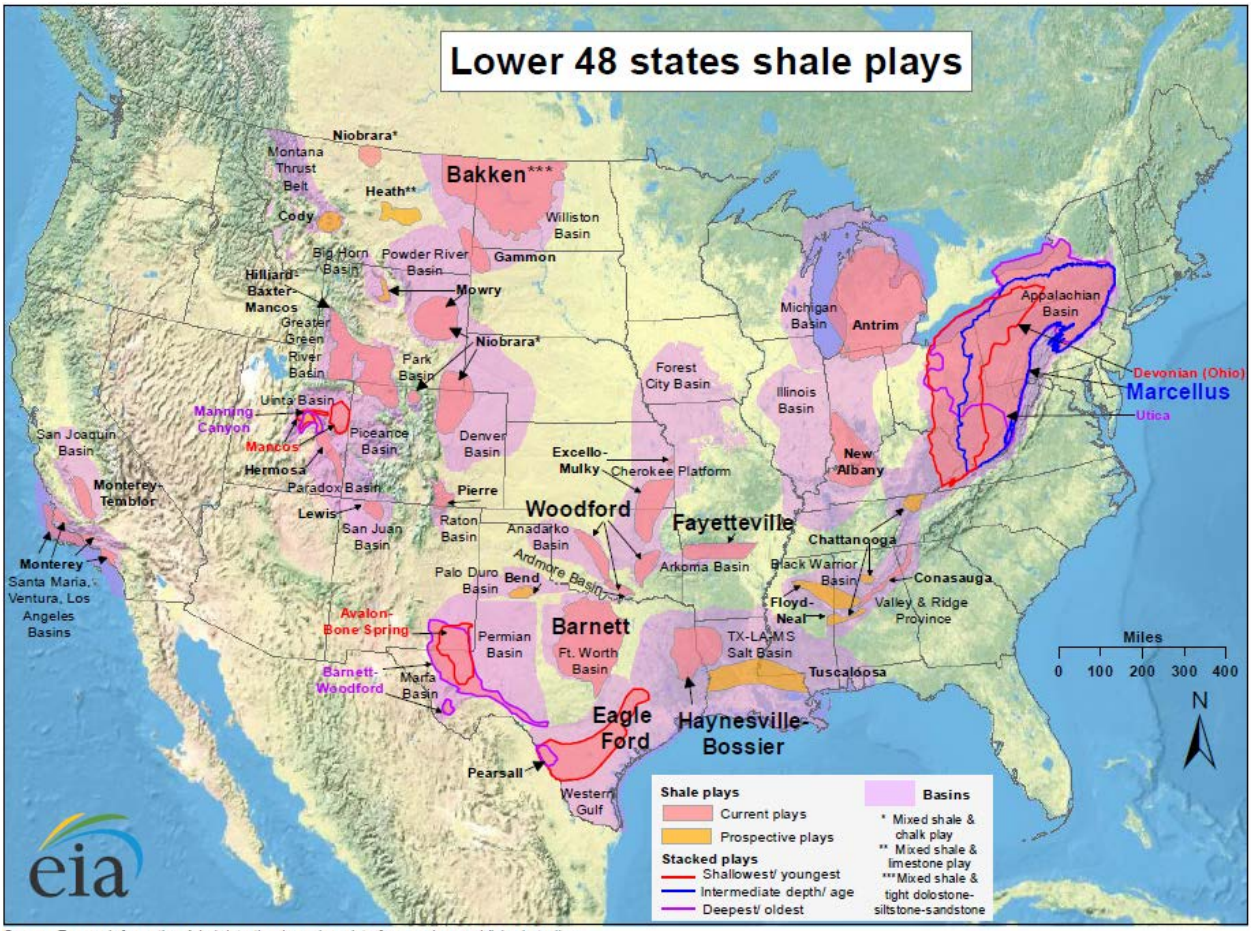
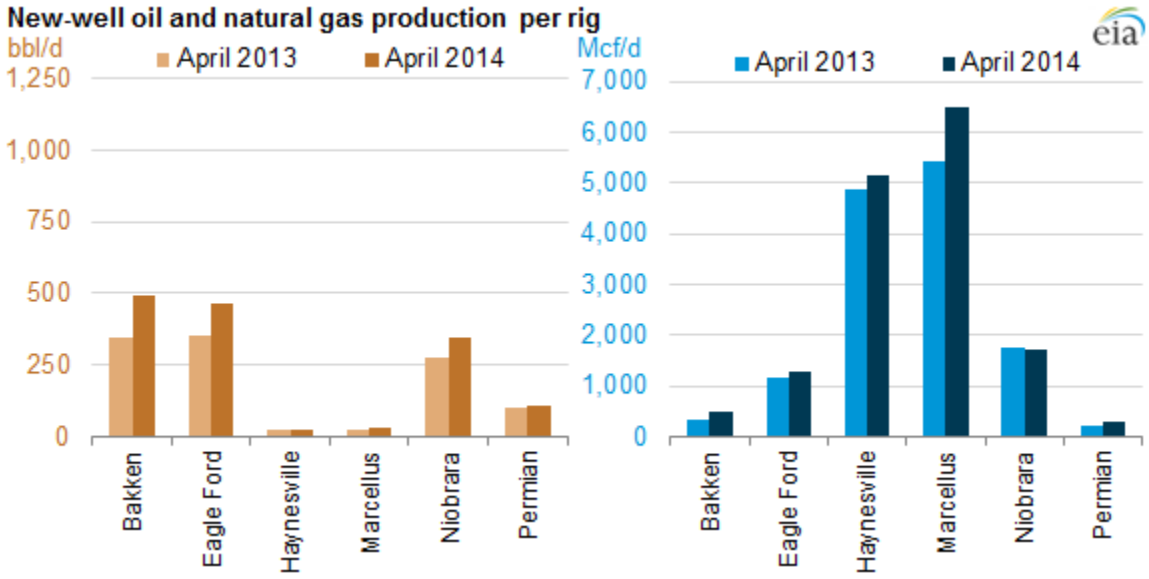


Source: Energy Information Administration based on data from various published studies.
Updated: May 9, 2011

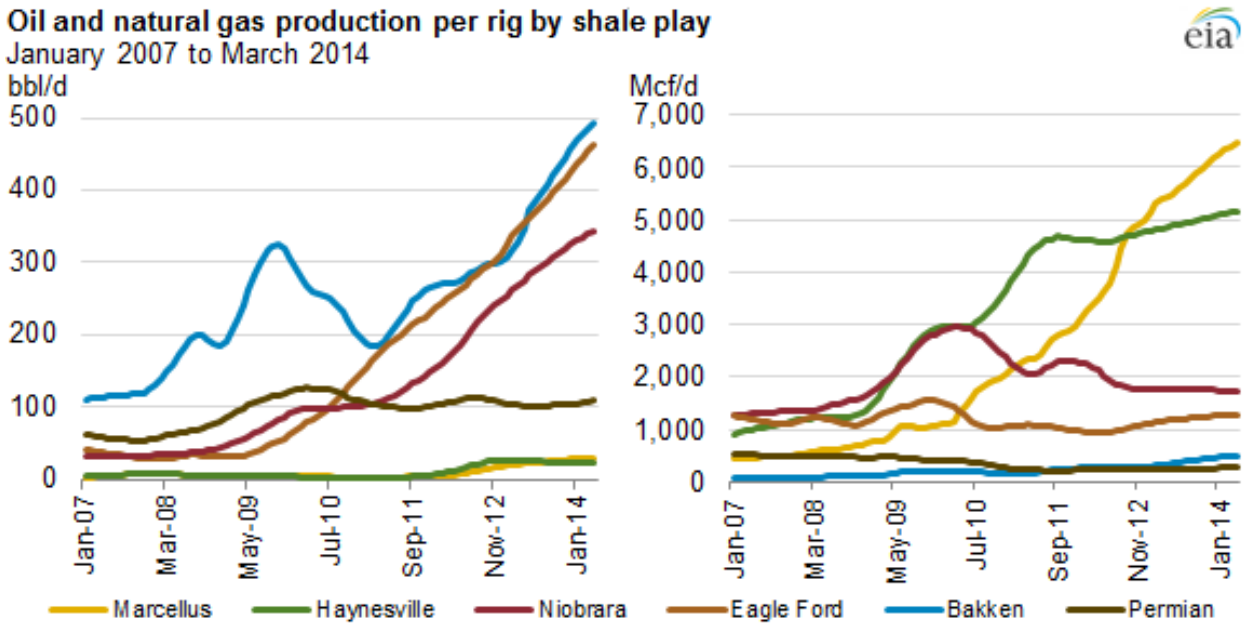


The productivity of oil and natural gas wells is steadily increasing in many basins across the United States because of the increasing precision and efficiency of horizontal drilling and hydraulic fracturing in oil and natural gas extraction.

Many resource-producing basins are experiencing an increasing yield over time in either oil (Bakken, Eagle Ford, Niobrara) or natural gas (Marcellus, Haynesville).

The geology of each oil and natural gas resource play is diverse, and individual rig or well performance can vary dramatically. However, drilling activity in U.S. shale plays is now generally producing greater quantities of oil and/or natural gas than in the past.

As noted in March's productivity report, five of the six U.S. shale plays tracked by the DPR have seen increases in oil and natural gas production per rig over the past few years. According to EIA's March DPR, the Eagle Ford Shale is leading in increased production of oil per rig, and the Marcellus Shale is leading in increased production of natural gas per rig.



Source: U.S. Energy Information Administration, March 2014 Drilling Productivity Report

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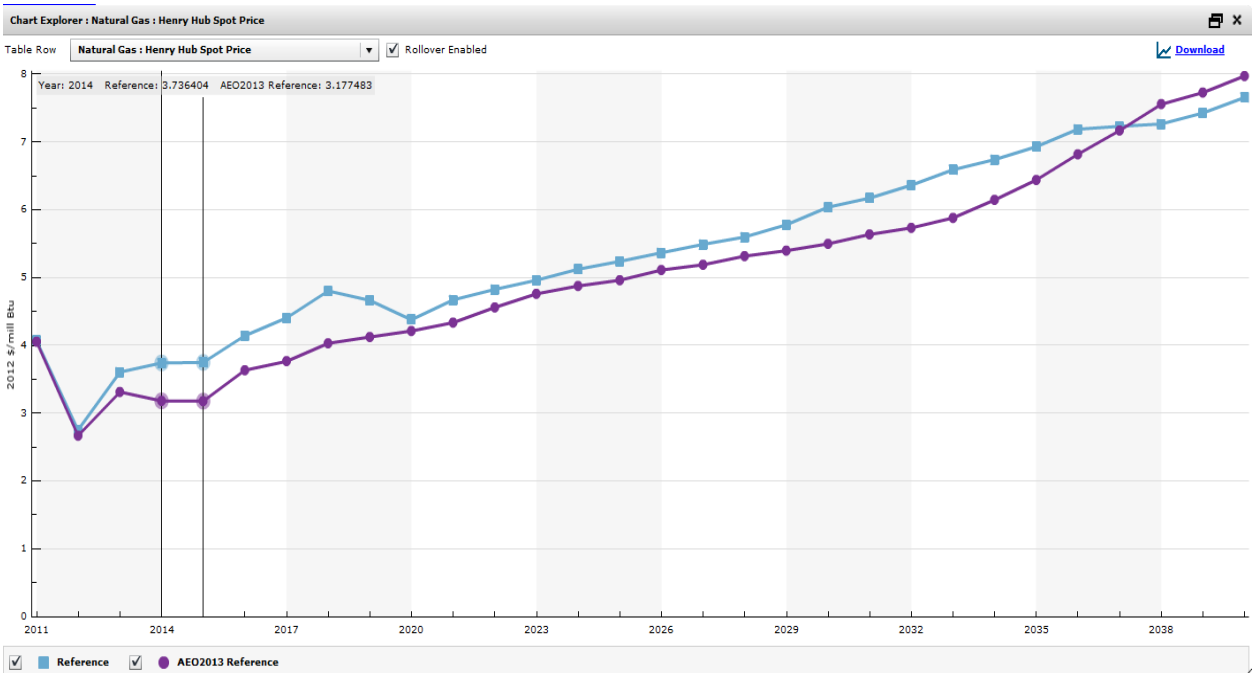
DPR data show that each drilling rig in the Eagle Ford Shale will contribute over 400 barrels of oil per day (bbl/d) more in April 2014 than it would have in the same formation in January 2007. At the same time, the DPR also shows that a Marcellus Shale well completed by a rig in April 2014 can be expected to yield over 6 million cubic feet of natural gas per day (Mcf/d) more than a well completed by that rig in that formation in 2007.

This trend of increasing rig productivity is one factor helping to increase the nation's oil and natural gas production. The latest Annual Energy Outlook forecasts that U.S. oil production will reach 9.6 million barrels per day in 2019, and natural gas production will increase by 56% through 2040.

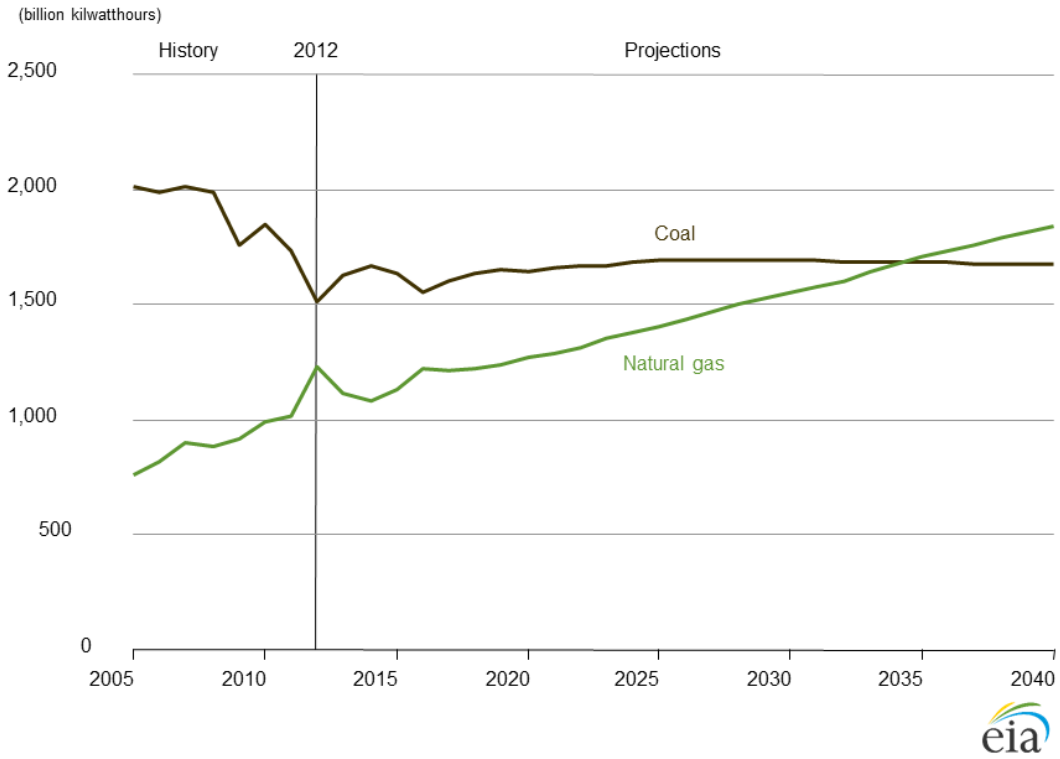
Natural gas spot prices (Henry Hub)

eia Source: Natural Gas Intelligence



Natural gas overtakes coal to provide the largest share of U.S. electric power generation

Figure 3. Electricity generation from natural gas and coal, 2005-2040



Projected low prices for natural gas make it a very attractive fuel for new generating capacity. In some areas, natural gas-fired generation replaces generation formerly supplied by coal and nuclear plants. In 2040, natural gas accounts for 35% of total electricity generation, while coal accounts for 32% (Figure 3).

Generation from renewable fuels, unlike coal and nuclear power, is higher in the *AEO2014* Reference case than in *AEO2013*. Electric power generation with renewables is bolstered by legislation enacted at the beginning of 2013 extending tax credits for various renewable technologies; which was passed after the *AEO2013* Reference case had been completed, but was considered in an alternative case in *AEO2013*. The full *AEO2014* will include a variety of cases addressing the implications of alternative market conditions and policies for the electricity generation mix.

Higher natural gas production also supports increases in exports of both pipeline and liquefied natural gas

U.S. exports of liquefied natural gas (LNG) increase to 3.5 Tcf in 2029 and remain at that level through 2040.

Pipeline exports of U.S. natural gas to Mexico grow by 6% per year, from 0.6 Tcf in 2012 to 3.1 Tcf in 2040, and pipeline exports to Canada grow by 1.2% per year, from 1.0 Tcf in 2012 to 1.4 Tcf in 2040.

Over the same period, U.S. pipeline imports from Canada fall by 30%, from 3.0 Tcf in 2012 to 2.1 Tcf in 2040, as more U.S. demand is met by domestic production.

Projected exports are sensitive to assumptions regarding conditions in U.S. and global natural gas markets. The full *AEO2014* will include cases that illustrate the sensitivity of projected natural gas exports to alternative resource, economic, and price scenarios.

Figure 4. U.S. natural gas imports and exports, 2000-40

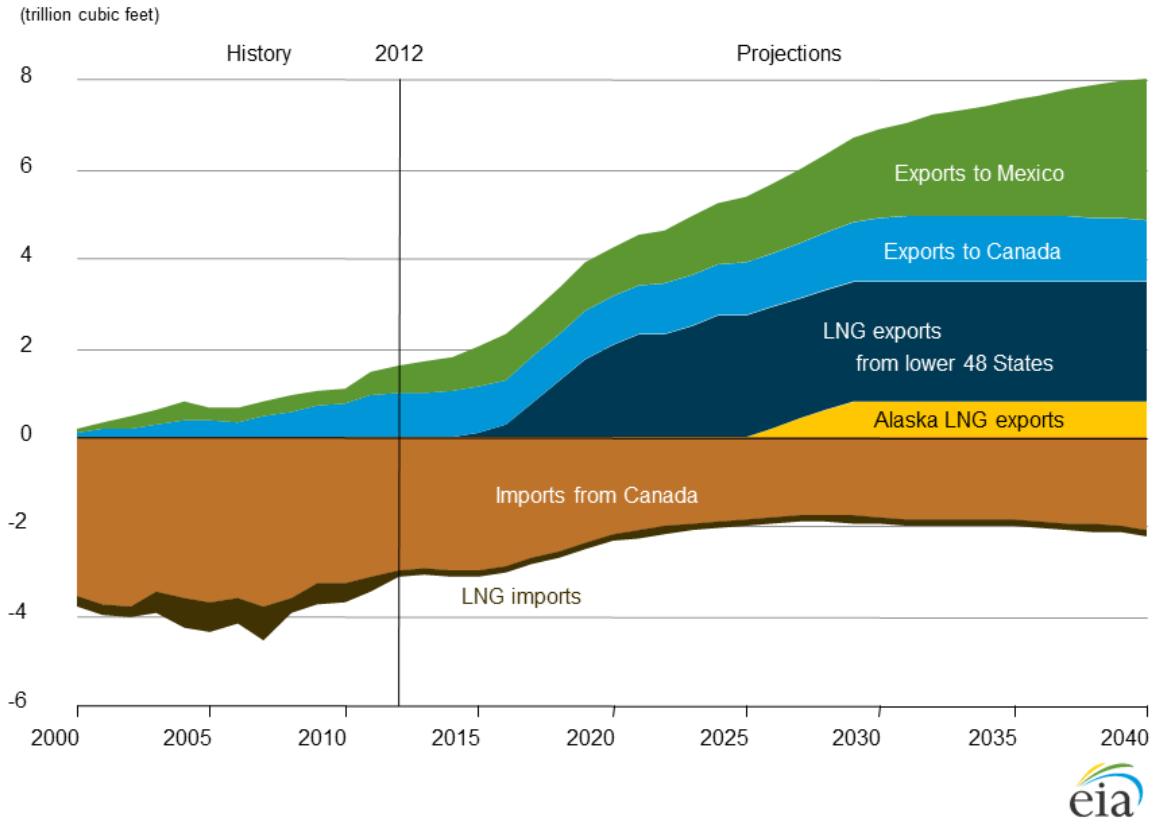


figure data

Feb 11 (Reuters) - The U.S. Energy Department on Tuesday approved exports from Sempra Energy's Cameron liquefied natural gas (LNG) project in Louisiana as the Obama administration moves forward with its goal of expanding the global market for the fuel.

The conditional approval of exports from the terminal to countries with which the United States does not have free trade agreements, such as India and Japan, was the sixth approval by the department since 2011, and the first since mid-November.

Cameron's application to export up to 1.7 billion cubic feet per day brings total U.S. authorized LNG exports to almost 8.5 bcf feet per day, once the terminals are constructed and working at full capacity.

With strong growth in domestic crude oil and natural gas production, U.S. use of imported fuels falls sharply

In the *AEO2014* Reference case, U.S. domestic energy production increases from 79.1 quadrillion Btu in 2012 to 102.1 quadrillion Btu in 2040, and net use of imported energy sources, which was 30% in 2005, falls from 16% of total consumption in 2012 to 4% in 2040. In the *AEO2013* Reference case, domestic energy production reached a total of 98.5 quadrillion Btu, and energy imports is projected to decline as a percentage of consumption to 9% in 2040. The larger increase in domestic energy production in *AEO2014* is primarily a result of higher projections of production of natural gas and biomass/other renewables. Crude oil production (including lease condensate) increases from 13.9 quadrillion Btu in 2012 to a peak of 20.5 quadrillion Btu in 2019 before dropping to 16.0 quadrillion Btu in 2040.

With domestic crude oil production rising to 9.5 MMbbl/d in 2016, the import share of U.S. petroleum and other liquids supply falls to about 25%. Domestic production begins to decline after 2019, and the import share of total petroleum and other liquids supply grows to 32% in 2040, still lower than the 2040 level of 37% in the *AEO2013* Reference case. The alternative cases in the full *AEO2014* will illustrate how different assumptions about resources, markets, and policies can dramatically impact projections of import dependence.

Improved efficiency of energy use in the residential and transportation sectors and a shift away from carbon-intensive fuels for electricity generation keep U.S. energy-related carbon dioxide emissions below their 2005 level through 2040

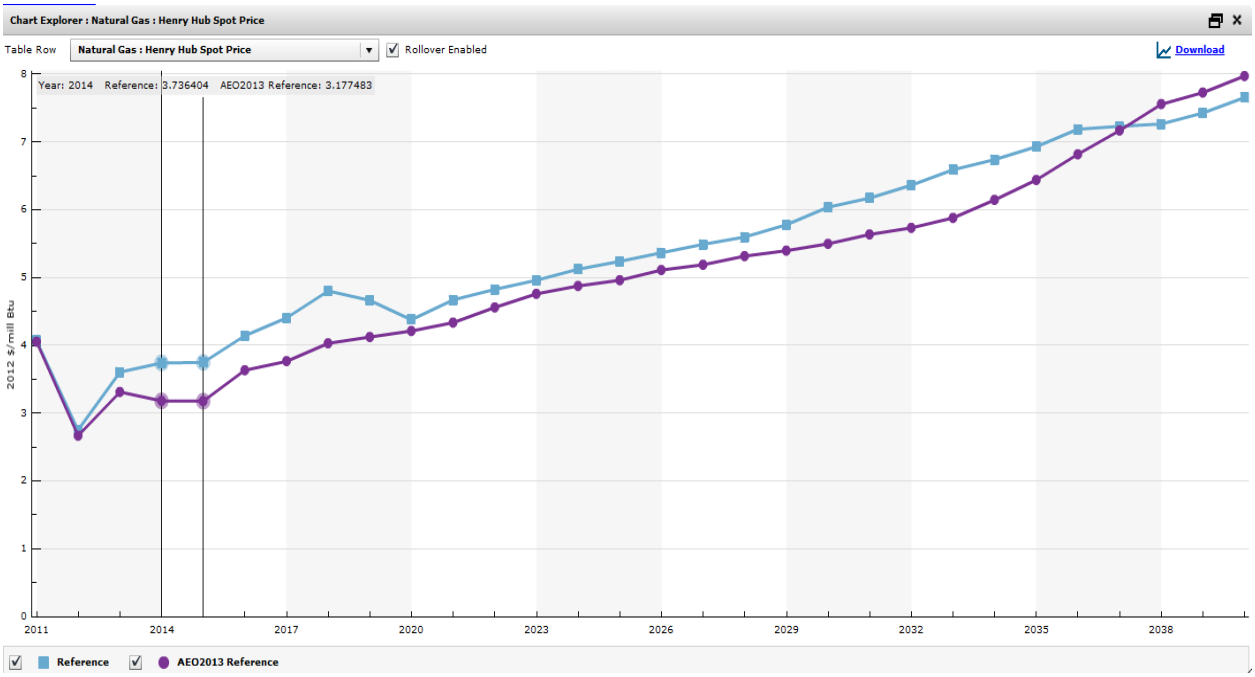
In the *AEO2014* Reference case, total U.S. energy-related emissions of carbon dioxide (CO_2) remain below the 2005 level in every year through 2040. Projected emissions in 2020 and 2040 are, respectively, about 9% and 7% below the 2005 level.

In *AEO2014*, CO_2 emissions associated with U.S. industrial activity (including CO_2 emissions associated with the generation of electricity used in the industrial sector) begin to surpass emissions from the transportation sector in the middle of the next decade for the first time since the late 1990s. In the transportation sector, as a result of new fuel economy standards, biofuel mandates, and shifts in consumer behavior, emissions from transportation sector use of petroleum and other liquids generally decline or remain stable from 2012 through 2040. Emissions

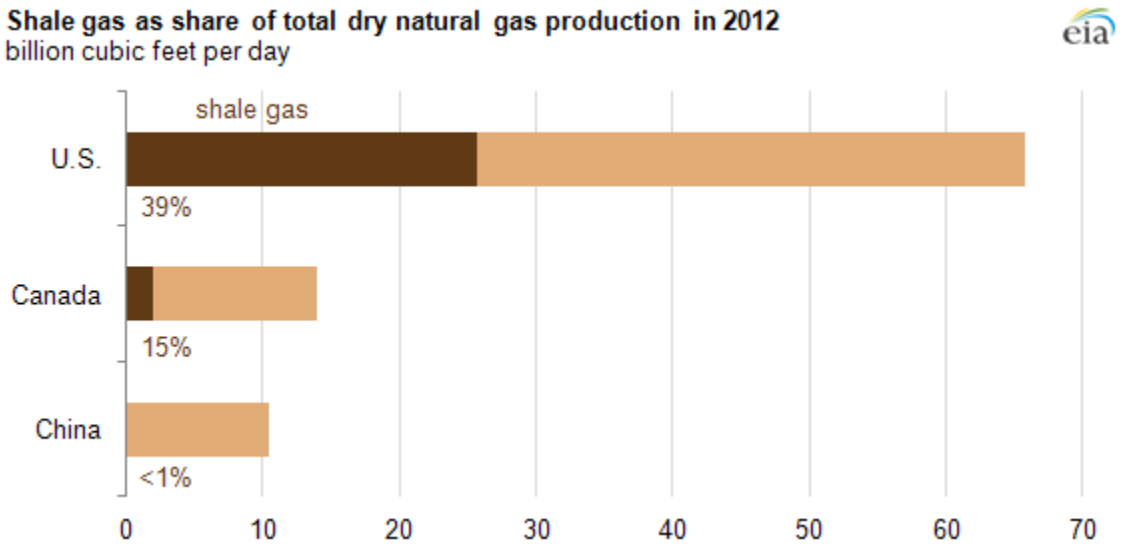
from energy use in the commercial sector increase more rapidly than in the residential sector, and in 2040 emissions from these two sectors are about equal. In the electric power sector, CO_2 emissions from coal combustion decline after 2029 as more power plants are fueled by lower-carbon fuels, including natural gas and renewables. However, the lower level of CO_2 emissions in the electric power sector because of the reduced role for coal is partially offset by less projected generation from nuclear power. Generation from nuclear power in *AEO2014* is 10% below levels in *AEO2013* in 2040 as a result of increased nuclear plant retirements.

Projected growth in real gross domestic product is slightly slower than in *AEO2013*, but projected per capita GDP and disposable income are higher than in *AEO2013* because of a reduced projection for U.S. population growth

Annual growth of real gross domestic product (GDP) from 2012 to 2040 averages 2.4% in the *AEO2014* Reference case, slightly below the *AEO2013* Reference case growth rate over the same period. However, industrial output growth is higher in *AEO2014*, averaging 2.1% per year from 2012 to 2040. Industries that supply equipment for increased natural gas production, as well as industries benefitting from lower natural gas prices, account for much of the higher growth in manufacturing. On a per capita basis, projected annual growth rates for real GDP and disposable income in *AEO2014*, both averaging 1.7% per year, are above the comparable rates in *AEO2013*, reflecting lower projected population growth rate estimates (0.7% in *AEO2014* compared to 0.9% in *AEO2013*) for the 2012-40 period provided by the U.S. Census Bureau.



North America leads the world in production of shale gas



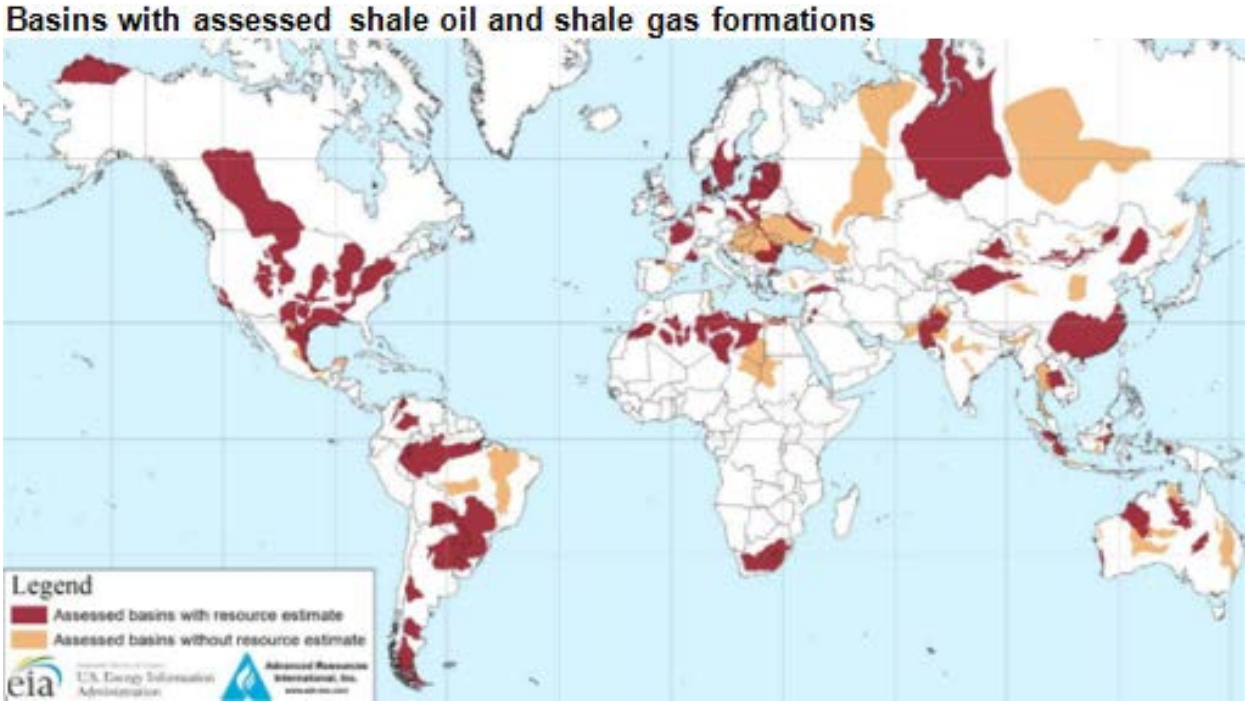
Source: U.S. Energy Information Administration, LCI Energy Insight, Canada National Energy Board, and Facts Global Energy
Note: Canadian data uses "marketable production," which is comparable to dry production.

The United States and Canada are the only major producers of commercially viable natural gas from shale formations in the world, even though about a dozen other countries have conducted exploratory test wells, according to a joint U.S. Energy Information Administration (EIA)/Advanced Resources International (ARI) study released in June. China is the only nation outside of North America that has registered commercially viable production of shale gas, although the volumes contribute less than 1% of the total natural gas production in that country. In comparison, shale gas as a share of total natural gas production in 2012 was 39% in the United States and 15% in Canada.

Shale gas dry production in the United States averaged 25.7 billion cubic feet per day (Bcf/d) in 2012, while total dry production averaged 65.7 Bcf/d. In Canada, total dry natural gas production from the two major shale plays—the Muskwa-Otter Park shale formation in the Horn River Basin of northern British Columbia and the adjacent Montney Basin that spreads over British Columbia and Alberta—averaged 2.0 Bcf/d in 2012, while total Canadian production averaged 14.0 Bcf/d. Gross withdrawals from Horn River and Montney averaged 2.5 Bcf/d in 2012, and reached 2.8 Bcf/d by May 2013. The potential for higher production from these two plays is currently constrained by limited pipeline infrastructure.

January 2, 2014

Shale oil and shale gas resources are globally abundant



Source: U.S. basins from U.S. Energy Information Administration and United States Geological Survey; other basins from Advanced Resources International (ARI) based on data from various published studies.
Note: Click to enlarge.

Estimated shale oil and shale gas resources in the United States and in 137 shale formations in 41 other countries represent 10% of the world's crude oil and 32% of the world's natural gas technically recoverable resources,

or those that can be produced using current technology without reference to economic profitability, according to a new EIA-sponsored study (see Table 1) released today (June 10, 2013).

Table 1. Technically recoverable shale oil and shale gas resources in the context of total world resources

	Crude oil (billion barrels)	Wet natural gas (trillion cubic feet)
Outside the United States		
Shale oil and shale gas[1]	287	6,634
Non-shale[2]	2,847	13,817
Total	**3,134**	**20,451**
Increase in total resources due to inclusion of shale oil and shale gas	**10%**	**48%**
Shale as a percent of total	**9%**	**32%**
United States[3]		
Shale / tight oil and shale gas	58	665
Non-shale	164	1,766
Total	**223**	**2,431**
Increase in total resources due to inclusion of shale oil and shale gas	**35%**	**38%**
Shale as a percent of total	**26%**	**27%**
Total World		
Shale / tight oil and shale gas	345	7,299
Non-shale	3,012	15,583
Total	**3,357**	**22,882**
Increase in total resources due to inclusion of shale oil and shale gas	**11%**	**47%**
Shale as a percent of total	**10%**	**32%**

[1] Advanced Resources International, Inc. (ARI) 2013.

[2] *Oil & Gas Journal*, Worldwide Report, December 3, 2012; U.S. Geological Survey, An Estimate of Undiscovered Conventional Oil and Gas Resources of the World, 2012, Fact Sheet 2012-3028, March 2012; U.S. Geological Survey, Assessment of Potential Additions to Conventional Oil and Gas Resources of the World (Outside the United States) from Reserve Growth, 2012, Fact Sheet 2012-3052, April 2012.

[3] U.S. Energy Information Administration, various reports.

More than half of the identified shale oil resources outside the United States are concentrated in four countries—Russia, China, Argentina, and Libya—while more than half of the non-U.S. shale gas resources are concentrated in five countries—China, Argentina, Algeria, Canada, and Mexico. The United States is ranked second after Russia for shale oil resources and fourth after Algeria for shale gas resources when compared with the 41 countries assessed (see Tables 2 & 3).

Table 2. Top 10 countries with technically recoverable shale oil resources

Rank	Country	Shale oil (billion barrels)	
1	Russia	75	
2	U.S.[1]	58	(48)
3	China	32	
4	Argentina	27	
5	Libya	26	
6	Australia	18	
7	Venezuela	13	
8	Mexico	13	
9	Pakistan	9	
10	Canada	9	
	World Total	**345**	**(335)**

[1] EIA estimates used for ranking order. ARI estimates in parentheses.

Table 3. Top 10 countries with technically recoverable shale gas resources

Rank	Country	Shale gas (trillion cubic feet)	
1	China	1,115	
2	Argentina	802	
3	Algeria	707	
4	U.S.[1]	665	(1,161)
5	Canada	573	
6	Mexico	545	
7	Australia	437	
8	South Africa	390	
9	Russia	285	
10	Brazil	245	
	World Total	**7,299**	**(7,795)**

[1] EIA estimates used for ranking order. ARI estimates in parentheses.

Technically Recoverable Shale Oil and Shale Gas Resources estimates that shale resources considered in conjunction with EIA's own assessment of resources within the United States indicate technically recoverable resources of 345 billion barrels of world shale oil resources and 7,299 trillion cubic feet of world shale gas resources (see Table 1). While the current report considers more shale formations than were assessed in the prior version of this assessment, it still does not assess many prospective shale formations, such as those underlying the large oil fields located in the Middle East and the Caspian region. Currently, only the United States and Canada are producing shale oil and shale gas in commercial quantities.

Unlike an earlier EIA-sponsored study that focused exclusively on natural gas, the new world shale assessment includes shale oil, which has recently been produced in significant volumes in the United States. In addition, more and better geologic information has become available for shale formations located outside the United States, in part because the earlier report stimulated new work on shale resources in many countries (e.g., Algeria, Argentina, and Mexico).

These shale oil and shale gas resource estimates are highly uncertain and will remain so until they are extensively tested with production wells. This report's methodology for estimating the shale resources outside the United States is based on the geology and resource recovery rates of similar shale formations in the United States (referred to as analogs) that have produced shale oil and shale gas from thousands of producing wells.

Because they have proven to be quickly producible in large volumes at a relatively low cost, shale / tight oil and shale gas resources have revolutionized U.S. oil and natural gas production, providing 29 percent of total U.S. crude oil production and 40 percent of total U.S. natural gas production in 2012. However, given the variation across the world's shale formations in both geology and above-the-ground conditions, the extent to which global technically recoverable shale resources will prove to be economically recoverable is not yet clear. The market impact of shale resources outside the United States will depend on their own production costs and volumes. For example, a potential shale well that costs twice as much and produces half the output of a typical U.S. well would be unlikely to back out current supply sources of oil or natural gas. In many cases, even significantly smaller differences in costs, well productivity, or both can make the difference between a resource that is a market game changer and one that is economically irrelevant at current market prices.

Several nations have begun to evaluate and test the production potential of shale formations located in their countries. Poland, for example, has leased prospective shale acreage and drilled 43 test wells as of April 2013. Argentina, Australia, China, England, Mexico, Russia, Saudi Arabia, and Turkey have begun exploration or expressed interest in their shale formations.

Tags: international , liquid fuels , natural gas , oil/petroleum , production , shale