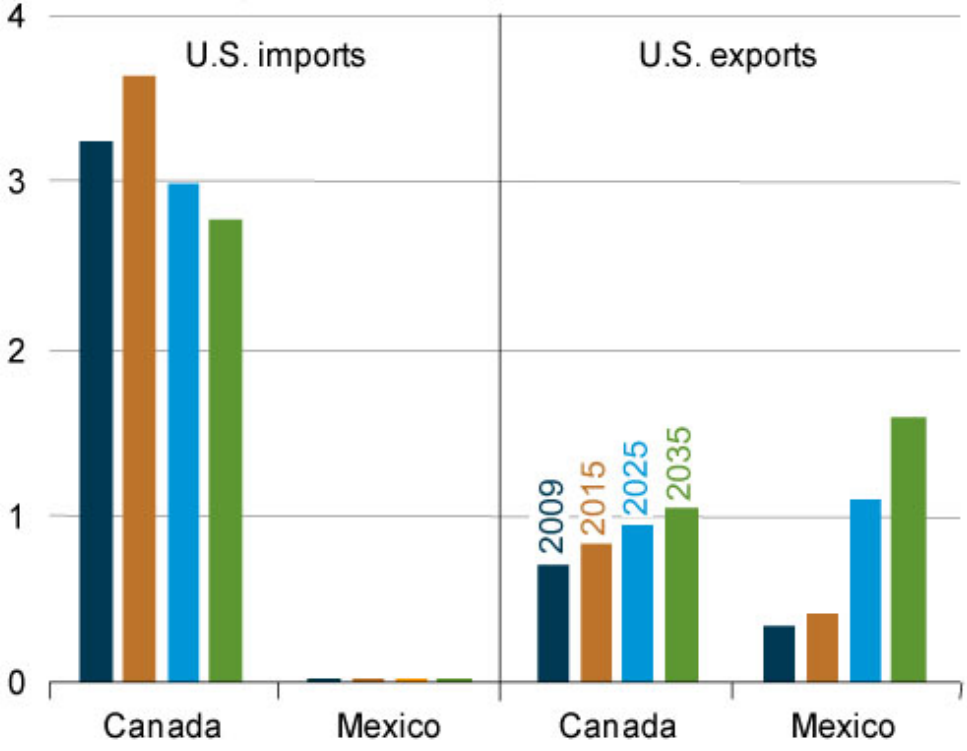
Figure 77. U.S. net imports of natural gas by source, 1990-2035 (trillion cubic feet)



Source: EIA-IEO 2010, p. 74

US Gas Imports Continue to Decline (2011 Estimate)

Figure 51. North American natural gas trade, 2009-2035
(trillion cubic feet)



The energy markets of the three North American nations (United States, Canada, and Mexico) are well integrated, with extensive infrastructure that allows cross-border trade between the United States and both Canada and Mexico.

The United States, which is by far the region's largest energy consumer, relies on Canada and Mexico for supplies of liquid fuels. Canada and Mexico were the largest suppliers of U.S. liquids imports in 2009, providing 2.5 and 1.2 million barrels per day, respectively. In addition, Canada supplies the United States with substantial natural gas supplies, exporting 3.2 trillion cubic feet to U.S. markets in 2009 (Figure 51).

In the *AEO2011* Reference case, the existing trade relationships between the United States and the two other North American countries continue. In 2035, the United States still imports 2.6 million barrels per day of liquid fuels from Canada and about 1.0 million barrels per day from Mexico.

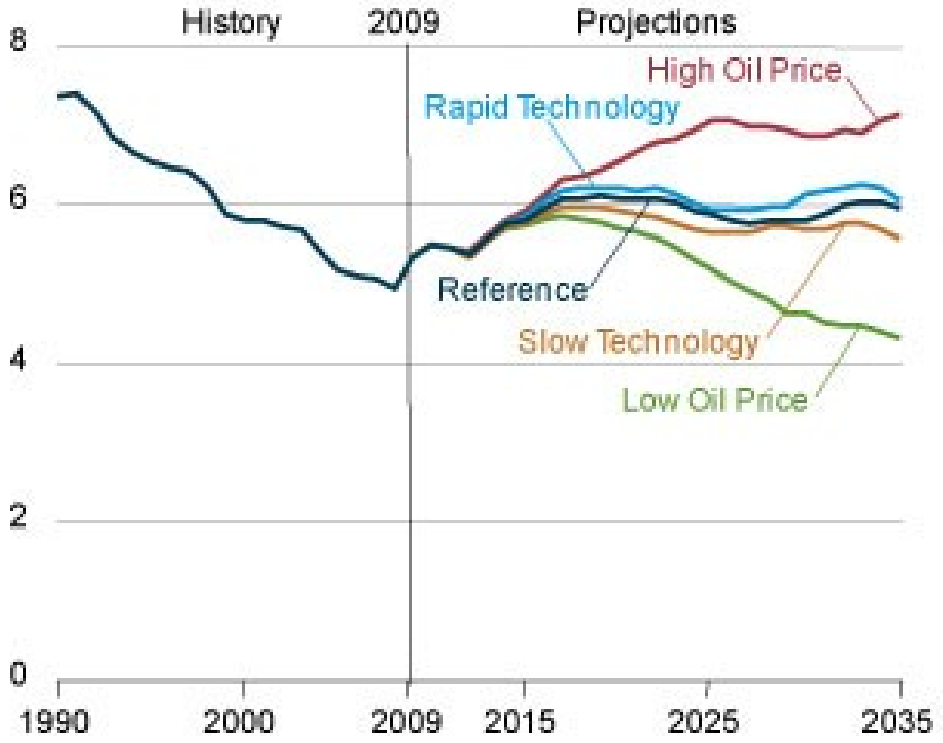
The improving prospects for domestic U.S. natural gas production, however, mean a smaller natural gas import requirement. In 2035, U.S. imports of Canadian natural gas fall to 2.8 trillion cubic feet. On the other hand, U.S. natural gas exports to both Canada and Mexico increase. Canada's imports of U.S. natural gas rise from 0.7 trillion cubic feet in 2009 to 1.0 trillion cubic feet in 2035, and Mexico's imports rise from 0.3 trillion cubic feet in 2009 to 1.6 trillion cubic feet in 2035.

EIA, Annual Energy Outlook, 2011, http://www.eia.doe.gov/forecasts/aeo/MT_naturalgas.cfm

DOE/EIA Assumptions for 2011 Include Major Increases in Domestic Production and Alternative Liquids

Price and Technology Increase US Domestic Oil Production

Figure 96. Total U.S. crude oil production in five cases, 1990-2035 (million barrels per day)



n the *AEO2011* Oil Price and Technology cases, total U.S. crude oil production is more responsive to changes in world oil prices than it is to advances in technology (Figure 96). The most significant difference between the Reference case and the High and Low Oil Price cases is the change in use of CO2â€“enhanced EOR in response to the changes in oil price assumptions.

From 2015 to 2035, when compared with the Reference case, crude oil production using CO2 EOR is 17 percent higher on average in the High Oil Price case. In comparison, in the Rapid Technology case, CO2 EOR technology shows little change, in part because of the limited availability of CO2 supplies.

Oil production from offshore areas, Alaska, and oil shale deposits also is responsive to changes in world oil prices, because higher or lower prices improve or worsen the economics of those supply sources. For example, production from oil shale in 2035 is nearly threefold higher in the High Oil Price case than in the Reference case, and oil production from offshore drilling is 26 percent higher than in the Reference case.

Advances in horizontal drilling and hydraulic fracturing techniques continue to enhance the development of shale oil formations. Improvements in drilling equipment and monitoring instrumentation are among the key advances that have contributed to the slowdown and subsequent reversal in the decline in U.S. domestic oil production.

EIA, Annual Energy Outlook, 2011, http://www.eia.doe.gov/forecasts/aeo/MT_liquidfuels.cfm

US Offshore Oil and Gas Resources are Significant, Price and Time Limit Access, and Import Dependence Remains High Under Best Case Assumptions

Figure 30. Offshore crude oil production in four cases, 2009-2035
(million barrels per day)

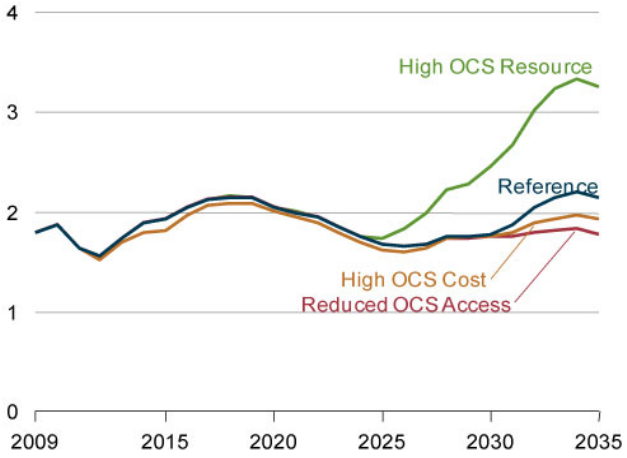
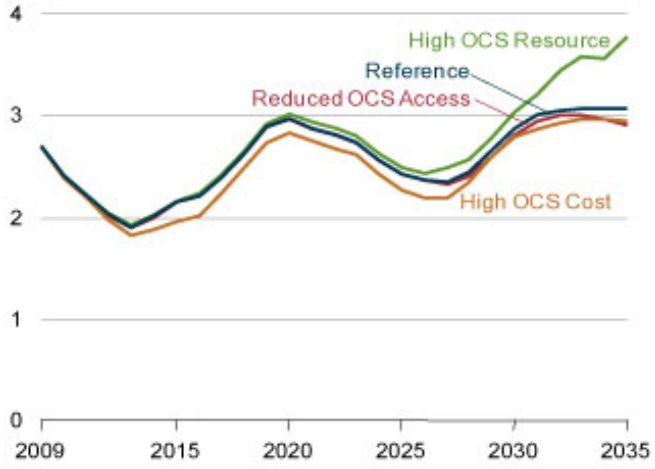


Figure 31. Offshore natural gas production in four cases, 2009-2035
(trillion cubic feet)

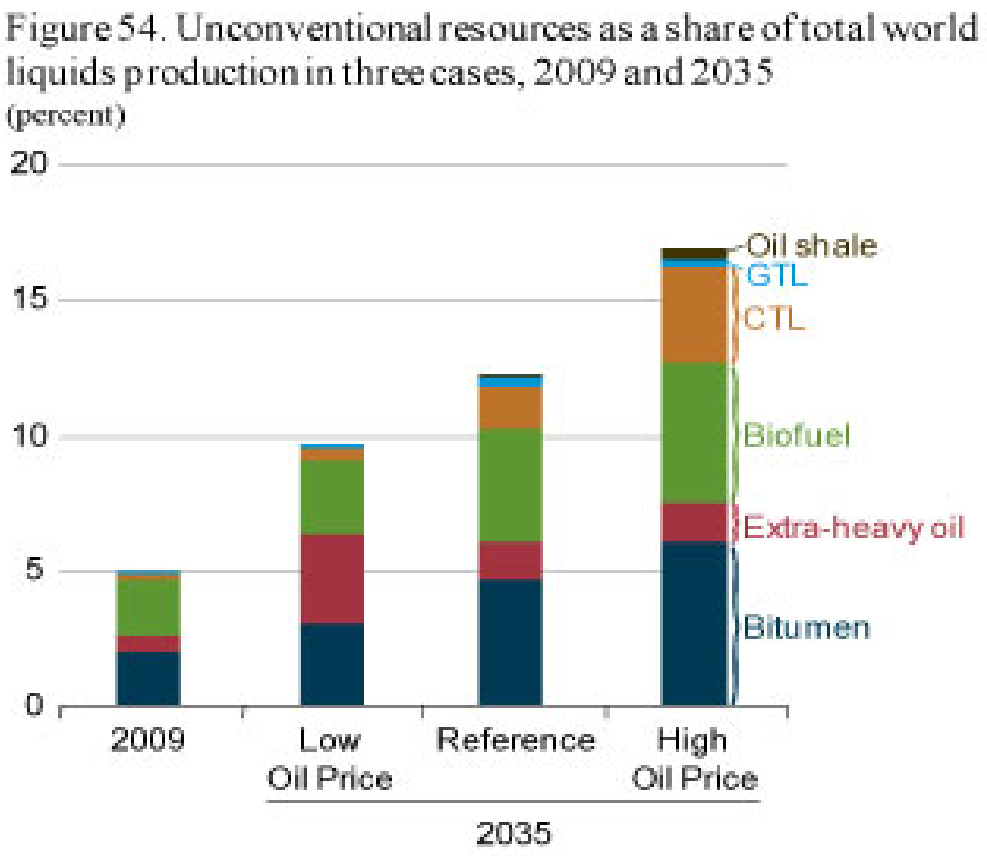


Resource estimates for most of the U.S. outer continental shelf (OCS) are uncertain, particularly for resources in undeveloped regions where there has been little or no exploration and development activity, and modern seismic survey data are lacking. In several recent studies prepared for the U.S. Department of Energy [56] and the National Association of Regulatory Utility Commissioners (NARUC) [57], technically recoverable resources in undeveloped areas of the OCS have been estimated at 2 to 5 times the latest (2006) estimates from the U.S. Department of the Interior's Bureau of Ocean Energy Management.
The *AEO2011* High OCS Resource case assumes a technically recoverable undiscovered crude oil resource base in the Atlantic, Pacific, and Alaska OCS and in areas of the eastern and central Gulf of Mexico (which are currently under a statutory drilling moratorium) that is triple the size of the resource base assumed in the Reference case (Table 6), resulting in a total OCS level of technically recoverable resources of 144.0 billion barrels of crude oil, as compared with 69.3 billion barrels in the Reference case. For natural gas, the High OCS Resource case triples the technically recoverable undiscovered resources in some areas, with the exception of the Alaska OCS. Projected natural gas production from the Alaska OCS is not sensitive to the level of technically undiscovered resources, because natural gas prices are not high enough to support investment in a pipeline to bring natural gas from the North Slope area to market.
The High OCS Cost case assumes that costs for exploration and development of offshore oil and natural gas resources are 30 percent higher than those in the Reference case. The higher cost assumption is not intended to be an estimate of the impact of any new regulatory or safety requirements, but is simply used to illustrate the potential impacts of higher costs on the production of OCS crude oil and natural gas resources.

In 2035, offshore crude oil production in the High OCS Resource case is 51 percent higher, at 3.25 million barrels per day, than the Reference case production level of 2.15 million barrels per day (Figure 30). The majority of the increase (65 percent) is from the Alaska OCS, based on the assumed discovery and development of a large field with 2 billion barrels of recoverable crude oil resources. As a result, total domestic crude oil production in 2035 is 1.05 million barrels per day (18 percent) higher in the High OCS Resource case than in the Reference case. Cumulative total domestic crude oil production from 2010 to 2035 in the High OCS Resource case is only 5 percent higher than in the Reference case.

EIA, Annual Energy Outlook, 2011, http://www.eia.gov/forecasts/aeo/IF_all.cfm#wop

Gains in Global Unconventional Liquids Reduce Increase in Global Demand for Oil Imports



EIA, Annual Energy Outlook, 2011, http://www.eia.gov/forecasts/aeo/MT_intl.cfm

World production of liquid fuels from unconventional resources in 2009 was 4.1 million barrels per day, or about 5 percent of total liquids production. In the *AEO2011* projections, production from unconventional sources grows to about 10.4, 13.5, and 19.4 million barrels per day in 2035 in the Low Oil Price, Reference, and High Oil Price cases, respectively, accounting for about 10, 12, and 17 percent of total world liquids production (Figure 54). countervailing impact of oil prices as a driver of growth.

The factors most likely to affect production levels vary for the different types of unconventional liquid. Price is the most important factor for bitumen production from Canadian oil sands, because the fiscal regime and extraction technologies remain relatively constant, regardless of world oil prices. Production of Venezuela's extra-heavy oil depends more on the prevailing investment environment and the assumed government-imposed levels of economic access to resources in the different price cases.

In the Low Oil Price case, with more foreign investment in extra-heavy oil, production in 2035 climbs to 3.6 million barrels per day. In the Reference and High Oil Price cases, with growing investment restrictions, extra-heavy oil production is limited to 1.5 million barrels per day and 1.7 million barrels per day, respectively, in 2035. Production levels for biofuels, coal-to-liquids (CTL), and gas-to-liquids (GTL) are driven largely by the price level and the extent of the need to compensate for restrictions on economic access to conventional liquid resources in other nations. In the Low Oil Price and High Oil Price cases, production from those three sources in 2035 totals 3.6 million barrels per day and 9.0 million barrels per day, respectively.

Gains in Unconventional Liquids Also Reduce Global US Demand for Oil Imports

Figure 94. U.S. domestic liquids production by source, 2009-2035
(million barrels per day)

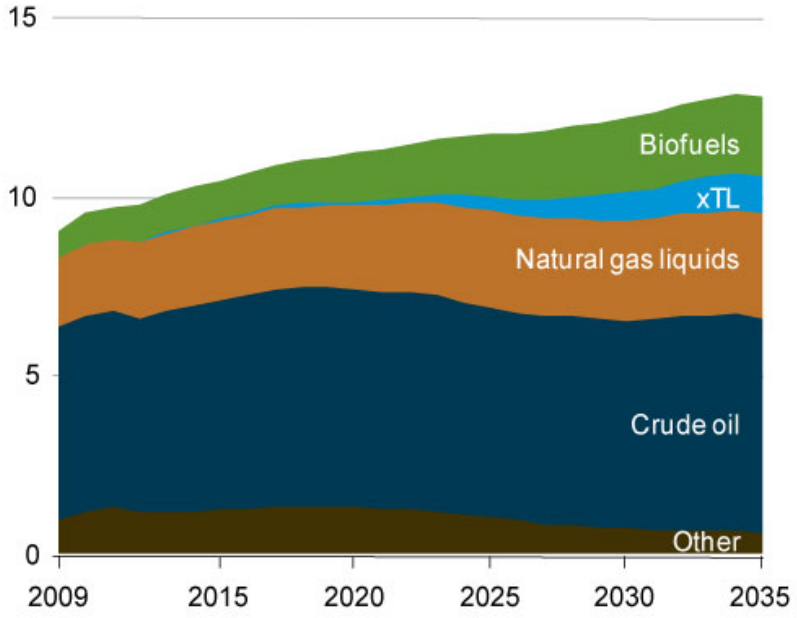
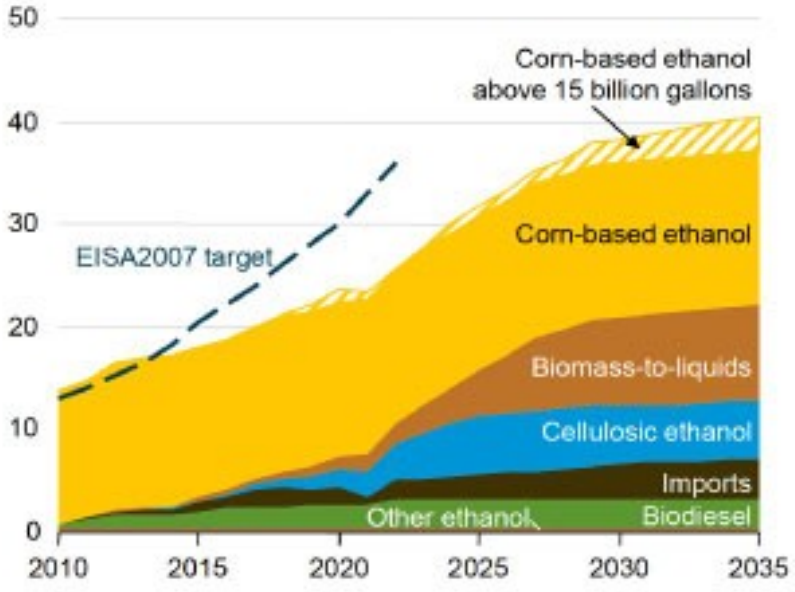


Figure 98. EISA2007 renewable fuels standard, 2010-2035
(billion ethanol equivalent gallons)



As a result of the EISA2007 renewable fuels standard, biofuels production increases by almost 1.5 million barrel per day, with ethanol accounting for the largest share of the increase. Ethanol production increases by more than 800,000 barrels per day from 2009 to 2035, displacing approximately 12 percent of gasoline demand in 2035 on an energy-equivalent basis. In the early years of the projection, ethanol is blended with gasoline and consumed as E10 or E15. By 2035, however, ethanol is consumed in roughly equal shares as E10, E15, and E85.

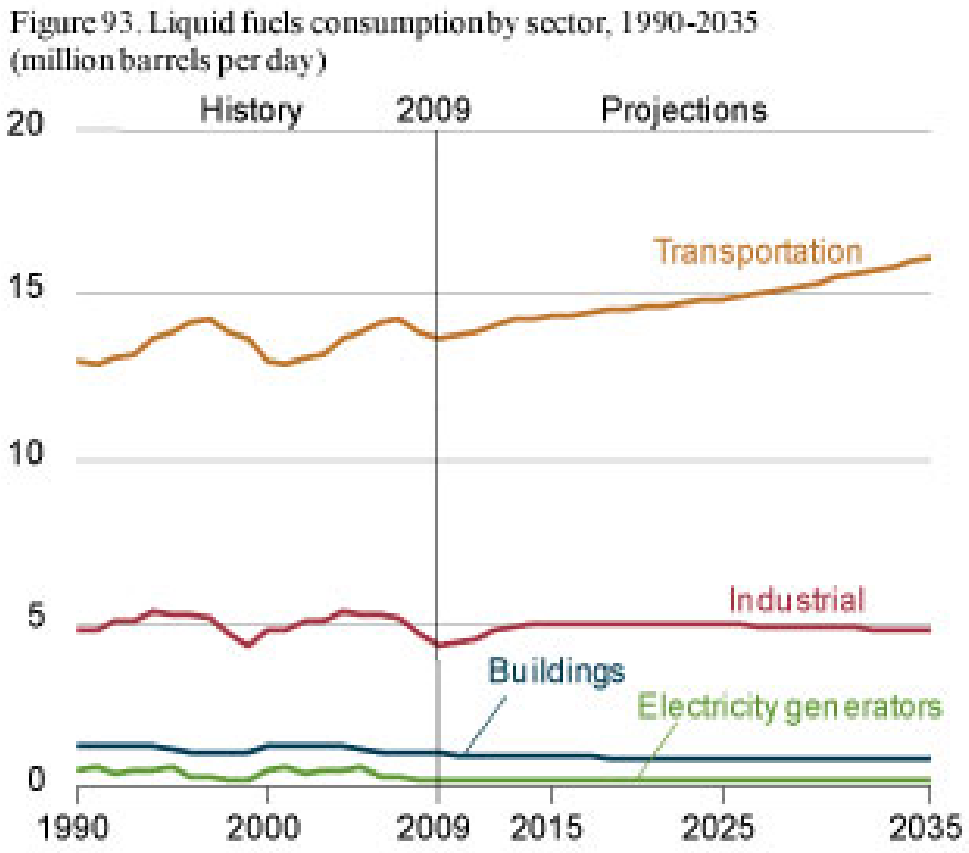
NGL production increases by 1.0 million barrels per day, to 2.9 million barrels per day in 2035, mainly as a result of strong growth in gas shale production, which tends to have relatively large amounts of liquids associated with it. BTL production increases to 516,000 barrels per day, and CTL production increases to 550,000 barrels per day in 2035.

Much of the increased liquids production comes from oil in shale formations (i.e., produced from kerogen, a solid hydrocarbon), CO2-enhanced oil recovery (EOR), and next-generation "xTL" production, which includes biomass-to-liquids (BTL), gas-to-liquids (GTL), and coal-to-liquids (CTL).

EIA, Annual Energy Outlook, 2011, http://www.eia.doe.gov/forecasts/aeo/MT_liquidfuels.cfm

Little Change Will Take Place in the Dependence of the US Transportation Sector on Liquid Fuels

Liquids Remain Critical to US Transportation Sector Well Beyond 2035



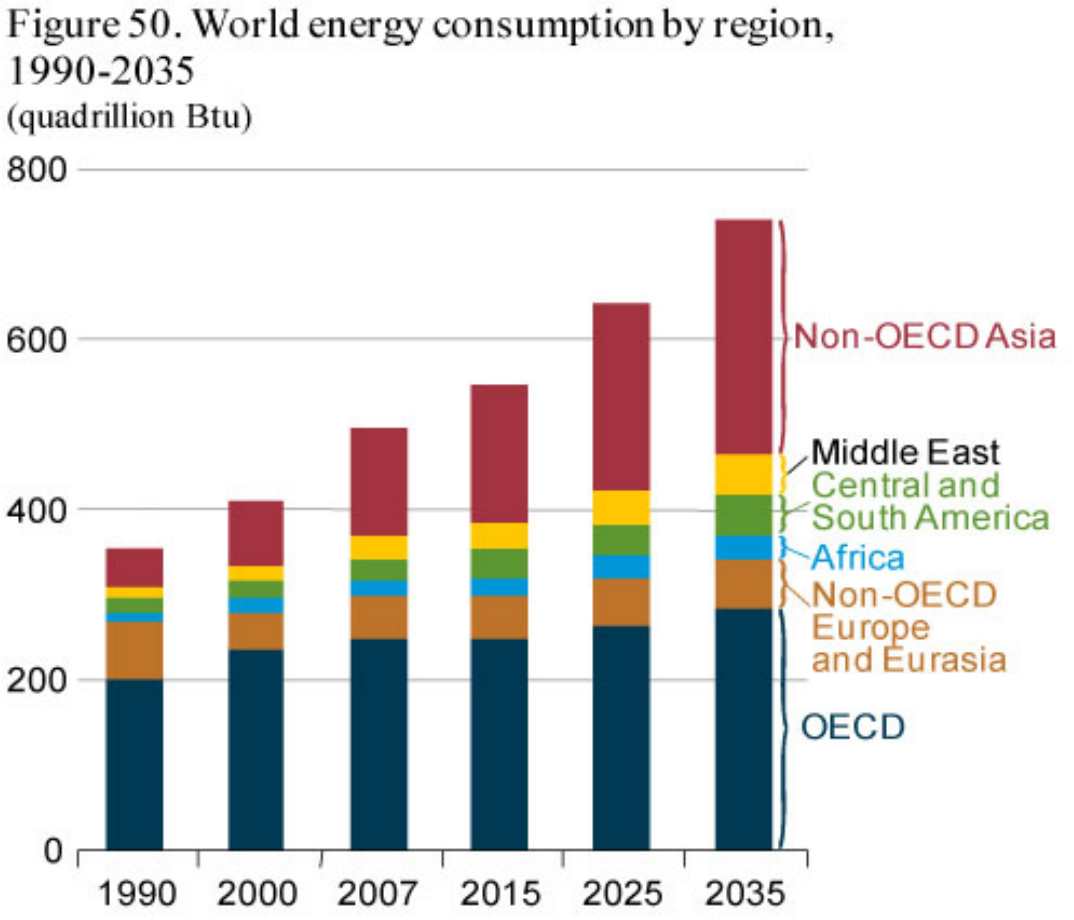
U.S. consumption of liquid fuels—including fuels from petroleum-based sources and, increasingly, those derived from non-petroleum primary fuels such as biomass and natural gas—totals 21.9 million barrels per day in 2035 in the *AEO2011* Reference case, an increase of 2.9 million barrels per day over the 2009 total (Figure 93). In all sectors except transportation, where consumption grows by about 2.5 million barrels per day, liquid fuel consumption remains at about the same level from 2009 to 2035. The transportation sector accounts for 73 percent of total liquid fuels consumption in 2035, up slightly from 71 percent in 2009.

Motor gasoline, ultra-low sulfur diesel, and jet fuel are the primary transportation fuels, supplemented by biofuels such as ethanol and biodiesel. The increase in demand for transportation fuels is met primarily by diesel and biofuels. Motor gasoline consumption increases by approximately 0.3 million barrels per day from 2009 to 2035 in the Reference case, while diesel fuel and E85 consumption increase by 1.3 and 0.8 million barrels per day, respectively, over the period. Biodiesel and a number of next-generation biofuels account for about 0.6 million barrels per day of the increase in liquid fuels consumption for transportation in 2035. The growth in biofuel use is primarily a result of the RFS mandates in EISA2007, although there is moderate production of corn ethanol beyond that which qualifies for RFS credits. The growth in diesel fuel consumption results from both an expansion of light-duty diesel vehicle sales to meet more stringent CAFE standards and an increase in industrial output that leads to more fuel use by heavy trucks.

EIA, Annual Energy Outlook, 2011, http://www.eia.doe.gov/forecasts/aeo/MT_liquidfuels.cfm

Increased Global Demand for Oil will Be Driven by Developing States, Present New Strategic Challenges, and Raise Prices

Developing Nations Make Massive Increases in Energy Use



EIA's *International Energy Outlook* shows world marketed energy consumption increasing strongly over the projection period, rising by nearly 50 percent from 2009 through 2035 (Figure 50). Most of the growth occurs in emerging economies outside the Organization for Economic Cooperation and Development (non-OECD), especially in non-OECD Asia. Total non-OECD energy use increases by 84 percent in the Reference case, compared with a 14-percent increase in the developed OECD nations.

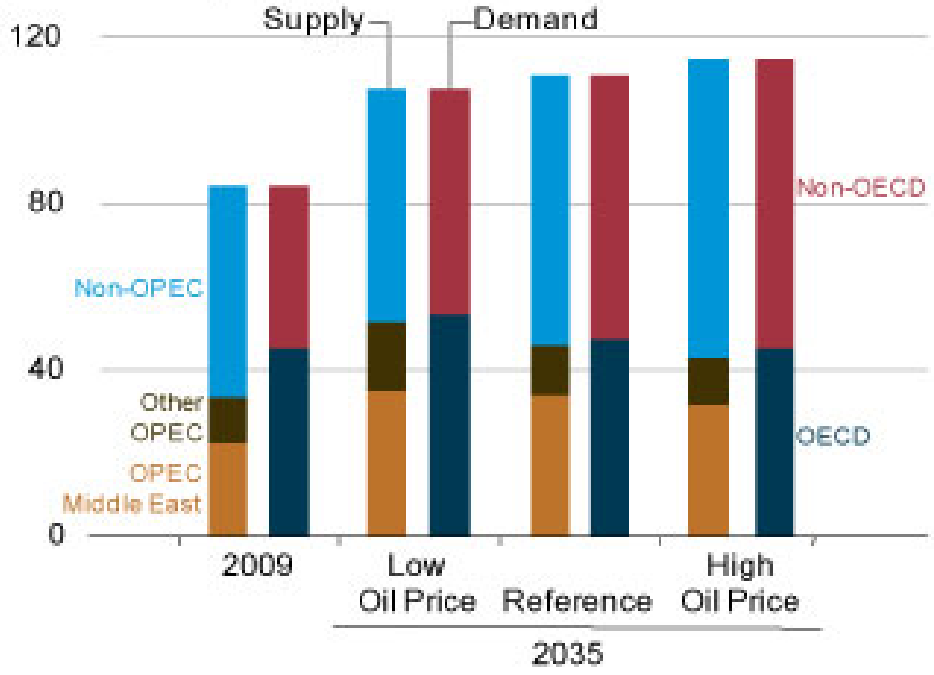
Energy use in non-OECD Asia, led by China and India, shows the most robust growth among the non-OECD regions, rising by 118 percent over the projection period. However, strong growth is also projected for much of the rest of the non-OECD regions: 82 percent growth in the Middle East, 63 percent in Africa, and 63 percent in Central and South America. The slowest growth among the non-OECD regions is projected for non-OECD Europe and Eurasia (including Russia), where substantial gains in energy efficiency are achieved through replacement of inefficient Soviet-era capital equipment.

Worldwide, the use of energy from all sources increases over the projection. Given expectations that oil prices will remain relatively high, petroleum and other liquids are the world's slowest-growing energy sources. High energy prices and concerns about the environmental consequences of greenhouse gas emissions lead a number of national governments to provide incentives in support of the development of alternative energy sources, making renewables the world's fastest-growing source of energy in the outlook.

EIA, Annual Energy Outlook, 2011, http://www.eia.gov/forecasts/aeo/MT_intl.cfm

And, Developing Nations Push Demand for Oil Imports

Figure 53. World liquids supply and demand by region in three cases, 2009 and 2035
(million barrels per day)



EIA, Annual Energy Outlook, 2011, http://www.eia.gov/forecasts/aeo/MT_intl.cfm

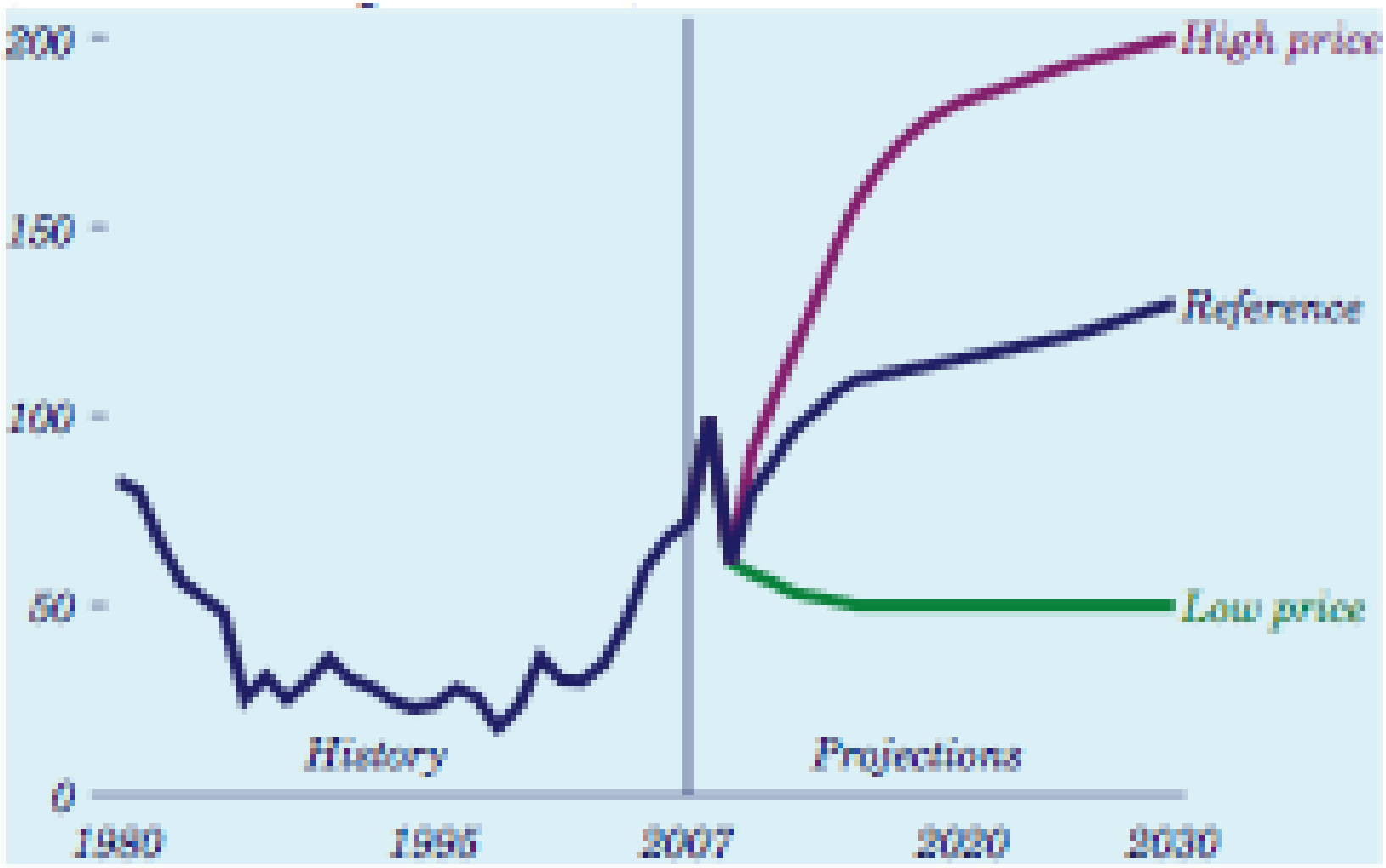
Total use of liquids is similar in the Reference, High Oil Price, and Low Oil Price cases, ranging from 108 to 115 million barrels per day in 2035, respectively. This occurs because the alternative oil price cases reflect a shifting of both supply and demand, with a resulting consumption and production level that is similar. Although total GDP growth in the OECD countries is assumed to be the same in all three cases, non-OECD GDP growth is lower in the Low Oil Price case and higher in the High Oil Price case, changing the shares of global liquids use by OECD and non-OECD countries among the three cases (Figure 53). Thus the cases reflect a future where the impact of income growth as a demand driver of oil prices overwhelms any countervailing impact of oil prices as a driver of growth.

In the Reference case, OECD liquids use grows to 47.9 million barrels per day, while non-OECD liquids use grows to 62.9 million barrels per day, in 2035. In the Low Oil Price case, OECD liquids use in 2035 is higher than in the Reference case, whereas non-OECD use is lower. In the High Oil Price case, OECD use falls to 53.1 million barrels per day in 2035. In contrast, non-OECD use, driven by higher GDP growth, increases to nearly 70 million barrels per day in 2035. Non-OECD Asia and the Middle East account for most of the difference from the Reference case, but liquids use in Central and South America in 2035 is also 1.1 million barrels per day higher than in the Reference case.

Total liquids production is nearly identical in the Reference and High Oil Price cases, with the most significant difference coming from increased unconventional production in the High Oil Price case as some advanced production technologies become economical. In the Low Oil Price case, lower demand and lower prices shutter more expensive conventional liquids projects and reduce unconventional liquids production.

Price Estimates Highlight Need to Recycle Petroleum Dollars

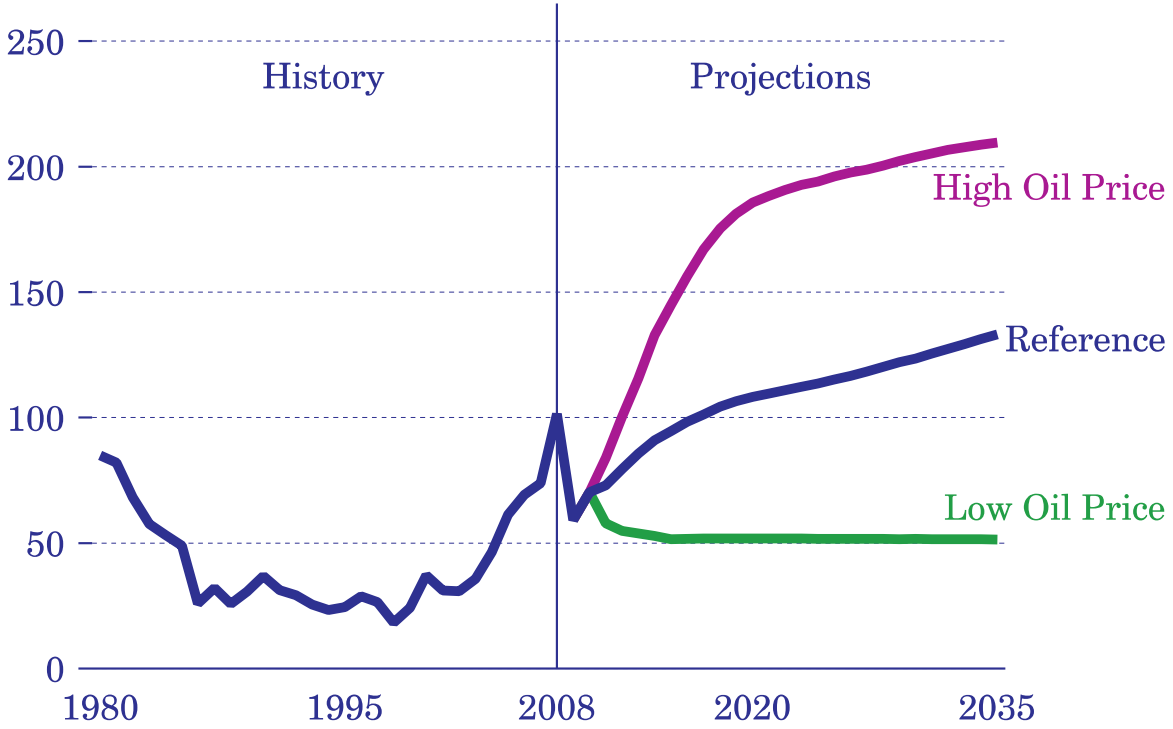
EIA Estimates of Future World Oil Prices (2009 Estimate)



Source: EIA-IEO 2009

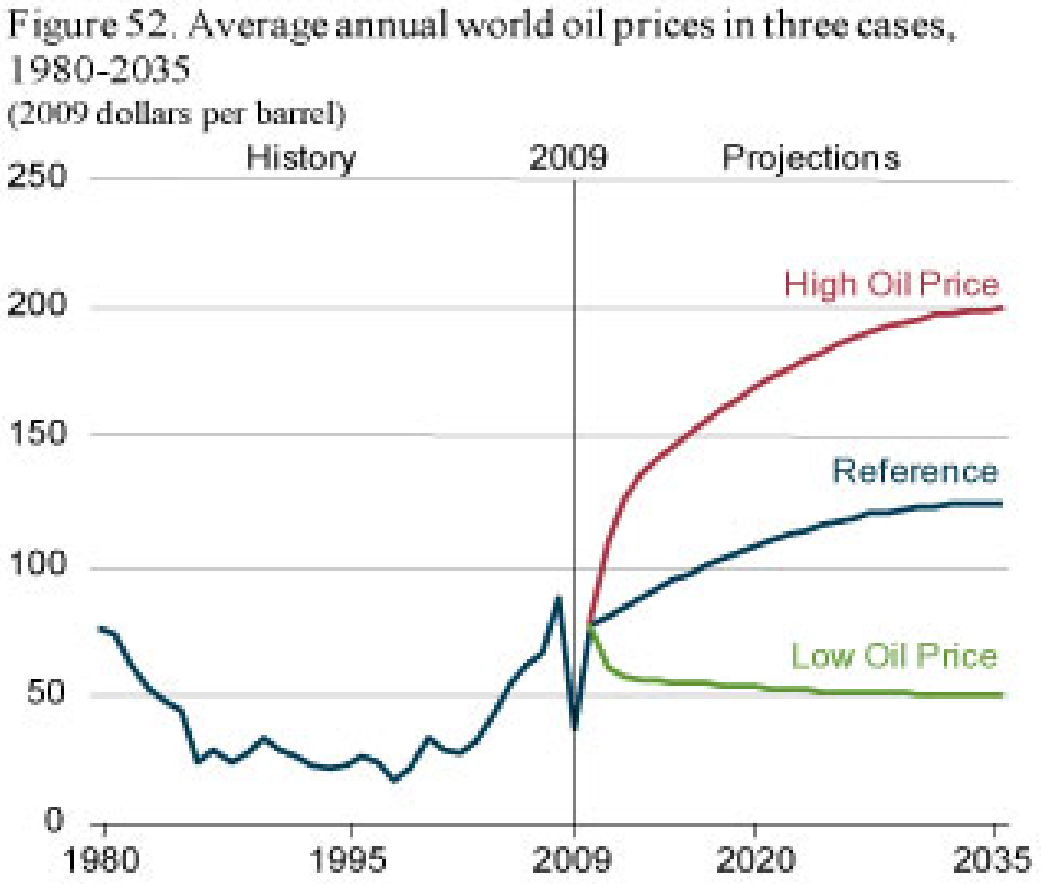
EIA Estimates of Future World Oil Prices (2010 Estimate)

Figure 16. Average annual world oil prices in three cases, 1980-2035 (2008 dollars per barrel)



Source: EIA-IEO 2010, p. 28

Oil Price Projections in 2011 are Driven by Increased Demand from Developing World



The Reference case assumes a continuation of current trends in terms of economic access to non-OPEC resources, the OPEC market share of world production, and global economic growth.

The High Oil Price case depicts a world oil market in which total GDP growth in the non-OECD countries is faster than in the Reference case, driving up demand for liquids. On the supply side, conventional production is more restricted by political decisions and limits on economic access to resources (e.g., use of quotas, fiscal regimes, and other approaches that restrict access) compared to the Reference case. Oil production in the major producing countries is reduced (e.g., OPEC share falls to 37 percent), and the consuming countries turn to high-cost unconventional liquids production to satisfy demand.

In the Low Oil Price case, GDP growth in non-OPEC countries is slower than in the Reference case, resulting in lower demand for liquids. Regarding supply, producing countries develop stable fiscal policies and investment regimes directed at encouraging development of their resources. OPEC nations increase production, achieving approximately a 48-percent market share of total liquids production by 2035, up from approximately 40 percent in 2009.

EIA, Annual Energy Outlook, 2011, http://www.eia.gov/forecasts/aeo/MT_intl.cfm