

# Railroads and Coal

ASSOCIATION OF AMERICAN RAILROADS

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## Summary

Rail coal volumes have declined in recent years, but coal remains a crucial commodity for U.S. freight railroads. In 2017, coal accounted for 32.2 percent of originated tonnage for U.S. Class I railroads, far more than any other commodity. Coal also accounted for 14.8 percent of rail revenue in 2017, behind only intermodal. Most coal in the United States is consumed at power plants, and approximately 70 percent of that coal is delivered by rail. In recent years, coal's share of U.S. electricity generation has fallen sharply, leading to sharp declines in rail coal carloads as well.

Looking ahead, coal will continue to play a major role in U.S. electricity markets, with the extent of that role determined by various market forces (especially the price of natural gas) combined with political forces related to environmental issues. Railroads will continue to haul large quantities of coal safely, efficiently, and reliably.

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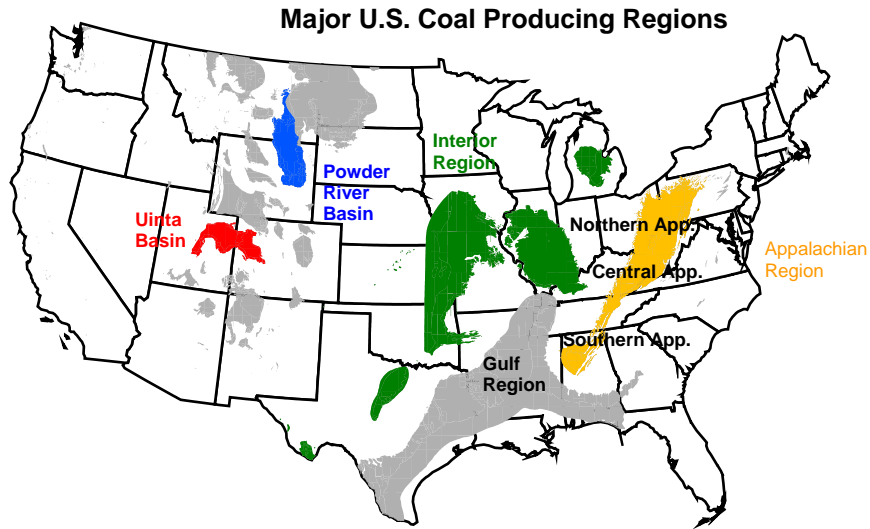
## Overview of Coal

Coal is formed over millions of years through pressure and temperature by the slow underground decomposition and chemical conversion of plant matter in what at one time were enormous swamps. Over time, the plant matter is transformed into peat, then lignite, then subbituminous coal, then bituminous coal, and finally anthracite.

Coal has value primarily because it yields a lot of energy when it's burned. It can be steam coal (used in power plants) or metallurgical coal (used to make coke for steelmaking). Energy content is measured in British Thermal Units (BTUs). On average, one ton of coal yields 20 to 21 million BTUs, but energy content varies considerably by type of coal. For example, the average heating value of bituminous coal is around 24 million BTUs per ton; for subbituminous, 18 million; for lignite, 13 million; and for anthracite, 23 million. Coal quality also varies based on the level of impurities found in the coal.

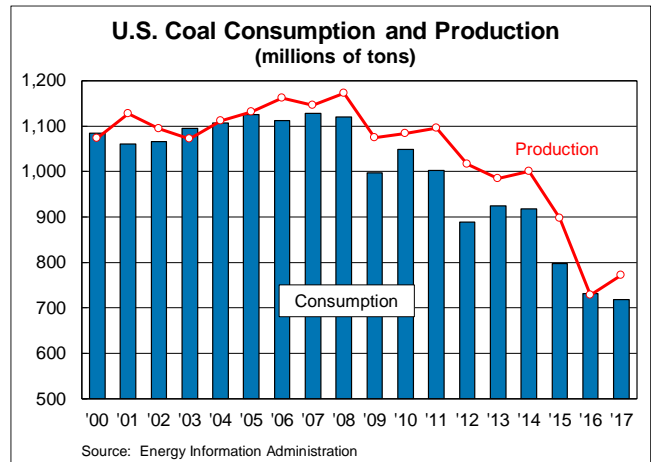
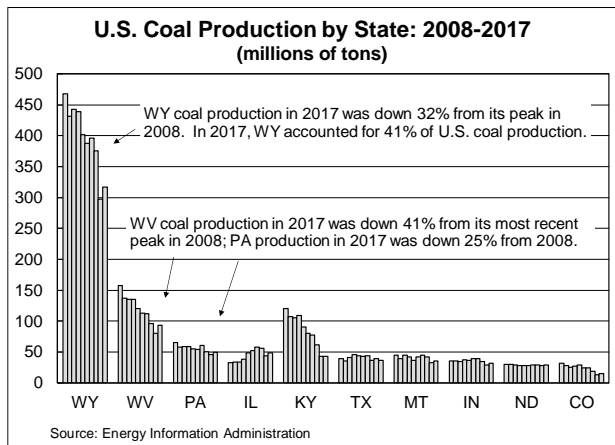
## U.S. Coal Production

According to the U.S. Energy Information Administration (EIA), U.S. coal production in 2017 was 774 million tons, up 6.3 percent from 2016's 728 million tons, down 34 percent from the all-time high of 1.17 billion tons set in 2008, and the second lowest annual total (behind 2016) since 1978. Wyoming accounted for 41 percent of U.S. coal production in 2017, followed by West Virginia (12 percent) and Pennsylvania (6 percent). Seven of the nation's top ten highest-producing U.S. coal mines are in Wyoming, including the top six.



Most U.S. coal production takes place in three major coal-producing areas:

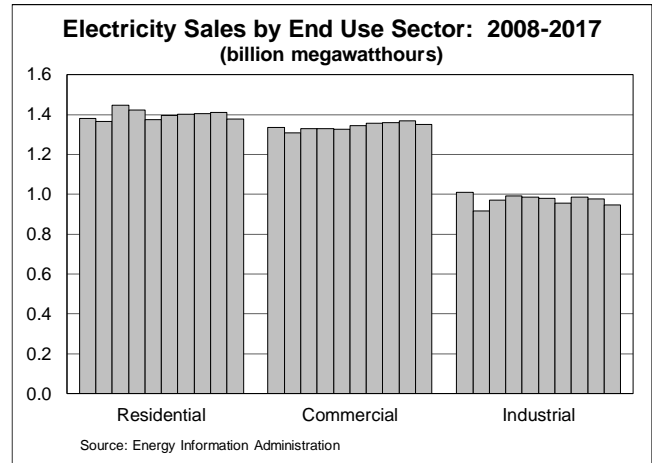
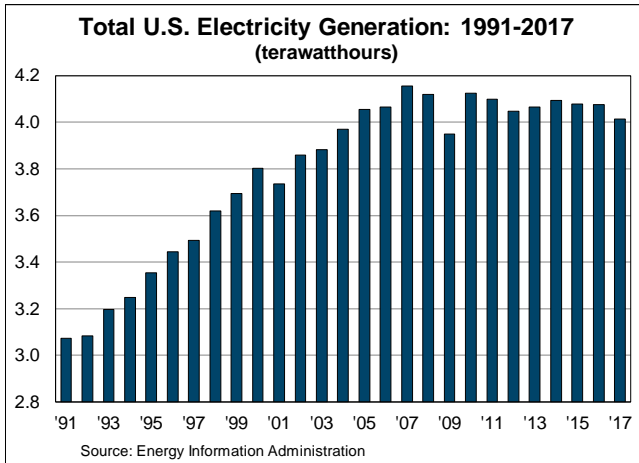
- “Appalachian” coal is mined in Pennsylvania, Maryland, Virginia, West Virginia, Tennessee, Alabama, Ohio, and eastern Kentucky. It is often further broken down into Southern, Central, and Northern Appalachia.
- “Interior” coal is mined in Illinois, Indiana, Missouri, Texas, and western Kentucky.
- “Western” coal is mined in Wyoming, Montana, Utah, Colorado, North Dakota, New Mexico, and Arizona. Most Western coal originates in the Powder River Basin (PRB) of northeast Wyoming and southeast Montana.



## U.S. Coal Consumption

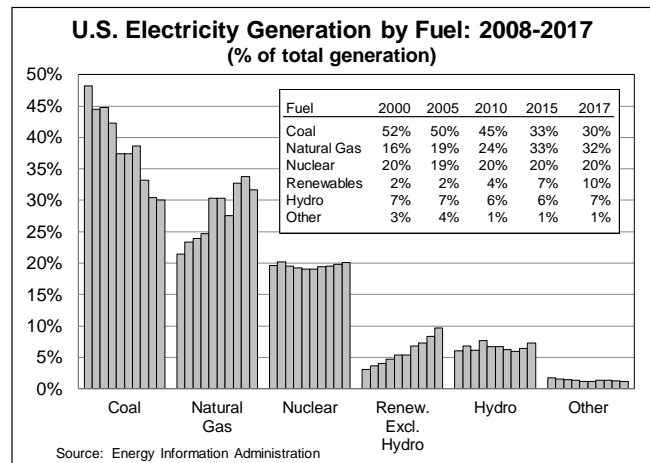
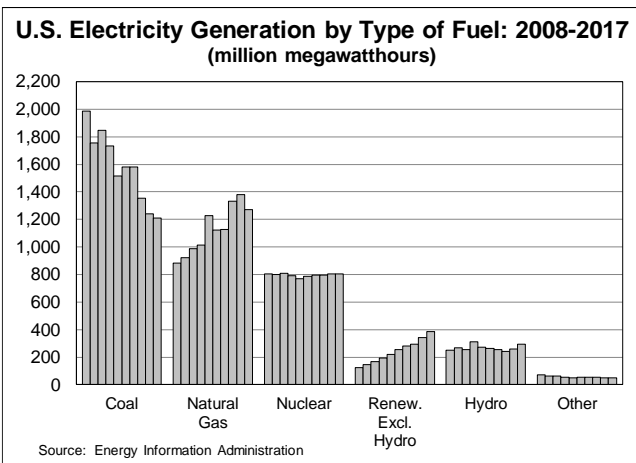
U.S. coal consumption in 2017 was 717 million tons, down 1.9 percent from 2016’s 731 million tons and 36.4 percent lower than the 2007 peak of 1.13 billion tons. In 2017, 92.7 percent of U.S. coal consumption was for electricity generation; 2.4 percent was to produce coke; and 4.8 percent was for other purposes, including combined heat and power plants.

Because power plants account for so much of U.S. coal consumption, the electricity market is key to coal's fortunes. Historically, U.S. electricity production rose steadily: from 1949 to 2007, total year-over-year U.S. electricity generation fell just twice: in 1982 (-2.3 percent) and in 2001 (-1.7 percent). However, since 2007, U.S. electricity generation has trended slightly downward.



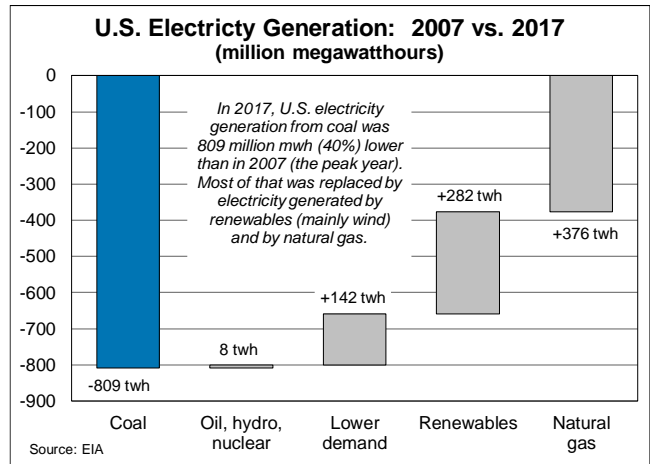
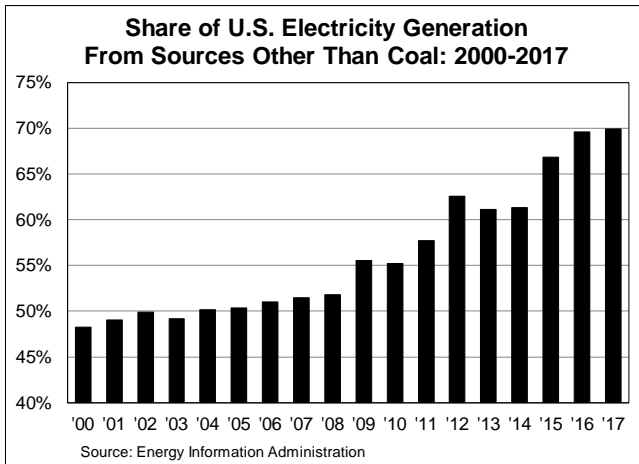
A huge amount of electricity is needed for day-to-day purposes, but on the margin electricity demand is largely a function of weather and the economy. For example, in 2008 and 2009, lower total electricity generation was in large part a function of the severe recession; a big increase in electricity generation in 2010 was in part due to stronger industrial demand and in part due to a hotter than usual summer, which meant more demand for electricity for air conditioning. The non-increases since 2013 have been a function of, among other things, continued slow economic growth, improvements in fuel efficiency, and less weather-related demand.

In the United States, the main fuel sources for generating electricity in 2017 were (in order) natural gas, coal, nuclear power, renewables (mainly wind and solar), and hydroelectric power. If market shares stayed constant, coal-based generation would rise or fall with total electricity generation. Market shares don't stay constant, though, and both the absolute amount of electricity generated from coal and coal's share of the total have been trending sharply down the past few years.



The chart on the bottom left of the previous page shows the absolute amount of electricity generated by various fuels; the chart on the bottom right of the previous page shows the percentage of total generation accounted for by each fuel.

In the 1990s, coal’s share of electricity generation averaged 52 percent. By 2005 it had fallen to 50 percent. Since then, it’s been mostly downhill for coal — the coal share was 45 percent in 2010 and just 30 percent in 2017. Meanwhile, the natural gas share rose from 16 percent in 2000 to 24 percent in 2010 and 32 percent in 2017. In 2016 and 2017, natural gas accounted for more electricity generation than coal, something that had never happened before. The share of U.S. electricity generation accounted for by renewables other than hydroelectric (mainly solar and wind) rose from 2 percent in 2000 to 10 percent in 2017.

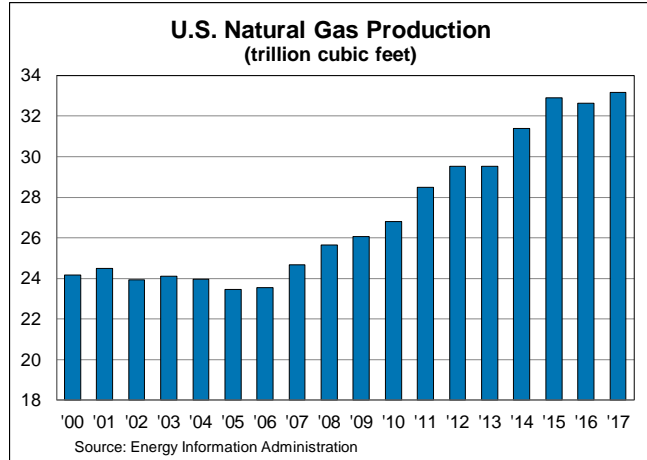
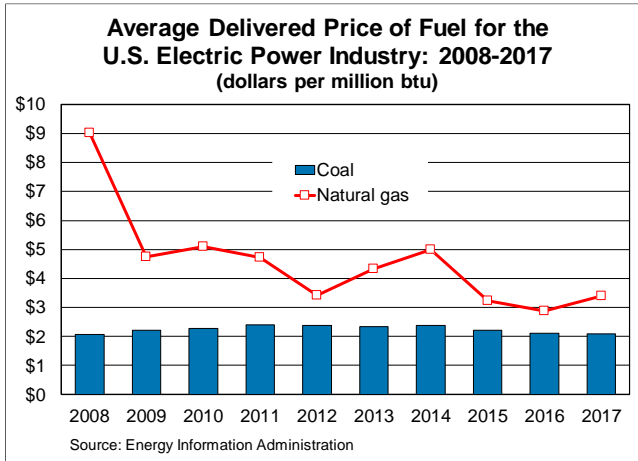


Different fuels dominate electricity generation in different states. For example, Indiana was the 14th largest electricity generator in 2017; coal accounted for 72 percent of its generation. California was the 3rd largest electricity generator, but coal accounted for virtually none of its generation. Electricity generators in California, the Pacific Northwest, and New England use relatively little coal; generators in the Midwest, Southeast, and Southwest burn much more.

The decline in coal’s share of electricity generation has accelerated in the past couple of years (see the charts below). Meanwhile, the natural gas share has been trending sharply upward. The renewable share has been rising too, though from a much lower base.

Natural gas and, even more so, renewables like wind and solar, are seen by many as more environmentally benign than coal, and that’s certainly played a key role in coal’s decline in (and could play an even bigger role in the future). In recent years, economic issues have probably been even more important. Natural gas is much cheaper for electricity producers than it was just a few years ago thanks to sharply higher natural gas production (see the chart on the top right of the next page) brought about by technological advances in natural gas extraction, especially hydraulic fracturing, or fracking.

There is still an enormous amount of uncertainty regarding the future of the natural gas market. Some say low natural gas prices are here to stay; others say they are bound to rise, possibly by a great deal, especially if natural gas exports become widespread. The more natural gas prices rise, everything else equal, the more competitive coal-based electricity generation will be compared with natural gas-based electricity generation.

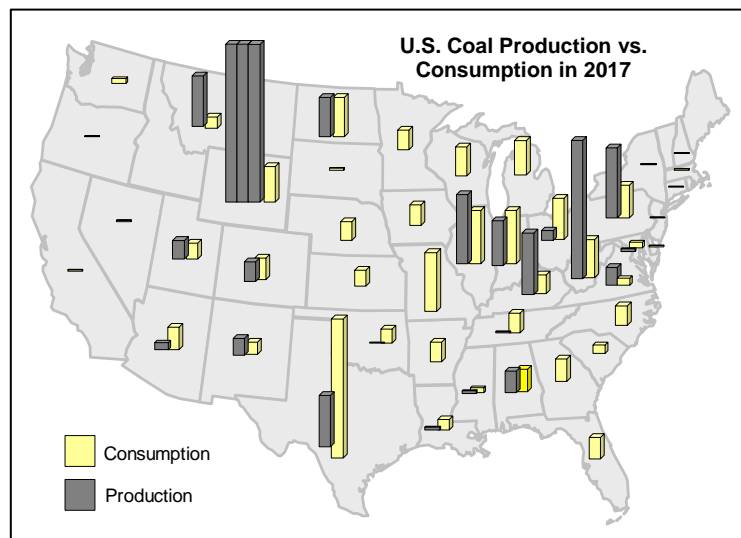


Natural gas is not immune to environmental concerns. Some say fracking is perfectly safe, and they have the support of key policymakers who think it’s a godsend for the economy. Others say fracking is an environmental catastrophe waiting to happen and want to ban it (as some states already have done.) Time will tell who’s right, but there’s no question that coal — and railroads that haul coal — will be greatly affected by what happens. Coal will almost certainly have a major long-term place in America’s energy supply, but how big that piece will end up being, and for how long, has been unclear for years and will likely remain unclear well into the future.

### Coal Transportation

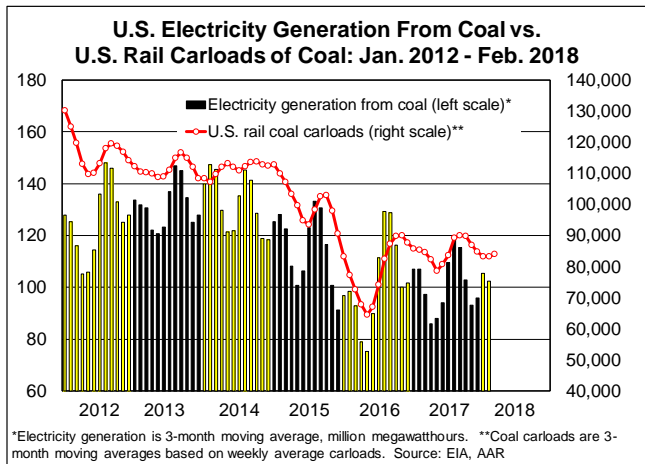
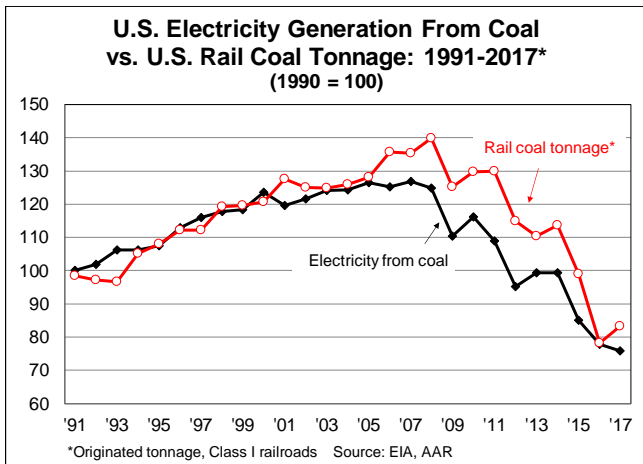
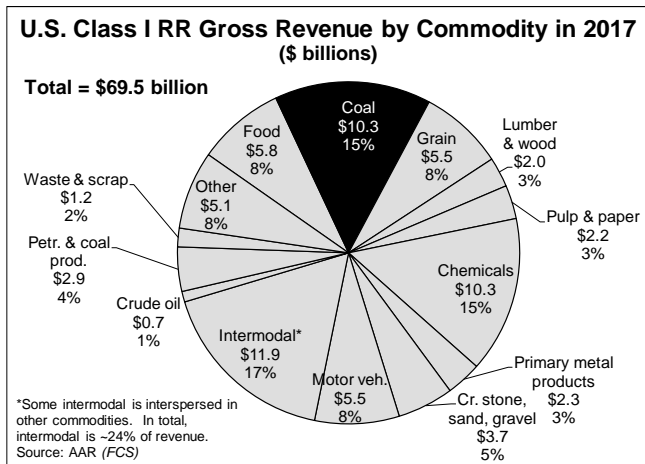
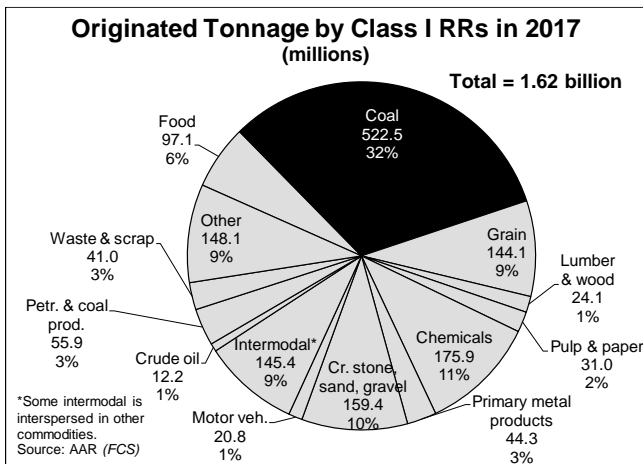
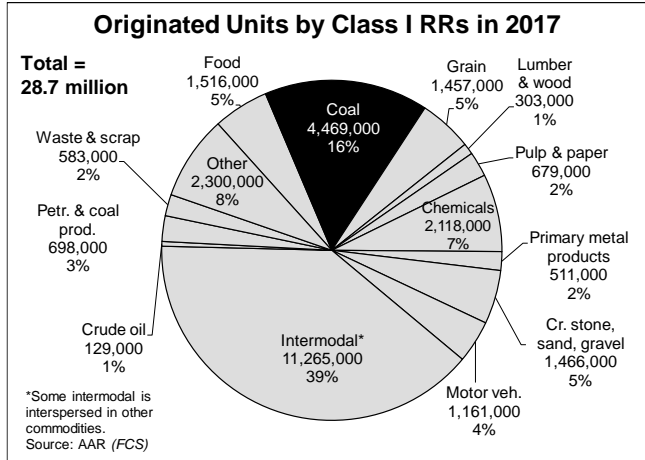
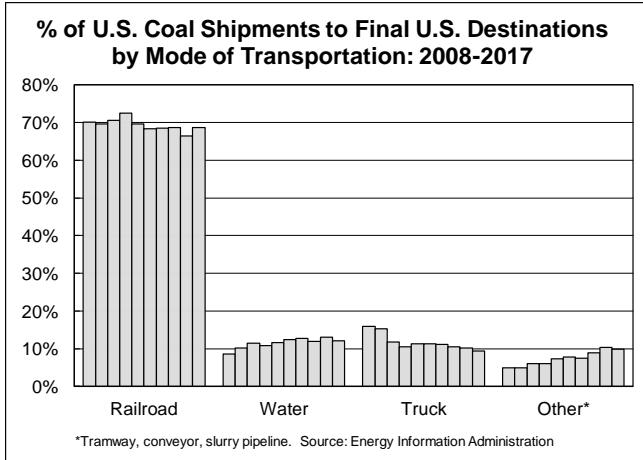
U.S. coal production is focused in a relatively small number of states, but coal is consumed in large amounts all over the country. This is possible because the United States has world’s most efficient and comprehensive coal transportation system, led by railroads.

All major surface transportation modes carry large amounts of coal. According to the EIA, 69 percent of U.S. coal shipments in 2017 were delivered to their final destinations by rail, followed by water (12 percent, mainly barges on inland waterways); conveyor belts and tramways (10 percent, mainly at minemouth plants); and truck (9 percent).



### Railroad Coal Traffic

Rail coal volumes have declined in recent years, but coal remains a crucial commodity for U.S. freight railroads. In 2017, coal accounted for 32.2 percent of originated tonnage for U.S. Class I railroads, far more than any other commodity. Coal also accounted for 14.8 percent of rail revenue in 2017, behind only intermodal.



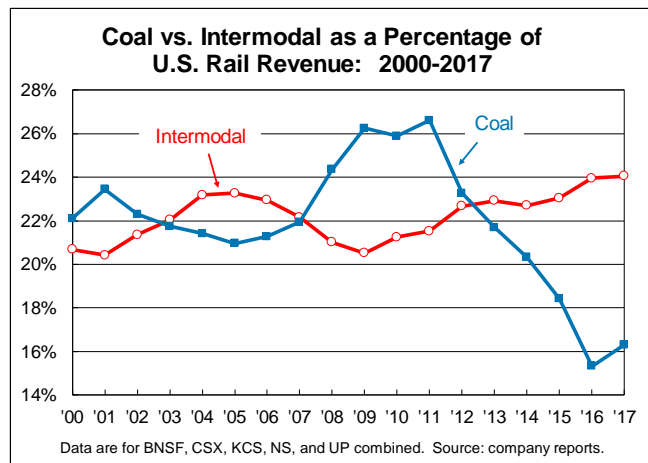
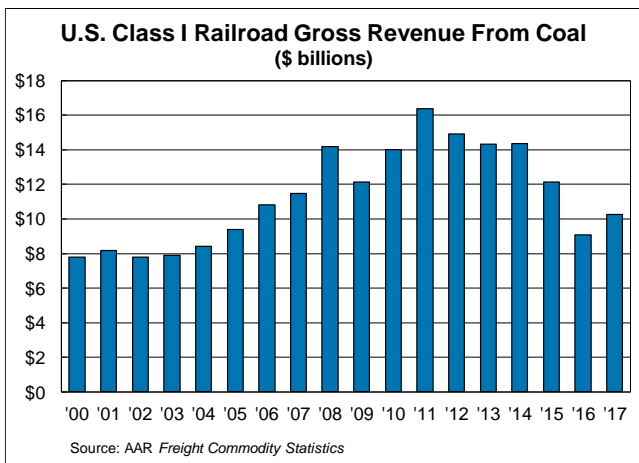
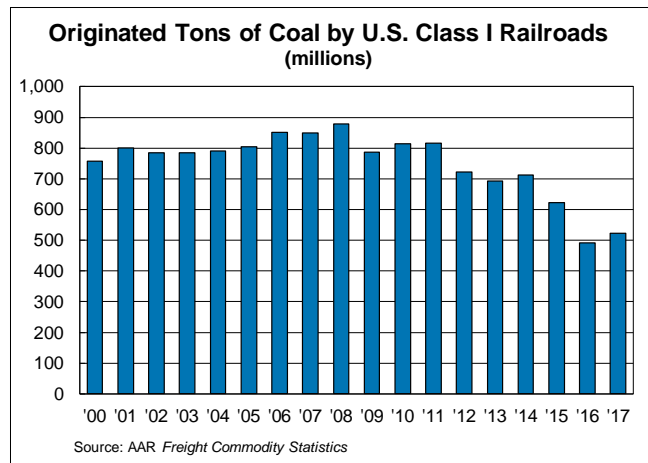
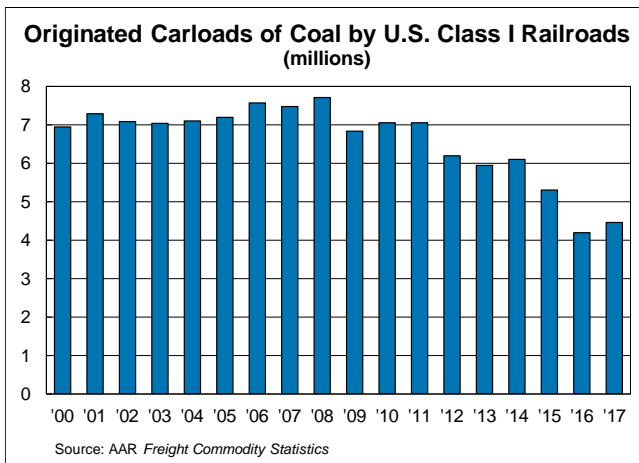
As noted above, coal's share of U.S. electricity generation has fallen sharply in recent years. Rail coal traffic has suffered accordingly. In 2008, the peak year for U.S. rail coal traffic, Class I railroads originated 7.71 million carloads of coal. In 2017, they originated 4.47 million carloads, down 42.1 percent from 2008's peak. Put another way, Class I railroads originated 3.2 million fewer carloads of coal in 2017 than in 2008. If you assume, for simplicity, 115 carloads per coal train, that's 28,200 fewer trainloads of coal in 2017 than in 2008. Carloads of coal in

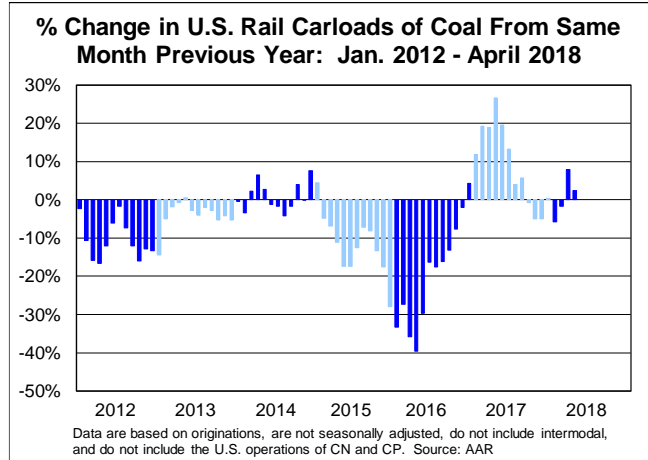
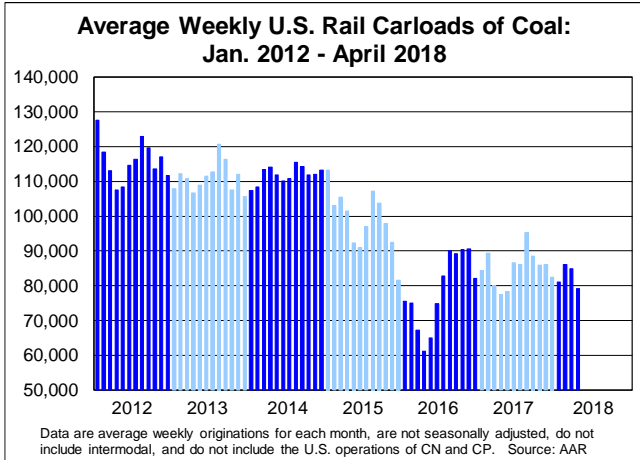
2017 were up 6.6 percent from 2016's 4.19 million and down 15.8 percent from 2015's 5.31 million.

U.S. Class I railroads originated 522.5 million tons of coal in 2017. That's up 6.3 percent from 2016's 491.7 million tons, down 40.5 percent from 2008's peak of 878.6 million tons, and the second lowest annual tonnage for coal since 1979.

Historically, railroads have derived more revenue from coal than from any other single commodity, but that's changed. The broad "intermodal" category, which consists of containers and trailers loaded with a huge variety of different products (but not coal), accounted for more revenue than coal for major U.S. freight railroads from 2003 to 2007 and again from 2013 through 2017. In addition, in 2016, for the first time ever, chemicals accounted for more revenue than coal, but coal revenue exceeded chemical revenue again in 2017. Class I railroad gross revenue from coal was \$10.3 billion in 2017, up 13.1 percent from 2016 but down 37.2 percent from a peak of \$16.4 billion in 2011.

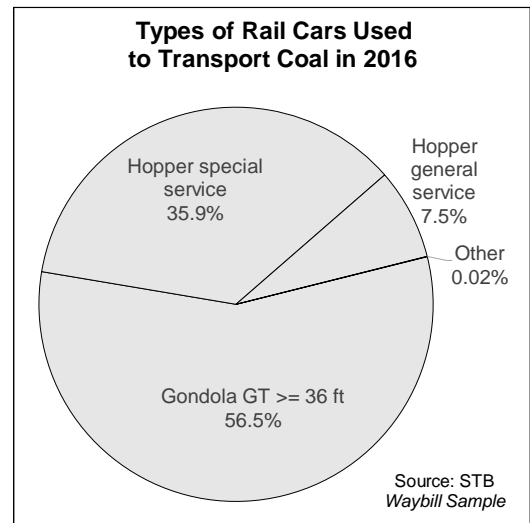
Thanks to huge productivity gains — including the use of lighter weight aluminum freight cars — railroads have dramatically increased their coal-carrying efficiency. In 2017, the average coal car carried 116.9 tons, up 19 percent from the 98.2 tons in 1990. Nearly all coal transported by rail moves in highly productive unit trains, which often operate around the clock, use dedicated equipment, and generally follow direct shipping routes.





In 2016, the average length of haul for rail coal movements was 856 miles. Coal movements exceeding 1,500 miles are not uncommon. The vast majority of coal moves in gondolas and open-top hoppers.

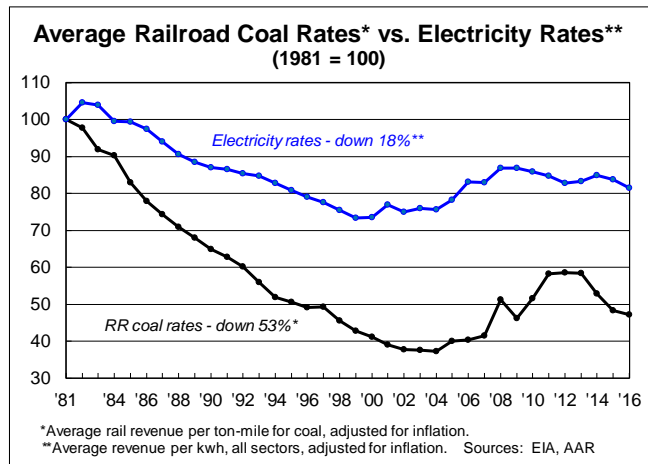
Coal dominates rail traffic in major coal producing states. In Kentucky, West Virginia and Wyoming, for example, coal accounted for 72 percent, 87 percent, and 94 percent, respectively, of total originated rail tonnage in 2016. Due to its widespread use in generating electricity, coal also accounts for a major share of terminated rail tons for many states. For example, in 2016 coal accounted for 31 percent of rail tons terminated in North Carolina, 54 percent in Wisconsin, and 28 percent in Georgia.



Rail Rates for Coal

Since it incorporates both distance and weight, revenue per ton-mile (RPTM) is a useful surrogate for rail rates. In 2016 (the most recent year for which data are available as of this writing), average RPTM for coal was 2.51 cents, by far the lowest such figure among major commodities carried by railroads. Average RPTM in 2016 for all commodities other than coal was 5.69 cents, well over double the comparable coal figure.

Adjusted for inflation, coal RPTM was 53 percent lower in 2016 than in 1981. This means a typical coal shipper can ship twice as much coal today for about what he paid more than 30 years ago. Over this period, the average decline in rail coal rates is much greater than the average decline in the price of electricity (see the chart at right).

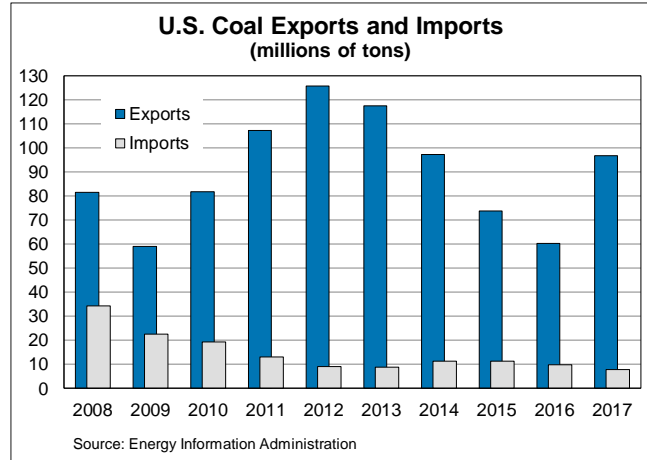




Another way to look at rail coal rates is in the context of electricity sales. According to data from the Energy Information Administration, total revenue from sales of electricity to ultimate consumers in 2017 was \$388.1 billion. Class I rail gross revenue from hauling coal in 2017 was \$10.3 billion, equal to just 2.6 percent of the revenue from electricity sales.

### U.S. Coal Foreign Trade

Competition in the global marketplace for coal sales is intense. U.S. coal exports were 97.0 million tons in 2017, the most since 2014 and up 60.9 percent from 2016's 60.3 million tons. A large portion of U.S. coal exports travels by rail. In 2017, the top recipients of U.S. coal exports were India, South Korea, the Netherlands, Brazil, India, and Japan. Over the past ten years, metallurgical coal has accounted for 60 percent of U.S. coal exports, and steam coal for 40 percent.



U.S. coal producers are hopeful that coal exports will grow in the future, with Asia — especially China and India — seen as key potential markets.

### Environmental Challenges

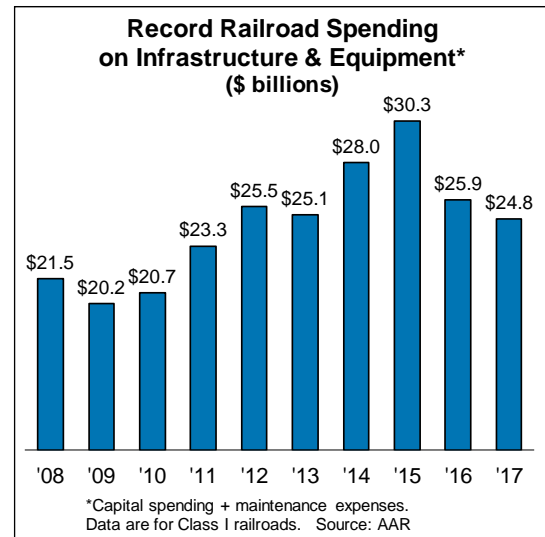
Over the years, the affordability of coal-based electricity has been a major factor behind America's economic growth and global competitiveness. In the years ahead, coal will continue to be needed to meet America's electricity demands.

That said, coal and coal-fueled electricity generation face serious environmental challenges, including challenges related to emissions (greenhouse gases, mercury, particulates, etc.), coal ash disposal, effluents, and other issues.

In addition to reasonable EPA regulations, railroads support the development of advanced carbon capture and storage and other clean coal technologies. By developing these technologies, America would continue to produce affordable electricity from its abundant domestic coal, energy independence would be promoted, and the environment would be protected — a win-win-win situation for all parties involved.

### Continued Spending Back Into the Rail Network

In the future, transportation demand will grow and new rail capacity will be needed. Recent forecasts from the Federal Highway Administration found that total U.S. freight shipments will rise from an estimated 18.1 billion tons in 2015 to 25.5 billion tons in 2040 — a 41 percent increase.



Freight railroads are preparing for this future demand today. Unlike trucks, barges, and airlines, which travel mainly on infrastructure that the government provides and pays for, America's privately owned freight railroads operate almost exclusively on infrastructure that they own, build, maintain, and pay for themselves. In recent years, America's freight railroads have been putting more money back into their networks than ever before. From 1980 through 2017, they spent more than \$660 billion — their own funds, not taxpayer funds — on renewal, maintenance, and expansion of their infrastructure and equipment. That's more than 40 cents out of every rail revenue dollar.

In the years to come, railroads will have to continue to maintain their existing capacity and install new capacity to meet the needs of current and potential customers. Additional spending on capacity can only be made if rail earnings are robust enough to attract the capital needed to pay for it.

## **Conclusion**

There's no question that the past few years have been difficult for everyone associated with coal, including railroads. How rail coal traffic behaves in the months and years ahead will depend on the same factors that have affected coal recently, including the competitiveness of fuels other than coal for electricity generation, weather, coal exports, and environmental laws and regulations. Through technological advances, innovative service, competitive rates, and aggressive reinvestment programs, railroads have shown their willingness and ability to provide safe, reliable, high-value transportation service to their coal customers throughout the country. Railroads look forward to continuing to do so long into the future.