

What Is Killing the US Coal Industry?

By Charles D. Kolstad

One of the themes of Donald Trump's presidential campaign was bringing back coal jobs to the Midwest. As president, he has doubled down on this, promising to "lift restrictions on American energy — including shale oil, natural gas and beautiful, clean coal."¹

Many Republicans have blamed environmental regulations enacted during the Obama administration for the decline of the country's coal industry. Republicans have pledged to bring back the industry and its jobs, primarily by neutering those regulations. One of the first actions by the new Congress was to cancel the updated Stream Protection Rule,

protecting streams near coal mines,² in an effort to relieve the coal industry of "burdensome" regulations.

Motivating the political focus on coal is a simple pair of facts: Coal production in the United States has declined recently after a half century of growth, and employment in the coal industry has dropped for years.

This Policy Brief explores the arguments made to explain those declines. And those who are inclined to place most — or all — of the blame on environmental regulations will learn there are other, likely stronger, influences at work.

² The Stream Protection Rule of December 2016 was an update of an earlier rule, implemented as part of the 1977 Surface Mining Control and Reclamation Act (SMCRA). The Congressional Review Act authorizes Congress by vote to cancel regulations less than 6 months old. President Trump signed into law the cancellation of the Stream Protection Rule on February 17, 2017.

¹ Speech by Donald J. Trump to Conservative Political Action Conference, February 24, 2017.

The state of coal in the U.S.

Taking the long view of coal in the United States, one is struck by the steady expansion of output since World War II.

Figure 1 shows U.S. coal production since 1949, separating the West (the region west of the Mississippi River) from the East (the region east of the Mississippi). The East is the traditional home of U.S. coal whereas the West is primarily a post-1970 supplier.³

Although over the past 60 years output of coal more than doubled,⁴ note that 2009 marked the start of a moderate decline in output. Also note that the post-World War II boom in coal is not uniform over the country. Virtually all of the gain in output was in the West, with mining in the East peaking in 1990 and declining slowly ever since.

³ The West primarily consists of coal deposits from New Mexico and Arizona, as far north as Montana and as far east as Texas. The East primarily consists of coal deposits in the Midwest and Appalachia, from Ohio and Pennsylvania down to Alabama.

⁴ Coal output in both physical and value terms more than doubled 1949-2011. According to the EIA, the price of coal at the mine was \$36.14/ton in 1949 and \$32.56 in 2011, in constant, inflation-adjusted 2005\$.

About the Author



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Environmental and Resource Economists and served as convening lead author for the Intergovernmental Panel on Climate Change (co-recipient of the 2007 Nobel Peace Prize).

Figure 2 shows employment in coal mining, in both the East and West. Despite great expansion in coal production over the past half century, employment has steadily declined, with a few employment booms, such as the first decade of this century and the decade of the 1970s. Remarkably, although most of the coal comes from West (Figure 1), the vast majority of jobs are in the East (Figure 2).

What's up?

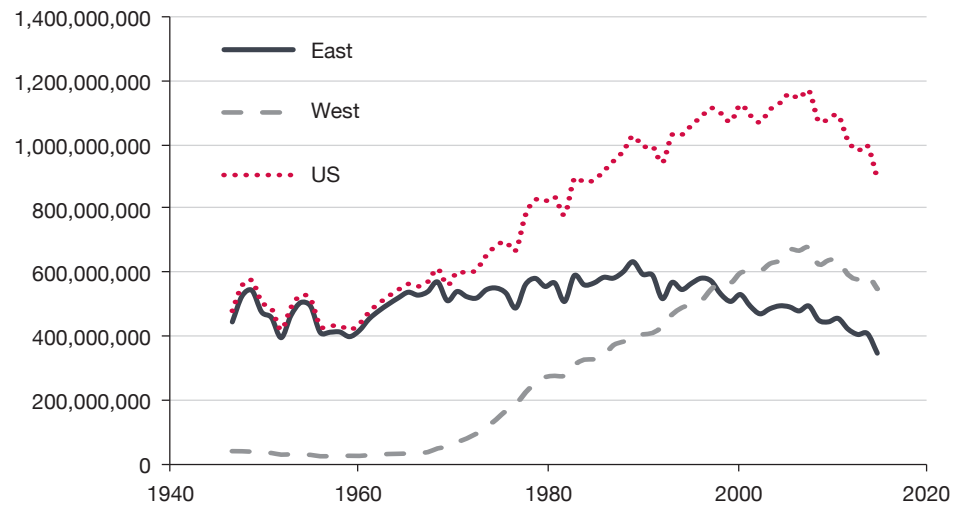
A number of explanations have been offered for the recent decline in coal production and jobs:

- Environmental regulations — the primary suspect for some — killed coal.
- Deregulating railroads in the 1970s allowed cheap Western coal to displace more costly Eastern coal, resulting in major job losses in the labor-intensive Eastern coal industry.
- The fracking revolution has driven down natural gas prices, making coal less competitive in electricity production.
- Coal mining jobs are going away because of the same productivity gains that have led to fewer manufacturing jobs across the country — workers can produce more coal per hour, meaning fewer workers are needed to maintain steady coal output.
- Other reasons include financial markets, which may see the future

of coal as risky (for a variety of reasons) and thus a poor investment.

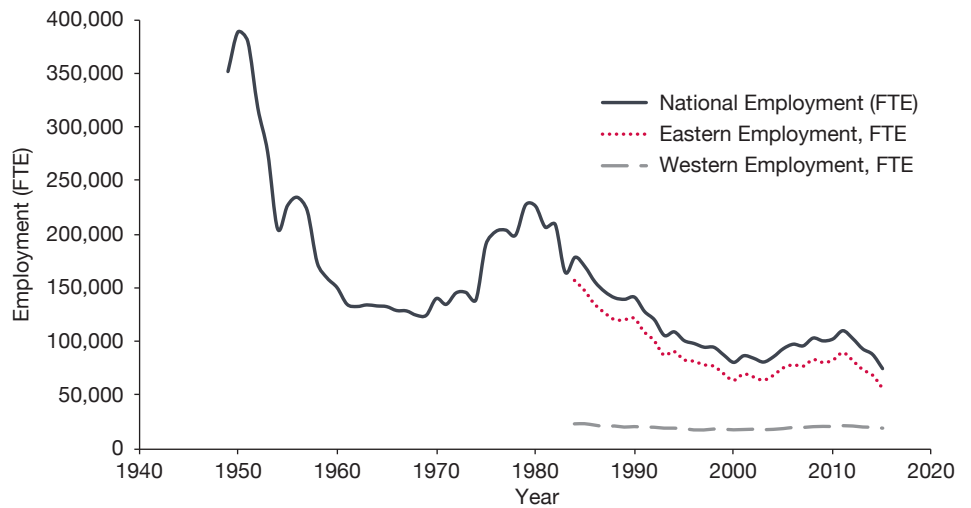
So which of these causes is the culprit for the recent decline in coal? We take a closer look.

Figure 1. Tons of coal output per year, by year for Eastern US, Western US and total US (1949-2015)



Source: Energy Information. East and West are demarked by Mississippi River.

Figure 2. Employment in coal mining, national, Western US and Eastern US (FTE: Full-Time Equivalent). Source: Energy Information Administration. FTE is computed from productivity (tons produced per person hour), total coal output annually, and an assumed 1,900 hours per year for a full-time equivalent employee.



Environmental Regulation?

The primary use of coal in the U.S. is for electricity generation, and the main environmental law affecting coal combustion for electricity generation is the Clean Air Act of 1970, signed into law by President Richard Nixon. The law imposed significant restrictions on sulfur emissions from new coal-fired power plants.

Back in the 1970s, natural gas was scarce and oil was expensive. But demand for electricity was strong and growing, which set off a boom in building coal-fired power plants, despite the Clean Air Act. This can be seen in Figure 3, which shows the vintage of all of the operating coal power plants in 2015. Note the big bulge in capacity additions in the 1970s and 1980s. This expansion in coal capacity translated

into an expansion in coal production nationwide.

The easiest way to meet the 1970 sulfur emissions regulations was to burn low-sulfur coal, which set off a dramatic expansion of low-sulfur coal mining, primarily in Wyoming. The strong demand for low-sulfur coal threatened high-sulfur coal producers, primarily in the East (see Figure 1).

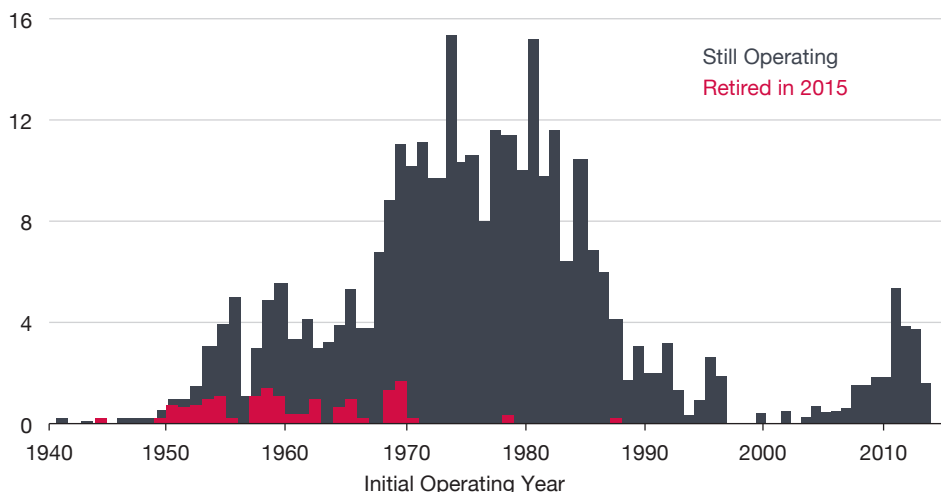
In order to save coal-mining jobs in the East, the Clean Air Act was amended in 1977 to require equipment on all new coal-fired power plants to physically remove sulfur from the smokestacks after combustion, reducing the attractiveness of low-sulfur coal (all coal becoming “compliance coal”). This reduced the competitive threat to Eastern mines.

Another feature of the 1970 Clean Air Act had more subtle and delayed effects. That is the exemption of existing (as of 1970) power plants from sulfur reduction rules. This “grandfathering” was done for political reasons to facilitate passage of the Act. But it was also viewed as fair and without long-term consequences since those older plants were expected to retire at the end of their 40- or 50-year lives anyway.

But as Revesz and Lienke (2016)⁵ detail, this exemption provided an incentive to keep old and dirty power plants operating rather than retire, despite the higher operating costs of old plants. To protect health and welfare, this necessitated the EPA’s imposition of more restrictions on old power plants over the years, including the acid rain provisions instituted in 1990 during the Bush administration. Additional rules were put in place during the next three presidential administrations to deal with the problems caused by old plants operating long after their assumed retirement date.

Now, nearly 50 years after the 1970 Act, shuttering of old power plants has finally begun. As can be seen from Figure 3, the coal plants retired in 2015 were quite old (the oldest began operation in 1944, the year the

Figure 3. Existing coal units by initial operating year and retirements in 2015 (net summer capacity, GW)



Source: EIA, “Today in Energy,” March 8, 2016.

⁵ Revesz, Richard L. and Jack Lienke, *Struggling for Air: Power Plants and the ‘War on Coal’* (Oxford University Press, New York, 2016).

Allies landed in Normandy). In fact, as can also be seen from the figure, nearly all of the plants retired began operating more than 40 years ago. This suggests that the decline in coal-fired electricity generation is largely the result of an aging fleet of power plants, which may well have been retired years ago absent the Clean Air Act's grandfathering clause.

Productivity?

One reason for expansion in the West and stagnation in the East is productivity — innovation and other measures that lead to fewer workers being needed to produce the same output. This is the same story we have heard in many industries over the last 50 years: Productivity gains have generated job losses, even in healthy industries.

Figure 4 shows how labor productivity in coal mining, again

divided into East and West, has changed over the past 60 years. Nationally, there has been a steady gain in productivity (with two small slumps), with output per worker-hour in the U.S. increasing fivefold. And most of these gains have been in the West.

Another point to note is that productivity in the East is currently about three tons of coal per miner-hour. It is nearly six times as high in the West. This is another reason that the West has taken so much market share in coal from the East, where employment is concentrated.

Railroad Deregulation?

As Figure 4 shows, in the late 1970s a miner in the West could produce approximately four times as much coal as in the East, and prices reflected this productivity advantage. But railroad rates were high, limiting

the ability of Western coal to compete with Eastern coal, despite low prices at the mine.

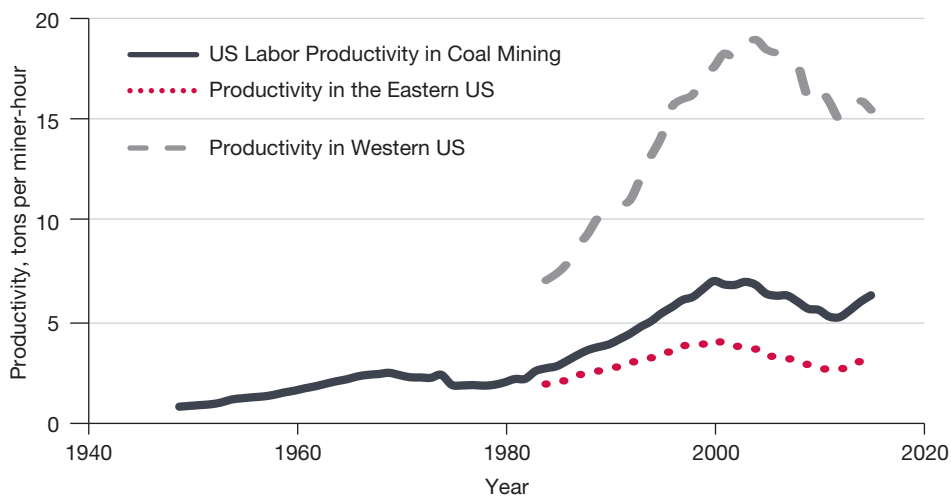
That changed in the late 1970s with a move to deregulate railroad rates for coal, culminating in the Staggers Rail Act of 1980. Rail rates per ton-mile dropped precipitously after deregulation, by 50 percent (in real terms) from 1980 to 2000.

Although the 1977 changes to the Clean Air Act helped Eastern coal compete with Western coal, the deregulation of railroad shipment of coal resulted in a vastly expanded market for Western coal, at the expense of Eastern coal.

As can be seen from Figure 1, there was a great expansion of Western coal starting in the mid-1970s. It's important to remember there were other things happening as well, such as increases in oil prices. But the effect of lower railroad rates can be seen dramatically in the market for what is now the largest coal mine — the North Antelope-New Rochelle mine. The mine is in Wyoming and produced about 10 percent of all U.S. coal in 2014 — shipping it all over the country to locations as far away as Florida.

The rise of cheap Western coal has been one of the most significant contributors to the decline of Eastern coal and the jobs that go with it.

Figure 4. Labor productivity in coal mining, 1949-2015



Continued on Back Flap

Natural Gas?

We have discussed the innovation in coal mining that has led to major increases in labor productivity in the production of coal, allowing the massive expansion of the U.S. coal market (though with fewer employees).

Another area of technological change with different implications for coal is the revolution in oil and gas extraction over the past decade or so — hydraulic fracturing (fracking) combined with precision horizontal drilling and the exploitation of unconventional gas deposits.⁶ These innovations have fundamentally

altered the supply and price of natural gas in the U.S.

For several decades prior to 2008, the price of crude oil and natural gas in the U.S. have tracked each other very closely. But something unusual happened in 2009.

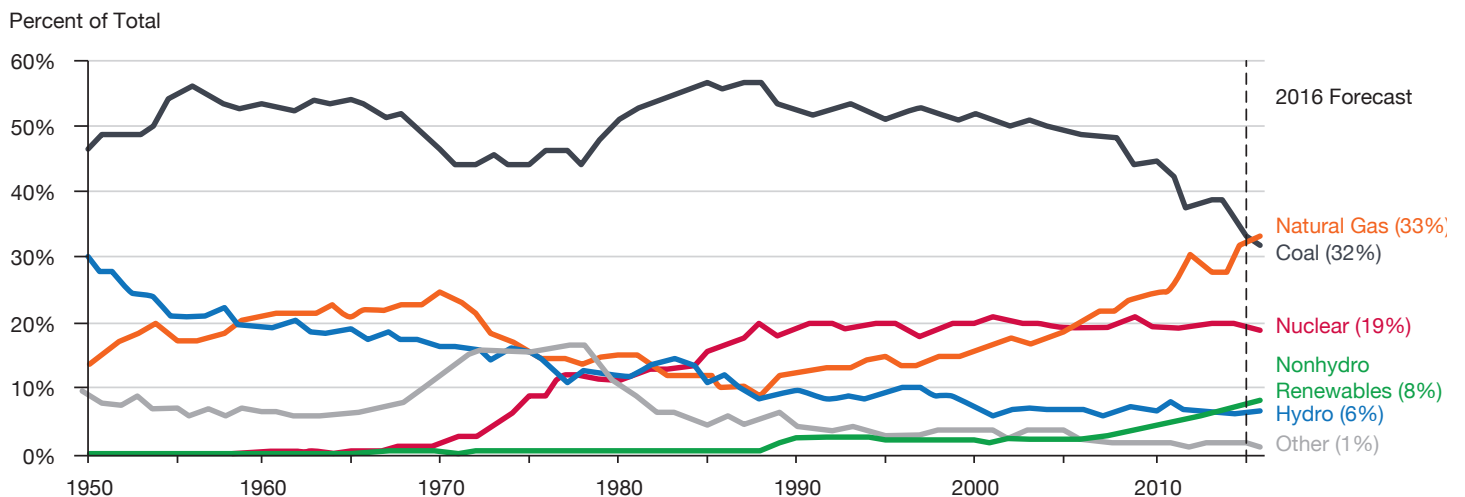
As the price of oil began to recover from the Great Recession, the price of gas continued to drop. In April 2012, oil was selling for \$103 per barrel, while the price of gas was \$11 per barrel-energy-equivalent, and coal was delivered at an average price of \$13 per barrel-energy-equivalent.⁷

Prices have fluctuated since then, but gas has continued to be plentiful and cheap. This has had two effects on coal. One is that cheap gas displaces coal in existing power systems. Secondly, cheap gas increases the incentives to finally retire old coal-fired plants from the 1940s and 1950s. Figure 5 shows the expansion of natural gas in electricity generation, in parallel with the decline of coal. The figure also shows the expansion of renewables such as wind and solar, likewise at the expense of coal.

⁶ A recent analysis of the local consequences of fracking is Bartik, Currie, Greenstone and Knittel, “The Local Economic and Welfare Consequences of Hydraulic Fracturing,” Working Paper w23060, National Bureau of Economic Research, Cambridge, Mass. (2017).

⁷ The price of oil is a spot price for West Texas Intermediate; gas, also a spot price, is Henry Hub; coal is the average price of coal delivered to electric utilities.

Figure 5. Annual share of total US electricity generated by source (1950 – 2016)



Source: Energy Information Administration

Conclusions

Coal has served the country well. It fueled dramatic increases in electricity demand in the 1950s and 1960s. It was there for us when oil prices skyrocketed in the 1970s.

But nothing is as constant as change. In the 1970s concern about pollution took center stage and coal adapted — for many it was still the cheapest alternative. In the 1980s the move to deregulate railroads shifted the competitive balance regionally, as Western coal (with high labor productivity) took market share from Eastern coal (with lower labor productivity).

In the first decade of the new millennium, productivity gains — this time in natural gas — generated a fundamental shift in which coal was no longer clearly the cheapest fossil fuel. At the same time, solar and wind have made significant inroads into electricity generation, again

providing a competitive threat to coal. Productivity gains, in coal, gas, and other energy sources, have been a primary force of change.

This buildup of pressures has finally resulted in the retirement of very old coal-fired generating units that were built before most Americans were born. Ironically, many of these retirements would probably have occurred long ago except for the Clean Air Act's preferential treatment of old coal plants.

There are two questions we asked at the beginning of this brief: What happened to the coal industry? And what happened to coal jobs? The coal industry expanded dramatically from 1950 to 2010 and has declined moderately for the past few years, for the very clear and logical reasons articulated here.

What happened to coal jobs is even simpler. It is the same thing that happened throughout much of the

country — productivity gains led to fewer workers needed to produce the same output.

An additional force hurt coal employment — regional competition between the East and the West. The labor-lean West has taken significant market share from the labor-intensive East. The result is that far fewer miners are needed.

Some policies have been proposed to bring back coal jobs. One is to cut environmental regulations, both on coal and natural gas production. But think about that move — it will probably accelerate the decline of coal, as natural gas makes further inroads into the market.

Eliminating regulation can have many consequences. Weakening regulation on railroads in the 1970s and 1980s resulted in job losses in Eastern coal.

What is clear from this discussion is that environmental regulations did not kill coal. Progress is the culprit.

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