EMD Coal Committee
Annual Report

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May 30, 2015

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Coal Commodity Report

Executive Summary

Coal still is the second-largest energy commodity worldwide, exceeded only by oil. Global coal production in 2012, according to the Energy Information Administration, was ~7.9 billion metric tons (~8.7 billion short tons [bst]). The top 10 coal producing countries account for about 90% of the world's total coal production, with China being the top coal-producing and -consuming country.

A current global oversupply of coal, with surpluses at approximately 10 million metric tons (~11 million short tons [mst]) in 2014, has led to a downturn in global coal prices. However, many of the top ten coal-producing countries are planning to ramp up production in expectation of the oversupply being consumed by 2016. Although natural gas continues to compete with coal as sources of electricity generation, coal still has a powerful influence on electricity prices, and coal plants are likely to remain price-setting power units for many countries. Consequently, future security of coal supply will be necessary to maintain stability in wholesale electricity prices. Metallurgical coal prices are also reduced in the global markets.

A recent decline in U.S. coal exports in 2014 was primarily related to a decrease in world coal demand, depressed international coal prices, and greater coal production in other coal-exporting countries. U.S. coal exports will fall from 88 million metric tons (97 mst) in 2014 to an annual average of 73.5 million metric tons (81 mst) in 2015 and 2016. In addition, coal consumption for electric power in the U.S. decreased by 0.8%, or ~6.4 million metric tons (7 mst) in 2014. Coal in the U.S. power sector will decrease by 2.2% in 2015, mainly as a result of lower natural gas prices and coal-plant retirements, owing to implementation of new air-quality and emission standards. Coal still accounts for 39% of electricity generated in the U.S., according to the Energy Information Administration.

The world's top ten coal producing countries in 2012, according to the Energy Information Administration, were: (1) China, (2) United States, (3) India, (4) Indonesia, (5) Australia, (6) Russia, (7) South Africa, (8) Germany, (9) Poland, and (10) Kazakhstan. China's coal production in 2014 dropped by 2.5%, with production of 3.52 billion metric tons (3.88 bst) of coal in the first eleven months of 2014. China produced 3.7 billion metric tons (~4.2 bst) of coal in 2013. This is the first annual decline in coal production in China in more than a decade. This decline is the result of weakening demand from industry and the power sector, oversupply, and initiatives from the government to reduce air pollution. Mine operators have also been directed to reduce coal production in an effort to boost plunging prices. Chinese power generation growth in 2014 was the slowest since 1998 and growth in steel production was also the weakest in more than 30 years.

World Coal Production and Consumption

Coal is still the second-largest energy commodity worldwide, exceeded only by oil. Global coal production in 2012 was ~7.9 billion metric tons (~8.7 bst) (Energy Information Administration, 2015a) (Table 1). The top 10 coal producing countries account for about 90% of the world's total coal production, with China leading the list (Mining Technology, 2015; Energy Information Administration, 2015a). The world's top ten coal producing countries in 2012, according to the Energy Information Administration, were: (1) China, (2) United States, (3) India, (4) Indonesia, (5) Australia, (6) Russia, (7) South Africa, (8) Germany, (9) Poland, and (10) Kazakhstan (Table 1). Although Canada is not in the top ten, it is included in this report because it accounted for approximately 66.5 million metric tons (73.3 mst) of coal production in 2012, and is the second greatest coal-producing country in North America. A description of coal in Canada is offered in this report as an update for many AAPG members who reside in the country.

Country	**2012 coal production (billion short tons)**
China	4.018
United States	1.016
India	0.650
Indonesia	0.488
Australia	0.464
Russia	0.390
South Africa	0.286
Germany	0.217
Poland	0.158
Kazakhstan	0.139
World Total	**8.687**

Table 1. Top ten coal-producing countries in 2012. Units are billion short tons. From Energy Information Administration (2015a).

Worldwide Impact of Hard Coal on Electricity Prices

Hard coal, defined in a recent report by the IEA (International Energy Agency, 2014a) as coal of gross calorific value ≥5,700 kcal/kg (kilocalories per kilogram) on an ash-free but moist basis and with a mean random vitrinite reflectance value of ≥0.6%, is the primary feedstock in electric power generation worldwide because full-generation costs are less

than those of oil, gas or renewable energy sources. When power prices are based on short-run marginal costs (the merit order principle), fuel costs tend to be set by power plants. As a result, inexpensive coal serves to decrease the price of electricity, when the price-setting plant is a coal-fired one. The U.S., Australia, China and South Africa have significant contributions from hard coal power generation, as they are largely self-suppliers of lower-cost domestic coal. Moreover, hard coal also is an important electric power generation source in Japan or Europe, although both are dependent on hard coal imports, since coal prices are well below prices of alternative energy sources. As expansion of renewables continues, electric power generation from coal in certain regions might decline. However, the impact of coal prices on power prices is expected to remain strong, as coal plants are likely to remain price-setting power units in many countries. Therefore, future security of coal supply will be necessary to maintain stability in wholesale electricity prices.

Worldwide Coal Markets and Supply

The global market for seaborne thermal coal in 2014 is experiencing an oversupply by ~10 million metric tons (~11 mst) (Reuters, 2014). This is expected to move coal prices below profitable levels for many coal producers in 2014 and 2015, with the result of some mines having to close or suspend operations until more favorable prices return. Coal prices have been reduced by as much as 50% in the past three years because of increased production from exporters that include the U.S., Australia, South Africa, Indonesia, and Colombia. Reuters (2014) reported that the oversupply for seaborne thermal coal was estimated by coal traders and analysts to range from 7 to 12 million metric tons (7.7 to 13.2 mst), and surplus coal could continue to be problematic into 2016. Demand for thermal coal, in Asia, particularly in China, is slowing. Economic growth in China has recently slackened, and in combination with pressure from the government to use more natural gas to mitigate air-pollution problems, coal mines may close. However, demand may pick up in 2016 as the thermal-coal oversupply begins to fall as a result of coal-mine closures. In other Asian markets, Indian utilities may require

more imported coal if Coal India cannot meet demand. This could result in a 6% increase in demand to almost 790 million metric tons (~871 mst) by the end of fiscal year 2015.

Worldwide Electricity from Coal: Future Technology Issues

The International Energy Agency has issued a study of coal technology and the role of coal in CO_2-related issues in the 21st century (International Energy Agency, 2014b). Titled "21st Century Coal", this study's salient points are:

- Over 30% of the world's total energy demand and >40% of generated electricity comes from coal.

- Benefits from electricity generated from coal are vital in improving the quality of human life, particularly in developing countries. The challenge for coal in the 21st century will be improving technology for electricity from coal to address increases in CO_2 emissions, while at the same time continuing to provide access to energy for developing countries.

- A large portfolio of technologies including advanced power generation (high thermal efficiency) and CCS (carbon capture and storage) will be required to be demonstrated and deployed in order to realize significant GHG (greenhouse gas) reductions from coal use. However, lowering CO_2 emissions from coal-fueled power plants will require an increase in thermal efficiency.

- The IEA roadmap for technology involving electricity generated from coal with CCS currently envisages slightly less than 280 gigawatts (GW) of CCS-equipped power plants worldwide by 2030. Approximately 630 GW of coal-fueled power plants with CCS would be required by 2050.

China

China continues to be the number one producer and consumer of coal in the world (World Coal Association, 2014), using more coal than the United States, Europe, and Japan combined (Moore, 2011; Vince, 2012; Sweet, 2013). China accounts for almost half of the world's coal consumption and is the world's largest power generator (Energy Information Administration, 2015b). China possessed an estimated 122.5 billion metric tons (126 bst) of recoverable coal reserves in 2011, equivalent to ~13% of the world's total coal reserves. Of the 28 provinces in China that produce coal, Shanxi, Inner Mongolia, Shaanxi, and Xinjiang contain most of China's coal resources (Fig. 1). China currently has about 12,000 coal mines producing primarily bituminous coal, anthracite, and lignite. Much of China's steam coal resources occur in the north-central and northwestern parts of the country. In contrast, coking coal reserves are found mostly in central and coastal parts of China.

Coal constituted 69% of China's total energy consumption in 2011 (Fig. 2). China consumed an estimated 3.6 billion metric tons (4 bst) of coal in 2012 (Fig. 3), almost half of the total coal consumption in the world. Approximately two-thirds of coal in China is used for power generation (Fig. 4). Since 2009 China has been a net coal importer. Total imports increased to 293 million metric tons (323 mst) in 2012. The rise in imports is a result of increased demand as well as high coal transportation costs caused by bottlenecks in China's railway capacity, making imported coal economically viable, particularly along coastal regions that are distant from coal mined in western China. China is attempting to consolidate its coal industry, as it has ~10,000 minor local coal mines where inadequate investment, outmoded equipment, and poor safety procedures have resulted in inefficient resource development. The current Five-Year Plan calls for improving industry efficiency by forming 10 large coal companies to represent 60% of the country's total coal production, as well as limiting the number of coal mines to ~4,000.

Electricity generation in China is operated by state-owned holding companies, although limited private and foreign investments have recently been made in the electricity sector.

Improvements to power grids are also being made to deal with power shortages. Chinese power generation growth in 2014 was the slowest since 1998 and growth in steel production was also the weakest in more than 30 years. China has expanded the construction of natural gas-fired and renewable power plants to introduce power to remote population centers. Areas in China with greatest coal production encompass parts of Inner Mongolia, as well as Shanxi and Shandong Provinces (Michieka, 2014) (Fig. 1). More than 90% of coal produced by China is from underground mines (Meng et al., 2009).

China's coal production in 2014 is estimated to have dropped by 2.5% by year, having produced 3.52 billion metric tons (3.88 bst) of coal in the first eleven months of 2014. China produced 3.7 billion metric tons (4.1 bst) in 2013. This is the first annual decline in coal production in China in more than a decade (Reuters, 2015). This decline is the result of weakening demand from industry and the power sector, oversupply, and initiatives from the government to reduce air pollution. Mine operators have also been directed to reduce coal production in an effort to boost plunging prices.

One near-term effect has been the falling of world-wide coal prices to six-year lows, along with coal-mine closures in China and some global mining companies threatened with bankruptcy (Puko and Yap, 2015). Coal demand in Europe and the U.S. is also slacking, and even India is not importing sufficient coal to offset China’s cutbacks. International benchmark prices for coal have declined nearly 50% in the last three years to approximately $62 per metric ton ($56 per short ton) and the U.S. benchmark has been reduced by 24% to $52.90 per metric ton ($48 per short ton) from peak levels in 2012 (Puko and Yap, 2015). However, some economists predict that coal consumption in China could rise slightly in the near future, given sufficient concerns about the flagging economy and if prices for oil and other fuels increase. Although the global coal market is currently oversupplied, demand may rebound in five years.

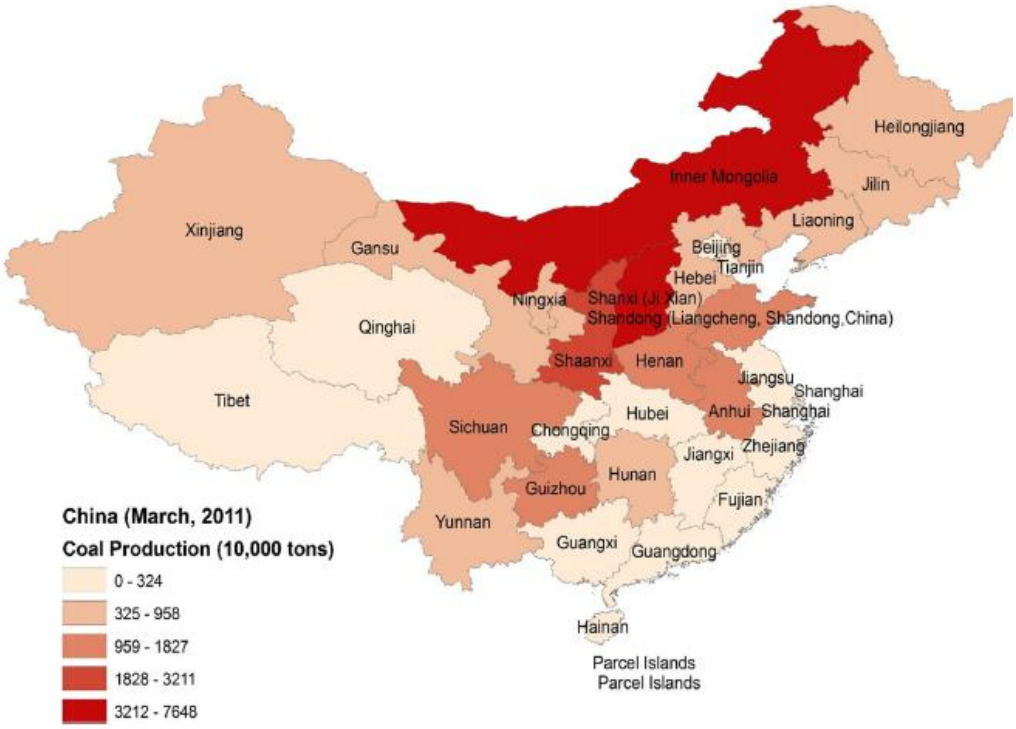


Figure 1. Distribution of recent coal production in China. These trends have changed little since 2011. From Michieka (2014).

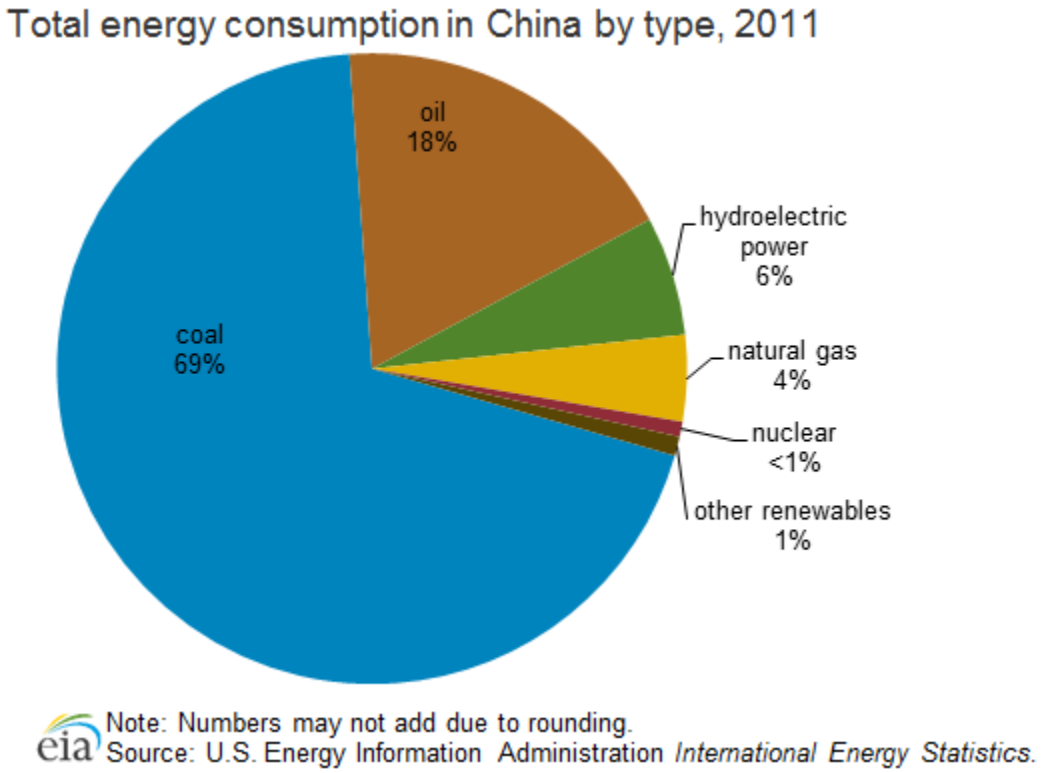


Figure 2. Total energy consumption in China by type, 2011. From Energy Information Administration (2015b).

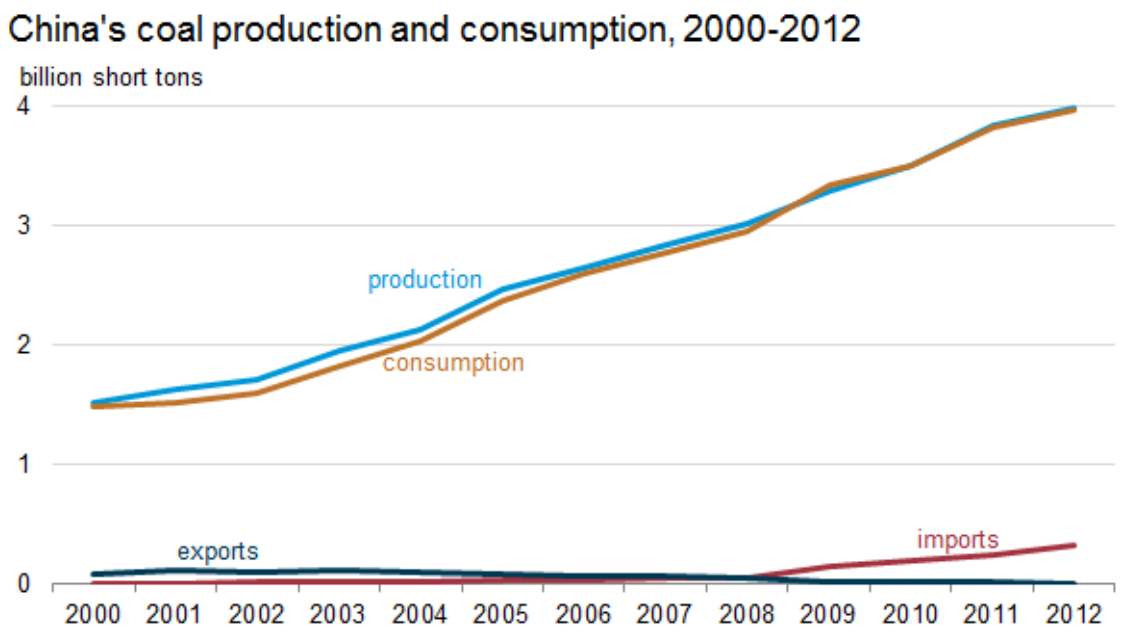


Figure 3. Coal production and consumption in China, 2002-2012. Units are billion short tons. From Energy Information Administration (2015b).

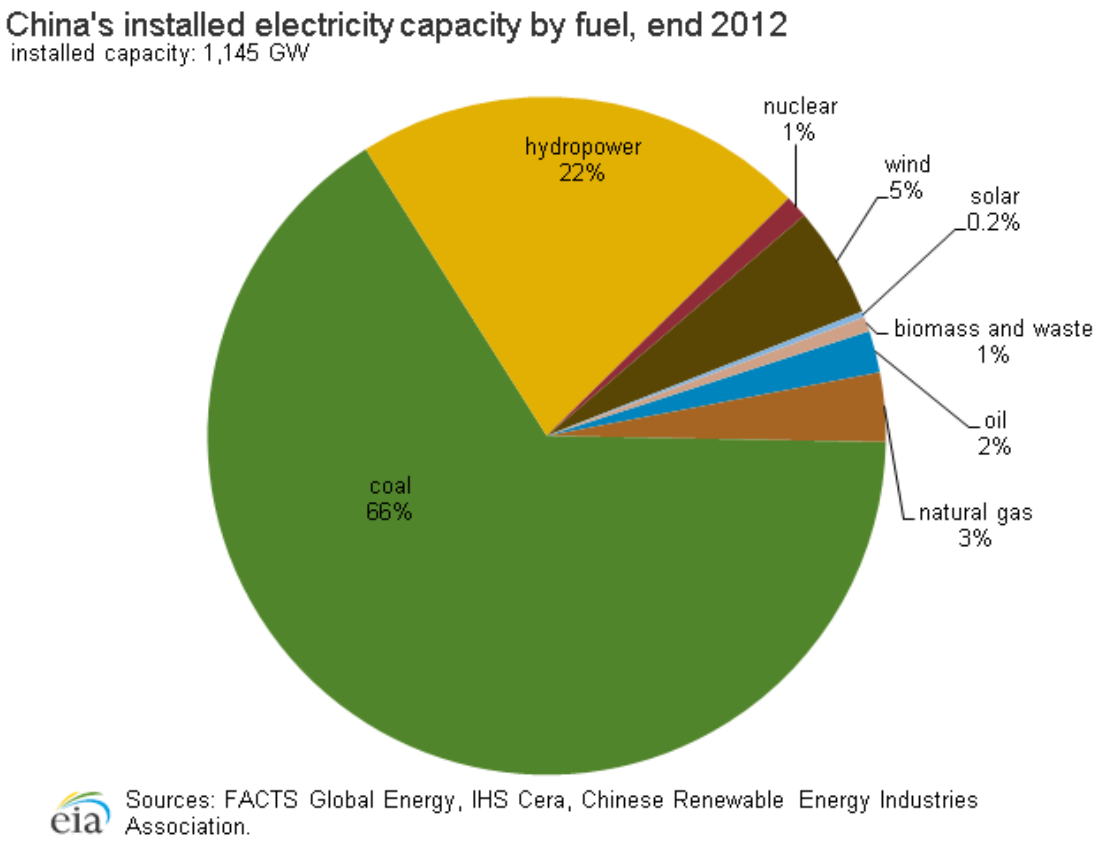


Figure 4. Electricity capacity by fuel in China, end-of-year 2012. From Energy Information Administration (2015b).

United States

Production, Consumption, and Markets

U.S. coal consumption in 2014 showed no increase, with third-quarter production on par with that in 2013 (Energy Information Administration, 2015c, d) (Fig. 5 and Table 2). Coal imports have held steady, but exports of both steam and metallurgical coal have declined from a second-quarter peak in 2012 (Figs. 6 and 7). The average price of U.S. steam and metallurgical coal exports during third-quarter 2014 was ~$95 per metric ton (~$86 per short ton) and ~$70 per metric ton (~$63.50 per short ton), respectively (Fig. 8). Wyoming continues to be the top coal-producing state, with 85.7 million metric tons (~94.5 mst) of production from April to June 2014 (Table 2).

The decline in U.S. coal exports in 2014 was primarily controlled by a decrease in world coal demand, depressed international coal prices, and greater coal production in other coal-exporting countries. The Energy Information Administration (2015e) projects coal exports will fall from 88 million metric tons (97 mst) in 2014 to an annual average of 73.5 million metric tons (81 mst) in 2015 and 2016. Coal consumption for electric power in the U.S. decreased by 0.8%, or 6.35 million metric tons (7 mst) in 2014. The Energy Information Administration (2015e) predicts that power sector coal will decrease by 2.2% in 2015, mainly as a result of lower natural gas prices and coal-plant retirements because of implementation of new air-quality and emission standards. An additional decline in coal consumption for electric power (0.5%) is projected in 2016. The annual average coal price to the electric power sector fell slightly from $2.39/MMBtu (million British thermal units) in 2011 to an estimated $2.36/MMBtu in 2014 (Energy Information Administration, 2015e). The delivered coal price is expected to average $2.31/MMBtu in 2015 and $2.34/MMBtu in 2016 (Energy Information Administration, 2015e).

Although U.S. coal production for exports continues to be strong, coal's share of the country's overall energy production is declining, primarily the result of expanded natural gas production (Humphries and Sherlock, 2013). Lower demand for coal in U.S. markets is projected from a combination of factors that include increasingly strict federal

regulations, lower natural gas prices, and coal-plant retirements. Reuters (2012), based on data from NERC (2011), estimated that market conditions and environmental regulations will contribute to between 59 and 77 GW of coal plant retirements by 2016 (Fig. 9). Greatest loss of coal-fired electricity generation is projected to occur in the southeastern U.S., with 27 to 30 GW of plant retirements, followed by the northeastern U.S. (18 to 26 GW).

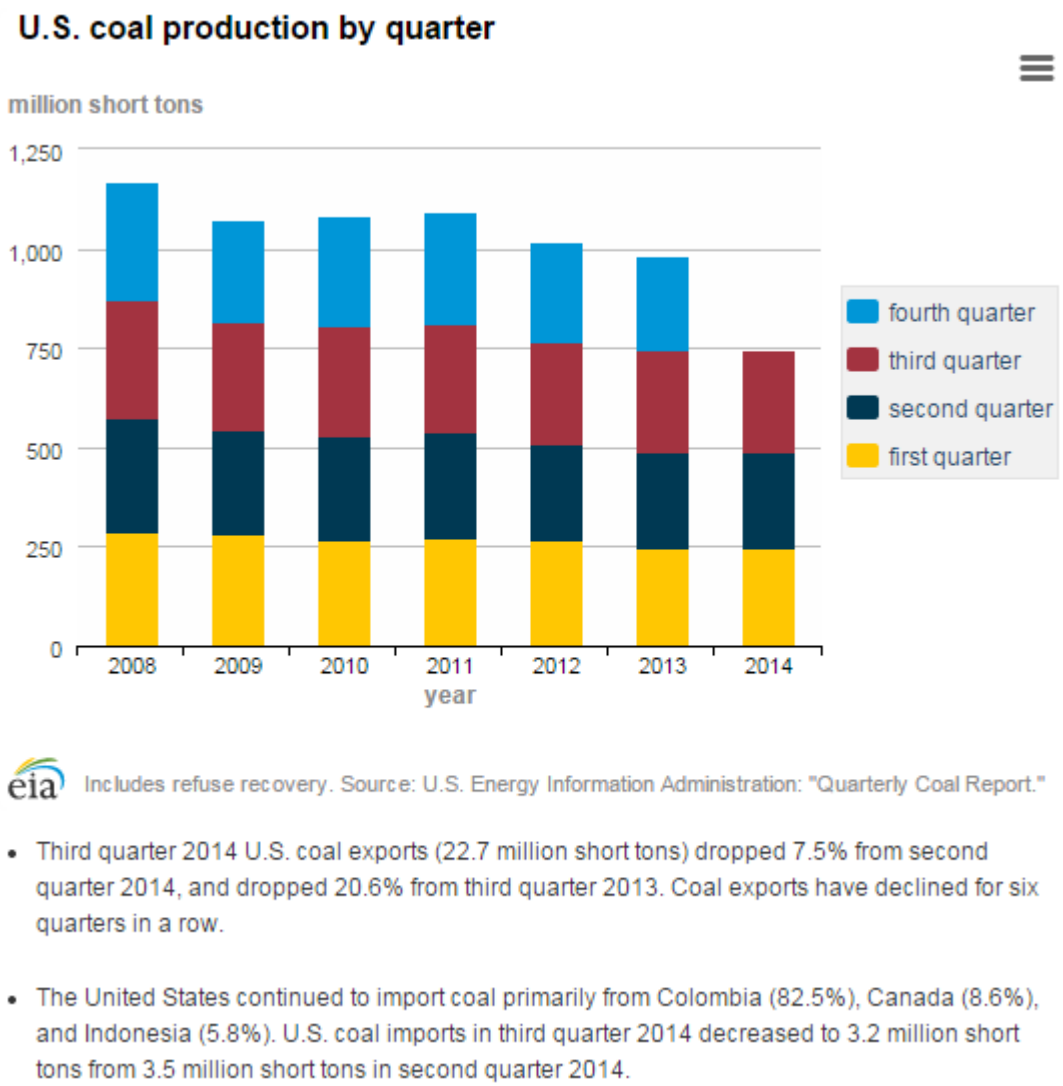
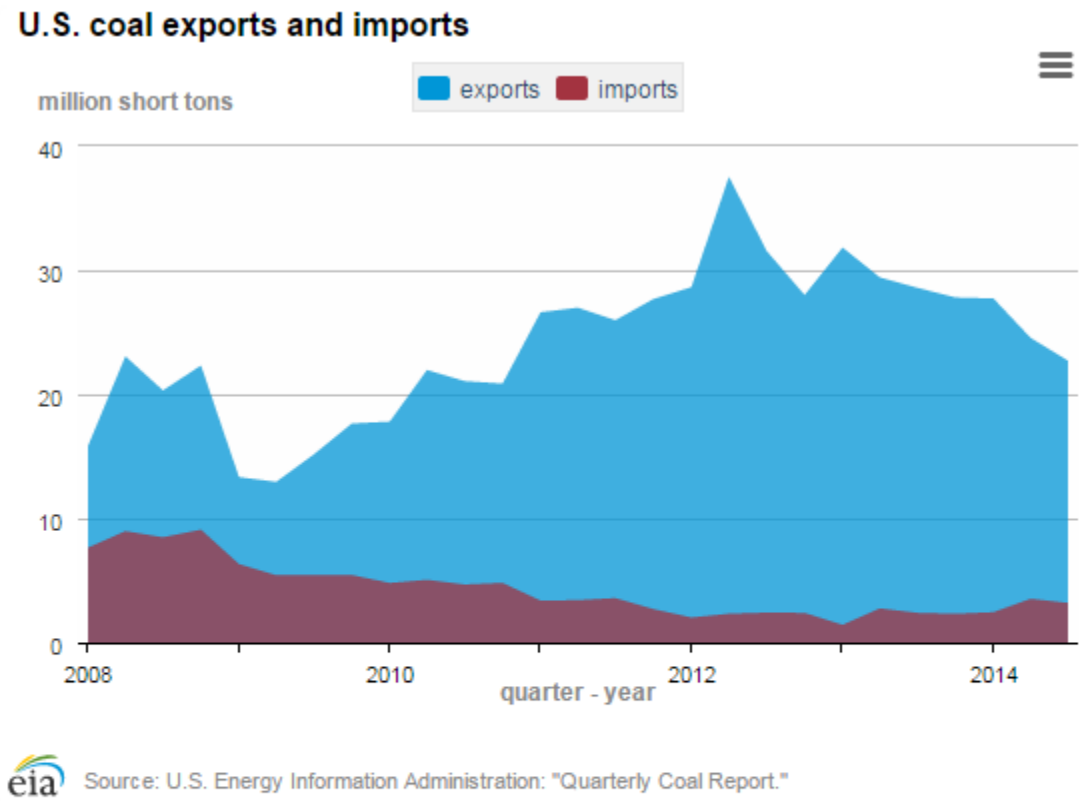


Figure 5. U.S. coal production by quarter from 2008 to third-quarter 2014. Units are million short tons. From Energy Information Administration (2015c).



The average price of U.S. coal exports during the third quarter 2014 was $85.81 per short ton. Steam coal exports totaled 7.5 million short tons (14.5% lower than second quarter 2014); metallurgical coal exports totaled 15.2 million short tons (3.7% lower than second quarter 2014).

Figure 6. U.S. coal imports and exports from 2008 to October, 2014. Units are million short tons. From Energy Information Administration (2015c).

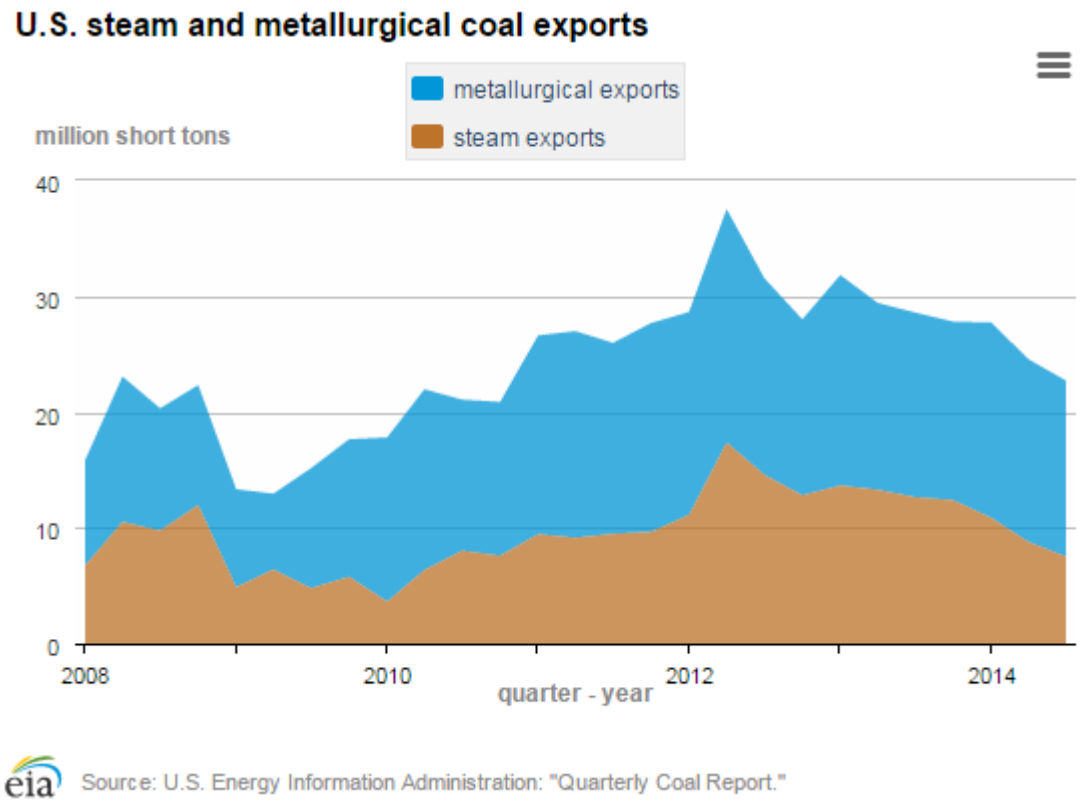


Figure 7. U.S. steam and metallurgical coal exports from 2008 to October, 2014. Units are million short tons. From Energy Information Administration (2015c).

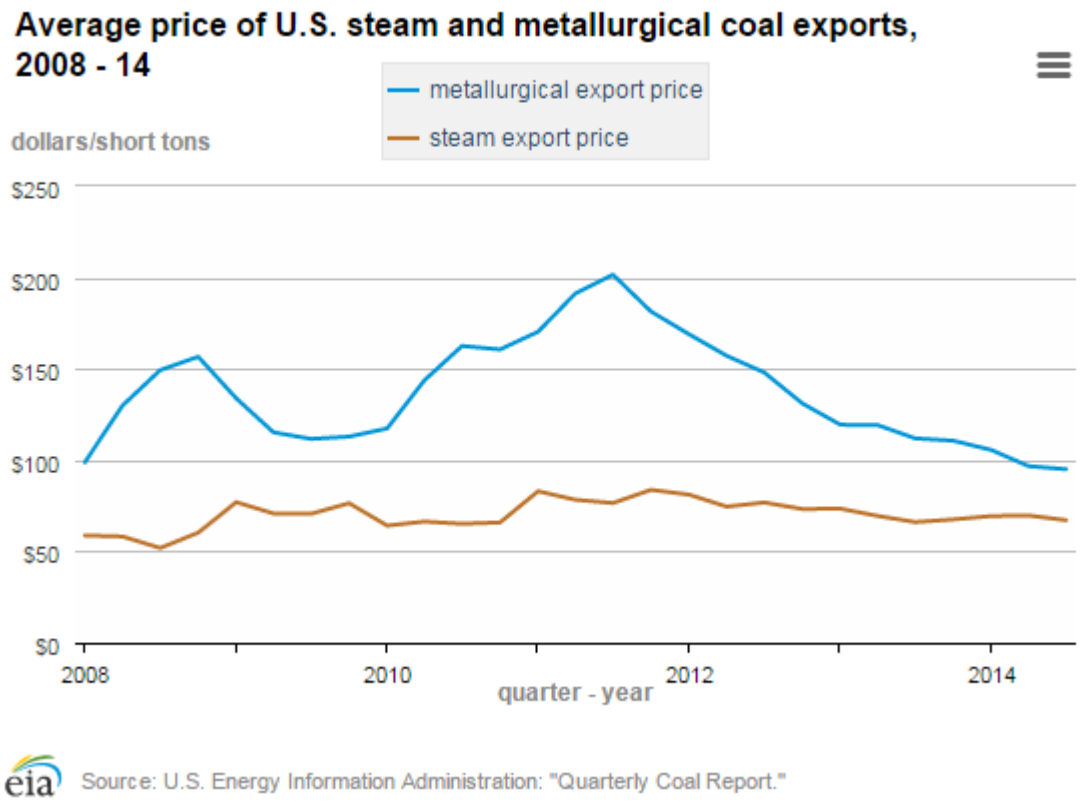


Figure 8. U.S. steam and metallurgical coal prices in dollars per short ton from 2008 to October, 2014. Units are million short tons. From Energy Information Administration (2015c).

Coal-Producing Region and State	July - September 2014	April - June 2014	July - September 2013	Year to Date 2014	Year to Date 2013	Percent Change
Alabama	4,315	3,644	4,862	12,386	14,077	-12.0
Alaska	372	399	403	1,178	1,244	-5.3
Arizona	2,165	1,844	1,805	5,979	5,814	2.8
Arkansas	18	23	24	58	30	94.2
Colorado	6,574	6,516	6,346	18,367	17,648	4.1
Illinois	14,805	13,583	12,511	42,540	39,987	6.4
Indiana	9,808	9,650	10,515	29,331	29,453	-0.4
Kansas	5	4	7	16	17	-3.4
Kentucky Total	19,869	19,832	19,897	59,197	61,264	-3.4
Eastern (Kentucky)	9,753	10,208	9,688	28,931	30,320	-4.6
Western (Kentucky)	10,117	9,624	10,209	30,266	30,944	-2.2
Louisiana	1,066	306	969	1,492	2,496	-40.2
Maryland	498	503	488	1,475	1,579	-6.6
Mississippi	1,073	949	1,176	3,008	2,680	12.2
Missouri	122	110	96	296	300	-1.4
Montana	11,874	10,981	11,566	31,783	31,203	1.9
New Mexico	5,502	5,823	5,870	17,093	17,555	-2.6
North Dakota	6,904	6,752	7,013	21,676	20,438	6.1
Ohio	5,432	6,305	5,936	17,288	19,691	-12.2
Oklahoma	217	235	269	704	849	-17.1
Pennsylvania Total	15,142	15,425	13,106	45,809	40,408	13.4
Anthracite (Pennsylvania)	531	418	515	1,373	1,577	-13.0
Bituminous (Pennsylvania)	14,612	15,007	12,591	44,436	38,831	14.4
Tennessee	221	181	258	595	854	-30.3
Texas	12,065	10,277	12,411	32,628	32,229	1.2
Utah	4,487	4,586	3,994	13,451	12,714	5.8
Virginia	3,657	3,829	3,992	11,434	12,535	-8.8
West Virginia Total	28,203	29,176	27,849	85,506	86,917	-1.6
Northern (West Virginia)	12,076	12,132	10,218	36,685	31,940	14.9
Southern (West Virginia)	16,127	17,044	17,631	48,821	54,977	-11.2
Wyoming	100,578	94,465	105,704	291,702	292,260	-0.2
Appalachia Total	67,221	69,271	66,179	203,424	206,381	-1.4
Appalachia Central	29,758	31,263	31,568	89,781	98,687	-9.0
Appalachia Northern	33,148	34,364	29,749	101,256	93,618	8.2
Appalachia Southern	4,315	3,644	4,862	12,386	14,077	-12.0
Interior Region Total	49,297	44,761	48,188	140,338	138,985	1.0
Illinois Basin	34,730	32,857	33,236	102,137	100,384	1.7
Interior	14,567	11,904	14,952	38,202	38,601	-1.0
Western Region Total	138,455	131,366	142,702	401,229	398,875	0.6
Powder River Basin	106,878	99,627	110,888	307,678	306,591	0.4
Uinta Region	10,611	10,623	9,898	30,447	29,154	4.4
Western	20,966	21,116	21,916	63,104	63,130	s
East of Mississippi River	103,024	103,078	100,591	308,568	309,445	-0.3
West of Mississippi River	151,949	142,321	156,479	436,423	434,796	0.4
U.S. Subtotal	254,974	245,398	257,069	744,991	744,241	0.1
Refuse Recovery	346	429	525	1,342	1,431	-6.3
U.S. Total	255,319	245,827	257,595	746,333	745,672	0.1

s = Absolute percentage less than 0.05 or value is less than 0.5 of the table metric.

Note: Total may not equal sum of components because of independent rounding.

Table 2. U.S. coal production in 2013 and 2014 by state. Units are thousand short tons. From Energy Information Administration (2015d).

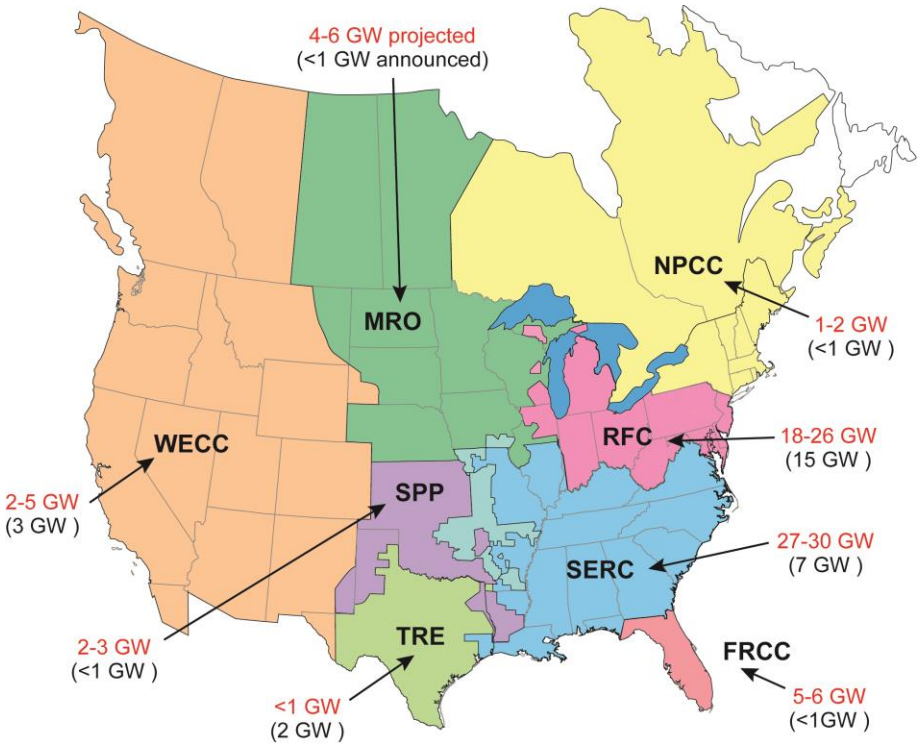


Figure 9. Distribution of anticipated U.S. coal plant retirements in terms of power-generation losses expressed in gigawatts (GW). Modified from Reuters (2012), based on data from NERC (2011). Florida Reliability Coordinating Council (FRCC); Midwest Reliability Organization (MRO); Northeast Power Coordinating Council (NPCC); ReliabilityFirst Corporation (RFC); SERC Reliability Corporation (SERC); Southwest Power Pool, RE (SPP); Texas Reliability Entity (TRE); Western Electricity Coordinating Council (WECC).

Coal Data Sources

The Energy Information Administration has an interactive, online Coal Data Browser that provides detailed information on U.S. coal. Accessible at http://www.eia.gov/beta/coal/data/browser/, this data site integrates comprehensive information, statistics, and visualizations for U.S. coal, including electricity generation. The browser also allows users to access data from the Mine Safety and Health Administration and coal trade information from the U.S. Census Bureau.

The Coal Data Browser allows the user to:

- Map coal imports and exports by country and by U.S. ports handling coal.
- Map where mines send coal and where power plants obtain coal.
- Analyze coal receipts by sulfur, ash, and heat content, as well as per mine.
- Observe changes in coal prices.
- Cross-link mine-level data pages with EIA's U.S. Energy Mapping System to discover data on all active coal mines.
- Observe changes in coal-worker employment in specific states.

India

The coal industry in India was the world's third largest in terms of production and the fifth largest in terms of reserves in 2012 (Energy Information Administration, 2015f). Annual production from Coal India, the primary operator of coal in the country, has steadily climbed in the last decade (Fig. 10). Coal India has a near-monopoly on the coal sector, of which the power sector comprises most of its coal consumption. However, it continues to undergo regulatory, technical, and distribution difficulties that limit production and prevent efficient transportation of coal to demand centers. Moreover, coal mines in the country are distant from the high-demand markets in western and southern India. Because coal production has failed to keep up with demand, particularly from the

power sector which accounted for 69% of coal consumption in 2011 (Fig. 11), India has been forced to import coal. India imported 162.4 million metric tons (179 mst) and was the third-largest coal importer in 2012 (Fig. 12). India imports thermal coal primarily from Indonesia and South Africa, as well as coking coal from Australia (Energy Information Administration, 2015f). Indonesia is the main source for imported coal in India (Fig. 13). The Indian coal ministry plans to scale down its production target of 795 million metric tons (876.4 mst) in the period from 2016 to 2017, owing to perceived problems in rail transport and compliance with environmental regulations (Thakkar, 2014). India possessed 249 GW of installed electricity generation capacity in 2014. However, owing to fuel shortages and limited transmission capacity, India still experiences electricity shortages and blackouts typically lasting from several hours to days.

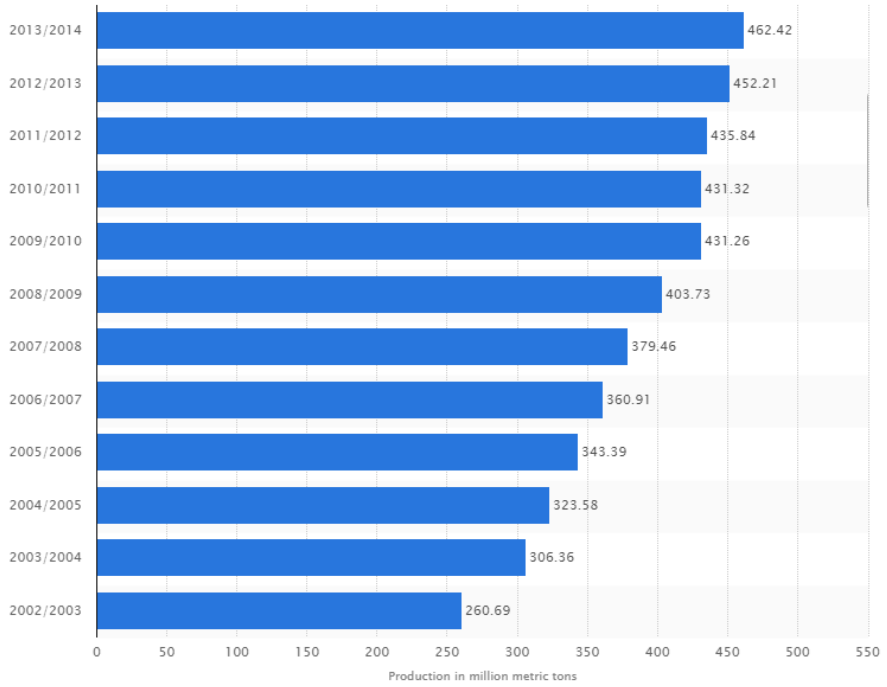


Figure 10. Recent coal production in Coal India. From Statista (2014). Units are million metric tons.

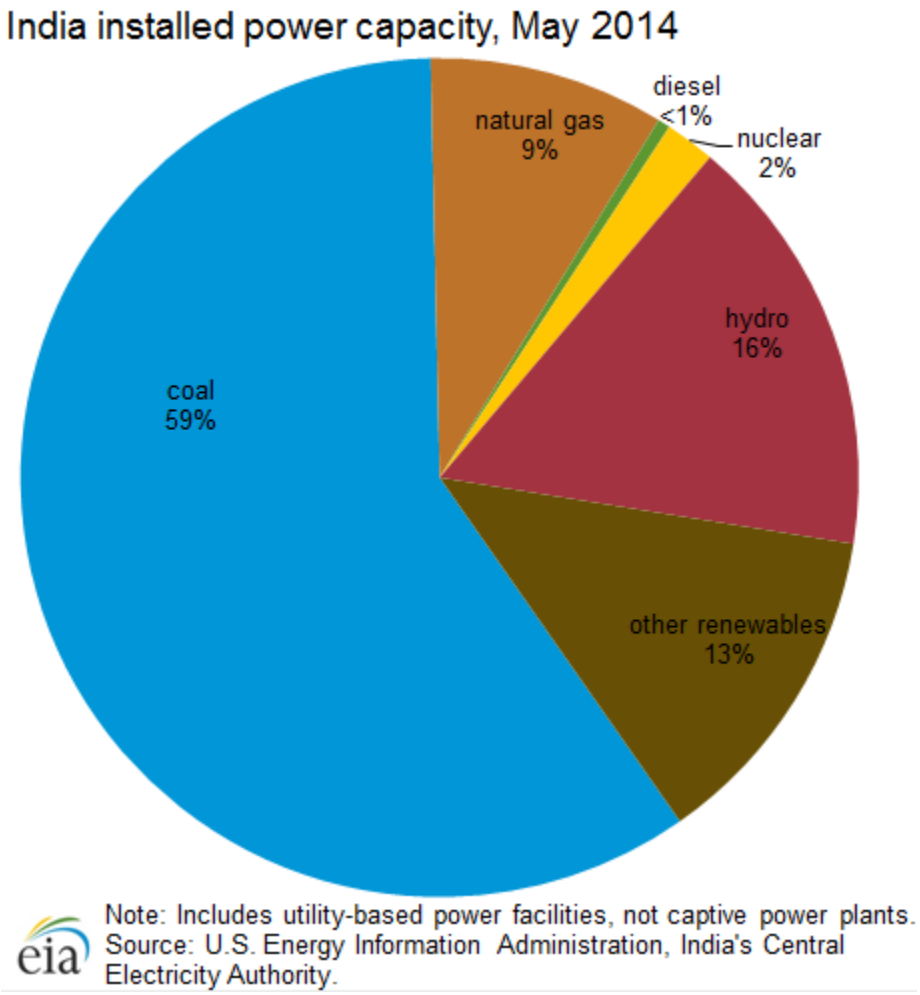


Figure 11. Installed power capacity in India by source, May 2014. From Energy Information Administration (2015f).

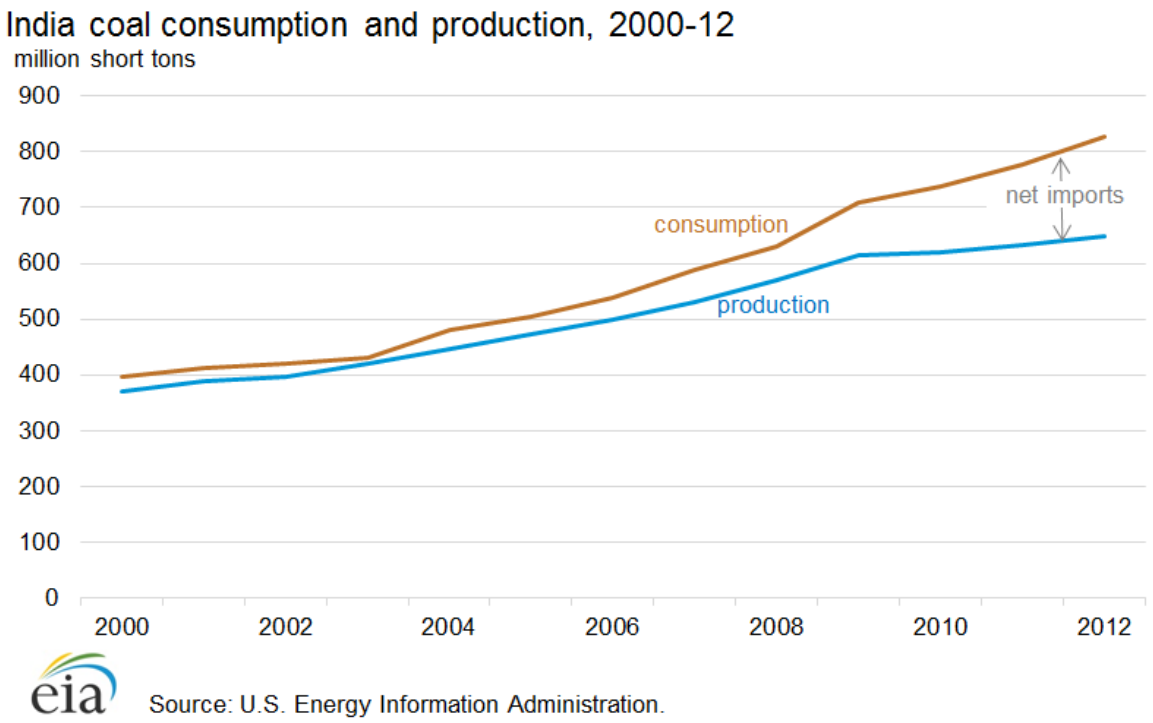


Figure 12. Coal consumption and production in India from 2000 to 2012. Units are million short tons. From Energy Information Administration (2015f).

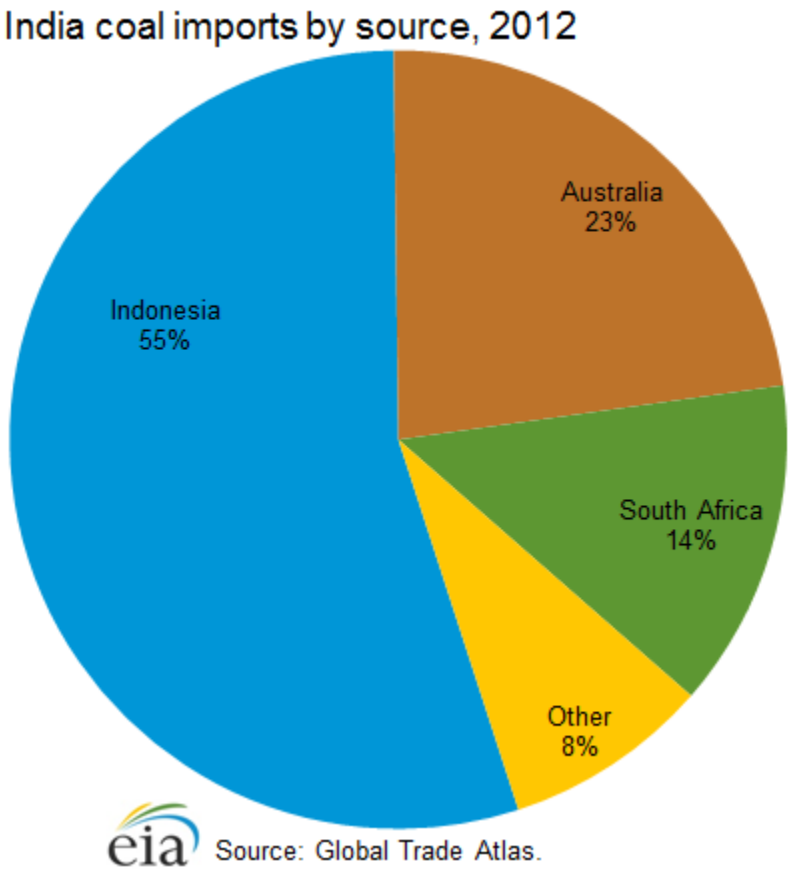


Figure 13. Coal imports to India by source in 2012. From Energy Information Administration (2015f).

Indonesia

Indonesia, the world’s largest exporter of thermal coal (Fig. 14), produces coal in three principal areas (Fig. 15). It is the world's largest exporter of coal by weight, exporting approximately 75% of its production (Energy Information Administration, 2015g). Indonesia overtook Australia as the world's largest exporter of coal by weight in 2011. The country’s coal production is mostly bituminous and subbituminous. Indonesia contains 5.5 billion metric tons (6.1 bst) of recoverable coal, although government and industry estimates suggest this resource base may be greater. Coal production quadrupled between 2002 and 2012, exceeding 408 million metric tons (450 mst). Indonesia's coal exports in 2011 were valued at $27 billion USD, representing 13.4% of total merchandise exports and most of the country's mining exports. These coal exports are mainly driven by growing demand for coal in China and India. In 2012, Indonesia exported 347.5 million metric tons (383 mst) of coal, destined mainly for Asian markets. In 2012, India became the largest importer of Indonesian coal, surpassing China, according to the Global Trade Atlas (Energy Information Administration, 2015g). Indonesia's coal consumption increased to 68.9 million metric tons (76 mst) in 2012. Electricity power generation accounts for most domestic coal consumption, with almost 70% of total coal sales in 2010. The government has been trying to increase domestic consumption, in part by supporting the development of mine-mouth power plants and promoting coal liquefaction and gasification. Indonesia boosted total 2014 production beyond the Indonesian government’s initial limits, even as a worldwide coal oversupply (exceeding 4.9 million metric tons [5.4 mst]) drove prices down to lowest levels in more than four years (Wulandari, 2014; Cahyafitri, 2014). New Indonesian coal export rule, designed to eliminate illegal mining, had little impact in October, 2014 the first month they were in effect, as shipments from the world's top thermal coal exporter increased 9.8% for the year (Asmarini, 2015).

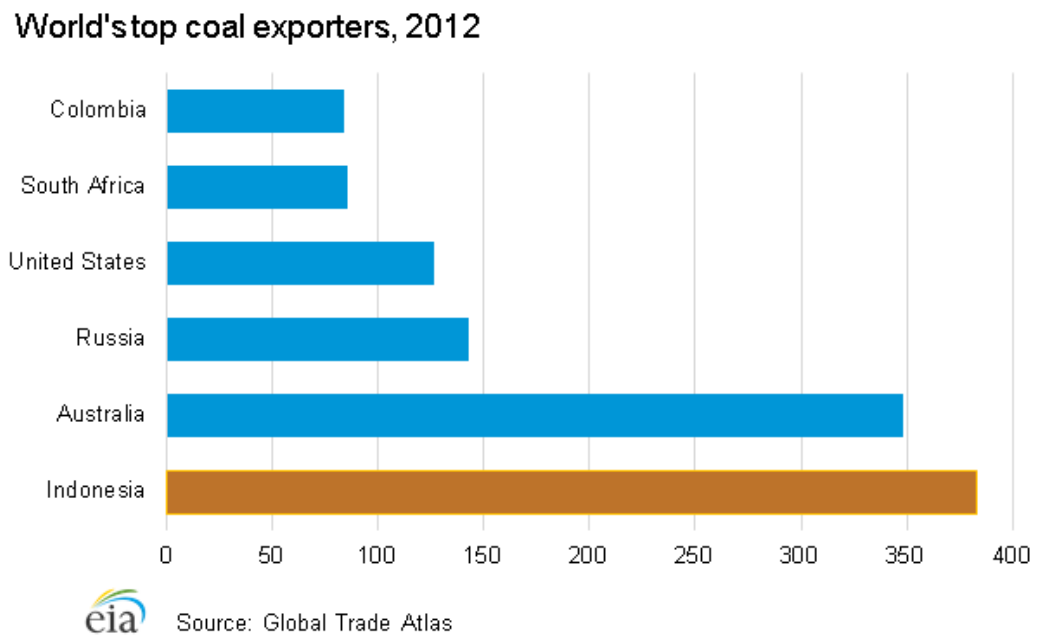


Figure 14. World's top coal exporters. Units are million metric tons. From Energy Information Administration (2015g).

(map) Major Coal Production Sites of Indonesia

1. South Sumatra
2. South Kalimantan
3. East Kalimantan

Figure 15. Principal coal-mining areas in Indonesia. From Indonesia Investments (2013).

Australia

Australia is the world's second-largest exporter of coal on a weight-basis (Energy Information Administration, 2015h). Australia had 105 billion metric tons (116 bst) of proved and probable commercial reserves in 2012, consisting of 58% from black coal (bituminous and higher-rank coal) and 42% from brown coal (lignite). Queensland and New South Wales represented 98% of Australia's black coal production in 2012, whereas almost all brown coal production was from Victoria. Australia's coal exports in 2012 amounted to ~$40 billion USD. Approximately 120 privately-owned coal mines are located in Australia. Most coal production is from open-pit mining, with international companies such as Rio Tinto (Australia-UK), BHP Billiton (Australia), Anglo American (UK), and Xstrata (Switzerland) leading the industry.

Australia produced 420.8 million metric tons (464 mst) of coal in 2012, a reduction of 3.6 million metric tons (4 mst) from 2010. This decline was in part a result of flooding in Queensland in 2011, which resulted in a fall off in production in that state by 30%. However, the coal industry in Australia continues to expand. By April 2014, Australia had $11.2 billion USD in advanced coal mining and infrastructure initiatives, which are projected to add almost 72.6 million metric tons (80 mst) of production capacity by 2017. Coal and lignite account for approximately 64% of Australian electricity generation (Fig. 16). Coal continues to represent a baseload source for electric power, owing to abundant resources and well-developed infrastructure. Coal exports from Australia in 2012 were ~301 million metric tons (~332 mst), accounting for 72% of total coal production in the country (Energy Information Administration, 2015h). Almost 35% of Australia's coal exports in 2013 were to Japan, with 25% transported to China and most of the remainder destined for South Korea, India (11%), and Taiwan. Queensland has seen a record amount of coal exports in 2014, with exports of almost 216 million metric tons (238.1 mst) (Latimer, 2015). However, many coal operators in Australia are cutting costs in an effort to adjust to the recent global fall in coal prices (Paton, 2014). These cost-cutting measures are seen as temporary, ahead of an anticipated market recovery in 2015.

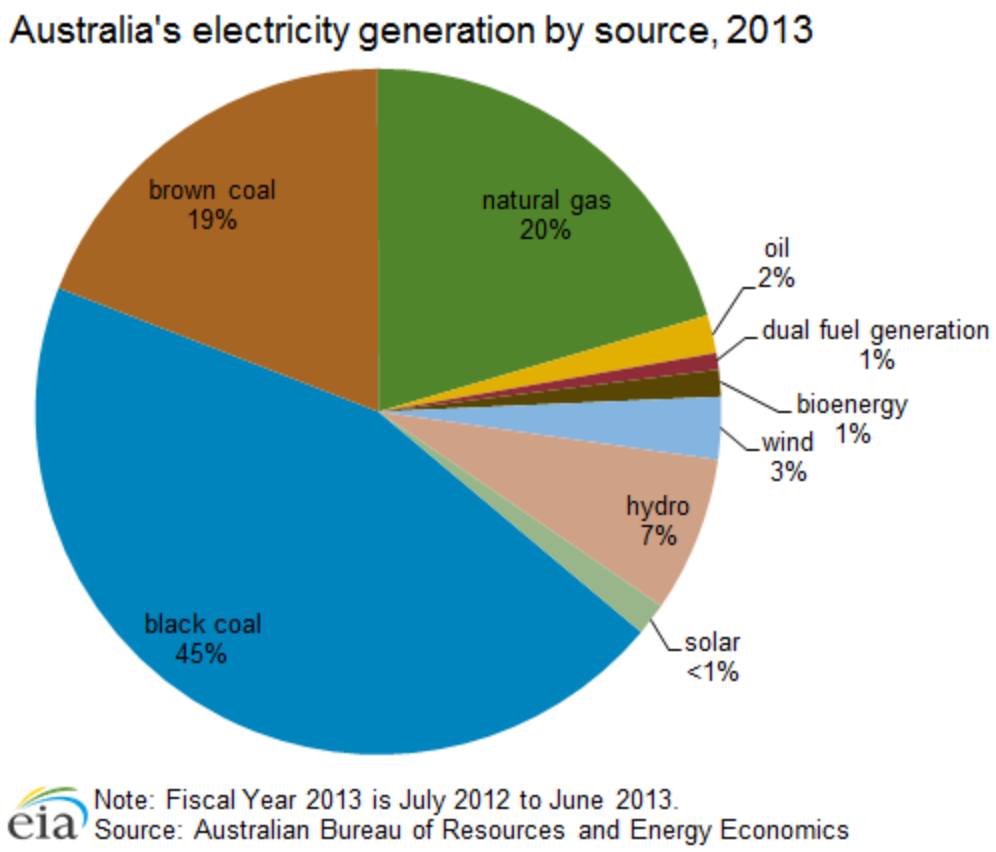


Figure 16. Electricity generation by source in Australia, 2013. From Energy Information Administration (2015h).

Russia

Although Russia has large coal reserves (236.7 billion metric tons [261 bst] reported in 2008 [Energy Information Administration, 2015i]), its coal production is modest (Table 1). Approximately 80% was steam coal for power generation and 20% was for the coking industry. Russian coal exports are projected to increase 8.8% over 2014 to reach 140.2 million metric tons (154.5 mst) (Worldcoal, 2015). The majority of this production (>65%) is from open-cast mining. Russia has inaugurated a long-term development plan for its flagging coal industry and is calling for an increase in coal production and electricity generation from coal (Dobrovidova, 2014). Russian coal exports in July 2014

failed to reach comparable levels to July 2013 (Fig. 17). Coal production in Russia, accounting for 16% of the nation's total energy mix, showed a consolidated loss of 22 billion rubles in 2013. Part of the reason for this loss is cheaper natural gas and global fall in coal prices. Russia plans to increase coal production to ~372 to 435.4 million metric tons (410 to 480 mst) by 2030, which would involve a growth in exports by 63.4 million metric tons (~70 mst). Domestic consumption would grow from 83.4 to ~118 million metric tons (92 to 130 mst) per year in this scenario. In order to meet this target of increased coal production, Russia has agreed to develop Siberian coal for Chinese markets (Homeriki, 2014). Rostech has signed an agreement with China's Shenhua Group to develop Siberian coal deposits in Russia's Siberia and Far East. The project will cost between $8 and $10 billion USD.

Figure 17. Russian coal exports, July 2013 to July 2014. CMLV = cumulative values for each year. Numbers on y axis are exports valued in terms of USD million. From Tradingeconomics.com (2014).

South Africa

South Africa contains 95% of Africa's total coal reserves (Energy Information Administration, 2015j). Proved coal reserves in South Africa are 27.4 billion metric tons (30.2 bst). Coal represents >70% of the country's total primary energy consumption (Fig. 18). South Africa exports approximately 25% of its coal production (Fig. 19). Most coal in the country is from Highveld, Witbank, and Ermelo coal fields near Swaziland. Coal production is expected to peak in the next decade, but increased development in areas such as Waterberg coal field could extend production. However, the ultimate productive capacity of South Africa is constrained by infrastructure and limited water resources. Eskom began work on expanding capacity at the coal-fired power stations Grootvlei and Komati by 30 and 90 megawatts (MW), respectively, in 2014, and plans to commence operations at the coal-fired Medupi power station (4,764 MW) and Kusile plants (4,740 MW) in the near future. South Africa is one location in the world where coal is commercially converted to other energy sources without combustion, as there is a facility that produces synthetic fuels mainly from low-rank coal. More than 33.6 million metric tons (37 mst) of coal per annum are processed into liquid fuels at the Sasol synfuels plant in Secunda. Plans are underway to expand this capacity by 30,000 barrels per day by 2015.

Some mining groups in South Africa are reducing their involvement in the coal mining industry (Ryan, 2014). Total Coal SA announced in January, 2014 that it was offering two operating mines for sale and BHP Billiton has been decreasing its part of the coal business in South Africa in the last ten years. Rio Tinto in 2010 also sold its Chapudi coal projects in Limpopo to Australian junior Coal of Africa (CoAL). Regulatory uncertainty also is a potential roadblock to expanded coal production, as a proposal from the South African government declaring coal a strategic mineral, could result in stricter regulation of domestic prices and export volumes. The bill was passed by the National Assembly, but still has yet to be passed by the National Council of Provinces.

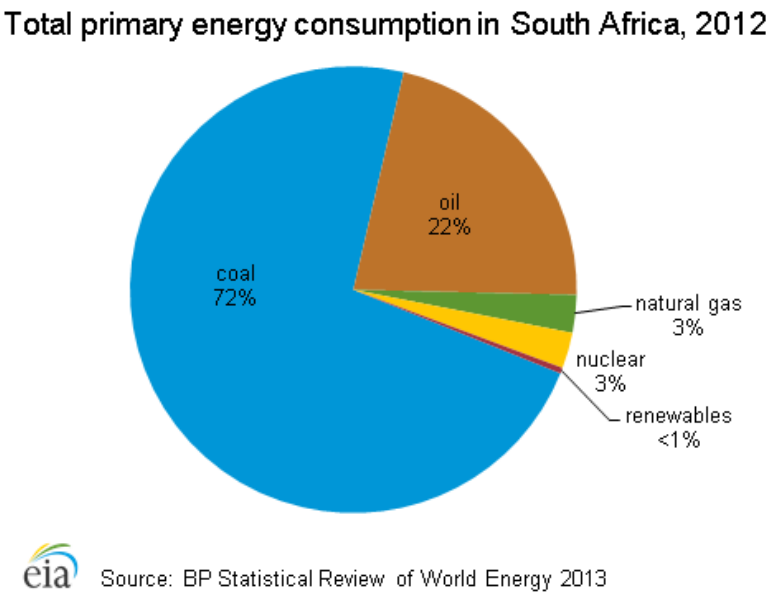


Figure 18. Total primary energy consumption in South Africa in 2012. From Energy Information Administration (2015j).

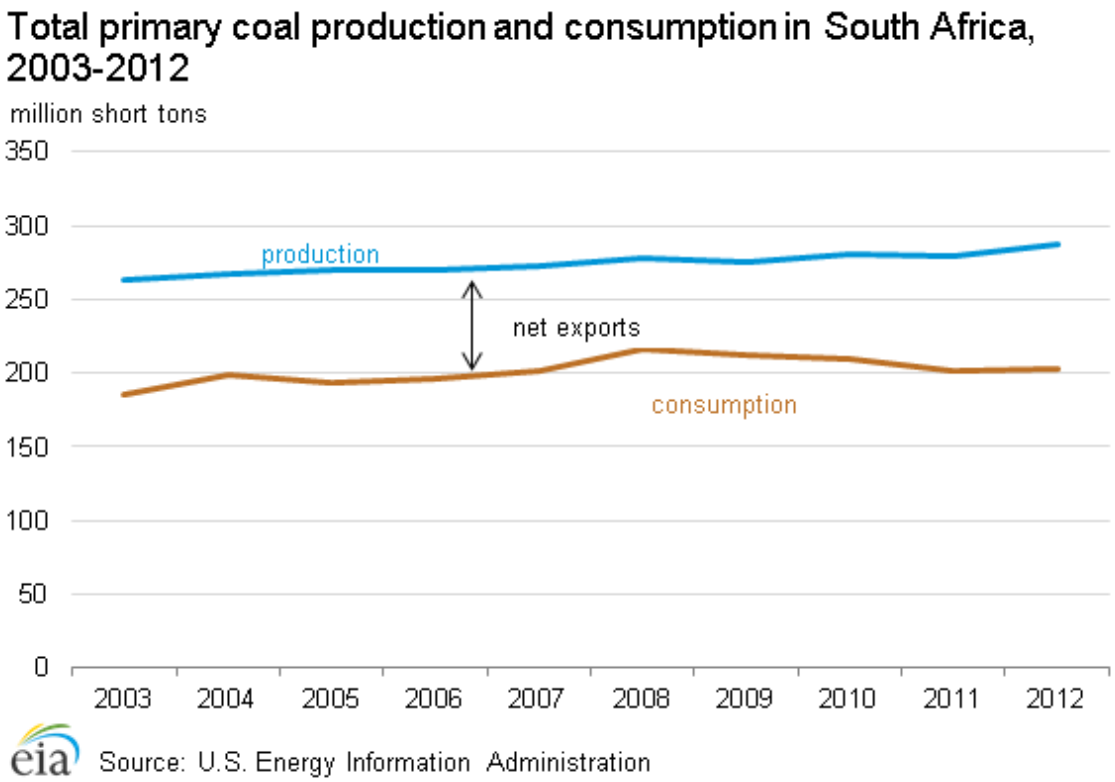


Figure 19. Total primary coal production and consumption in South Africa, 2003 to 2012. Units are in million short tons. From Energy Information Administration (2015j).

Germany

Coal represented 24% of Germany's total primary energy consumption in 2012, a slight increase compared to recent years (Energy Information Administration, 2015k), in part from increased reliance on coal as a result of Japan's Fukushima reactor accident in 2011. Almost all coal production in Germany is dedicated to power and industrial sectors. Germany plans to reduce greenhouse gas emissions by 40% (from 1990 levels) by 2020 (Destatis, 2015). Coal was still the dominant source of electricity in Germany in 2014, although there is increased energy production from renewables (Fig. 20).

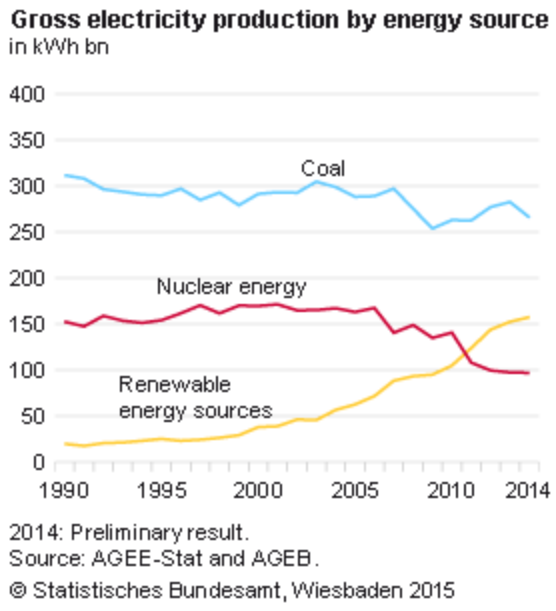


Figure 20. Gross electricity generation by energy source in Germany, 1990 to 2014. Units are in kilowatt-hours. From Destatis (2015).

However, coal is not making a significant comeback in Germany because new coal plants are not related to Germany's nuclear phase-out, following the Fukushima incident (Jungjohann and Morris, 2015). In contrast, an increase in renewable energy is more effectively offsetting the decline in nuclear energy. The impact on hard coal is expected to be greater than that on brown coal. Lignite will likely be impacted only slightly during this reduced dependence on nuclear energy (Andresen, 2014). Currently, Germany lacks policies to reduce lignite consumption. The market is unlikely to bring about a reduction in power production from lignite until the mid-2020s.

The recent decision by Germany's Chancellor Angela Merkel to close all 17 of Germany's nuclear power stations by 2022 has resulted in the German power utility company RWE AG posting its first loss since World War II. RWE has increased production from its coal-fired facilities, most of which are fueled by lignite. As a result, RWE now generates 52% of its electricity in Germany from lignite, a 7% increase since 2011. However, environmental legislation limits the return to coal as an electricity-

generating source, and electricity generation from coal in Germany is down in 2014 compared to 2013 (Fig. 21). E.ON is one of the world's largest investor-owned power and gas companies and operates facilities across Europe, Russia, and North America. E.ON has recently fared better than RWE, producing power for new international markets. Nevertheless, RWE still plans to continue with lignite and is moving ahead with plans to construct a 1.1 GW power plant in Niederaussem, Germany. The plant is scheduled to commence operations in 2018.

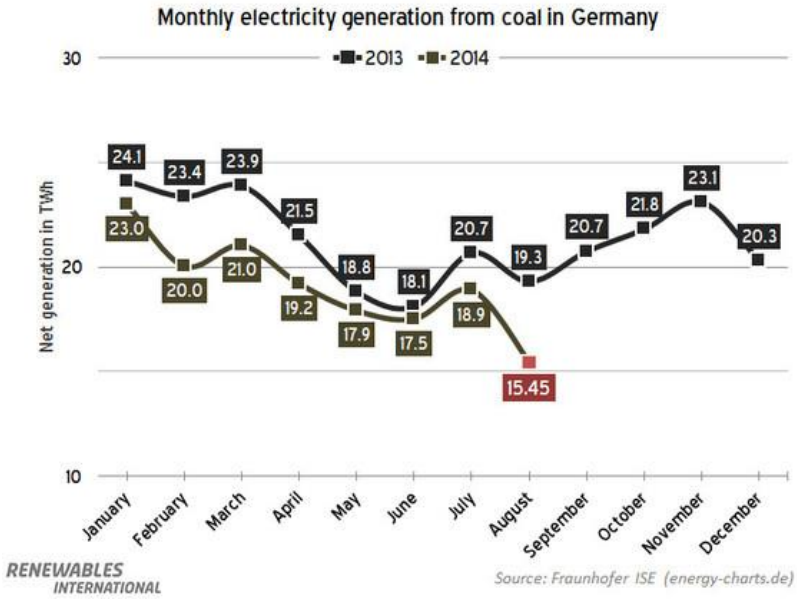


Figure 21. Monthly electricity generation from coal in Germany, 2013 to end of July 2014. From Gerke (2014).

Poland

Coal production in Poland is the second largest in Europe, exceeded by Germany (Energy Information Administration, 2015l). Of the 3.9 quadrillion BTU (British Thermal Units) of Poland's primary energy consumption in 2012, coal represented 55%. Coal production in the same year was 143.3 million metric tons (158 mst), or ~20% of total coal production in Europe. Poland consumes almost all of its produced coal, with significant use from the electricity sector. Abundant coal in Poland is seen as a means of lessening dependence on Russian natural gas, with climate objectives as being secondary (Bauerova, 2015). Poland has the lowest reliance on natural gas among the EU's 10 largest economies. It also has the support of the Czech Republic and Slovakia, which also have substantial coal deposits. Polish industry spent 23% less for power than German industry in 2012, as well as having provided jobs for >100,000 people. Nevertheless, coal's future in Poland will be influenced by European Union (EU) policies on the environment and the development of alternative and renewable energy sources (Ministry of the Treasury, Republic of Poland, 2015). Last year Polish mines in 2013 produced less than in 2012, a 4.5% decline (Fig. 22). Nuclear energy and renewables may lower the demand for coal and new coal-burning power generation capacity in the future.

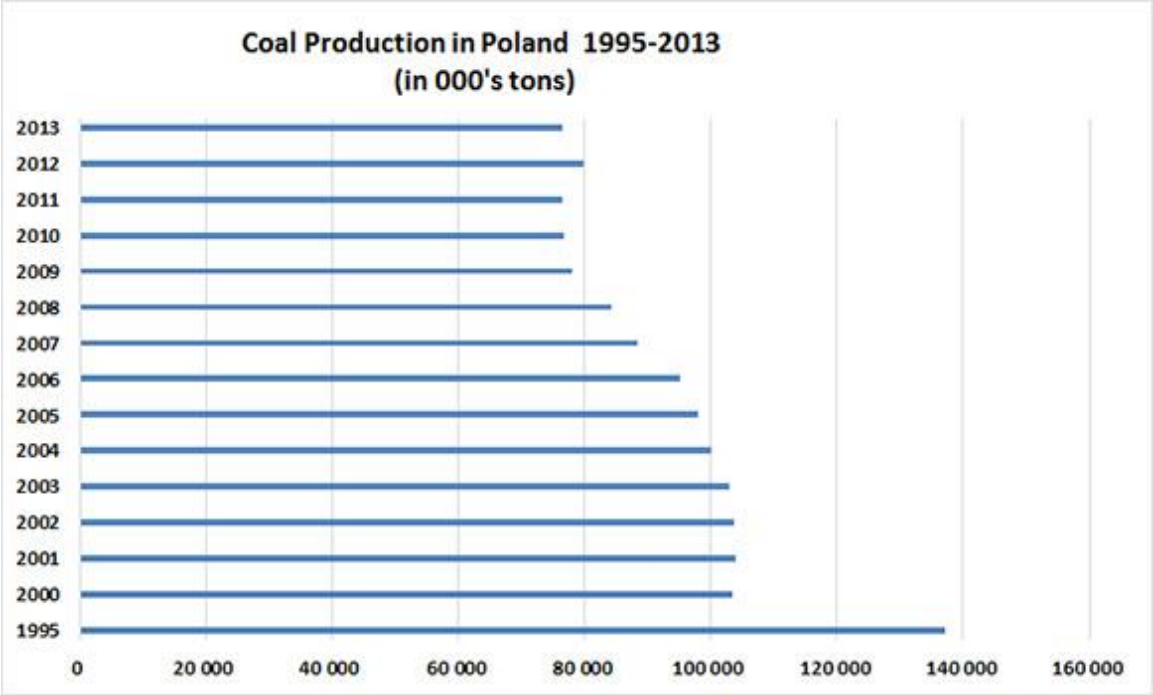


Figure 22. Coal production in Poland, 1995-2013. Units are thousands of short tons. From Ministry of the Treasury, Republic of Poland (2015).

Kazakhstan

Coal represented 63% of Kazakhstan's total energy consumption in 2012 (Fig. 23). Kazakhstan contained 33,593 million metric tons (37,038 mst) of total recoverable coal reserves in 2011. It is 12th in the world in terms of coal consumption. Although Kazakhstan is in the list of the top ten coal-producing countries, the country contributes only minor amounts to global coal volumes (between 1% and 4%). Kazakhstan exports ~25% of its produced coal, with most destined for Russia. All of these exports are steam

coal. Kazakhstan also produces minor amounts of metallurgical coal for domestic consumption. Most of Kazakhstan's electricity is from coal-fired power plants, many located in the north part of the country where coal is produced. The country's total installed generating capacity was approximately 17.8 GW in 2012, of which 87% is from hydrocarbons.

A coal-to-liquids (CTL) facility is underway in Kazakhstan (Urazova, 2015). It is an experimental complex for transformation of brown coal into gasoline and diesel fuel. The facility is located in Akmola Oblast and is designed for a capacity of 7.3 metric tons, or 8 short tons per day.

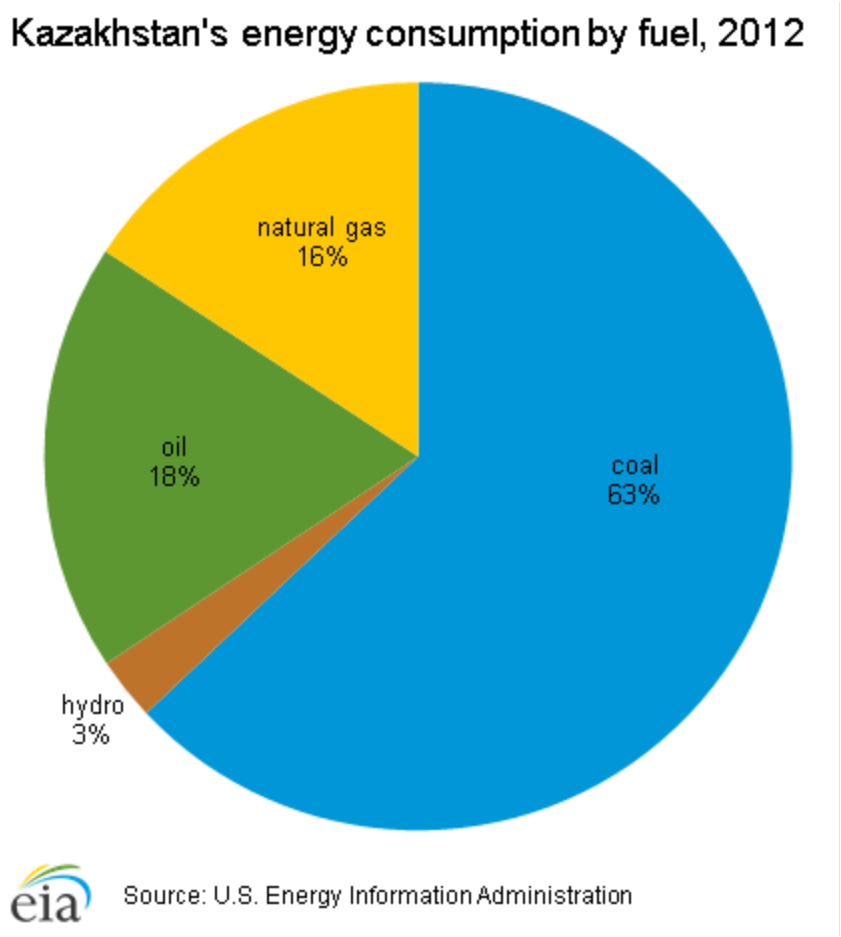


Figure 23. Energy consumption by fuel type in Kazakhstan in 2012. From Energy Information Administration (2015m).

Canada

The distribution of coal as a sedimentary rock in Canada is on the margin of a vast central craton (where sedimentary rocks are not preserved), with sedimentary basins on the eastern, western, and northern extensions of the continent. The craton also appears to wrap around the relatively unexplored sedimentary basin of Hudson Bay/James Bay, which, along with the northern extension of the continent, comprising mainly the Sverdrup Basin, contain coal occurrences and deposit reserves. However, there is little to no development in this area and they are not mentioned further here.

The primary area of coal resources in Canada is in the "Western Canadian Sedimentary Basin" that covers portions of two territories and four provinces. The mountainous far west has numerous intermontane sedimentary basins that were created as a result of tectonic forces. One of these is on the west coast of British Columbia where coal seams were mined near tidewater and exported around the world. The eastern sedimentary areas in three Maritime Provinces of Canada are generally the northernmost extensions of Appalachian strata and structure.

The remainder of this section reports on coal production, consumption, and regulatory issues from Alberta, British Columbia, Nova Scotia, and Saskatchewan. Other provinces and territories do not have much coal mining activity. Ontario, Manitoba, and New Brunswick are mentioned after Saskatchewan as coal-importing provinces with thermal power stations.

Alberta has 70% of Canada's coal reserves and has extensive production of coal for three very different markets: domestic thermal coal (sub-bituminous coal usually for mine-mouth power plants), export domestic thermal coal (bituminous coal with higher heating value), and export metallurgical coal (bituminous coal with coking character). The large area of the Plains region is underlain by shallow-dipping thermal coal and the export

coals are limited to the Mountains and Foothills regions. Alberta is also a large producer of CBM (coalbed methane), discussed in another EMD commodity report. Reserves of coal are over 32.6 billion metric tons (36 bst), but only a small portion is currently permitted for mining. Two permitted mines for metallurgical coal exist in the Mountains region, but one mine was suspended in 2014 and the other is on reduced production. Three mines for export thermal coal are permitted in the Foothills region, but one was closed and had a catastrophic tailings release, one has had initial construction stopped, and the other one is on reduced production. Four mines in the Plains supply mine-mouth power plants with sub-bituminous coal and they are independent of world coal prices, so their production remains continuous as Alberta does not yet have a plan to reduce greenhouse gas emissions. Coal fuels 43% of electrical power generation in Alberta and Natural gas fuels 40% of electrical generation. There are an additional two small mines in the Plains supplying local heating fuel for small consumers. Report ST-26 (Alberta Coal Industry Monthly Statistics), which summarizes coal mining in Alberta, can be accessed for purchase at http://www.aer.ca/documents/sts/ST98/ST98-2014.pdf.

British Columbia has extensive resources of thermal coal that were previously mined or explored in the intermontane basins, but currently there is only one producing thermal coal mine on the west coast of the province and no coal-fired power plants. As the single producing thermal mine is exporting to the world market, it has faced the same price reductions and reduced its activity. A small mine in the interior was supplying high-ash coal to the portland cement industry. The province has legislation requiring coal-fired power plants to have zero emissions and there is an emphasis on renewable energy (BC Energy, 2015). Some intermontane basins also contain metallurgical coal resources with extensive exploration, but there is no current production. One proposed mine has had the coal leases put into stasis until the contentious issues of opening a mine are resolved. All of the current coal mines in eastern areas of the province exist for the production of export metallurgical coal (bituminous coal with coking character) similar to Alberta. Many of these mines are in similar strata to that seen in the Alberta foothills, either along structural strike or in the next structural domain within the tectonic thrust belt of the eastern Cordillera. There are five mines currently in production in the south eastern area

of the province and they are continuing full production from Jurassic-Cretaceous coals, but the four mines in the northeastern area that were mining Lower Cretaceous coals were suspended in 2014 due to the low market prices. In 2014, coal production was 46% of the value of all mining in British Columbia (British Columbia Geological Survey, 2014).

Nova Scotia has some of the oldest mining activities in Canada, with large resources and many years of mining in three main structural basins (Cumberland, Sydney, and Stellarton) and a number of smaller sub-basins. Currently, there is no mining activity in Nova Scotia since the provincial corporation DevCo closed the last of its mines on November 23, 2001 in the Sydney coal basin and the Westray explosion and fire on May 9, 1992 in the Stellarton coal basin. Some interest has been shown in extending some rock tunnels at Donkin (Sydney coal basin) for access to otherwise stranded resources offshore of older collieries. Nova Scotia Power Inc. in 2014 generated 60% of the electricity in Nova Scotia from coal-fired power plants at Trenton (310 MW), Lingan (620 MW), Tupper (150 MW), and Point Aconi (165 MW), all of which are fuelled by coal imported from outside Canada.

There are three coal mines in Saskatchewan producing lignite primarily for mine-mouth power plants with some minor export of fuel to power plants in other provinces. No other mineable coal resources occur in the province. As described in the other provinces below, the lignite export has been seriously reduced. The coal mines and corresponding power plants are at Poplar River, Boundary Dam, and Shand and all are operated by SaskPower Inc. which generate 37% of the electricity in Saskatchewan. Announcements in 2013 and 2014 have focussed on the carbon capture project at the Boundary Dam facility where about 90% of CO_2 emissions are to be captured and used for tertiary recovery of oil reservoirs.

Ontario does not have large coal resources or coal mining activity, but has imported thermal coal from eastern provinces for fuel at the Nanticoke power plant. When these provinces ceased production, Nanticoke imported coal from the northern U.S. The 3,964 MW Nanticoke facility was decommissioned from coal combustion between 2010 and

December 31, 2013. The next largest power plant was the Lakeview facility, but it ceased burning coal in 2005. The third largest coal facility was Lambton, but it was decommissioned from coal combustion between 2010 and December 31, 2013. The power plant at Atikokan is a small facility of 230 MW that imported lignite from Saskatchewan, but it was converted to biomass fuel in 2014. There are no plans for future coal-fired power generation in Ontario.

Manitoba has a combination power plant at Brandon with a 110 MW coal-fired unit using lignite imported from Saskatchewan, but the use of this unit was restricted by legislation to only "emergency use" in 2010. There is no plan for coal combustion in Manitoba.

NBPower (previously New Brunswick Power Corporation) in 2014 generated some of the electricity in New Brunswick from a coal-fired power plant at Belledune (450 MW) fuelled by coal imported from outside Canada. The power plant at Dalhousie (165 MW) had one burner designed for coal, but it was switched to bitumen fuel (from Venezuela) in 1994, but when that fuel supply was closed in 2004, it was announced on September 27, 2012 that it would be closed. Coal had been mined near Minto since 1986, but the last mine closed in 2009 and the corresponding power plant at Grand Lake was demolished in 2012.

Provincial governments are responsible for regulating the development of the energy resources within each province, but the federal government has overarching environmental control. The federal government issued regulations starting in 2011 that new coal plants would need very strong emissions controls as detailed at: http://laws.justice.gc.ca/eng/regulations/sor-2012-167/index.html. Subtext states that the intent is to either switch to renewable energy or employ CCS.

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