No. ID-040

OFFICE OF INDUSTRIES WORKING PAPER

U.S. International Trade Commission

PRODUCTION INCREASES FROM SHALE DEPOSITS DRIVE CHANGES IN U.S. ENERGY TRADE

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March 2015

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ADDRESS CORRESPONDENCE TO:
OFFICE OF INDUSTRIES
U.S. INTERNATIONAL TRADE COMMISSION
WASHINGTON, DC 20436 USA

Abstract

The United States is one of the world's largest producers and consumers of energy products and is likely to continue to be both for the foreseeable future. Technological improvements related to accessing the crude petroleum and natural gas in shale through hydraulic fracturing have caused significant structural changes in the U.S. energy sector. As a result of this "shale revolution", there have been large increases in U.S. production of crude petroleum and natural gas, and the United States faces the prospect of soon becoming a net exporter of natural gas. However, the outlook for coal is more pessimistic due to both recently enacted and upcoming environmental regulations as well as increased competition from newly abundant natural gas.

Introduction

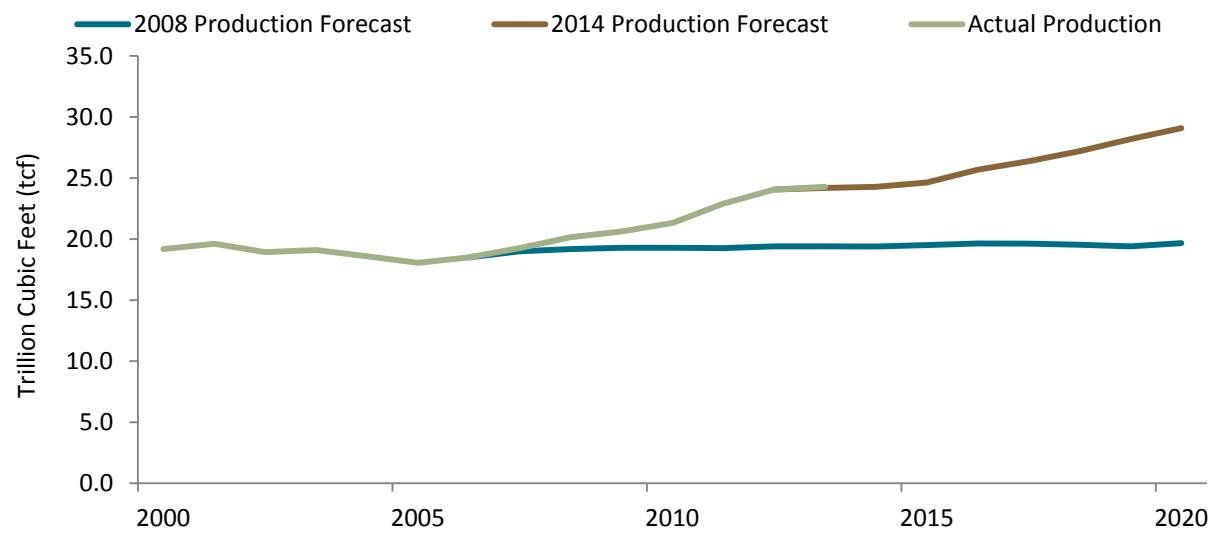
The United States is one of the world's largest producers and consumers of energy products and is likely to continue to be both for the foreseeable future. The major internationally traded energy products can be divided into four categories: crude petroleum, refined petroleum products, natural gas, and coal, and the United States is an important trader of all of these goods.[1] As recently as the mid-2000s, forecasts had projected that U.S. crude petroleum and natural gas production would decline, requiring increased imports to maintain domestic consumption levels. However, technological improvements related to hydraulic fracturing have reversed this trend, significantly increasing crude petroleum and natural gas production and leading to reduced imports of crude petroleum and increased exports of refined petroleum products. This structural change is projected to persist for several decades and result in the United States becoming a net exporter of natural gas while significantly reducing U.S. dependence on imported crude petroleum. By contrast, U.S. coal production and consumption have dropped in recent years due to the low price of natural gas and the closure of coal–fired power plants because of new environmental regulations. This paper examines these major structural changes impacting the U.S. energy sector by looking individually at each of the four major fuel types.

Natural Gas

Improvements in natural gas extraction using hydraulic fracturing (or "fracking") and related technologies have greatly increased U.S. natural gas production from heretofore uneconomical shale gas deposits. This technology-driven growth in gas output was largely unanticipated, and as late as 2008, the Energy Information Administration (EIA) was predicting no major increases in U.S. natural gas production over the next decade (figure 1). But, in fact, this "shale revolution" has led to large increases in domestic natural gas production and consumption, and similarly large reductions in imports (figure 2). The EIA now projects that U.S. natural gas production will continue to grow and that the United States will soon become a net exporter of natural gas to Mexico, Europe, and Asia.

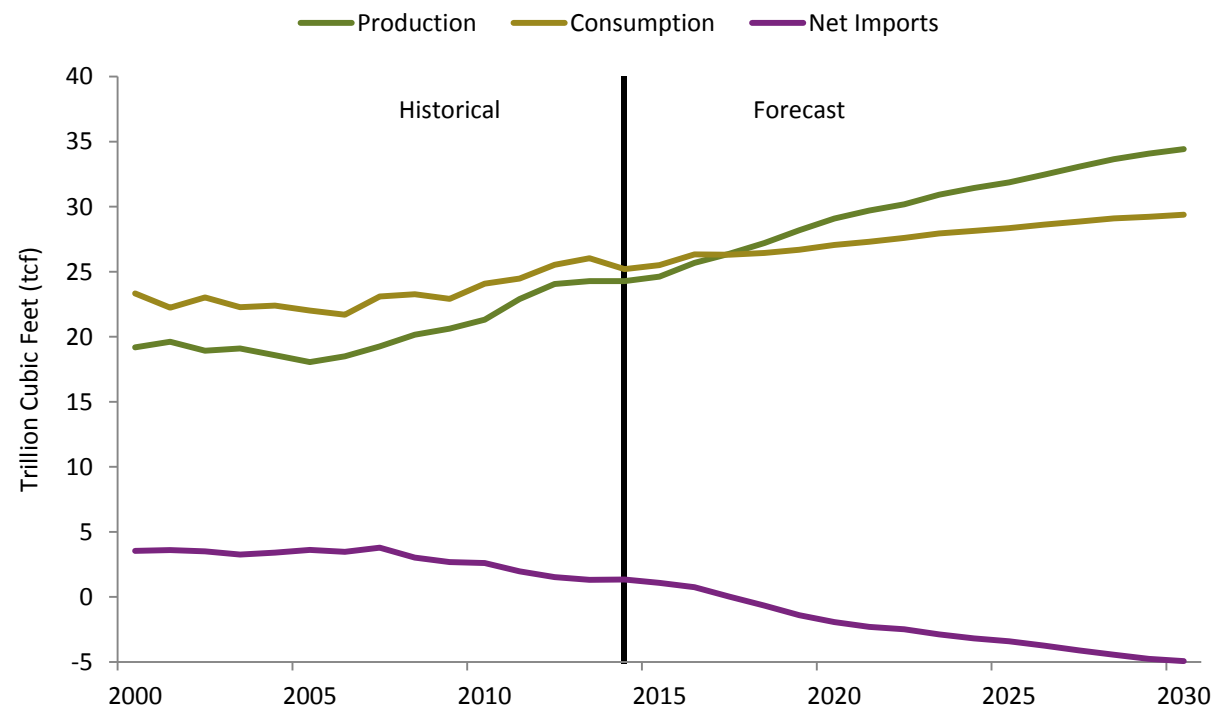
[1] Nuclear materials are not included in this article due to their small trade volumes and certain restrictions applied to such trade.

Figure 1: Recent U.S. natural gas production has greatly exceeded forecast



Sources: (1) EIA. Annual Energy Outlook, 2008, Data Table 13. (2) EIA. Annual Energy Outlook, 2014, Data Table 13. (3) EIA. Natural Gas Withdrawals and Production, November 28, 2014.

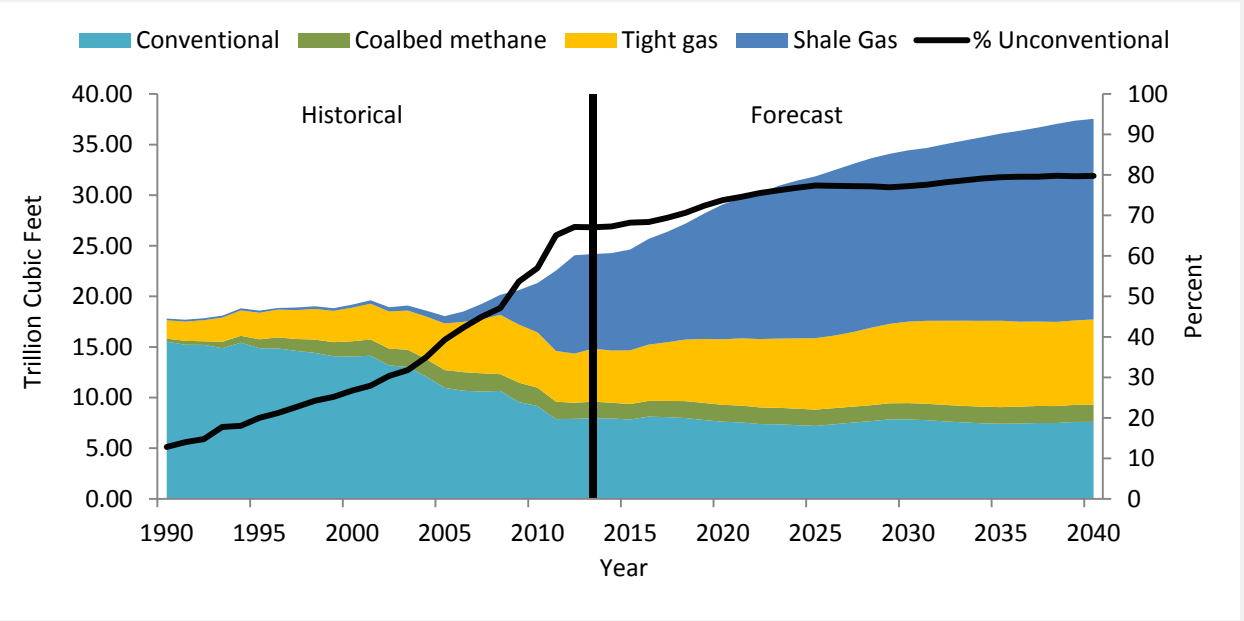
Figure 2: The United States is projected to soon become a net exporter of natural gas



Sources: (1) EIA. Annual Energy Outlook, 2014. (2) EIA. US Natural Gas Consumption by End Use, September 30, 2014. (3) EIA. U.S. Natural Gas Imports by Country, September 30, 2014. (4) EIA. US Natural Gas Exports and Re-Exports by Country, September 30, 2014. (5) EIA. Natural Gas Gross Withdrawals and Production, September 30, 2014.
Notes: Data for 2014 and later are forecasts from EIA. Annual Energy Outlook, 2014.

The United States has long been a major producer of natural gas but most of this production came from conventional wells, not shale. Although it was well-known by the industry that the United States had large shale gas deposits, these deposits were not economical to extract. However, this situation changed when improvements to hydraulic fracturing and other pre-existing technologies[2] resulted in economically viable production from shale deposits. Related technological improvements have also been applied to tight natural gas and coalbed methane and the ensemble effect has been a boom of unconventional natural gas production starting in 2009. Although conventional natural gas production has been in decline, the increase in shale production has more than made up for these declines, increasing total natural gas output (figure 3). The United States is now the world's largest producer of natural gas, producing 24 trillion cubic feet (tcf) in 2012, followed by Russia with 22 tcf, and the European Union with 6 tcf (figure 4).

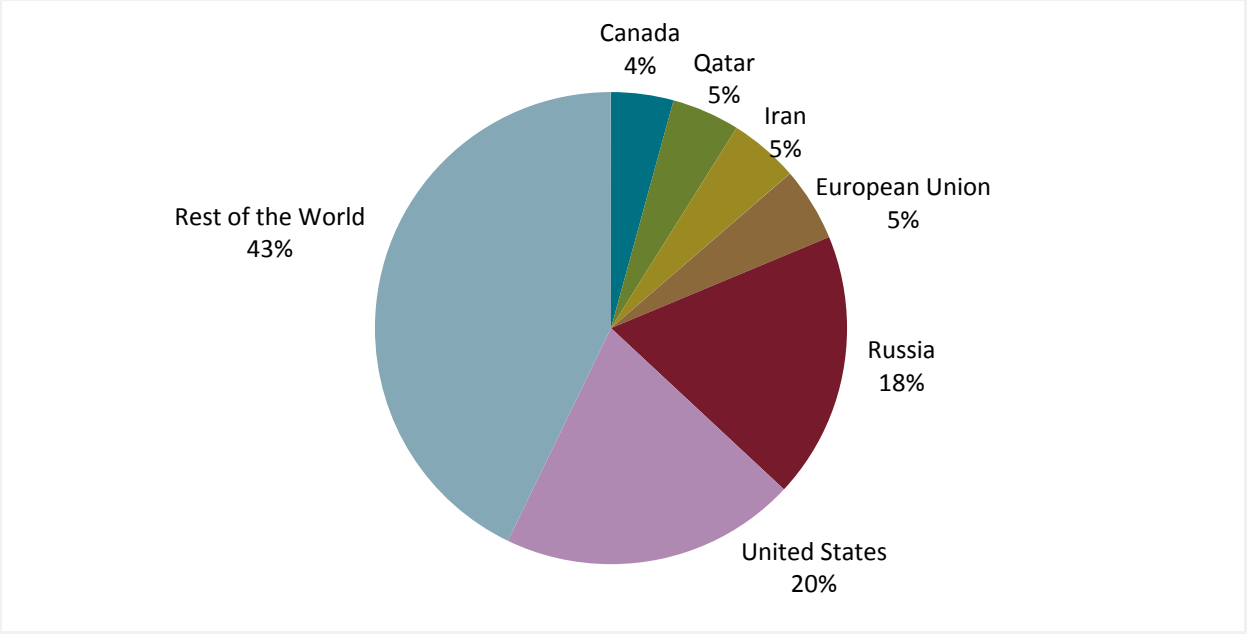
Figure 3: U.S. natural gas production from unconventional sources is growing



Source: Official statistics of the U.S. Department of Energy, Energy Information Administration.
Note: Data for 2013 and later are forecasts.

[2] Other key technologies include horizontal drilling and slickwater. Slickwater fracturing is a method of hydraulic fracturing which involves adding chemicals to water pumped into wells to increase the fluid flow of crude petroleum and natural gas to the surface.

Figure 4: Country percentages of world natural gas production in 2012



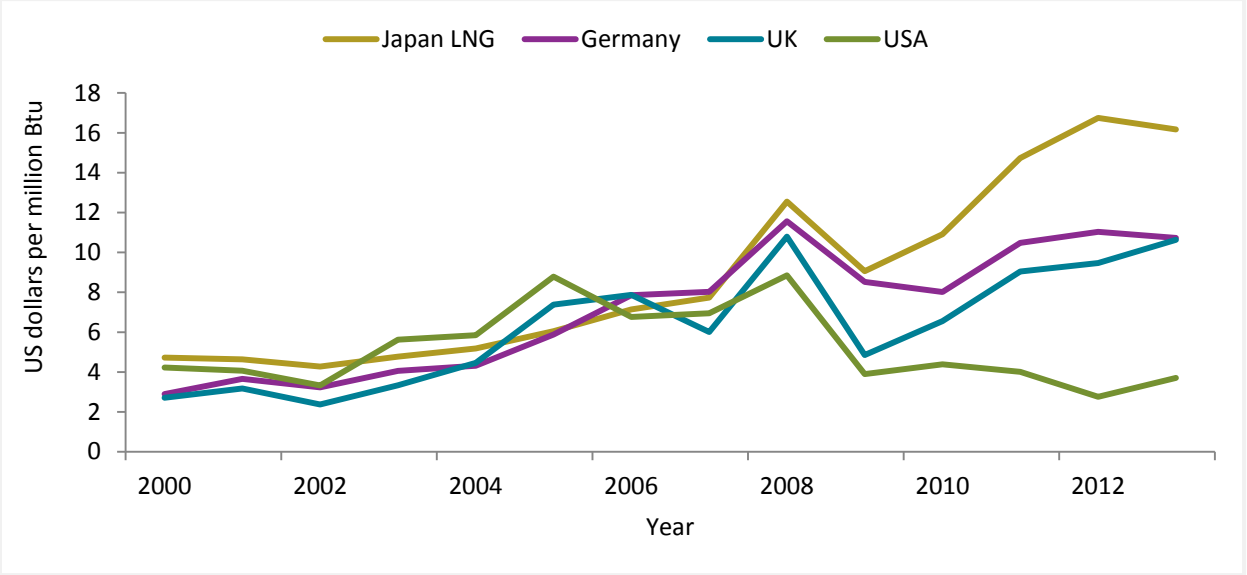
Source: EIA. International Energy Statistics: Gas; Production (accessed October 24, 2014).

Electricity generation is the largest single use of natural gas, and the average domestic price of natural gas for electricity has fallen from a high of $9.02 per million British Thermal Units (Btu) in 2008 to $4.98 per million Btu in 2014.[3] [4] [5] Natural gas also has industrial applications in petrochemical production, primary metals, and other industries but of all the uses of natural gas, electricity has seen the largest consumption increase since 2012.[6] The rising consumption of natural gas has mainly come at the expense of coal, which has seen its share of electricity generation fall from 52 percent in 2000 to 39 percent in 2013.[7]

The shale revolution has resulted in decreased U.S. imports and is projected to lead to the United States soon becoming a significant exporter of natural gas. The United States has historically been a major producer and consumer of natural gas, but with relatively little trade outside of North America. However, the EIA predicts that the shale revolution could turn the United States from a net importer to a net exporter with Mexico (principally via pipeline), and expand U.S. exports outside North America with liquefied natural gas (LNG) tanker ships. These exports will take advantage of the large differences between U.S. and foreign natural gas prices caused by growth in U.S. shale gas production (figure 5). Net exports of natural gas to Mexico

[3] EIA. US Natural Gas Consumption by End Use, September 30, 2014.
[4] EIA. Electric Power Annual, December 12, 2013. Table 7.1.
[5] EIA. Short-Term Energy Outlook, March 10, 2015.
[6] EIA. US Natural Gas Consumption by End Use, September 30, 2014.
[7] EIA. October 2014 Monthly Energy Review, October 28, 2014. Table 7.2a.

Figure 5: Natural gas is now much cheaper in the United States than in other countries



Source: BP. Statistical Review of World Energy, June 2014.

Table 1: U.S. imports and exports of natural gas, by country, for 2013

Country	U.S. imports (million cubic feet)	Country	U.S. exports (million cubic feet)
Pipeline total	2,786,496	Pipeline total	1,569,375
Canada	2,785,427	Canada	911,007
Mexico	1,069	Mexico	658,368
LNG total	96,859	LNG total	2,924
Trinidad	69,744	Canada (by truck)	71
Yemen	11,024	Mexico (by truck)	128
All other	16,091	Re–exports to Mexico	2,725
Grand total	2,883,355	Grand total	1,572,413

Source: Official statistics of the U.S. Department of Energy.

are expected to grow as Mexican demand is forecast to double over the next decade.[8] By contrast, as of 2013, the United States continued to be a net importer of natural gas from Canada (table 1), although the trade deficit with Canada has fallen from 3.6 trillion cubic feet (tcf) in 2008 to 1.8 tcf in 2013.[9]

Asian and European countries are likely to be the United States' main LNG trading partners. Japan, Korea, the EU, Taiwan, China, and India were the world's top LNG importers in 2013 and together they accounted for 83 percent of reported world LNG imports by value.[10] Developing countries are projected to lead future demand growth—the International Energy Agency (IEA) forecasts that world gas demand will grow by an average of 1.6 percent per year from 2010

[8] Ford. Mexico's energy ministry projects rapid near-term growth of natural gas imports from U.S., May 29, 2014.
[9] EIA. U.S. Natural Gas Imports by Country, September 30, 2014.
[10] Global Trade Information Services. Global Trade Atlas, accessed December 18, 2014.

to 2035, driven by non-OECD demand in general (2.3 percent growth per year) and Chinese demand in particular (6.6 percent growth per year).[11] However, events in developed countries have also created demand for U.S. LNG. After the Fukushima-Daiichi disaster in 2011, Japan shuttered nuclear power plants representing 27 percent of their power supply and increased electricity generation from natural gas.[12] Japan, already the world's largest LNG market, [13] saw LNG imports increase by 25 percent from 2010 to 2012.[14] And, after the Ukraine crisis began in 2013, concerns about European dependency on Russian natural gas have encouraged Europe to look to the United States for LNG exports.[15]

Although U.S. natural gas production and exports are anticipated to show strong growth, other natural gas exporting countries have also seen the same opportunities and are acting to increase their export capacity. 3.8 tcf of LNG export capacity are currently under construction worldwide and will be operational by 2018,[16] thereby increasing total world LNG export capacity to 17 tcf.[17] It is important to note that while U.S. LNG exports will be substantial compared to international LNG trade, they will still be small compared to the entire world natural gas market. The international Energy Agency (IEA) projects world natural gas demand to increase to 139 tcf in 2020 and 175 tcf in 2035.[18] By comparison, the EIA forecasts that U.S. LNG exports could be 1.1 tcf in 2018 and reach a peak of 3.4 tcf in 2030.[19]

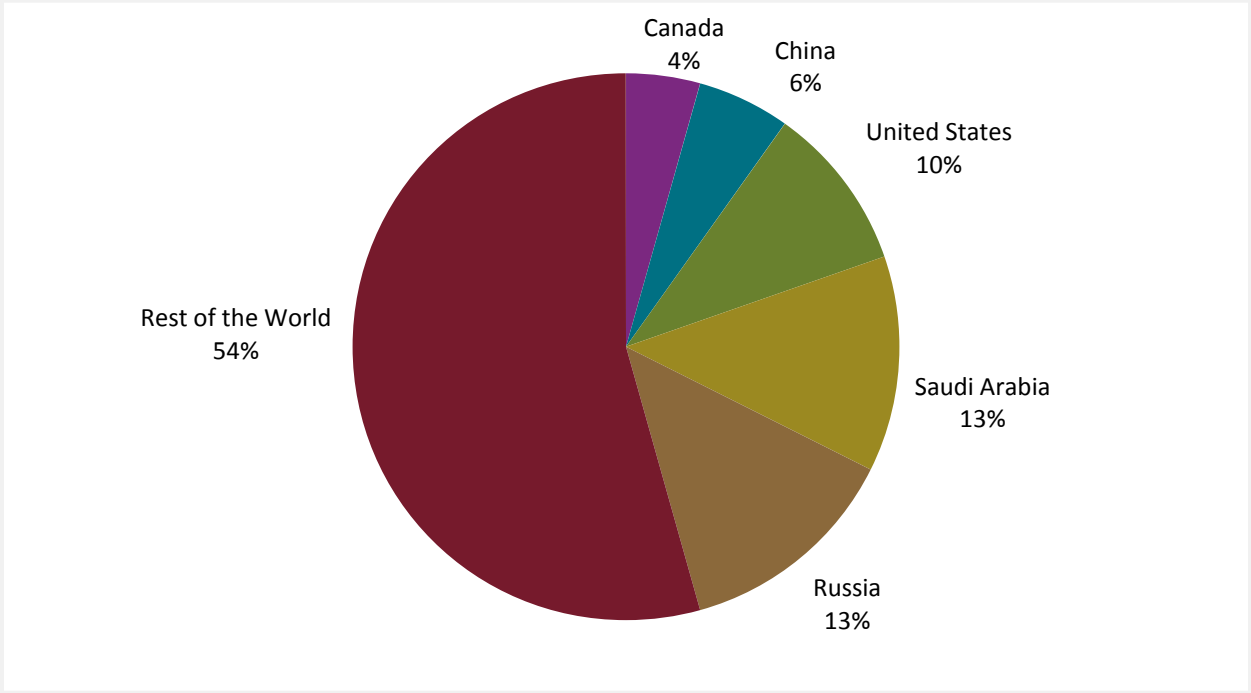
Crude Petroleum

During the last five years, U.S. crude petroleum production has increased significantly, due in large part to growing shale-related supplies (appendix). At the same time, domestic consumption has decreased slightly, resulting in a large drop in U.S. imports. In fact, for the first time in more than a decade, imports accounted for less than 50 percent of U.S. crude consumption. As a result of the largely stagnant U.S. consumption and strongly growing consumption in non-OECD countries, the U.S. share of global consumption has steadily decreased, reaching a low of 16 percent in 2014.

[11] International Energy Agency. World Energy Outlook, 2014, 128.
[12] EIA. Japan, January 30, 2015.
[13] Global Trade Information Services. Global Trade Atlas, accessed December 18, 2014.
[14] Ibid.
[15] Lopatka. Central Europeans want U.S. gas to cut dependence on Russia, March 8, 2014.
[16] International Energy Agency. World Energy Outlook, 2014, 150. 108 billion cubic meters (bcm) is equal to 3.8 tcf.
[17] International Energy Agency. World Energy Outlook, 2014, 148. 480 bcm is 17 tcf.
[18] International Energy Agency. World Energy Outlook, 2014, 128. 3943 bcm is 139 tcf. 4955 bcm is 175 tcf.
[19] EIA. Annual Energy Outlook, 2014, Data Table 13.

The world's largest producers of crude petroleum are collectively the member nations of OPEC (which includes Saudi Arabia),[20] followed by Russia, the United States, and Canada. Individually, the largest single producer of crude in 2013 was Russia, followed by Saudi Arabia and the United States (figure 6). The United States is by far the world's largest consumer of crude petroleum, and in 2013 it consumed 19.0 million barrels per day, almost twice as much as China, the second largest consumer, at 10.3 million barrels per day.[21]

Figure 6: Country percentages of world crude petroleum production in 2013

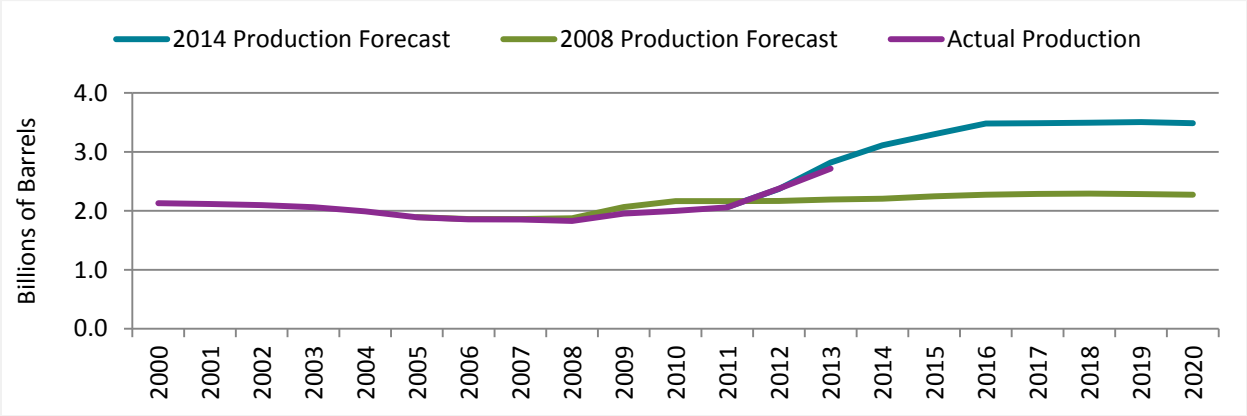


Source: EIA. International Energy Statistics: Petroleum; Production; Production of Crude Oil including Lease Condensate (accessed October 24, 2014).

After decades of decline, U.S. production of crude petroleum has risen rapidly in recent years (figure 7) as a result of high world prices that incentivized technological innovation in tertiary production methods. In particular, horizontal drilling and multistage hydraulic fracturing are now utilized to access crude and natural gas resources from shale rock formations that were once uneconomical. The increased output has largely occurred in the Bakken (Montana and North Dakota), Eagle Ford (Texas), and Permian (Texas) deposits. As a result, U.S. production of crude petroleum rose by 33 percent from 2012–2014 and the U.S. share of total world production has risen to 10 percent (appendix). These new supplies have substantially reduced U.S. dependence on crude imports (figure 8), and continued efficient development of domestic

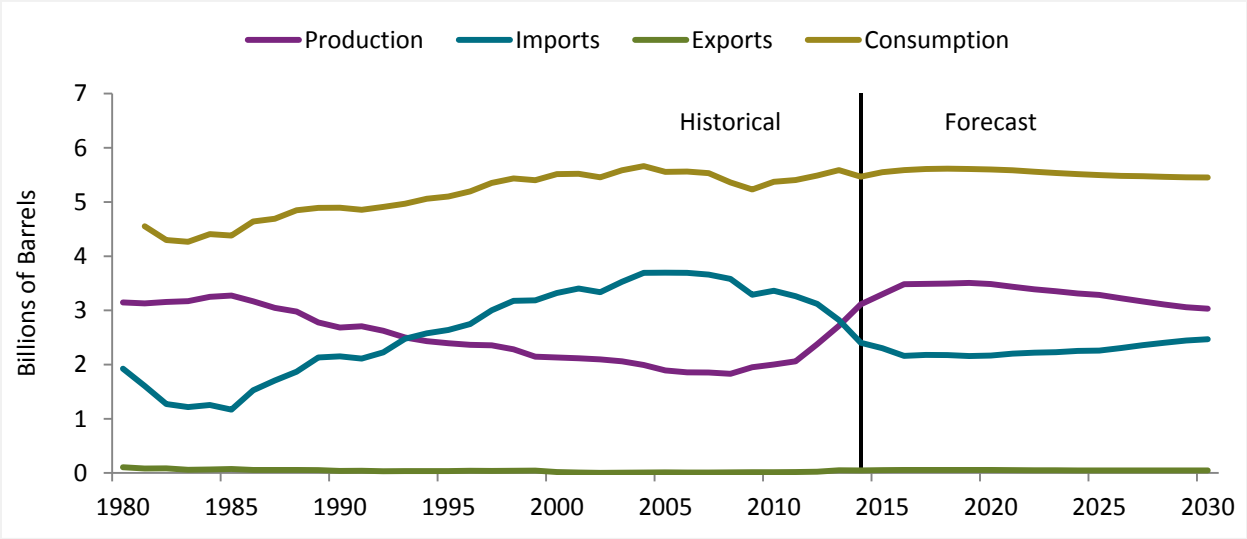
[20] The 12 member countries of OPEC are Iran, Iraq, Kuwait, Saudi Arabia, Venezuela, Qatar, Libya, the United Arab Emirates, Angola, Algeria, Nigeria, and Ecuador.
[21] EIA. 2013 World Oil Consumption, accessed February 19, 2015.

Figure 7: U.S. crude petroleum production unexpectedly increased



Sources: (1) EIA. Annual Energy Outlook, 2008, Table 14. (2) EIA. Annual Energy Outlook, 2014, Table 11. (3) EIA. U.S. Crude Oil Supply & Disposition, September 30, 2014.

Figure 8: Increased U.S. production of crude petroleum has led to declining imports



Sources: (1) EIA. Annual Energy Outlook, 2014, Table 11. (2) EIA. U.S. Crude Oil Supply & Disposition, September 30, 2014.

resources promises even greater improvement in the domestic supply-demand balance. Although the fall in crude prices during 2014 has not yet significantly impacted domestic production, prolonged low prices would eventually result in less new well drilling, which would eventually reduce production rates.[22]

During 2004–2012, U.S. consumption of crude petroleum was flat or slightly declining due principally to the weakened U.S. economy, high crude prices, and more fuel–efficient

[22] Cook and Perrin. Lower 48 oil production outlook stable despite expected near-term reduction in rig count, January 26, 2015.

automobiles.[23] As a result of the flat U.S. crude consumption and growing demand in non-OECD countries, the U.S. share of the global crude market steadily decreased, reaching a low of 16 percent in 2013 (appendix). However, absolute (not percentage) U.S. consumption of crude petroleum began to rise slightly in 2012. This trend is expected to continue through 2015 and beyond as demand increases from domestic producers of petrochemicals and consumers of refined petroleum products.[24]

As a result of U.S. crude consumption largely holding constant and domestic production increasing, U.S. imports fell by 27 percent during 2004–2014. The United States is now the second-largest world importer of crude petroleum, having been overtaken by China in 2013.[25] Canada has been the largest foreign supplier of crude petroleum to the United States for decades and continues to be so (table 2). Large multinational energy companies operate in both countries and exchange crude and petroleum products across the border. Also, an integrated system of shared pipelines crossing the U.S.-Canada border makes it easy and cost efficient to transport crude petroleum from the wellhead to refineries. U.S. imports of crude petroleum from all other major sources declined during 2005–2013, particularly from OPEC member nations.

The more than 90 percent decline in U.S. imports of crude from Nigeria during 2011–2014 was particularly noteworthy. Although partially caused by supply disruptions in Nigeria, it was primarily the result of U.S. production increases from shale deposits such as the Bakken and Eagle Ford formations. The crude produced from these deposits is of similar quality to Nigeria's crude, and as production from these formations increased, U.S. imports from Nigeria declined. As a result, two U.S. East Coast refineries that specialized in refining Nigerian crude are now primarily using domestically produced crude petroleum instead.[26]

The United States is not a significant exporter of crude petroleum. In fact, U.S. exports of crude petroleum have been prohibited since 1973, except as approved by the U.S. government. Canada has been the only consistent market for such exports, which are part of a commercial exchange agreement between U.S. and Canadian refiners. However, although U.S. exports of crude are prohibited, the increase in domestic production of crude has contributed to tremendous recent growth in U.S. exports of refined petroleum products.

[23] Staff telephone interviews with industry sources, January 14, 2015.
[24] Ibid.
[25] Data derived from official statistics of the U.S. Department of Energy.
[26] *Oil and Gas Journal,* "Western Europe Leads Global Refining Contraction," December 2, 2013.

Table 2: U.S. imports and exports of crude petroleum, by country, for 2013

Country	U.S. imports (1,000 barrels per day)	Country	U.S. exports (1,000 barrels per day)
Canada	2,579	Canada	133
Mexico	850	All other	[a]
All other non–OPEC	808		
OPEC	3,493		
Saudi Arabia	1,325		
Venezuela	755		
Nigeria	239		
All other OPEC	1,174		
Grand total	7,730	Grand total	133

Source: Official statistics of the U.S. Department of Energy.
[a] Less than 500 barrels per day.

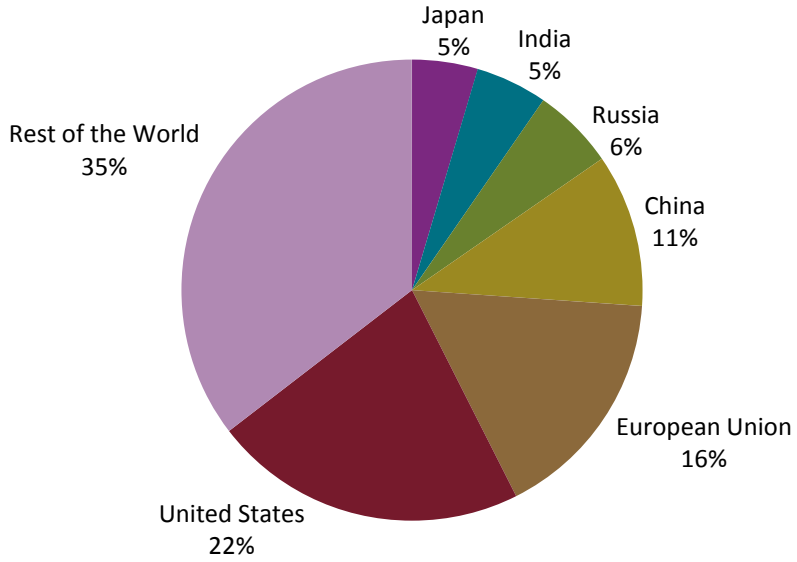
Refined Petroleum Products

During the last decade, the United States experienced strong, steady growth in the production of refined petroleum products, and is currently the world's largest producer (figure 9).[27] The United States has also accounted for an increasing share of global exports in recent years, rising from 8 percent in 2009 to 15 percent in 2014 (appendix). Moreover, in 2011, for the first time in over 60 years, the United States became a net exporter of petroleum products, with most of these exports coming from the U.S. Gulf Coast, where some of the world's most sophisticated refining capacity is concentrated.

Because of increasing domestic production of crude petroleum, U.S. refiners have had access to a rising supply of low-priced domestic feedstock with which to produce refined petroleum products. During 2004–2014, U.S. refined products output rose by 11 percent to roughly 20 million barrels per day. At the same time, U.S. consumption of refined products fell by 11 percent to roughly 18 million barrels per day. Declining domestic consumption resulted primarily from the use of more fuel-efficient cars, fuel switching toward natural gas and away from refined petroleum products by certain industrial consumers, and the overall dampening effects of the Great Recession on demand for refined products. The growth in U.S. production and decline in domestic consumption have had important implications for U.S. trade in refined products.

[27] Refined petroleum products are produced in refineries from crude petroleum and include distillate and residual fuel oils, motor fuels (including natural gasoline and jet fuels), naphtha, lubricants, and greases, as well as many other products. What this document refers to as refined petroleum products is most similar to "petroleum products" under EIA definitions, although it is not exactly identical.

Figure 9: Country percentages of world refined petroleum products production in 2013



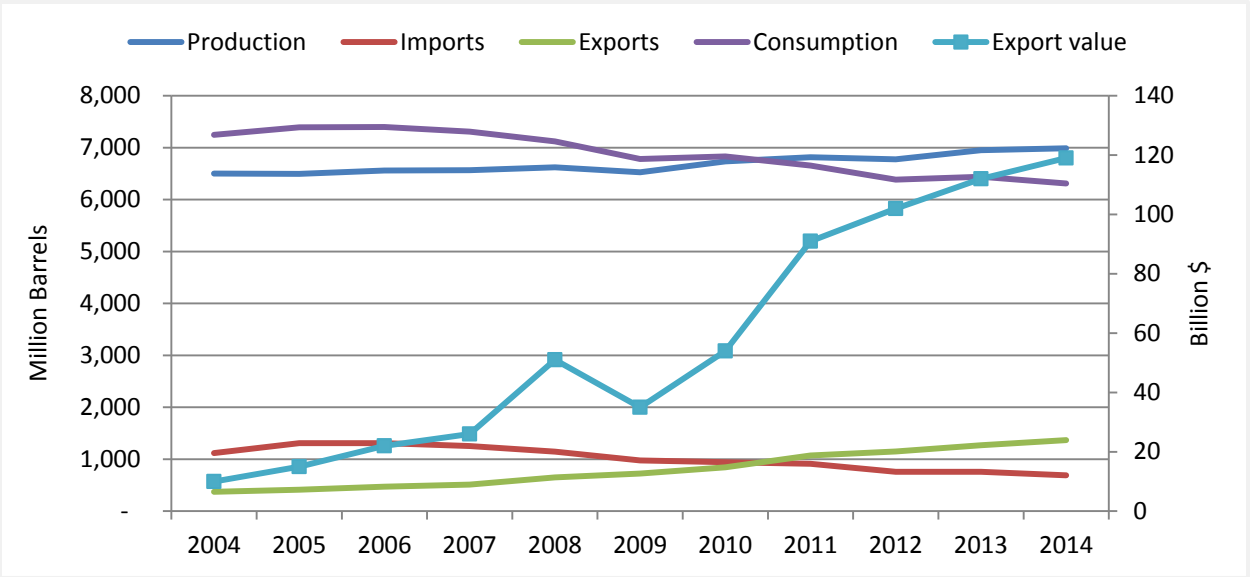
Source: EIA. International Energy Statistics: Petroleum; Production; Total Refinery Output of Petroleum Products (accessed October 24, 2014).

During 2004–2014, U.S. exports of petroleum products more than doubled to 3.7 million barrels in 2014, and the U.S. share of global exports rose from five percent to fifteen percent. Moreover, industry experts expect that U.S. exports will continue to rise in the foreseeable future. The increase in the quantity of U.S. exports of petroleum products is attributable to the domestic supply and demand factors listed above as well as high demand for fuel oils on the world market.[28] In particular, the ban on U.S. exports of crude is credited with keeping the acquisition costs for domestic refiners below the costs of similar crude varieties on the global market, thereby lowering input costs and improving the competitiveness of U.S. refined product exports.

Due to a changing product mix of U.S. exports (since refineries produce a variety of products from a barrel of crude) and the rise in the refiner acquisition cost of a barrel of crude petroleum during most of 2004–2014, the value of U.S. exports showed an even more dramatic increase, rising from roughly $18 billion to $120 billion during the period (figure 10). Global demand for distillate fuel oils rose faster than demand for other primary petroleum products, prompting U.S. refiners to increase their yield of these fuel oils (a barrel of crude in U.S. refineries currently yields an average of 31 percent distillate fuel).[29] Moreover, exports of fuel oils tended

[28] USITC staff telephone interview with officials of the American Petroleum Institute, January 15, 2015.
[29] *Oil and Gas Journal*, "Western Europe Leads Global Refining Contraction," December 2, 2013 and *Petroleum Economist*, "Refining Survey," September, 2014.

Figure 10: Increased U.S. production and declining U.S. consumption have led to rising exports of refined petroleum products



Source: Official statistics of the U.S. Department of Energy, Energy Information Administration.

to have higher profit margins for U.S. refiners than natural gasoline.[30] The rising value of U.S. exports was also impacted by the refiner acquisition cost of a barrel of crude petroleum, which rose from $29 in 2003 to over $100 in 2013 and was about $95 per barrel in most of 2014. However, this cost decreased sharply in late 2014 and into 2015 as a result of a global oversupply of crude petroleum.

U.S. export growth is expected to continue as U.S. demand remains flat, U.S. production continues to grow, and refinery investments and upgrades in the EU and Latin America are delayed, keeping production there stagnant.[31] In recent years, U.S. export growth has been strongest to Latin America (not including Mexico) and the EU. Latin America's share of U.S. exports rose from 21 percent in 2009 to 28 percent in 2013, while the EU's share rose from 17 percent to 20 percent. Together, Canada and Mexico continue to account for about 27 percent of U.S. exports of petroleum products.[32]

The increased domestic production of refined products coupled with reduced consumption has led to a nearly 50-percent decline in the volume of U.S. imports during 2005–2014. Canada remained the leading single country source of U.S. imports of petroleum products in 2014,

[30] *Oil and Gas Journal,* "Western Europe Leads Global Refining Contraction," December 2, 2013.
[31] EIA, *Short-Term Energy Outlook,* February 11, 2014.
[32] Ibid.

followed by Russia (table 3).[33] U.S. imports from most sources have declined in recent years, including from OPEC.

Table 3: U.S. imports and exports of refined petroleum products, by country, for 2013

Country	U.S. imports (1,000 barrels per day)	Country	U.S. exports (1,000 barrels per day)
Canada	563	European Union	556
Russia	428	Mexico	532
European Union	400	Canada	415
OPEC	227	Chile	142
All other	511	China	128
		All other	1,714
Grand total	2,129	Grand total	3,487

Source: Official statistics of the U.S. Department of Energy.

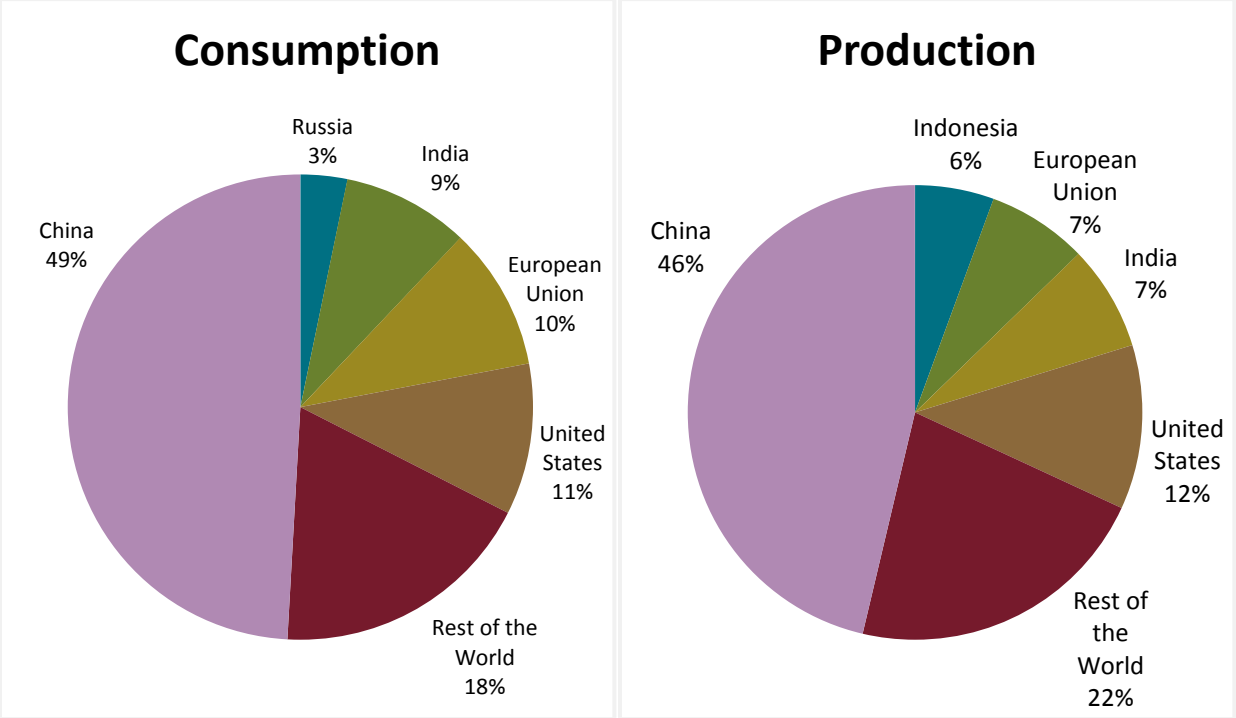
Coal

The United States leads the world in terms of coal reserves and is the world's second largest producer of coal (figure 11). [34] In particular, the United States has an abundance of bituminous coal, which is the highest quality variety and the type most desired for electricity generation. However, U.S. coal demand has experienced a significant decline during the last decade (figure 12). The drop in demand led to declines in U.S. production which have only partly been offset by falling imports and strong exports.

Coal consumption falls into two categories: steam coal used to produce electricity and metallurgical coal used in the production of steel. Ninety percent of U.S. coal consumption is for generating electricity.[35] However, domestic consumption of coal for electricity generation has been falling since 2009 due to rising competition from cleaner-burning and lower priced natural gas and increasingly stringent environmental regulations on emissions from coal-fired power plants. Total U.S. coal consumption is projected to be largely flat during the next decade as retirements of coal power plants rise in response to the implementation of the Mercury and Air Toxics Act and other environmental regulations.

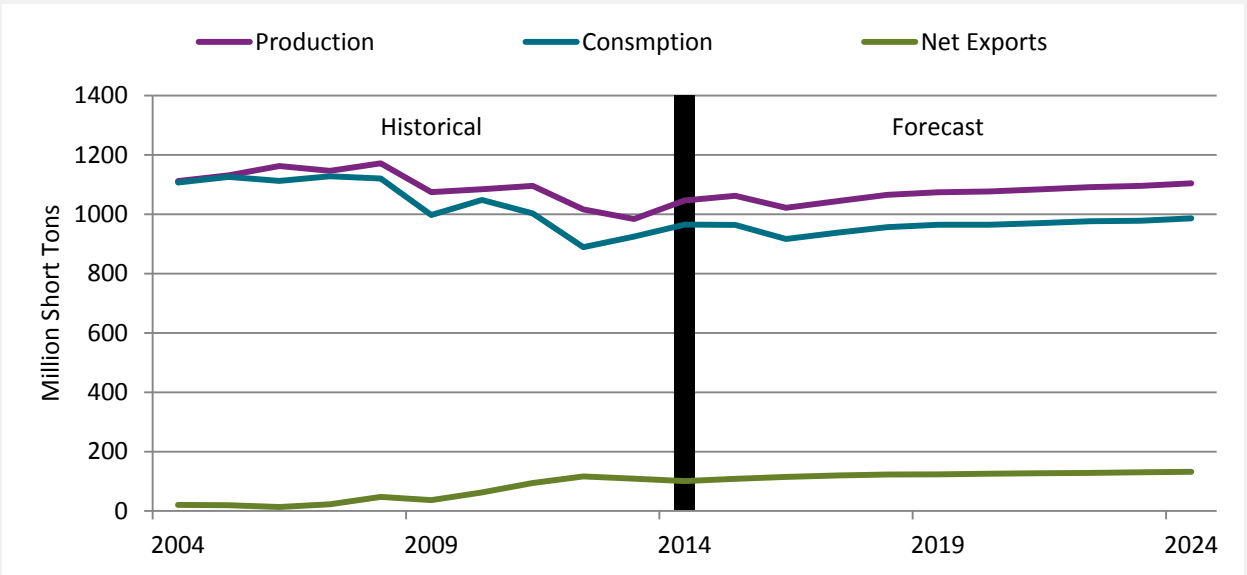
[33] U.S. imports of refined petroleum products from Canada are mostly distillate and residual fuel oils and natural gasoline (including stocks for blending motor fuel). (Derived from official U.S. government statistics).
[34] Other countries with large reserves of coal include Russia, China, and India. (Derived from official U.S. government statistics).
[35] Official statistics of the U.S. Department of Energy, Energy Information Administration.

Figure 11: Country percentages of world coal production and consumption in 2013



Source: (1) EIA. International Energy Statistics: Coal, production (accessed October 31, 2014) and (2) EIA. International Energy Statistics: Coal, consumption (accessed October 31, 2014).

Figure 12: Decreased U.S. consumption of coal has been somewhat offset by continued strong exports



Source: Official statistics of the U.S. Department of Energy, Energy Information Administration.

The vast majority of U.S. coal production has historically been destined for the domestic market. As a result, the decline in U.S. coal consumption has had a direct adverse impact on

domestic output—U.S. production fell by roughly 10 percent by volume during 2004–2014 (appendix). While U.S. coal production declined, significant production increases in other countries (particularly China) has driven growth in overall world coal output.[36] As a result, the U.S. share of global production has dropped from 18 percent to 12 percent during 2004–2014 (appendix). The decline in U.S. production would have been even larger but for falling U.S. imports and growing exports. In fact, during 2004–2012, the domestic coal industry became increasingly reliant on exports as the export share of production rose from 4 percent to 12 percent. However, U.S. exports seemed to have weakened in 2013–2014.

Most U.S. exports go to countries in Europe and Asia (table 4). However, the recent (2013–2014) export declines reflect both lower European demand for U.S. steam coal and increased competition from other global suppliers. The EU has set the goal of reducing greenhouse gas emissions and has been reducing coal consumption, and thereby imports.[37] Asian demand has increased significantly in recent years,[38] and Asia is expected to be the primary growth market for coal in the coming years. However, competition for U.S. exports in those markets from other well-situated suppliers is anticipated to be intense.

Table 4: U.S. imports and exports of coal by country, for 2013

Country	U.S. imports (short tons)	Country	U.S. exports (short tons)
Colombia	6,680	United Kingdom	13,254
Canada	980	Netherlands	12,529
Indonesia	890	Korea	8,947
All other	356	Brazil	8,777
		China	8,517
		Canada	7,525
		All other	58,110
Grand total	8,906	Grand total	117,659

Source: Official statistics of the U.S. Department of Energy.

In terms of Asian markets, China and India are two of the worlds' largest coal consumers (figure 11). Both countries are also leading coal producers. In fact, China is the world's largest coal producer, followed by the United States, India, Indonesia, South Africa, Australia, and Russia.[39] EU, Chinese, and Indian coal production is principally for domestic consumption, while U.S., South African, and Russian production is for both domestic consumption and export. By comparison, Indonesian and Australian production is heavily focused on exports. U.S. exports are anticipated to find a challenging environment in Asian markets due to increasing coal

[36] EIA. International Energy Statistics: Coal, production (accessed October 31, 2014).
[37] EIA, International Energy Outlook 2014, Annual Coal Report, and various EU nations' Country Analysis Briefs.
[38] EIA. 25 percent of U.S. coal exports go to Asia, but remain a small share of Asia's total coal imports, June 21, 2013.
[39] Data derived from official statistics of the U.S. Department of Energy.

output in major coal-consuming countries (China and India) as well as export competition from Australia and Indonesia.[40]

[40] EIA, *Short-Term Energy Outlook,* February 11, 2014.

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Appendix A
U.S. energy products data

Table A 1: U.S. production, trade, consumption, and share of world total for energy products, 2004–2014

	Crude petroleum		Refined petroleum products		Natural gas[a]		Coal	
	(1,000 barrels per day)	(% of total world)	(1,000 barrels per day)	(% of total world)	(billion cubic feet)	(% of total world)	(1,000 short tons)	(% of total world)
Production								
2004	5,441	8	17,814	22	18,591	15	1,112,099	18
2005	5,181	7	17,800	21	18,051	15	1,131,498	17
2006	5,088	6	17,975	22	18,504	15	1,162,750	17
2007	5,077	6	17,994	22	19,266	15	1,146,635	16
2008	5,000	7	18,146	22	20,159	15	1,171,809	16
2009	5,350	7	17,882	22	20,624	15	1,074,923	14
2010	5,482	7	18,452	22	21,316	16	1,084,368	14
2011	5,645	8	18,673	22	22,902	16	1,095,628	13
2012	6,497	9	18,564	23	24,033	16	1,016,458	12
2013	7,452	10	19,106	23	24,334	16	984,842	12
2014	8,667	11[b]	19,682	23[b]	23,286	14[b]	996,666	12
Imports								
2004	10,088	23	3,057	17	4,259	15	27,280	3
2005	10,126	23	3,588	19	4,341	13	30,460	3
2006	10,118	23	3,589	18	4,186	13	36,246	3
2007	10,031	23	3,437	17	4,608	13	36,347	3
2008	9,783	20	3,132	17	3,984	11	34,208	3
2009	9,013	21	2,678	12	3,751	12	22,639	2
2010	9,213	21	2,580	11	3,741	10	19,353	2
2011	8,935	20	2,501	11	3,469	9	13,088	1
2012	8,527	19	2,071	9	3,138	9	9,159	<1
2013	7,730	18	2,129	8	2,883	8	8,906	<1
2014	7,360	16[b]	1,886	7[b]	1,384	[c]	10,764	2[c]

	Crude petroleum		Refined petroleum products		Natural gas[a]		Coal	
	(1,000 barrels per day)	(% of total world)	(1,000 barrels per day)	(% of total world)	(billion cubic feet)	(% of total world)	(1,000 short tons)	(% of total world)
Exports								
2004	27	0	1,021	5	854	3	47,998	6
2005	32	0	1,133	6	729	2	49,942	5
2006	25	0	1,292	6	724	2	49,647	5
2007	27	0	1,405	7	822	3	59,163	5
2008	29	0	1,773	9	963	3	81,519	8
2009	44	0	1,980	8	1,072	3	59,097	6
2010	42	0	2,311	10	1,137	3	81,716	7
2011	47	0	2,939	12	1,506	4	107,259	8
2012	67	0	3,137	13	1,619	5	125,746	9
2013	134	0	3,487	14	1,572	4	117,659	9
2014	331	0	3,711	15[b]	779	[c]	104,764	8[b]
Apparent consumption[d]								
2004	15,502	20	19,823	24	21,996	19	1,091,381	17
2005	15,275	18	20,223	24	21,663	18	1,112,016	17
2006	15,181	18	20,247	24	21,966	17	1,149,349	17
2007	15,081	18	19,998	23	23,052	18	1,123,819	17
2008	14,754	17	19,476	23	23,180	17	1,124,498	15
2009	14,319	16	18,536	22	23,303	18	1,038,465	14
2010	14,653	17	18,679	21	23,920	17	1,022,005	13
2011	14,533	17	18,188	21	24,865	17	1,001,457	12
2012	14,957	16	17,430	20	25,552	17	899,871	11
2013	15,047	16	17,614	19	25,645	18	875,211	10
2014	15,420	16	17,749	18	23,891	[c]	595,498	[c]

Source: Derived from official statistics of the U.S. Department of Energy, Energy Information Administration and industry sources.

[a] Natural gas production is dry natural gas.

[b] Estimate

[c] Not available

[d] Apparent consumption is defined as production plus imports minus exports and is typically used by the U.S. International Trade Commission.