

## **EMD Coal Committee Annual Report**

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**May 4, 2018**

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# Coal Commodity Report

## Executive Summary

Coal is the second-largest energy commodity worldwide in terms of energy use, exceeded only by oil. Production from the top ten coal-producing countries in 2016 was 8,012.2 million short tons (MMst), or 7,268.6 million metric tons (MMt). These countries account for ~90% of the world's total coal production, with China being the top coal-producing and consuming country. The world's top ten coal-producing countries, in terms of decreasing production according to the Energy Information Administration, are: (1) China, (2) India, (3) United States, (4) Australia, (5) Indonesia, (6) Russia, (7) South Africa, (8) Germany, (9) Poland, and (10) Kazakhstan.

Worldwide coal consumption, projected to the year 2040, will only slightly rise with respect to 2015 levels. China will continue to be the largest consumer of coal (~73 quadrillion Btu [British Thermal Units]), although its coal consumption is expected to decline. In contrast, coal consumption in India is projected to increase by almost 3% per year, surpassing coal consumption in the United States. Wyoming continues to be the leading U.S. coal-producing state, having produced 316,454 Mst (316.4 MMst [~287 MMt]) in 2017, a 6.5% increase relative to 2016. The Powder River Basin was maintained as the number-one major supply region for the U.S., with 2017 coal production of 334,366 Mst ([334.4 MMst [303.3 MMt]). U.S coal exports in 2017 saw a dramatic increase from 60,271 Mst (60.2 MMst [54.6 MMt]) in 2016 to 96,954 Mst (~97.0 MMst [~88.0 MMt]) in 2017. Coke exports also increased in the same period by 21%, with Canada and Mexico being the chief destinations.

Although natural gas continues to compete with coal as a source for electricity generation, coal still has a powerful influence on electricity prices worldwide, 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. Asia will remain the world's largest importer of coal, whereas Australia and Indonesia are expected to be the largest exporters. By 2040, Australia will provide 37% of the world's coal exports, followed by Indonesia at 28%. Coal consumption in OECD (Organization for Economic Cooperation and Development) countries is anticipated to decline by 0.6% per year because of increased reliance on natural gas and renewables, coupled with moderate electricity demand. Trade in metallurgical coal for steel production will gradually increase overall, reflecting increased industrial consumption in India.

## Leading Coal-Producing Countries in 2016

China, India, and the United States were the top-three leading countries for coal production in 2016 (Table 1). However, world coal production in 2016 fell by >6%, the largest decline on record (Fig. 1). Moreover, world coal consumption in the same period fell by almost 2%. The largest decreases occurred in the U.S., where coal production fell by 8.8% in 2016. However, U.S. coal production in 2017 began to rise again, with an increase of 6% relative to that in 2016 (Energy Information Administration, 2018). This reflects shifts in international coal markets and expanded exports of U.S. metallurgical coal to Canada and Mexico.

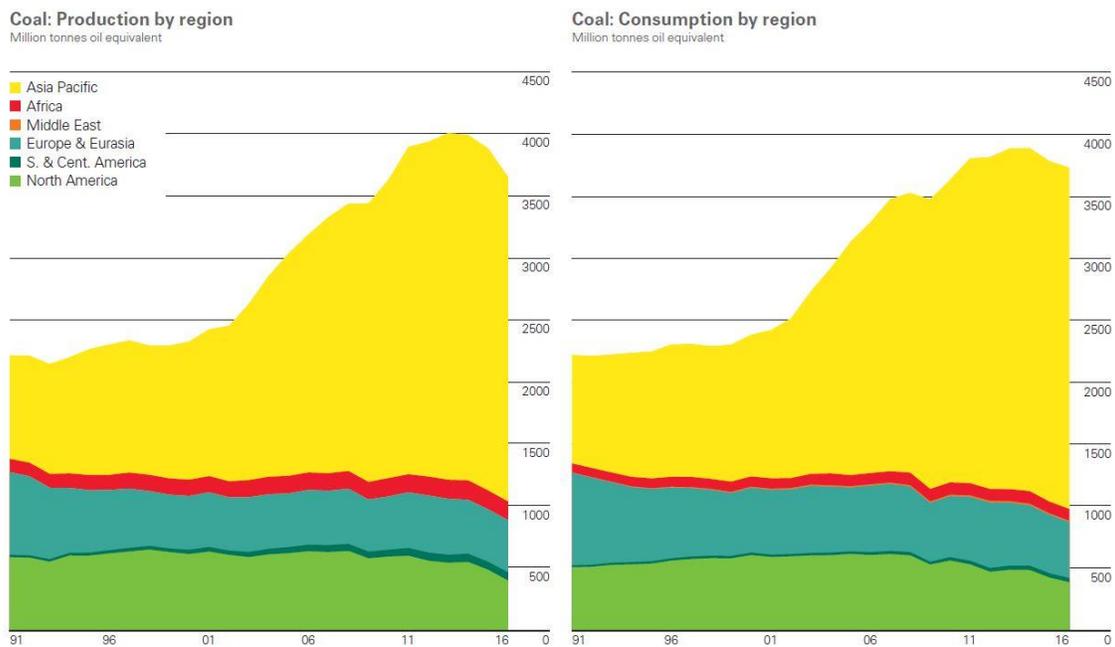


Figure 1. World coal production and consumption from 1991 to 2016. From British Petroleum (2017).

Representing two-thirds of the world’s coal production, China, India, and the United States began to increase coal production in the first half of 2017 (The Energy Advocate, 2017). This was the result of several factors that include India’s continued efforts to augment existing electrification, shifting energy markets in the United States, and energy-policy changes in China.

| <b>Country</b>  | <b>2016 production (MMst)</b> | <b>2016 production (MMt)</b> |
|-----------------|-------------------------------|------------------------------|
| China           | 3,574.2                       | 3,242.5                      |
| India           | 780.0                         | 707.6                        |
| United States   | 740.5                         | 671.8                        |
| Australia       | 554.8                         | 503.3                        |
| Indonesia       | 507.6                         | 460.5                        |
| Russia          | 402.9                         | 365.5                        |
| South Africa    | 283.2                         | 256.9                        |
| Germany         | 193.6                         | 175.6                        |
| Poland          | 144.3                         | 130.9                        |
| Kazakhstan      | 107.9                         | 97.9                         |
| Other Countries | 723.2                         | 656.1                        |
| Total           | 8,012.2                       | 7,268.6                      |

Table 1. The top-ten coal-producing countries in 2016. Data from the International Energy Agency (IEA). Reference: National Mining Association (2017).

### **Future Worldwide Coal Production and Consumption**

Global coal production, projected to the year 2040, is expected to change only slightly, increasing by only 3% (Fig. 2). China, which designates almost all of its coal production for use within its own country, is projected to decrease coal production by 15% from 2015 to 2040, concurrent with decreased demand. However, India is projected to offset this trend in China by increasing its annual coal production as demand rises.

Worldwide coal consumption is projected to the year 2040 as only slightly rising with respect to 2015 levels (Fig. 3). China will continue to be the largest consumer of coal in 2040 (about 73 quadrillion Btu), although its coal consumption is expected to decline. In contrast, coal consumption in India is projected to increase by almost 3% per year, surpassing the United States.

Asia will remain the world's largest importer of coal (Fig. 4), whereas Australia and Indonesia are expected to be the largest exporters (Fig. 5). By 2040, Australia will provide 37% of the world's coal exports, followed by Indonesia at 28%. Coal consumption in OECD (Organization for Economic Cooperation and Development) countries is anticipated to decline by 0.6% per year because of increased reliance on natural gas and renewables, coupled with moderate electricity demand. Trade in metallurgical coal for steel production will gradually increase overall, reflecting increased industrial consumption in India.

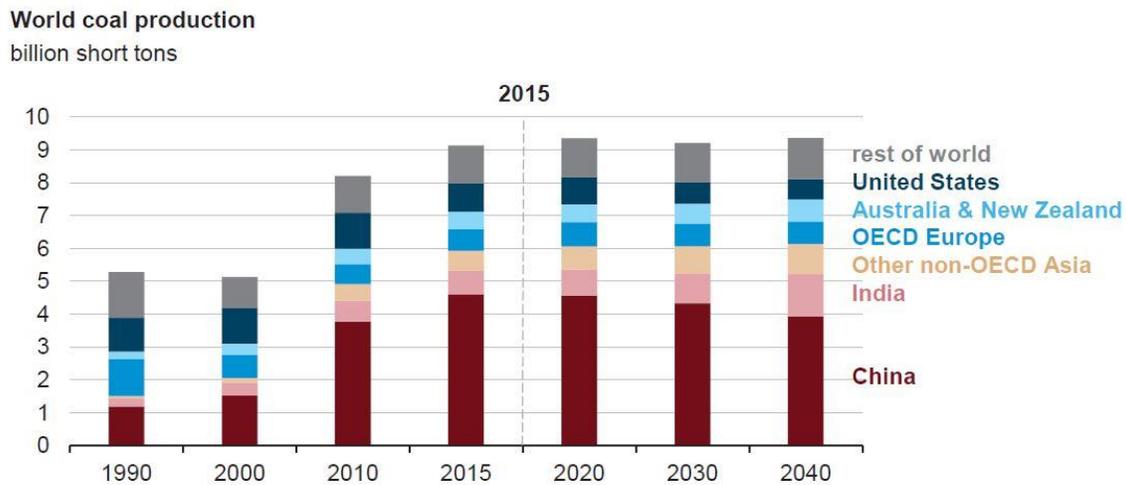


Figure 2. World coal production projected to 2040. Values are in billion short tons (Bst). From Energy Information Administration (2017a).

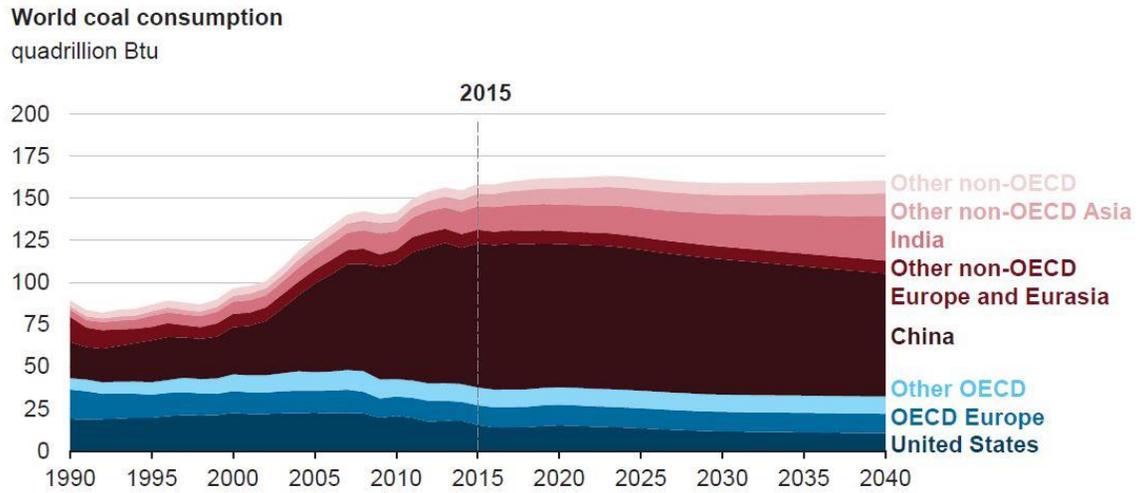


Figure 3. World coal consumption projected to 2040. Values are in quadrillion Btu (British Thermal Units). From Energy Information Administration (2017a).

## Coal imports billion short tons

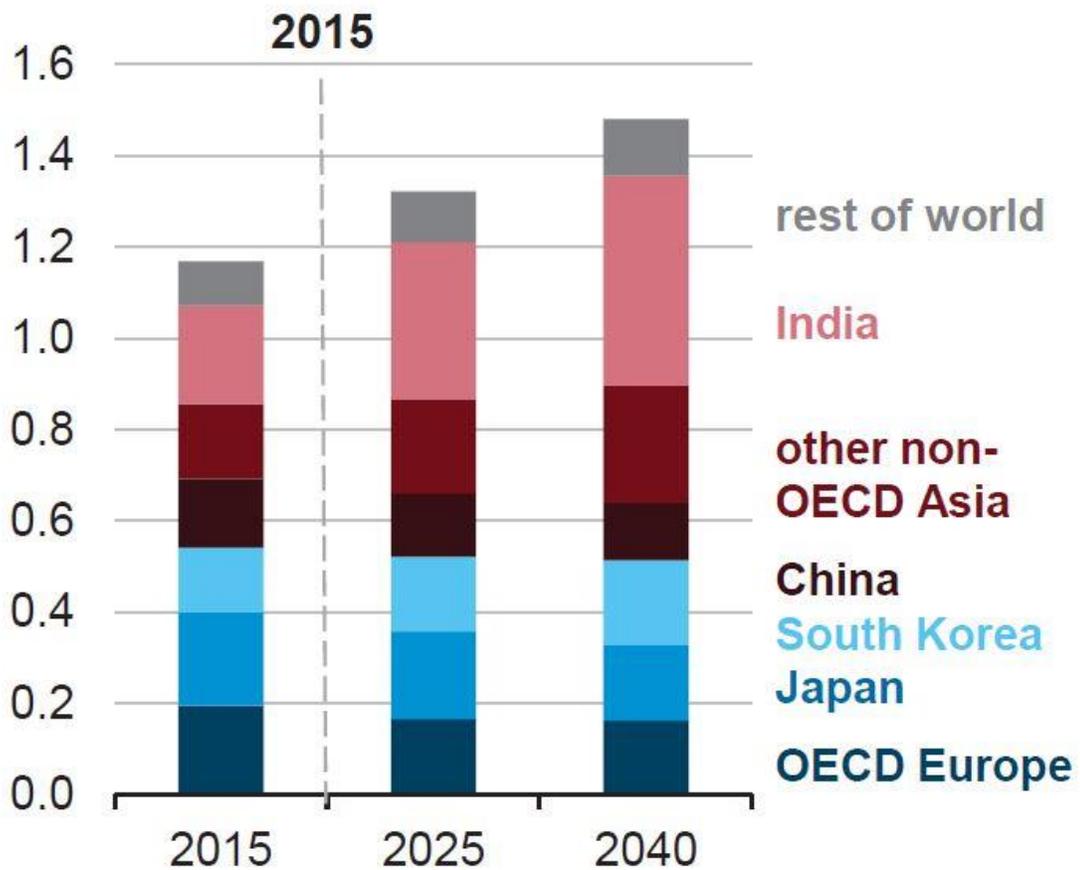


Figure 4. World coal imports projected to 2040. Values are in billion short tons (Bst). From Energy Information Administration (2017a).

## Coal exports billion short tons

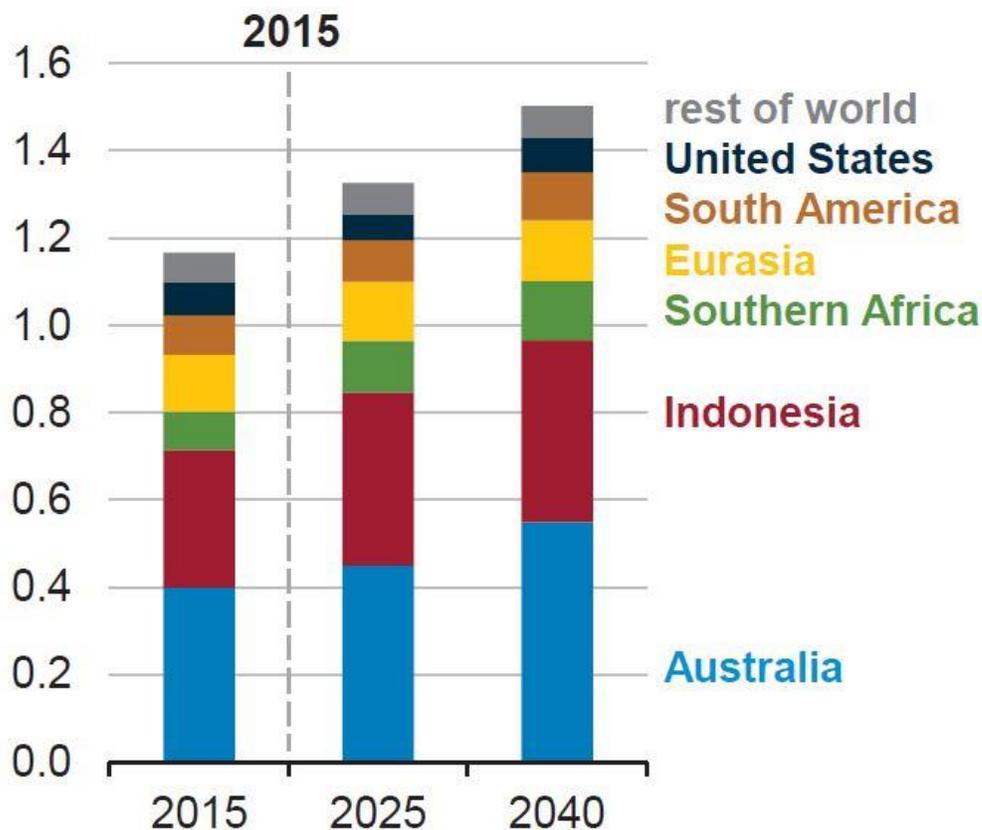


Figure 5. World coal exports projected to 2040. Values are in billion short tons (Bst). From Energy Information Administration (2017a).

## China

China continues to lead the world in coal production, with 2016 production at 3,574.2 MMst (3,242.5 MMt) (Table 1). Of the 28 provinces in China that produce coal, Shanxi, Inner Mongolia, Shaanxi, and Xinjiang contain most of China's coal resources (Meng et al., 2009). China continues to be the largest energy consumer globally, representing 23% of the world's energy consumption. Shenhua Group and China National Coal Group,

China's largest state-owned coal companies, produce ~50% of the coal in China. Local state-owned companies account for ~20%, with small mines producing 30%. Because of new government regulations and decreasing prices, many of the ~10,000 inefficient and small mines in the country have been closing, with the result of large state-owned companies having a greater share in China's overall coal production. China is also welcoming foreign investment to modernize existing large-scale coal mines and to apply new technologies. In addition to coal, China is also becoming more open to foreign investment in CTL, coalbed methane (CBM), coal-to-gas (CTG), and slurry pipeline transportation projects.

Of the top-ten coal-producing countries in 2016, China accounted for ~45% of the world's coal production. However, China's coal production in 2016 declined 7.9% and coal consumption also fell by 1.6% in 2016. At the same time, natural gas production in China rose by 1.4% (British Petroleum, 2017). However, coal is still China's main source of fuel, accounting for 62% of the nation's energy use.

Coal consumption in China is expected to fall from approximately 84 quadrillion Btu (British Thermal Units) in 2015 to approximately 73 quadrillion Btu (Fig. 6). Electric power and industrial use will continue to dominate China's coal consumption. Coal imports are also expected to decline (Fig. 7). China will import only about 3% of its coal for consumption through 2040 because of its policy to be self-sufficient (Energy Information Administration, 2017a).

Chinese companies are constructing or planning to develop more than 700 new coal-fired plants in China and around the world (Tabuchi, 2017). Approximately 20% of these new plants, to be located outside of China, would increase the world's coal-fired electricity output by >40%. 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. China has expanded the construction of natural gas-fired and renewable power plants to introduce power to remote population centers. The relative contribution of coal for generation of electricity is projected to decline from 72 to 47% by

2040, with increasing contributions from other fuels (Fig. 8). Coal will continue to be important feedstock for electricity generation in China, reaching a high value of approximately 4,400 billion kilowatt-hours by 2030. Already 150 gigawatts (GW) of new coal-fired capacity has been canceled or delayed until at least 2020, in view of China's plans for stricter emission controls and retirements of old, inefficient power plants that account for up to 20 GW of power.

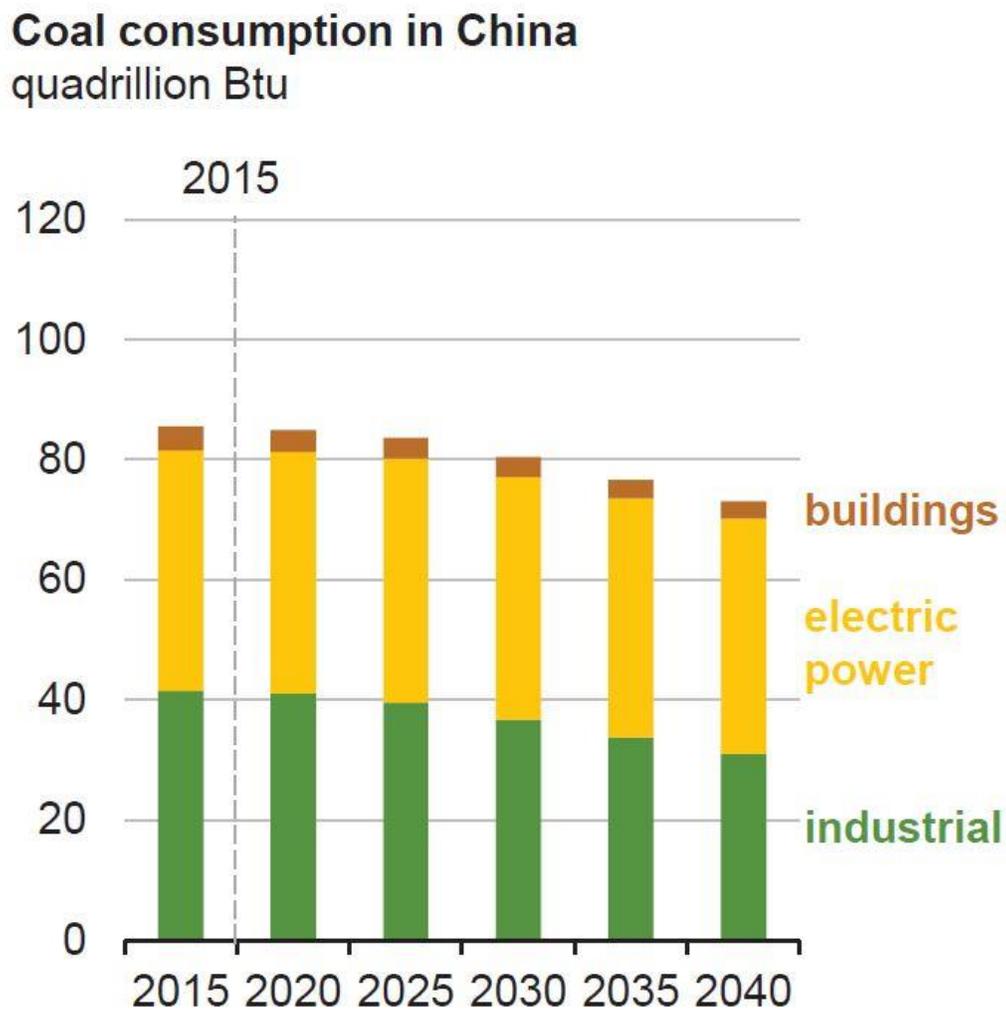


Figure 6. Coal consumption in China to 2040. Values are in quadrillion Btu (British Thermal Units). From Energy Information Administration (2017a).

## Coal imports in China

million short tons

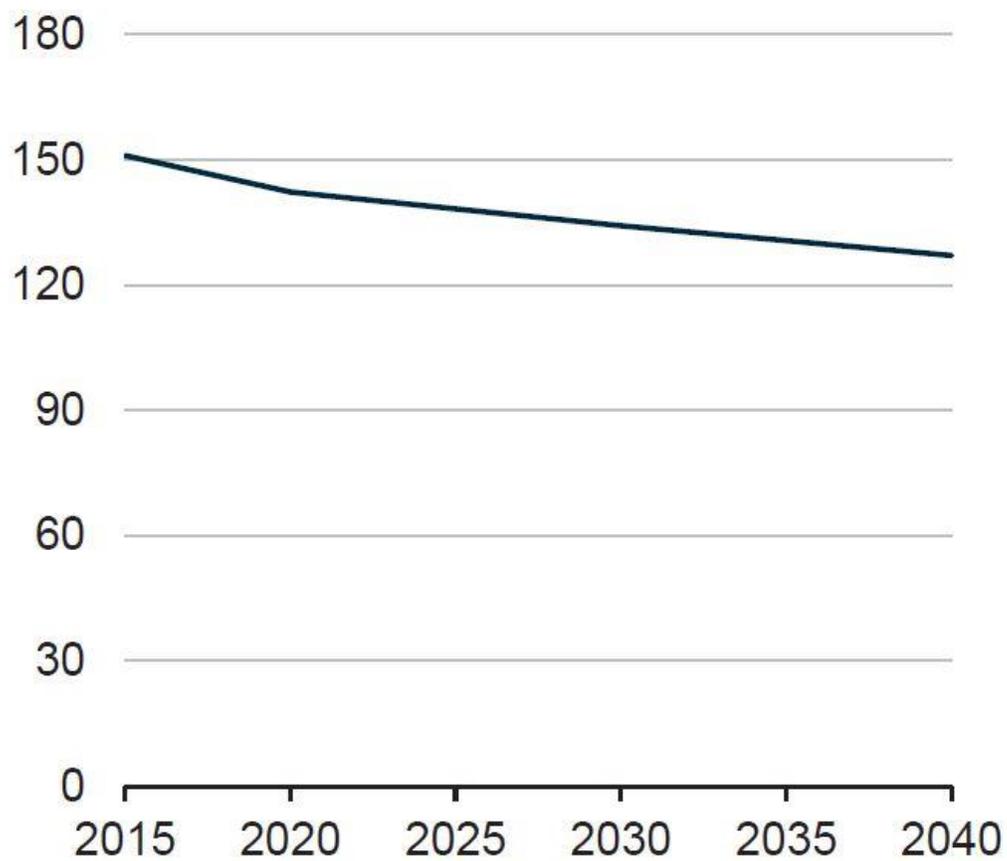


Figure 7. Coal imports to China to 2040. Values are in million short tons (MMst). From Energy Information Administration (2017a).

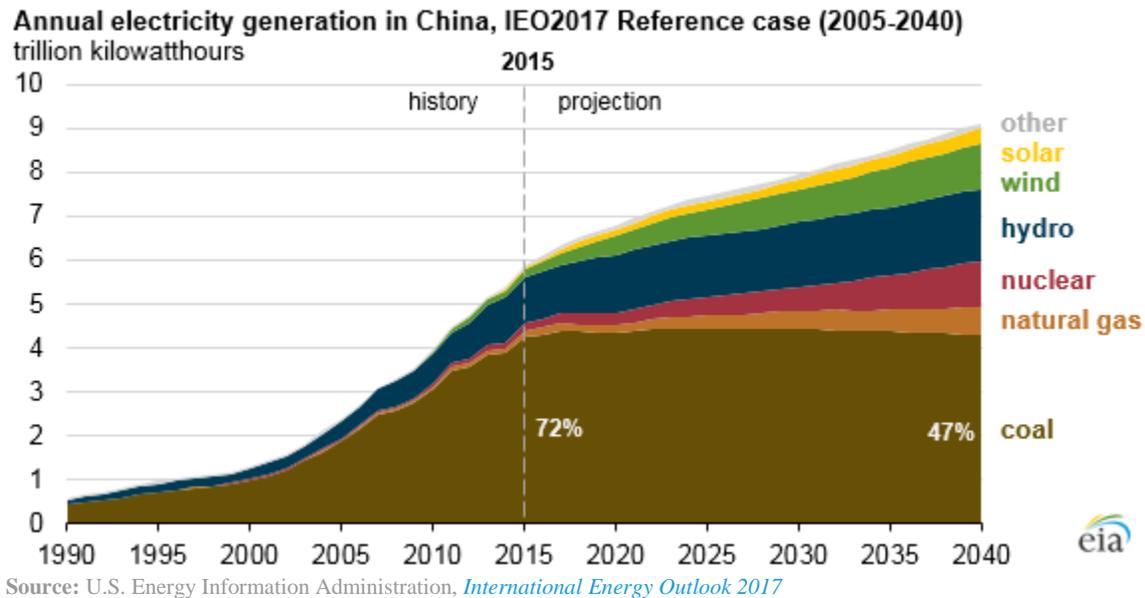


Figure 8. Annual electricity generation in China in 2015, projected to 2040. The relative contribution from coal is expected to fall from 72% to 47% by 2040. Values are in trillion kilowatt-hours. From Energy Information Administration (2017b).

## India

Most of India's coal reserves occur in the eastern part of the country. Jharkhand, Chhattisgarh, and Odisha states together comprise 64% of the country's coal reserves. Other significant coal-producing states include West Bengal, Andhra Pradesh, Madhya Pradesh, and Maharashtra (Energy Information Administration, 2016a). Coal India Limited (CIL) is India's largest and the world's largest coal producer, having produced >80% of the country's coal in the last five years (Reuters, 2016).

Most of India's coal consumption is from electric power (Fig. 9). Coal demand in India is expected to increase significantly by 90% to 2040 because of industrial growth and continued rural electrification (Energy Information Administration, 2017a). Coal is

expected to keep pace with other sources of energy for electricity generation (Fig. 10). Even though coal is the greatest provider of electricity generation in India, accounting for approximately 60% of installed power capacity, coal shortages continue to cause shortfalls in electricity generation, resulting in frequent blackouts. Approximately 90% of the country's coal mines are opencast mines, which although being cost-effective, cause environmental damage. India lacks advanced technology for large-scale, underground mining operations with the result that overall productivity levels in the country are low. Low levels of competition in the coal sector inhibit private and foreign investment and state regulations continue to cause delays for mining companies in receiving mining permits. Additional delays are caused by limited railway capacity, delays in new railroad projects, and high transport costs. However, India has recently completed three major rail transportation projects for increased shipments of coal from major producing regions in northeastern India to other parts of the country.

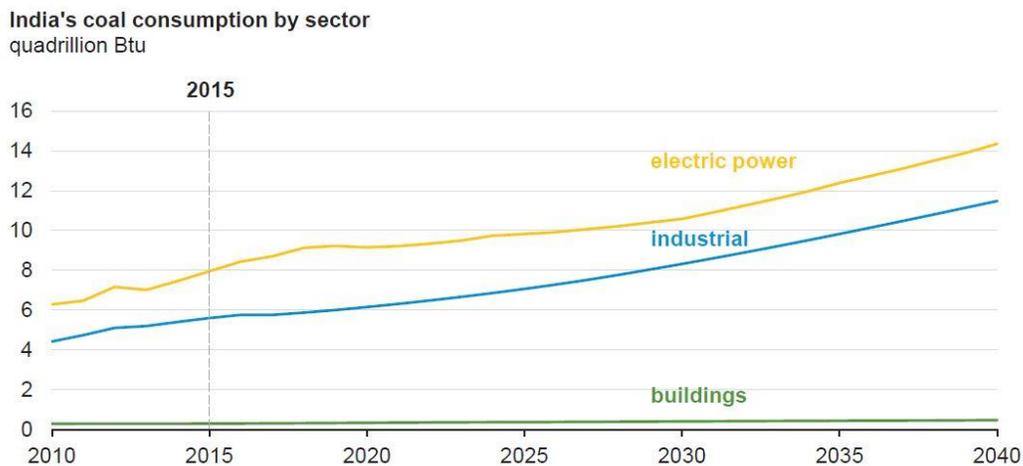


Figure 9. India's coal consumption by sector, projected to 2040. Values are in quadrillion Btu (British Thermal Units). From Energy Information Administration (2017a).

# Sources of electricity generation in India

billion kilowatthours

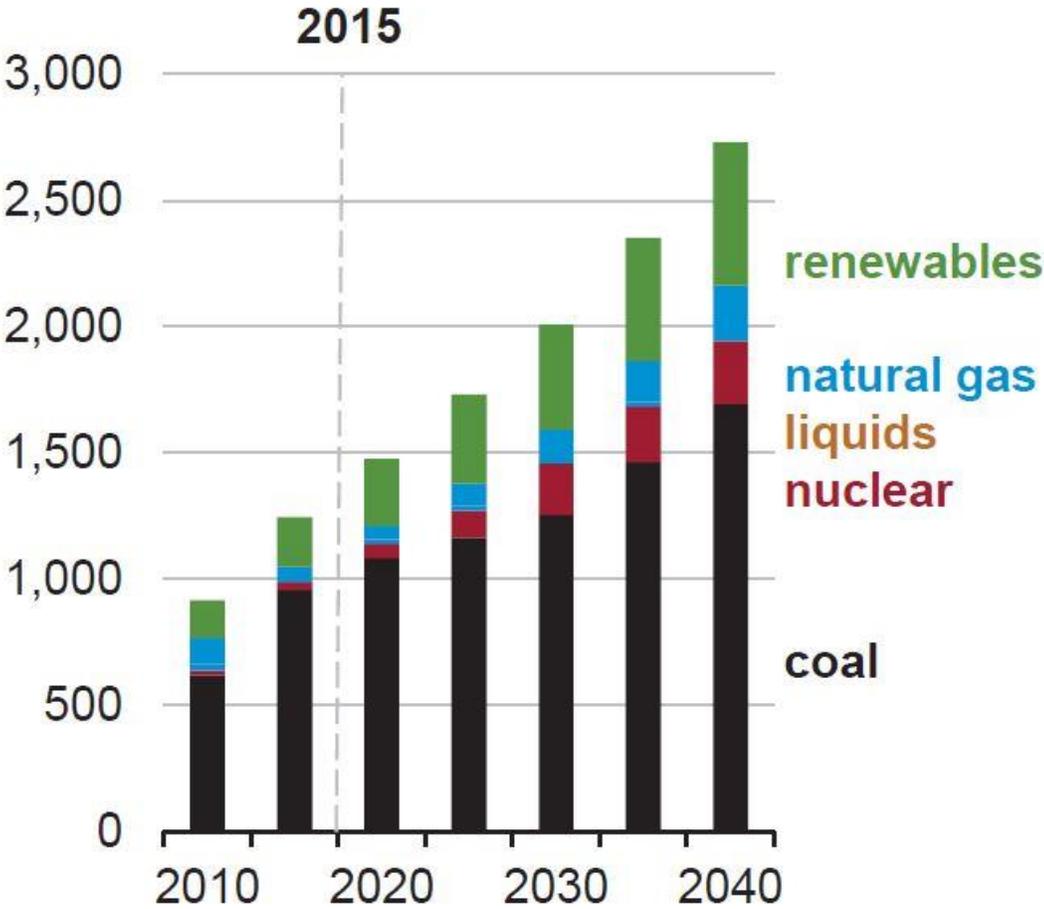


Figure 10. Projected sources of electricity generation in India to the year 2040. Values are in billion kilowatt-hours. From Energy Information Administration (2017a).

## United States

### Production, Exports, and Imports

Natural gas continues to take a larger share of the U.S. energy base relative to coal. According to the October-December 2017 Quarterly Coal Report (Energy Information Administration, 2018), released in April, 2018, U.S. coal production in 2017 was 774,118 thousand short tons (~774 MMst [~702 MMt]), representing a 6% increase relative to a comparable period in 2016 (Table 2). U.S. coking coal production in 2017 also saw an increase of 9% relative to 2016, bring 12,948 thousand short tons (~12.9 MMst [~11.7 MMt]). Wyoming continues to be the leading coal-producing state, having produced 316,454 Mst (316.4 MMst [~287 MMt]) in 2017, a 6.5% increase relative to 2016 (Table 3). Two major coal-producing states that experienced sharp declines in coal production include Ohio (-25.7%) and Texas (-6.8%). The Powder River Basin was maintained as the number-one major supply region for the U.S., with 2017 coal production of 334,366 Mst ([334.4 MMst [303.3 MMt]) (Table 3).

Coal exports in 2017 saw a dramatic increase from 60,271 Mst (60.2 MMst [54.6 MMt]) in 2016 to 96,954 Mst (~97.0 MMst [~88.0 MMt]) in 2017 (Table 4). Coke exports also increased in the same period by 21%, with Canada and Mexico being the chief destinations (Table 5).

### 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.

The Energy Information Administration also provides an energy mapping system for a variety of energy sources that include coal, including coal mines and location and identity of coal-fired electricity installations in the United States. Information on coal can be accessed at: <https://www.eia.gov/state/maps.cfm?v=Coal>. The general site can be reached via: <https://www.eia.gov/state/maps.cfm?v=Fossil%20Fuel%20Resources>.

The annual coal distribution report, released on November 21, 2017 by the Energy Information Administration, consists of an archive of coal distribution by state, destination by state, consumer category, method of transportation, as well as foreign coal distribution by major coal-exporting state. It can be accessed at <https://www.eia.gov/coal/distribution/annual/archive.php>.

| Year | January - March | April - June | July - September | October - December | Total     |
|------|-----------------|--------------|------------------|--------------------|-----------|
| 2011 | 273,478         | 264,291      | 275,006          | 282,853            | 1,095,628 |
| 2012 | 266,865         | 241,047      | 258,956          | 249,591            | 1,016,458 |
| 2013 | 244,867         | 243,211      | 257,595          | 239,169            | 984,842   |
| 2014 | 245,271         | 245,844      | 255,377          | 253,557            | 1,000,049 |
| 2015 | 240,324         | 212,557      | 236,823          | 207,237            | 896,941   |
| 2016 | 173,225         | 160,853      | 195,101          | 199,186            | 728,364   |
| 2017 | 197,033         | 187,082      | 196,161          | 193,842            | 774,118   |

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

Source: U.S. Department of Labor, Mine Safety and Health Administration, Form 7000-2, 'Quarterly Mine Employment and Coal Production Report.'

Table 2. U.S. coal summary statistics from 2011 to the end of 2017. Values are thousands of short tons (Mst). Modified from Energy Information Administration (2018).

| Coal-Producing Region and State | October - December 2017 | July - September 2017 | October - December 2016 | Year to Date   |                | Percent Change |
|---------------------------------|-------------------------|-----------------------|-------------------------|----------------|----------------|----------------|
|                                 |                         |                       |                         | 2017           | 2016           |                |
| Alabama                         | 3,084                   | 2,780                 | 2,597                   | 12,613         | 9,643          | 30.8           |
| Alaska                          | 264                     | 237                   | 211                     | 959            | 932            | 2.9            |
| Arizona                         | 1,798                   | 1,374                 | 1,384                   | 6,221          | 5,423          | 14.7           |
| Arkansas                        | -                       | -                     | 11                      | 27             | 49             | -46.4          |
| Colorado                        | 3,745                   | 3,147                 | 4,012                   | 15,047         | 12,634         | 19.1           |
| Illinois                        | 11,430                  | 11,311                | 10,990                  | 48,128         | 43,422         | 10.8           |
| Indiana                         | 7,668                   | 7,738                 | 7,296                   | 31,418         | 28,767         | 9.2            |
| Kansas                          | -                       | -                     | -                       | -              | 27             | -              |
| <b>Kentucky Total</b>           | <b>9,926</b>            | <b>9,890</b>          | <b>11,164</b>           | <b>42,608</b>  | <b>42,868</b>  | <b>-0.6</b>    |
| Eastern (Kentucky)              | 4,613                   | 4,205                 | 4,427                   | 18,842         | 16,772         | 12.3           |
| Western (Kentucky)              | 5,314                   | 5,686                 | 6,737                   | 23,766         | 26,096         | -8.9           |
| Louisiana                       | 489                     | 164                   | 805                     | 2,079          | 2,798          | -25.7          |
| Maryland                        | 351                     | 431                   | 491                     | 1,662          | 1,616          | 2.8            |
| Mississippi                     | 582                     | 453                   | 751                     | 2,604          | 2,870          | -9.3           |
| Missouri                        | 60                      | 63                    | 60                      | 244            | 234            | 4.5            |
| Montana                         | 9,739                   | 10,450                | 9,398                   | 35,232         | 32,336         | 9.0            |
| New Mexico                      | 2,765                   | 3,175                 | 3,691                   | 13,198         | 13,341         | -1.1           |
| North Dakota                    | 7,506                   | 7,463                 | 7,455                   | 28,788         | 28,121         | 2.4            |
| Ohio                            | 2,439                   | 2,265                 | 2,451                   | 9,336          | 12,564         | -25.7          |
| Oklahoma                        | 146                     | 131                   | 160                     | 561            | 654            | -14.2          |
| <b>Pennsylvania Total</b>       | <b>12,165</b>           | <b>11,688</b>         | <b>12,802</b>           | <b>49,065</b>  | <b>45,720</b>  | <b>7.3</b>     |
| Anthracite (Pennsylvania)       | 483                     | 409                   | 387                     | 1,849          | 1,500          | 23.3           |
| Bituminous (Pennsylvania)       | 11,682                  | 11,279                | 12,416                  | 47,217         | 44,220         | 6.8            |
| Tennessee                       | 71                      | 90                    | 141                     | 431            | 644            | -33.1          |
| Texas                           | 9,906                   | 9,288                 | 10,071                  | 36,338         | 39,001         | -6.8           |
| Utah                            | 4,127                   | 3,272                 | 3,673                   | 14,326         | 13,966         | 2.6            |
| Virginia                        | 3,133                   | 3,137                 | 3,339                   | 13,205         | 12,910         | 2.3            |
| <b>West Virginia Total</b>      | <b>24,241</b>           | <b>21,528</b>         | <b>21,064</b>           | <b>92,733</b>  | <b>79,757</b>  | <b>16.3</b>    |
| Northern (West Virginia)        | 12,375                  | 10,389                | 11,505                  | 46,785         | 43,524         | 7.5            |
| Southern (West Virginia)        | 11,866                  | 11,139                | 9,559                   | 45,948         | 36,233         | 26.8           |
| Wyoming                         | 78,052                  | 85,867                | 84,943                  | 316,454        | 297,218        | 6.5            |
| <b>Appalachia Total</b>         | <b>50,096</b>           | <b>46,123</b>         | <b>47,312</b>           | <b>197,887</b> | <b>179,626</b> | <b>10.2</b>    |
| Appalachia Central              | 19,683                  | 18,570                | 17,466                  | 78,426         | 66,558         | 17.8           |
| Appalachia Northern             | 27,330                  | 24,773                | 27,249                  | 106,849        | 103,424        | 3.3            |
| Appalachia Southern             | 3,084                   | 2,780                 | 2,597                   | 12,613         | 9,643          | 30.8           |
| <b>Interior Region Total</b>    | <b>35,594</b>           | <b>34,833</b>         | <b>36,881</b>           | <b>145,164</b> | <b>143,917</b> | <b>0.9</b>     |
| Illinois Basin                  | 24,411                  | 24,734                | 25,022                  | 103,312        | 98,285         | 5.1            |
| Interior                        | 11,183                  | 10,099                | 11,858                  | 41,853         | 45,632         | -8.3           |
| <b>Western Region Total</b>     | <b>107,996</b>          | <b>114,985</b>        | <b>114,768</b>          | <b>430,224</b> | <b>403,971</b> | <b>6.5</b>     |
| Powder River Basin              | 83,362                  | 91,214                | 90,512                  | 334,366        | 313,752        | 6.6            |
| Uinta Region                    | 7,519                   | 6,116                 | 7,287                   | 28,068         | 25,077         | 11.9           |
| Western                         | 17,115                  | 17,655                | 16,969                  | 67,790         | 65,142         | 4.1            |
| East of Mississippi River       | 75,089                  | 71,310                | 73,086                  | 303,802        | 280,780        | 8.2            |
| West of Mississippi River       | 118,597                 | 124,631               | 125,875                 | 469,473        | 446,734        | 5.1            |
| U.S. Subtotal                   | 193,687                 | 195,941               | 198,960                 | 773,275        | 727,514        | 6.3            |
| Refuse Recovery                 | 155                     | 220                   | 226                     | 843            | 851            | -0.9           |
| <b>U.S. Total</b>               | <b>193,842</b>          | <b>196,161</b>        | <b>199,186</b>          | <b>774,118</b> | <b>728,364</b> | <b>6.3</b>     |

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

Source: U.S. Department of Labor, Mine Safety and Health Administration, Form 7000-2, "Quarterly Mine Employment and Coal Production Report."

Table 3. U.S. coal production by state, 2016 to December 2017. Values are thousands of short tons (Mst). Modified from Energy Information Administration (2018).

| Year | January - March |         | April - June |         | July - September |         | October - December |         | Total   |         |
|------|-----------------|---------|--------------|---------|------------------|---------|--------------------|---------|---------|---------|
|      | Exports         | Imports | Exports      | Imports | Exports          | Imports | Exports            | Imports | Exports | Imports |
| 2011 | 26,617          | 3,381   | 26,987       | 3,419   | 25,976           | 3,588   | 27,679             | 2,700   | 107,259 | 13,088  |
| 2012 | 28,642          | 2,022   | 37,534       | 2,329   | 31,563           | 2,415   | 28,006             | 2,394   | 125,746 | 9,159   |
| 2013 | 31,835          | 1,429   | 29,427       | 2,756   | 28,589           | 2,398   | 27,809             | 2,323   | 117,659 | 8,906   |
| 2014 | 27,584          | 2,450   | 24,674       | 3,574   | 22,723           | 3,151   | 22,276             | 2,174   | 97,257  | 11,350  |
| 2015 | 21,979          | 3,009   | 19,766       | 2,640   | 16,914           | 2,965   | 15,299             | 2,705   | 73,958  | 11,318  |
| 2016 | 14,153          | 2,698   | 14,223       | 2,292   | 12,552           | 2,733   | 19,343             | 2,124   | 60,271  | 9,846   |
| 2017 | 22,307          | 1,915   | 21,796       | 2,197   | 24,644           | 2,308   | 28,206             | 1,357   | 96,953  | 7,777   |

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

Source: Exports: U.S. Department of Commerce, Bureau of the Census, "Monthly Report EM 545"; and Imports: U.S. Department of Commerce, Bureau of the Census, "Monthly Report IM 145."

Table 4. U.S. coal exports and imports, 2011 to 2017. Values are thousands of short tons (Mst). Modified from Energy Information Administration (2018).

| Continent and Country of Destination | October - December 2017 | July - September 2017 | Year to Date            |           |           | Percent Change |
|--------------------------------------|-------------------------|-----------------------|-------------------------|-----------|-----------|----------------|
|                                      |                         |                       | October - December 2016 | 2017      | 2016      |                |
| <b>North America Total</b>           | 387,738                 | 277,649               | 466,796                 | 1,066,195 | 976,131   | 9.2            |
| Canada*                              | 244,822                 | 183,506               | 247,481                 | 772,477   | 602,934   | 28.1           |
| Mexico                               | 142,081                 | 93,601                | 219,081                 | 291,871   | 372,138   | -21.6          |
| Other**                              | 835                     | 542                   | 234                     | 1,847     | 1,059     | 74.4           |
| <b>South America Total</b>           | -                       | 69                    | -                       | 95        | 53        | 79.2           |
| Other**                              | -                       | 69                    | -                       | 95        | 53        | 79.2           |
| <b>Europe Total</b>                  | 69,855                  | 110                   | 92                      | 102,002   | 22,402    | 355.3          |
| Other**                              | 69,855                  | 110                   | 92                      | 102,002   | 22,402    | 355.3          |
| <b>Asia Total</b>                    | 126                     | 343                   | 87                      | 22,233    | 1,119     | NM             |
| Other**                              | 126                     | 343                   | 87                      | 22,233    | 1,119     | NM             |
| <b>Australia and Oceania Total</b>   | 86                      | 171                   | 268                     | 334       | 613       | -45.5          |
| Other**                              | 86                      | 171                   | 268                     | 334       | 613       | -45.5          |
| <b>Africa Total</b>                  | -                       | -                     | -                       | 18,188    | -         | -              |
| Other**                              | -                       | -                     | -                       | 18,188    | -         | -              |
| <b>Total</b>                         | 457,805                 | 278,342               | 467,243                 | 1,209,047 | 1,000,318 | 20.9           |

\* Based on the U.S. - Canada Free Trade Agreement; as of January 1990, the U.S. Department of Commerce began reporting statistics on U.S. exports to Canada based on information on imports provided monthly by the Canadian government.

\*\* Includes countries with coal exports less than or equal to 50,000 short tons in 2016.

- = No data reported.

NM = Not meaningful due to changes of 500 percent or more.

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

Source: U.S. Department of Commerce, Bureau of the Census, 'Monthly Report EM 545.'

Table 5. U.S. coke exports in 2016 and 2017. Values are thousands of short tons (Mst). Modified from Energy Information Administration (2018).

## Australia

Australia is the top-ranked coal-exporting nation. By 2040, Australia will provide 37% of the world's coal exports (Fig. 11). Metallurgical coal is Australia's second-largest export commodity, exceeded only by iron ore on a weight basis. Australia exported approximately US \$28 billion of both metallurgical and steam coal in FY 2015 (Energy Information Administration, 2017c). Most of the Australia's coal, which is typically low in ash content, occurs in Queensland and New South Wales (Sydney and Bowen Basins, respectively). These basins accounted for most of Australia's black coal production in 2015. The Gippsland Basin in Victoria was associated with 96% of brown coal production in the same year.

Coal production in Australia has grown by 42% in the last ten years (Energy Information Administration, 2017c). Most of Australia's coal is exported, with domestic use being

<25% of total production (Fig. 11). Coal accounts for 32% of all energy consumption (Fig. 12) and 63% of electric generation in Australia (Fig. 13). Coal consumption in Australia had been declining because of fuel switching to natural gas and increased reliance on renewables. However, after repeal of the carbon tax in 2014, coal consumption has increased slightly since 2015 (Energy Information Administration, 2017c). Coal exports are supported by nine major coal ports and export terminals in Queensland and New South Wales. These terminals have a combined capacity of >510 MMst (>462.7 MMt) per year. New port projects are being developed and were projected to add >50 MMst (>45.4 MMt) to annual coal loading capacity into 2017 (Energy Information Administration, 2017c). Australia has ~120 privately-owned coal mines, with most of Australia's coal production is from open pit operations. BHP Billiton, Anglo American (UK), Xstrata (Switzerland), and Rio Tinto (Australia-UK), are major players in Australia's coal industry. Australia has invested \$11.2 billion in advanced infrastructure projects to add nearly 80 MMst (72.6 MMt) to production capacity by 2017.

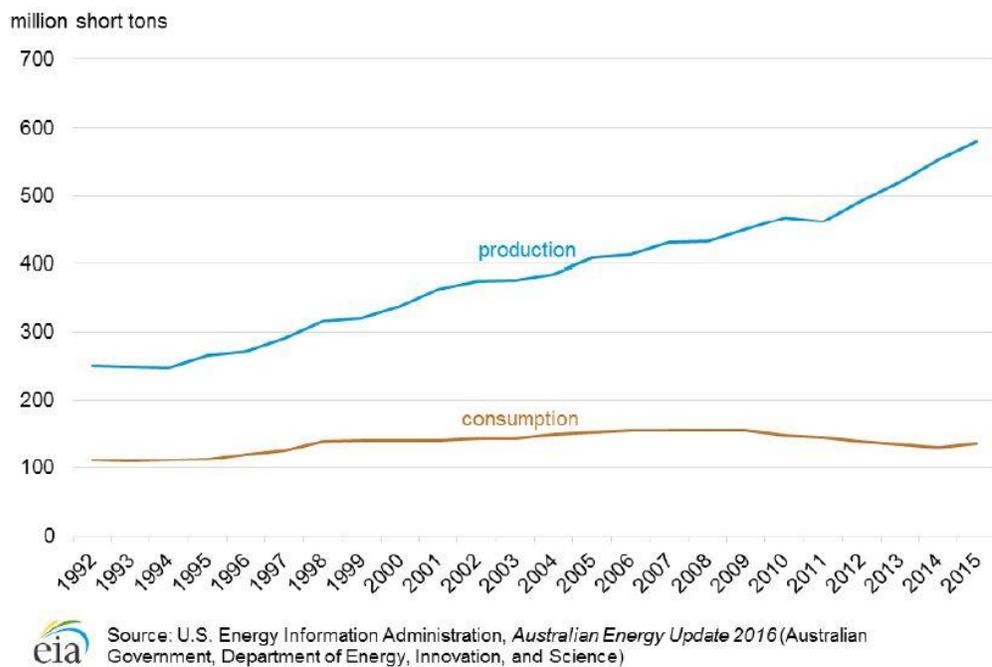


Figure 11. Coal production and consumption in Australia from 1992 to 2015. Values are in million short tons (MMst). Modified from Energy Information Administration (2017c).

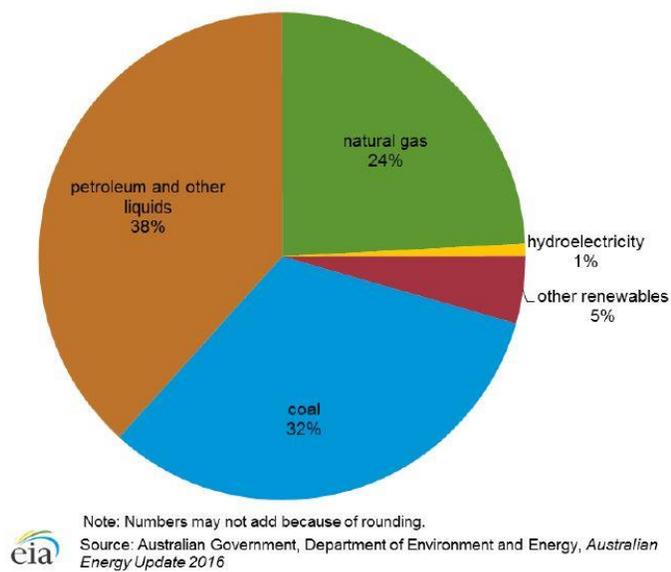


Figure 12. Relative percentage of energy consumption in Australia in 2015 according to fuel type. Modified from Energy Information Administration (2017c).

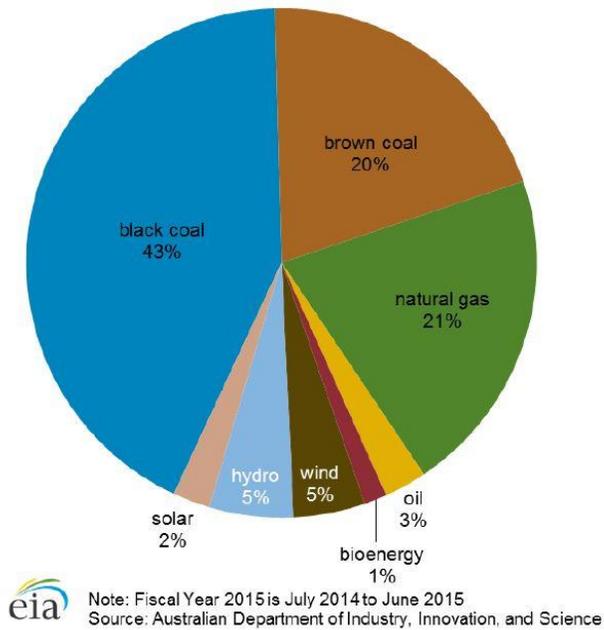


Figure 13. Relative percentage of energy sources for electricity generation in Australia in 2015 according to fuel type. Modified from Energy Information Administration (2017c).

## **Indonesia**

The three largest coal-resource regions in Indonesia are South Sumatra, South Kalimantan, and East Kalimantan (Fig. 14). Indonesia currently ranks ninth in coal reserves worldwide, containing slightly more than 2% of total global coal reserves (Indonesia-Investments, 2017). Approximately 60% of these reserves are composed of subbituminous coal.

Production, export, and consumption of coal in Indonesia have all increased substantially since 2007 (Table 6). Indonesia exports almost 80% of its produced coal (Energy Information Administration, 2015). Indonesia has recently become important as a source for Chinese coal imports. Indonesia's coal exports are primarily destined for Asian markets, with 85% of total coal exports going to China, Japan, South Korea, India, and Taiwan.

Indonesia's energy mix, projected to the year 2025, includes increased reliance on coal, although renewable energy is expected to rise at a higher rate than that for coal (Table 7). Indonesia is projected to increase annual coal production by an average of 3% to 2020 (Jardine Lloyd Thompson Group, 2017). One of the main reasons for this projected increase is because the Government of Indonesia plans to invest in power infrastructure in the near future, hoping to reach a level of 99.7% electrification by 2025. This plan calls for coal to compose 60% of the overall national fuel mix to achieve a total power capacity of 90.5 GW by the end of 2019.

PT Bumi Resources Tbk is Indonesia's largest mining company and coal producer, with 88 MMst (79.8 MMT) produced in 2013. PT Bumi plans have been to increase production of power-station coal in 2017, in expectation of stable coal prices that reflect recent rises

in Chinese thermal coal futures (Jensen, 2016). PT Adaro is the second-largest coal producer in Indonesia, accounting for almost 60 MMst (54.4 MMt) of coal in 2013. Other major producers include PT Kideco Jaya, PT Indotambang Raya Megah, and PT Berau. The top five producers in Indonesia have recently accounted for more than 45% of coal production (Indonesia-Investments, 2017).



Figure 14. The three major coal-resource regions in Indonesia. Regions are (1) South Sumatra, (2) South Kalimantan, and (3) East Kalimantan. From Indonesia-Investments (2017).

#### Indonesian Production, Export, Consumption & Price of Coal:

|                                    | 2007 | 2008 | 2009 | 2010 | 2011  | 2012 | 2013 | 2014 | 2015 | 2016 |
|------------------------------------|------|------|------|------|-------|------|------|------|------|------|
| <b>Production</b><br>(in mln tons) | 217  | 240  | 254  | 275  | 353   | 412  | 474  | 458  | 461  | 419  |
| <b>Export</b><br>(in mln tons)     | 163  | 191  | 198  | 210  | 287   | 345  | 402  | 382  | 366  | 333  |
| <b>Domestic</b><br>(in mln tons)   | 61   | 49   | 56   | 65   | 66    | 67   | 72   | 76   | 87   | 86   |
| <b>Price (HBA)</b><br>(in USD/ton) | n.a  | n.a  | 70.7 | 91.7 | 118.4 | 95.5 | 82.9 | 72.6 | 60.1 | 61.8 |

Sources: Indonesian Coal Mining Association (APBI) & Ministry of Energy and Mineral Resources

Table 6. Production, export, consumption, and coal prices in Indonesia from 2007 to 2016. From Indonesia-Investments (2017).

#### Indonesia's Energy Mix:

|                         | Energy Mix<br>2011 | Energy Mix<br>2025 |
|-------------------------|--------------------|--------------------|
| <b>Oil</b>              | 50%                | 23%                |
| <b>Coal</b>             | 24%                | 30%                |
| <b>Gas</b>              | 20%                | 20%                |
| <b>Renewable Energy</b> | 6%                 | 26%                |

Source: Ministry of Energy and Mineral Resources

Table 7. Projected energy mix in Indonesia projected to the year 2025. From Indonesia-Investments (2017).

## Russia

Approximately 80% of Russia's coal production is thermal (steam) coal and, and 20% is metallurgical (coking) coal. Russia's coal reserves account for almost 18% of the world's total coal reserves, although Russia's share of coal production has recently been <5% (Fig. 15) (Sliviyak, 2015). More than half of Russia's coal exports, which have risen significantly since 2002, go to Europe. China accounts for 16% of Asian exports, whereas the United Kingdom receives 10% (Fig. 15).

The majority of Russia's coal production and reserves are located in the Kansk-Achinskiy and Kuznetskiy Basins in central Russia (Fig. 16). Coal in these regions requires long-distance transport to reach markets, placing Russian coal at an economic disadvantage with respect to other competing sources. However, some economists believe that the weaker ruble, resulting from sanctions and low oil prices, should make Russian coal exports more price-competitive. Russia has plans to expand its port capacity for increased Asian exports.

Coal production in Russia has risen in the last three years, having increased by 3% by the end of 2017 and reaching a value of 438.4 MMst (397.7 MMt) (Reuters, 2017). Thermal coal exports will exceed 168.7 MMst (153 MMt) in 2017, up from 164.2 MMst (149 MMt) in 2016. Metallurgical coal exports will have risen from 23.9 MMst (21.7 MMt) to between 25.4 and 26.5 MMst (23 and 24 MMt).

Russian thermal coal exports to Europe are expected to diminish in the next decades as Europe develops more green-energy systems, coupled with greater competition from exports from Colombia and the United State (IHS Markit, 2017). Russian export markets are anticipated to shift to Southeast Asia, with Russia exporting 57.3 MMst (52 MMt) to Southeast Asia and the Pacific Rim by 2020.

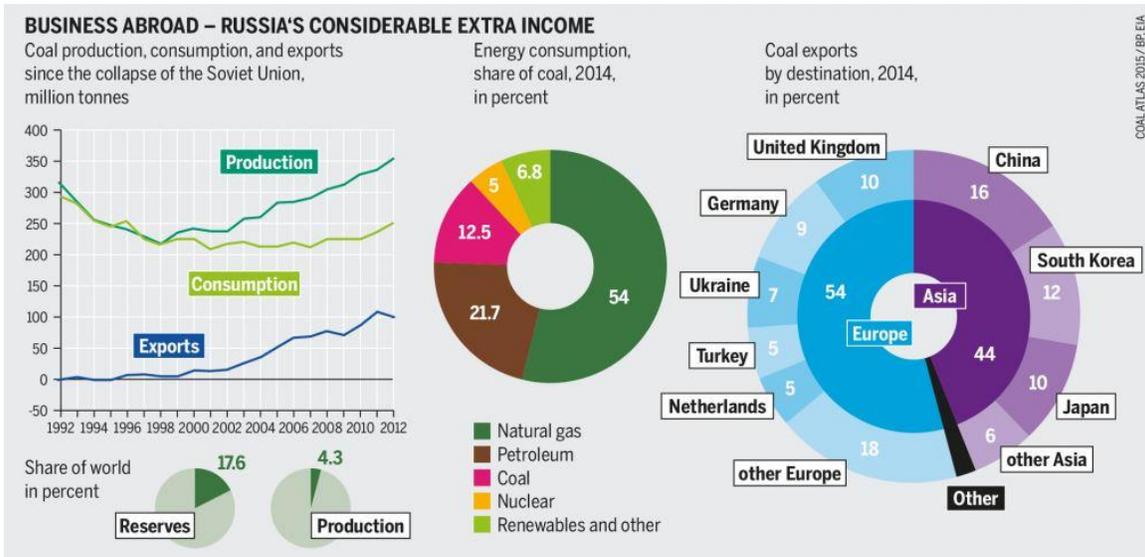


Figure 15. Summary of Russia's coal production, consumption, reserves, and exports. From Slivyak (2015).

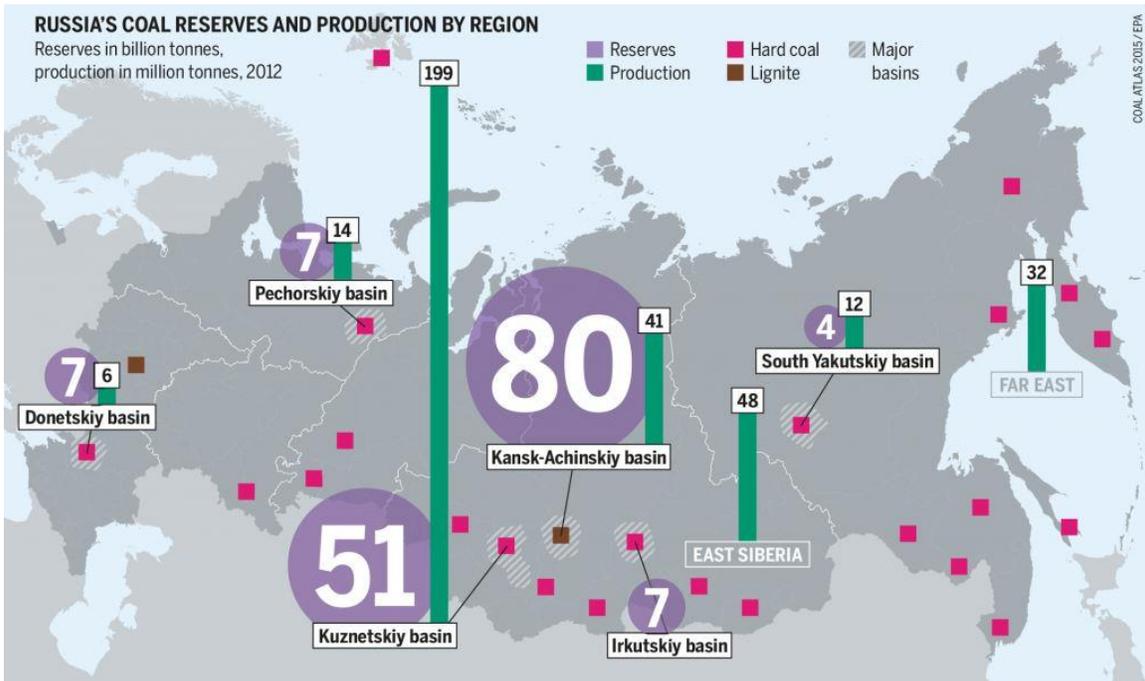


Figure 16. Russia's coal reserves and production by region. Reserves are in billion metric tons (Bt). Production is in million metric tons (MMt). From Slivyak (2015).

## South Africa

South Africa contains 95% of Africa's total coal reserves (Energy Information Administration, 2017d), and relies heavily on its large-scale, coal mining industry. The country also has a well-developed synthetic fuels (synfuels) industry, manufacturing gasoline and diesel fuel from the Secunda CTL plant and Mossel Bay GTL plant. The synfuels industry represents nearly all of South Africa's oil, as its domestic production is small. More than 37 MMst (>33.6 MMt) of coal are processed yearly and converted into liquid fuels and a range of chemical feedstock at the Sasol synfuels plant in Secunda. The plant has a capacity of 160,000 barrels per day (bbl/d) of oil equivalent. Sasol has plans for expanding Secunda's capacity by 30,000 bbl/d.

Coal accounts for 72% of the country's total primary energy consumption (Fig. 17). The electricity sector accounts for >50% of the coal consumed in South Africa, with lesser amounts represented by petrochemical and metallurgical industries followed by domestic heating and cooking.

Most of South Africa's coal production is from the northeastern part of the country (Fig. 17). South Africa exports have recently accounted for approximately 25% of its coal production. However, development of global alternative energy sources has affected South African coal-export markets (Olalde, 2017). In addition, there has been a trend of an increasing number of smaller coal-mining companies in South Africa, formerly dominated by large companies such as Eskom. Six companies in 2007 accounted for 90% of South Africa's production, with eight mines producing more than 60% of the country's coal. The number of coal mines in 2007 was 93, but increased to 148 mines by 2016. However, total coal production rose by only 10% in the same period.

Despite shrinking coal-export markets, domestic coal mining in South Africa remains a vital part of the economy, having employed more than 77,500 people in 2016,

representing 17% of the total employment in the South African mining sector (Chamber of Mines of South Africa, 2017). Total coal sales were approximately R 112 billion, with coal-export earnings averaging 12% of all merchandise exports.

## LOCATION AND GEOLOGY

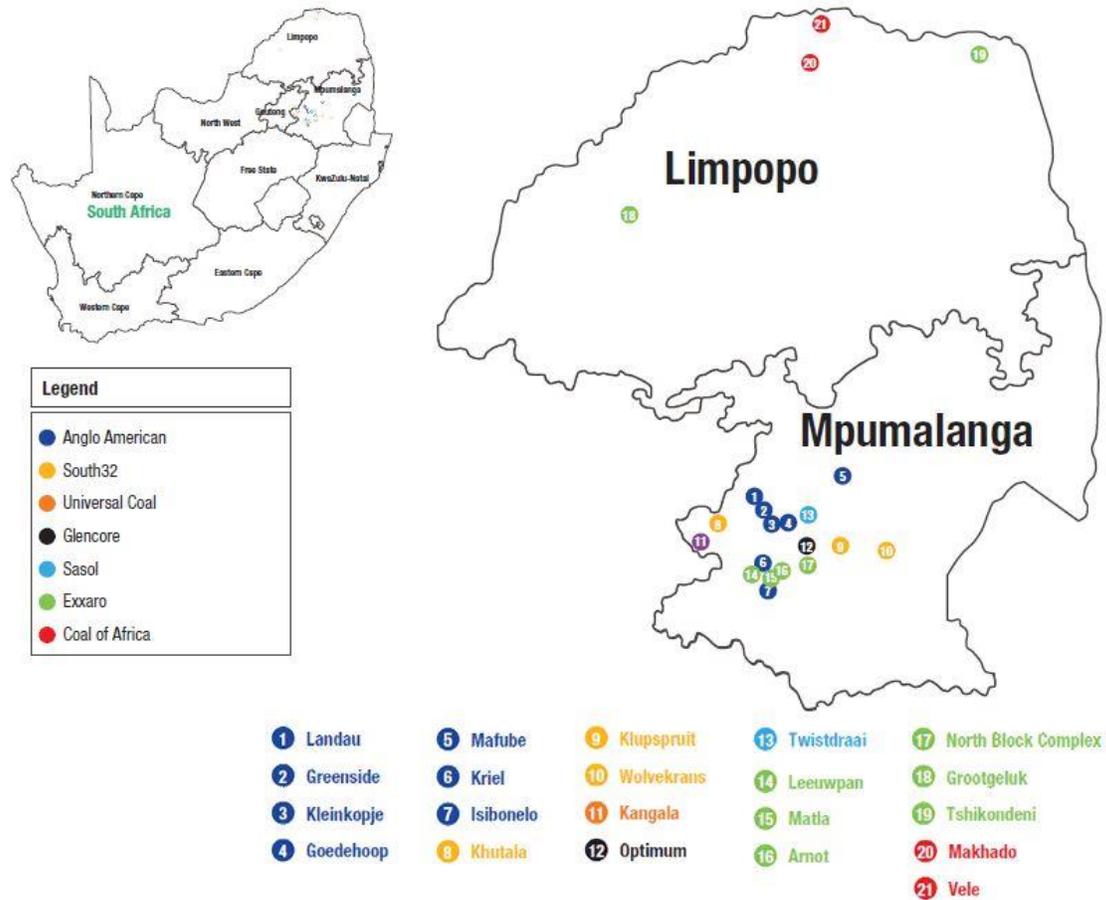


Figure 17. Principal coal mines and companies in South Africa. From Chamber of Mines of South Africa (2016).

## Germany

Coal is Germany's most abundant indigenous energy resource, and it accounted for about 25% of Germany's total primary energy consumption in 2014 (Energy Information Administration, 2016b). Power and industrial sectors consume most of the coal in Germany, with lignite-fired generation providing ~44% of total electric generation in 2014. Although Germany has large reserves of lignite and hard coal, only 22.0 MMst (~20 MMt) are planned for development because of Germany's decision to curtail subsidized hard coal production in 2018 (Euracoal, 2017a). However, lignite's future in Germany is better, with an estimated 5,510 MMst (~5,000 MMt) of mineable reserves in existing and approved surface mines.

Hard coal and lignite accounted for approximately 13% and 12% of Germany's main energy production, respectively, in 2015 (Euracoal, 2017a). However, 90% of Germany's hard coal was imported, mainly from Russia, Colombia, the United States, Australia, Poland and South Africa. Lignite production in Germany in 2015 was 196.2 MMst (~178 MMt). This production came from four main areas that include (1) the Rhenish mining district encompassing Cologne, Aachen and Mönchengladbach, (2) the Lusatian mining district in southeastern Brandenburg and northeastern Saxony, (3) the Central German mining district in southeastern Saxony-Anhalt, and (4) and in northwestern Saxony as well as the Helmstedt mining area in Lower Saxony (Euracoal, 2017a). Almost 90% of the lignite was employed for power generation. Slightly more than 42% of electric power generation in Germany in 2015 came from hard coal and lignite. Coal-fired power plants in Germany are still required to compensate for nuclear power, which Germany is foregoing in the wake of the Fukushima incident. Germany's current energy mix reflects long-term plans to eventually phase out coal while renewable-energy sources are developed (Fig. 18).

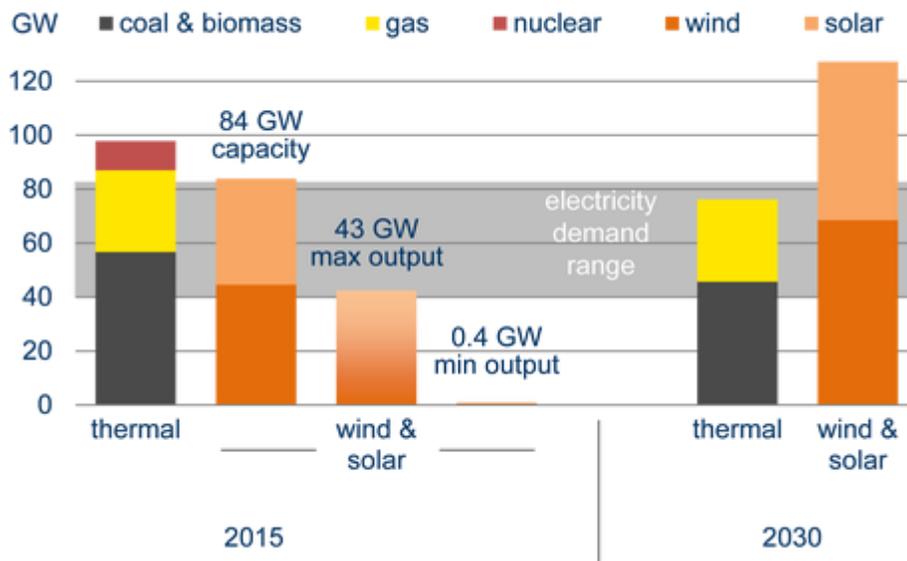


Figure 18. Germany’s projected energy mix from 2015 to 2030. Values are in gigawatts (GW). From Euracoal (2017a).

## Poland

Poland is the second largest coal producer in Europe, with Germany in first rank (Energy Information Administration, 2016c). Coal accounted for 55% of energy consumption, with oil representing 26%, natural gas being 15%, and renewable energy sources comprising 4%. Poland consumes virtually all its domestic coal production, with minor coal exports to the Czech Republic, Germany, and Ukraine. Poland’s coal-fired power plants represent >75% of installed electric generating capacity.

Compared with other countries in the European Union, Poland has large reserves of hard coal and lignite that are devoted to electricity generation (Euracoal, 2017b). Hard coal reserves in Poland amount to 23.3 billion short tons (Bst), or 21.1 Bt, most of which are

located in the Upper Silesian and Lublin coal basins. Lignite reserves in the country are 1.54 Bst (1.4 Bt). In addition, 24.4 Bst (22.1 Bt) of lignite resources exist in Poland. Upper Silesia accounts for ~approximately 79% of Poland's reserves of hard coal, with approximately half of these seams being economically workable. These hard coal reserves, almost all of which are mines with longwall systems, are mined at an average depth of ~1,970 ft (600 m). Steam coal represented 82% of hard coal mined in 2015 (Euracoal, 2017b).

Lignite reserves in Poland are mined at the surface. Two mines are in central Poland, whereas a third is in the southwestern part of the country. Production of lignite in 2015 was 69.6 MMst (63.1 MMt). Virtually of this lignite is devoted to mine-mouth power plants (Euracoal, 2017b). Approximately 80% of Poland's electrical generation capacity is from hard coal and lignite. Poland has the lowest reliance on natural gas among the EU's 10 largest economies. Polish industry spent 23% less for power than German industry in 2012, as well as having provided jobs for >100,000 people.

## **Kazakhstan**

Coal accounts for 56% of Kazakhstan's total energy consumption (Fig. 19) (Energy Information Administration, 2017e). Despite Kazakhstan being ranked among the top-ten coal-producing countries (Table 1), it contributes comparatively little to global coal volumes (<4%) (World Energy Council, 2017). Kazakhstan exports ~25% of its own coal production (virtually all steam coal), with most exports bound for Russia (Energy Information Administration, 2017e). The country plans to offset export losses to Russia with new markets in Finland, Greece Italy, Kyrgyzstan, the United Kingdom, and China,

Approximately one-third of Kazakhstan's coal and lignite deposits are composed of lignite. Most coal production is sourced from the Karaganda Basin, a source of underground coking coal, and the Ekibastuz Basin that supplies coal for electric-power generation (World Energy Council, 2017). Kazakhstan also produces minor volumes of

metallurgical coal for domestic consumption. Coal provides most of Kazakhstan's power generation, with most coal-fired plants being located in the north part of the country. Kazakhstan's total installed generating capacity is ~18 GW, of which 87% comes from fossil fuels.

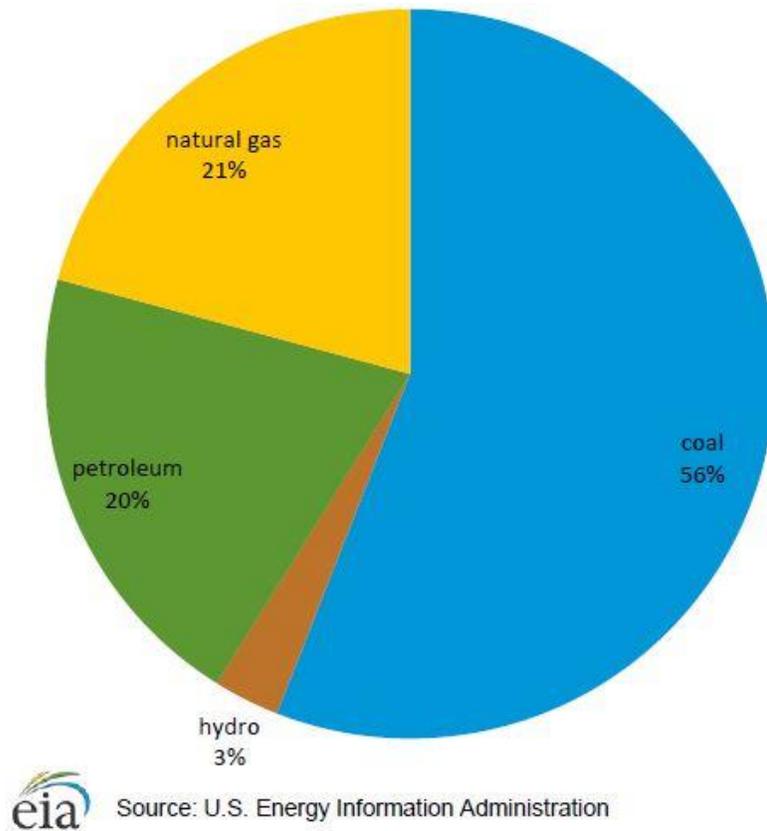


Figure 19. Relative percentage of energy consumption by fuel type in Kazakhstan in 2014. From Energy Information Administration (2017e).

## References

British Petroleum, 2017, BP statistical review 2017: China's energy market in 2016: <https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/statistical-review-2017/bp-statistical-review-of-world-energy-2017-china-insights.pdf>, last accessed April 20, 2018.

Chamber of Mines of South Africa, 2017, Facts and figures 2016: [www.chamberofmines.org.za/industry-news/.../facts.../442-facts-and-figures-2016](http://www.chamberofmines.org.za/industry-news/.../facts.../442-facts-and-figures-2016), last accessed April 24, 2018.

Energy Information Administration, 2015, Indonesia: Country analysis brief overview: <https://www.eia.gov/beta/international/analysis.cfm?iso=IDN>, last accessed April 24, 2018.

Energy Information Administration, 2016a, India: Country analysis brief overview: <https://www.eia.gov/beta/international/analysis.cfm?iso=IND>, last accessed April 25, 2018.

Energy Information Administration, 2016b, Germany: Country analysis brief overview: <http://www.eia.gov/beta/international/analysis.cfm?iso=DEU>, last accessed April 24, 2018.

Energy Information Administration, 2016c, Poland: Country analysis brief overview: <http://www.eia.gov/beta/international/analysis.cfm?iso=POL>, last accessed April 24, 2018.

Energy Information Administration, 2017a, International energy outlook 2017: [https://www.eia.gov/outlooks/ieo/pdf/0484\(2017\).pdf](https://www.eia.gov/outlooks/ieo/pdf/0484(2017).pdf), last accessed April 20, 2018.

Energy Information Administration, 2017b, Chinese coal-fired electricity generation expected to flatten as mix shifts to renewables: <https://www.eia.gov/todayinenergy/detail.php?id=33092>, last accessed April 25, 2018.

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Energy Information Administration, 2017c, Country analysis brief: Australia: <https://www.eia.gov/beta/international/analysis.cfm?iso=AUS>, last accessed April 24, 2018.

Energy Information Administration, 2017d, South Africa: Country analysis brief overview: [https://www.eia.gov/beta/international/analysis\\_includes/countries\\_long/South\\_Africa/south\\_africa.pdf](https://www.eia.gov/beta/international/analysis_includes/countries_long/South_Africa/south_africa.pdf), last accessed April 24, 2018.

Energy Information Administration, 2017e, Kazakhstan: Country analysis brief overview: <http://www.eia.gov/beta/international/analysis.cfm?iso=KAZ>, last accessed April 25, 2018.

Energy Information Administration, 2018, Quarterly coal report (October-December 2017) (Full Report): <https://www.eia.gov/coal/production/quarterly/pdf/qcr.pdf>, last accessed April 23, 2018.

Euracoal, 2017a, Germany: Country profile: <https://euracoal.eu/info/country-profiles/germany/>, last accessed April 24, 2018.

Euracoal, 2017b, Poland: Country profile: <https://euracoal.eu/info/country-profiles/poland/>, last accessed April 24, 2018.

IHS Markit, 2017, Russian coal market news and analysis: <https://www.ihs.com/topic/russian-coal-market.html>, last accessed April 24, 2018.

---

Indonesia-Investments, 2017, Coal in Indonesia: <https://www.indonesia-investments.com/business/commodities/coal/item236>, last accessed April 24, 2017.

Jardine Lloyd Thompson Group, 2017, An outlook on the Indonesian coal industry: <https://www.jlt.com/our-insights/our-insights/an-outlook-on-the-indonesian-coal-industry>, last accessed April 24, 2018.

Jensen, F., 2016, Indonesia's Bumi plans to boost coal output in 2017 on improved prices: <http://af.reuters.com/article/commoditiesNews/idAFL4N1D41BD>, last accessed April 24, 2018.

Meng, L., Feng, Q., Zhou, L., Ping, L., and Meng, Q., 2009, Environmental cumulative effects of coal underground mining: *Procedia Earth and Planetary Science*, vol. 1, no. 1, p. 1280–1284.

National Mining Association (NMA), 2017, World coal production, trade and demand - 2016: [https://nma.org/wp-content/uploads/2017/09/int\\_coal\\_prod\\_trade\\_demand\\_2016.pdf](https://nma.org/wp-content/uploads/2017/09/int_coal_prod_trade_demand_2016.pdf), last accessed April 20, 2018.

Olalde, M., 2017, Days of coal mines are numbered as Eskom shifts focus: <https://www.iol.co.za/news/south-africa/gauteng/days-of-coal-mines-are-numbered-as-eskom-shifts-focus-8378695>, last accessed April 24, 2018.

Reuters, 2016, Coal India, world's largest coal miner, may be broken up into 7 companies: <http://www.financialexpress.com/economy/coal-india-worlds-largest-coal-miner-may-be-broken-up-into-7-companies/461506/>, last accessed April 25, 2018.

Reuters, 2017, Russia's coal exports to rise by up to 3.3 pct in 2017 -Energy Ministry: <https://uk.reuters.com/article/russia-coal/russias-coal-exports-to-rise-by-up-to-3-3-pct-in-2017-energy-ministry-idUKL8N1HF1K8>, last accessed April 24, 2018.

Sliviyak, V., 2015, Russia: the land without doubt or debate: Heinrich Böll Foundation: <https://www.boell.de/en/2015/11/10/russia-land-without-doubt-or-debate>, last accessed April 24, 2018.

The Energy Advocate, 2017, India, China, US increase coal production in 2017: <https://theenergyadvocate.co.uk/2017/06/27/india-china-us-increase-coal-production-2017/>, last accessed April 20, 2018.

Tabuchi, H., 2017, As Beijing joins climate fight, Chinese companies build coal plants: <https://www.nytimes.com/2017/07/01/climate/china-energy-companies-coal-plants-climate-change.html>, last accessed April 25, 2018.

World Energy Council 2017, Kazakhstan coal resources: <https://www.worldenergy.org/data/resources/country/kazakhstan/coal/>, last accessed April 25, 2018.