

# 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 2018, coal accounted for 31.4 percent of originated tonnage for U.S. Class I railroads, far more than any other commodity. Coal also accounted for 16.1 percent of rail revenue in 2018 for Class I railroads, behind only intermodal among all major rail traffic segments. 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 carloads of coal. 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.

## Overview of Coal

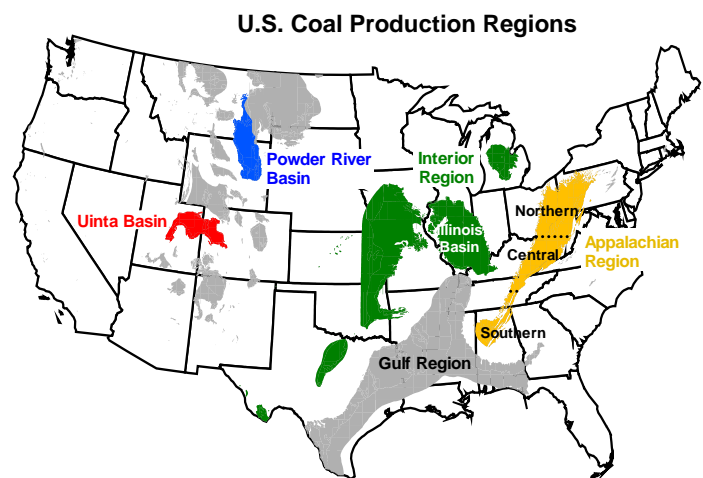
Coal is formed over millions of years through pressure and temperature by the slow underground decomposition and chemical conversion of plant matter in what at one time were enormous swamps. Over time, the plant matter is transformed into peat, then lignite, then subbituminous coal, then bituminous coal,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

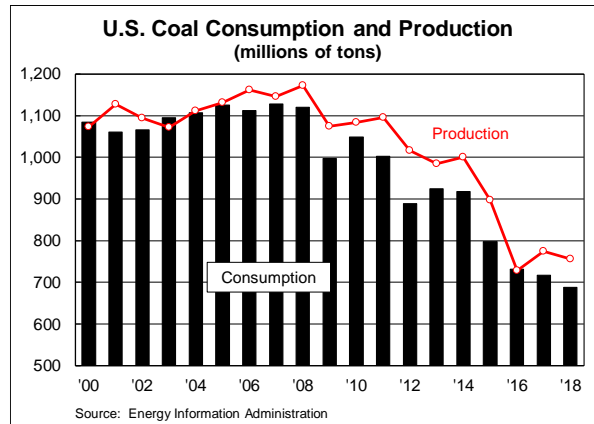
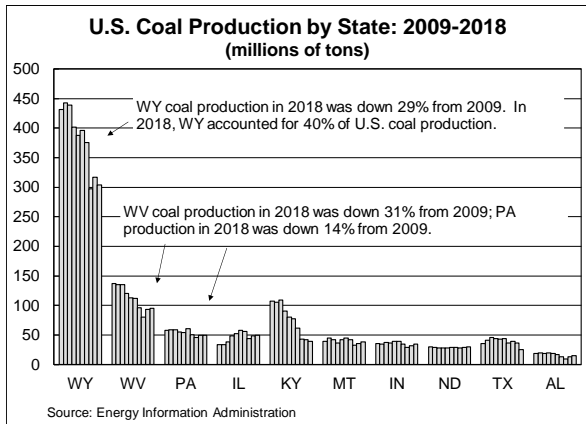
Coal can be steam coal (used in power plants) or metallurgical coal (used to make coke for steelmaking). Energy content is measured in British Thermal Units (BTUs). On average, one ton of coal yields 20 to 21 million BTUs, but energy content varies by coal type. For example, the average heating value 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 2018 was 756 million tons, down 36 percent from the all-time high of 1.17 billion tons set in 2008 and the second lowest annual total (behind 2016) since 1978.

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





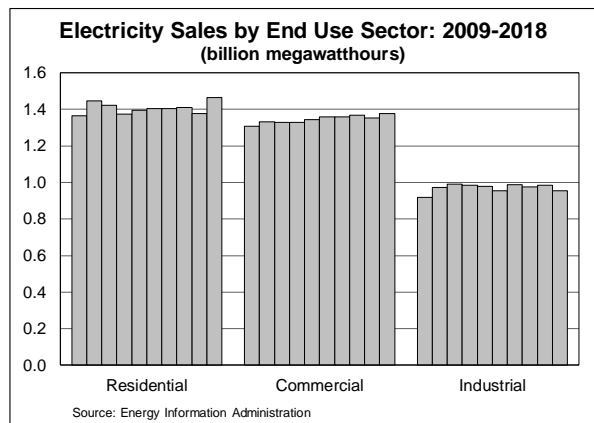
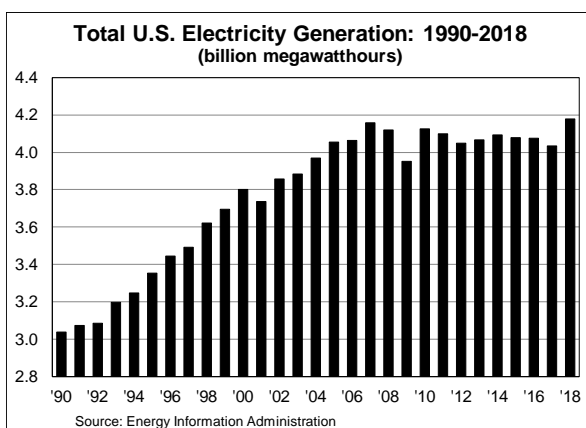
- “Appalachian” coal is mined in Pennsylvania, Maryland, Virginia, West Virginia, Tennessee, Alabama, Ohio, and eastern Kentucky. It is often further broken down into Southern, Central, and Northern Appalachia.
- “Interior” coal is mined in Illinois, Indiana, Missouri, Texas, and western Kentucky.
- “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.

Wyoming accounted for 40 percent of U.S. coal production in 2018, followed by West Virginia (13 percent) and Pennsylvania (7 percent). The five highest-producing U.S. coal mines in 2018 were in Wyoming.

### U.S. Coal Consumption

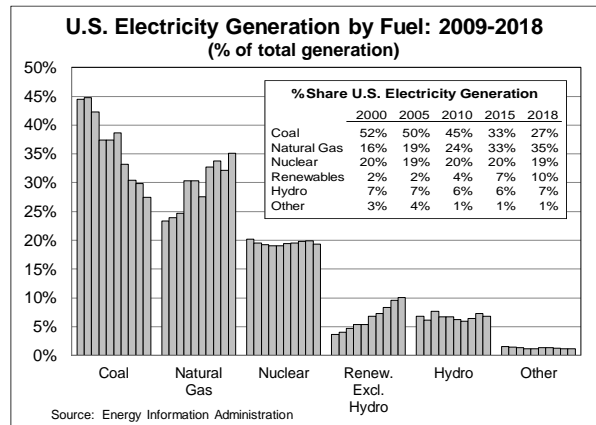
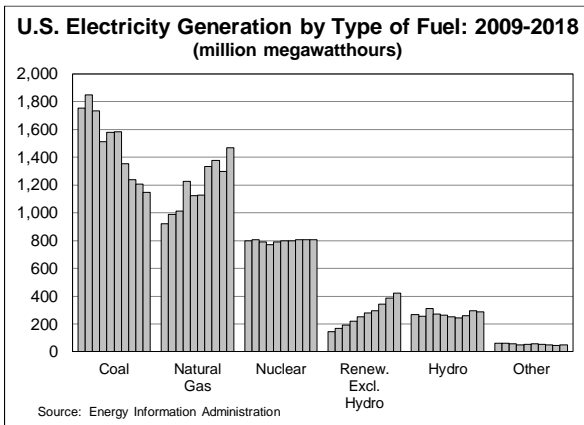
U.S. coal consumption in 2018 was 687 million tons, down 4.1 percent from 2017’s 717 million tons and 39.1 percent lower than the 2007 peak of 1.13 billion tons. In 2018, 92.6 percent of U.S. coal consumption was for electricity generation; 2.7 percent was to produce coke; and 4.7 percent was for other purposes, including combined heat and power plants.

Because power plants account for such a large share of U.S. coal consumption, the electricity market is key to coal’s fortunes. Historically, annual U.S. electricity generation rose steadily: from 1949 to 2007, it fell just twice. From 2007 to 2017, though, annual U.S. electricity output trended down, though it jumped in 2018 to a new record high.



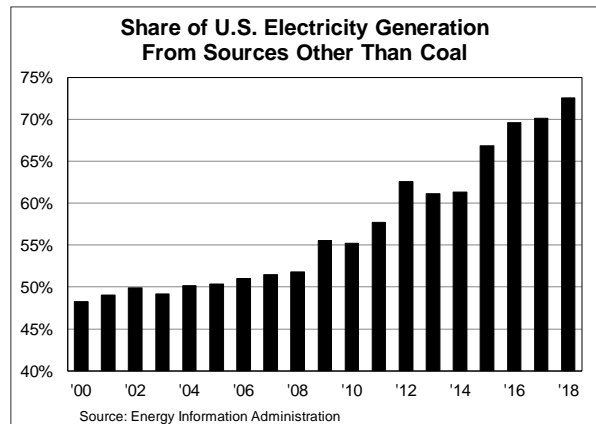
A huge amount of electricity is needed for day-to-day purposes, but on the margin electricity demand is largely a function of weather and the economy. For example, in 2008 and 2009, lower total electricity generation was largely a function of the severe recession, while a big increase in electricity generation in 2010 was in part due to stronger industrial demand and in part due to a hotter than usual summer. Non-increases in electricity generation from 2013 to 2017 were a function of, among other things, continued slow economic growth, improvements in fuel efficiency, and reduced weather-related demand. In 2018, weather-related factors increased demand for space heating in the winter and for air conditioning in the summer.

The main fuel sources for generating electricity in 2018 in the United States were 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 over the past decade.



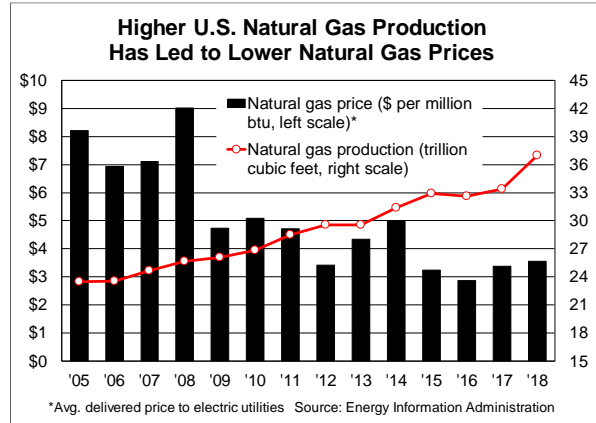
In the 1990s, coal's share of electricity generation averaged 52 percent. By 2005 it had fallen to 50 percent. Since then, it's been mostly downhill for coal — the coal share was 45 percent in 2010 and just 27 percent in 2018. Meanwhile, the natural gas share rose from 16 percent in 2000 to 24 percent in 2010 to 35 percent in 2018.

Since 2016, natural gas has accounted for more electricity generation than coal, something that had not happened previously. The share of U.S. electricity generation accounted for by renewables other than hydroelectric rose from 2 percent in 2000 to 10 percent in 2018.



Different fuels dominate electricity generation in different states. For example, Indiana was the 14th largest electricity generator in 2018; coal accounted for 69 percent of its generation and it was the second-largest generator of electricity from coal (behind Texas). Meanwhile, California was the 3rd largest electricity generator in 2018, 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 use much more.

Concerns about the environmental impact of coal has played a major role in coal's decline and in the increase in the use of natural gas and renewables like wind and solar. In recent years, though, economic issues have been even more important. Sharply higher natural gas production brought about by technological advances in natural gas extraction, especially hydraulic fracturing — also known as fracking — has meant that natural gas is much more plentiful and cheaper for electricity producers than it used to be.



There is still a large 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 large amount, especially if natural gas exports become widespread or if opposition to fracking spreads. The more natural gas prices rise, everything else equal, the more competitive coal-based electricity generation will be compared with gas-based electricity generation.

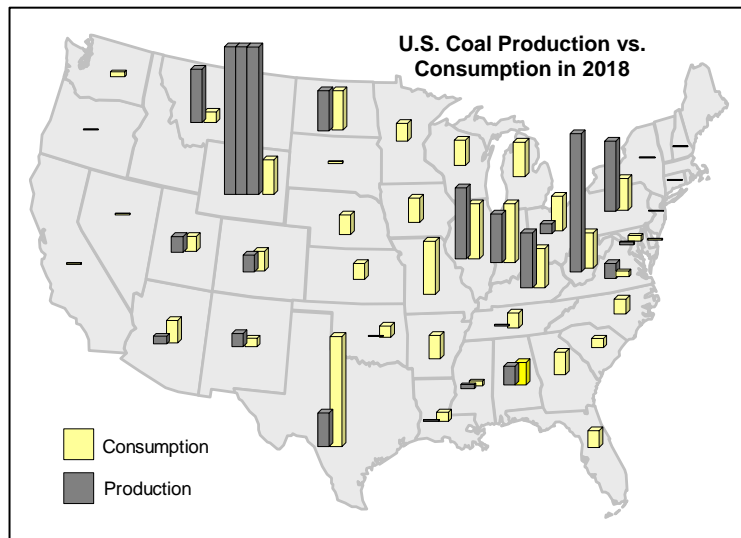
Natural gas is also not immune to environmental concerns. Some say fracking is perfectly safe, and they have the support of key policymakers who think it's a godsend for the economy. Others say fracking is an environmental catastrophe waiting to happen and want to ban it (as some states already have done). Time will tell who's right, but there's no question that coal — and railroads that haul coal — will be greatly impacted 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. That's possible because the United States has the world's most efficient and comprehensive coal transportation system, led by railroads.

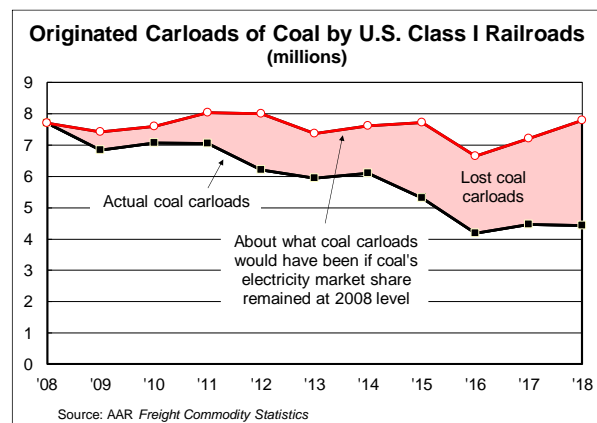
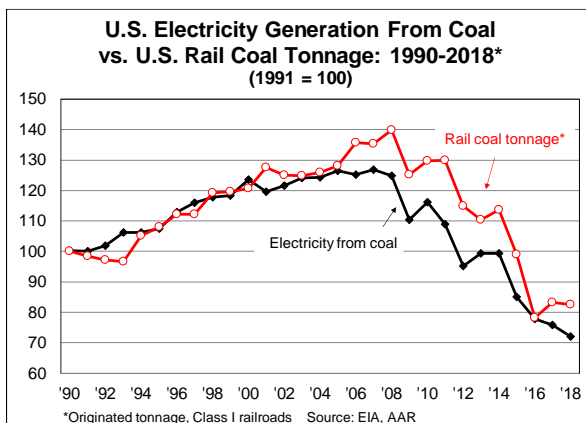
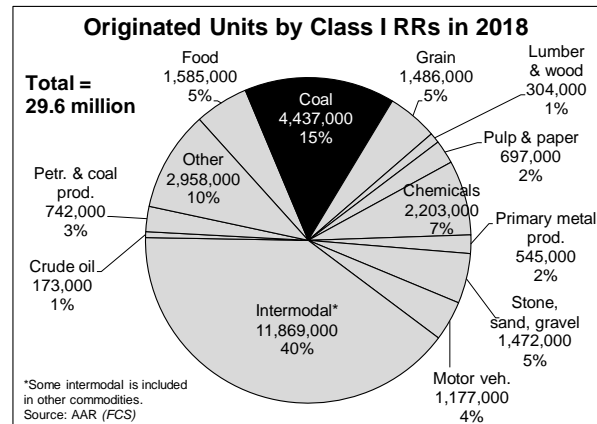
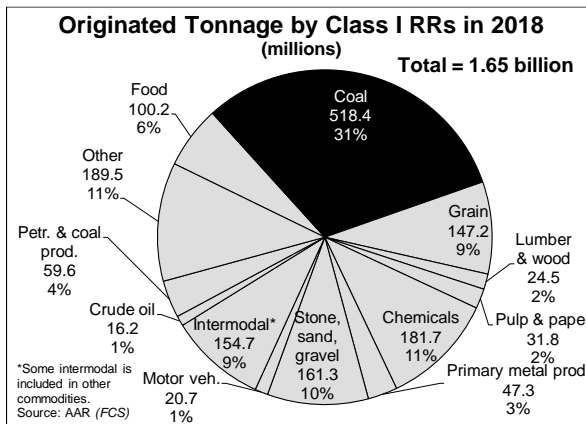
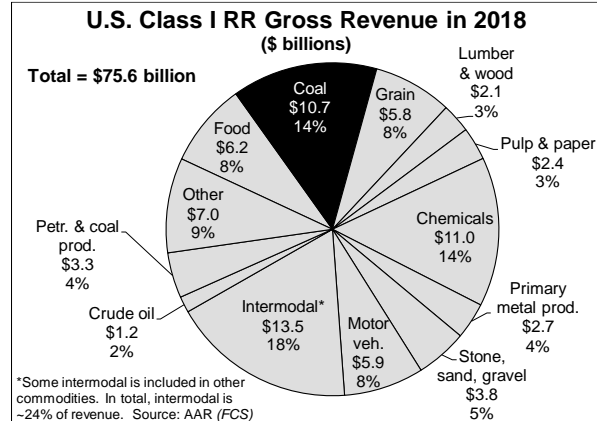
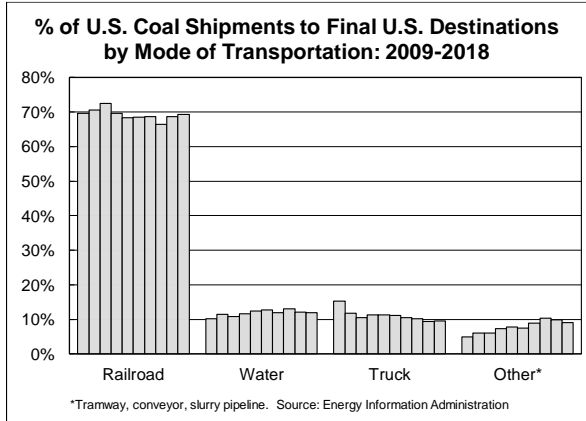
According to the Energy Information Administration, 69 percent of U.S. coal shipments in 2018 were delivered to their final destinations by rail, followed by water (12 percent, virtually all via barges on inland waterways); truck (10 percent); and conveyor belts and tramways (9 percent, mainly at minemouth plants).



## Railroad Coal Traffic

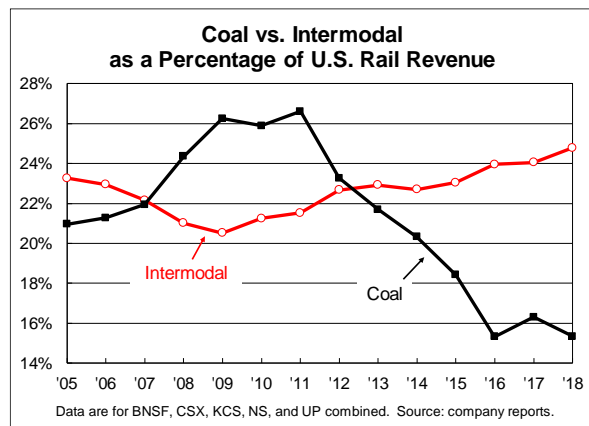
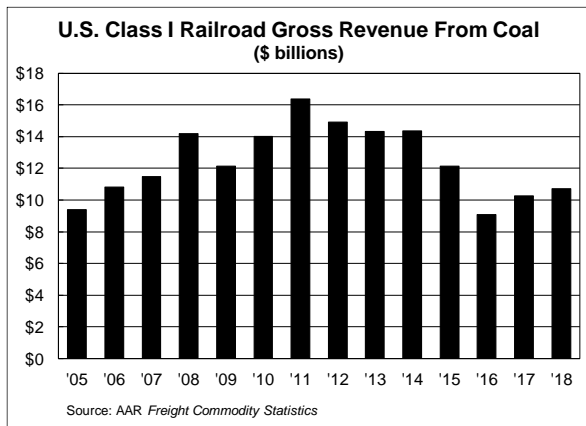
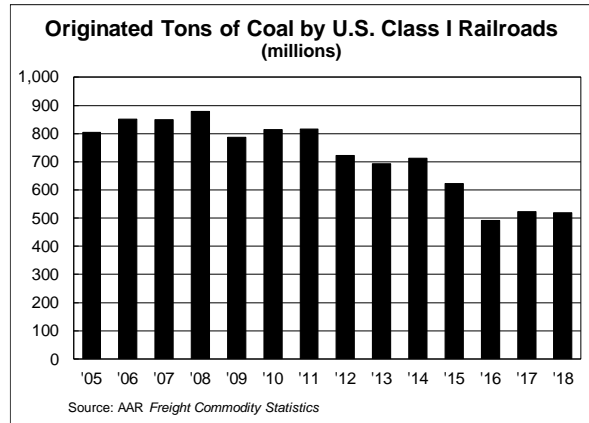
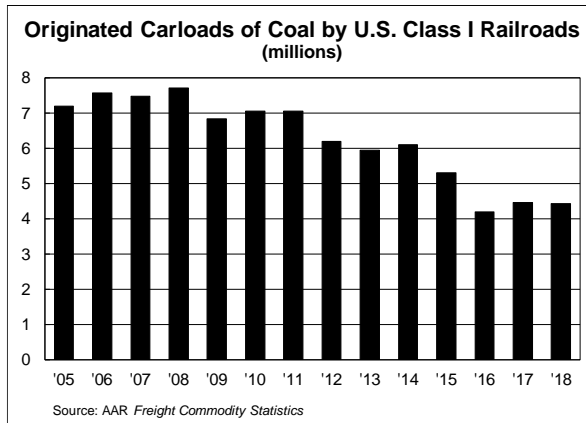
Rail coal volumes have declined in recent years, but coal remains a crucial commodity for U.S. freight railroads. In 2018, coal accounted for 31.4 percent of originated tonnage for U.S. Class I railroads, far more than any other commodity. Coal also accounted for 16.1 percent of Class I rail revenue in 2018; among rail traffic segments, only intermodal accounted for more.

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 2018, they originated 4.44 million



carloads, down 42.5 percent from 2008's peak. Put another way, Class I railroads originated 3.3 million fewer carloads of coal in 2018 than in 2008. If you assume, for simplicity, 115 carloads per coal train, that's 28,500 fewer trainloads of coal in 2018 than in 2008. U.S. natural gas production and the decline in coal's market share began around 2008. All else equal, if coal's share had remained the same in later years as it was in 2008, railroads would have originated somewhere around 18 million more carloads of coal from 2009-2018 than they actually did.

U.S. Class I railroads originated 518.4 million tons of coal in 2018 —down 41.0 percent from 2008's peak of 878.6 million tons and the second lowest annual tonnage for coal since 1979 (only 2016 was lower).

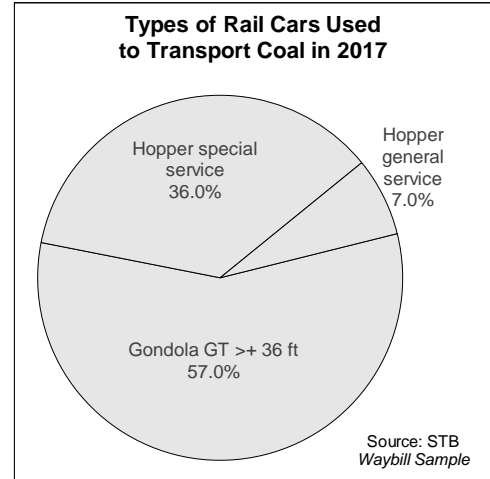


Historically, railroads derived more revenue from coal than from anything else, but that's changed. Intermodal, which consists of containers and trailers loaded with a huge variety of different products (but not coal), accounted for more revenue than coal for major U.S. freight railroads from 2003 to 2007 and again from 2013 through 2018. In 2018, chemicals accounted for more revenue than coal as well. Class I railroad gross revenue from coal was \$10.7 billion in 2018, up 4.1 percent from 2017 but down 34.6 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 2018, the average coal car carried 116.8 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 2017, the average length of haul for rail coal movements was 887 miles. Coal movements exceeding 1,500 miles are not uncommon. The vast majority of coal moves in gondolas and open-top hoppers.

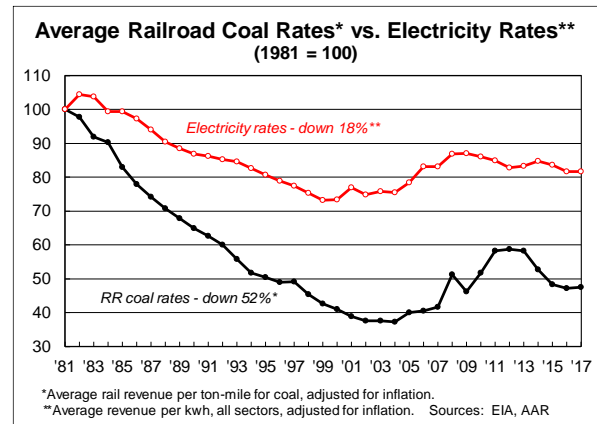
Coal dominates rail traffic in major coal producing states. In Kentucky, West Virginia and Wyoming, for example, coal accounted for 70 percent, 89 percent, and 94 percent, respectively, of originated rail tonnage in 2017. Due to its widespread use in generating electricity, coal also accounts for a major share of terminated rail tons for many states. For example, in 2017 coal accounted for 31 percent of rail tons terminated in North Carolina, 50 percent in Wisconsin, and 26 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 2017 (the most recent year for which data are available as of this writing), average RPTM for coal was 2.58 cents, by far the lowest such figure among major rail commodities. Average RPTM in 2017 for all commodities other than coal was 5.76 cents, well over double the coal figure.

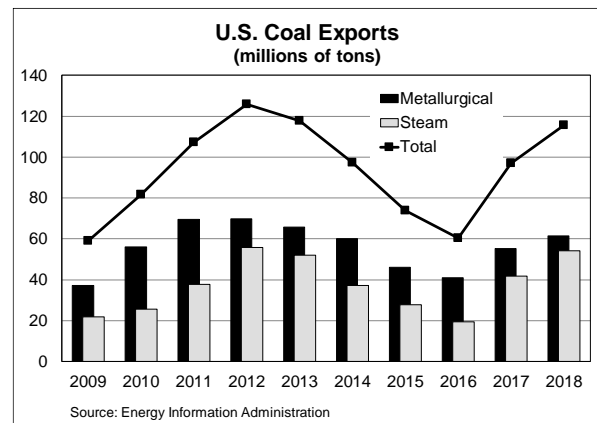
Adjusted for inflation, coal RPTM was 52 percent lower in 2017 than in 1981. This means a typical coal shipper can ship about twice as much coal today for about what it paid more than 35 years ago. Over this period, the average decline in rail coal rates is much greater than the average decline in the price of electricity.



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 2018 was \$402.3 billion. Class I rail gross revenue from hauling coal in 2018 was \$10.7 billion, equal to just 2.7 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 115.6 million tons in 2018, the most since 2013. A large portion of U.S. coal exports travels by rail. In 2018, the top recipients of U.S. coal exports were India, the Netherlands, Japan, South Korea, and Brazil. Over the past ten years, metallurgical coal has accounted for 60 percent of U.S. coal exports; steam coal accounted for 40 percent. U.S. coal imports are very low.



## 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.

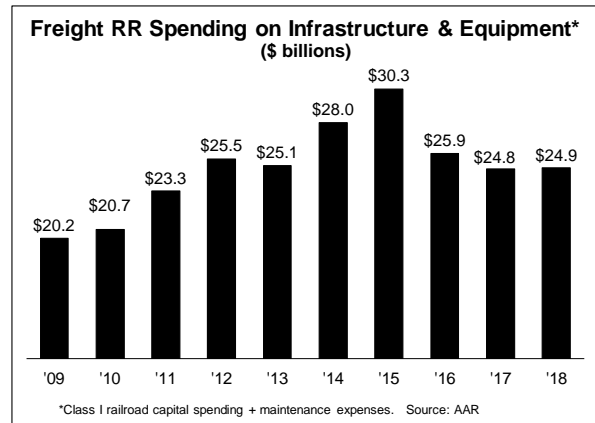
That said, coal and coal-fueled electricity generation face serious environmental challenges, including challenges related to emissions (greenhouse gases, mercury, particulates, etc.), coal ash disposal, effluents, and other issues.

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, freight 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 17.8 billion tons in 2017 to around 24.1 billion tons in 2040 — a 35 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 2018, they spent more than \$685 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

The past decade has 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.