Coal Transportation

Chapter 5

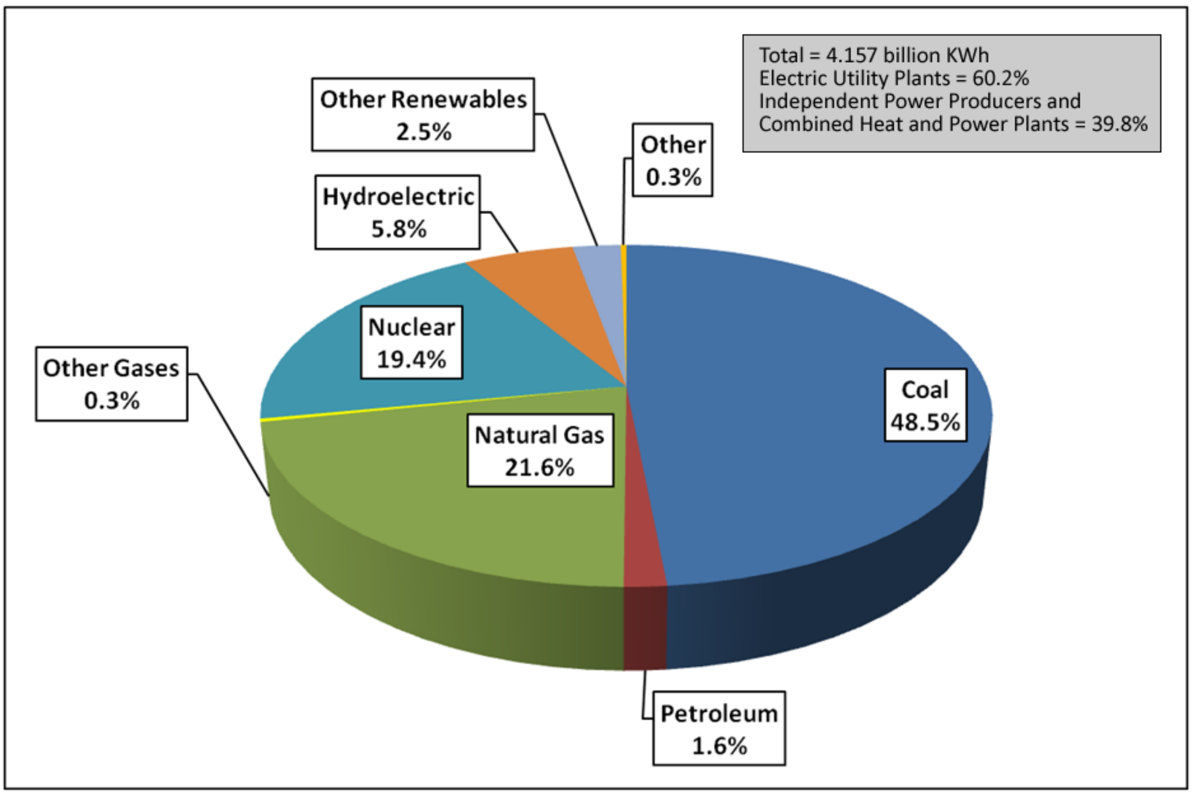
Chapter 5: Coal Transportation

This chapter focuses on coal transportation issues, especially on the importance and performance of transportation in providing coal for generating electricity in rural areas.

Coal is a major source of energy in the United States. In 2006, it was responsible for about one-third of domestic energy production,[68] and almost half the electric power generation (Figure 5-1).

Because coal plays such an important role as an energy source for the generation of electricity, its costs—including delivery costs—significantly impact the price the consumer pays for electricity. The cost of coal delivered to electric plants has increased every year since 2000; the delivered cost of coal was 9.7 percent higher in 2006 than in 2005.[69]

Figure 5-1: U.S. electric power industry net generation, 2007



Source: EIA, *Power Plant Operations Report*, Form EIA-923

Coal production in the United States has been increasing since the oil embargo, and the subsequent oil price increase, of 1974. In 2006, a record 1,163 million tons were produced. All this increase has been west of the Mississippi River. Production in the historic coal-mining regions of Appalachia and the Midwest have been in slow decline. Although U.S. production is shifting to the Western States, the places coal is used have remained much the same, resulting in changed coal transportation flows.

The rapid growth of Western coal production (mostly from Wyoming and Montana) means that most coal is transported by rail; water transportation is unavailable in western coal-producing areas. Coal is the primary rail commodity in both tonnage (46 percent) and revenue (23 percent) of Class I railroads and is second only to mixed shipments, which are mostly intermodal, in carloads.[70]

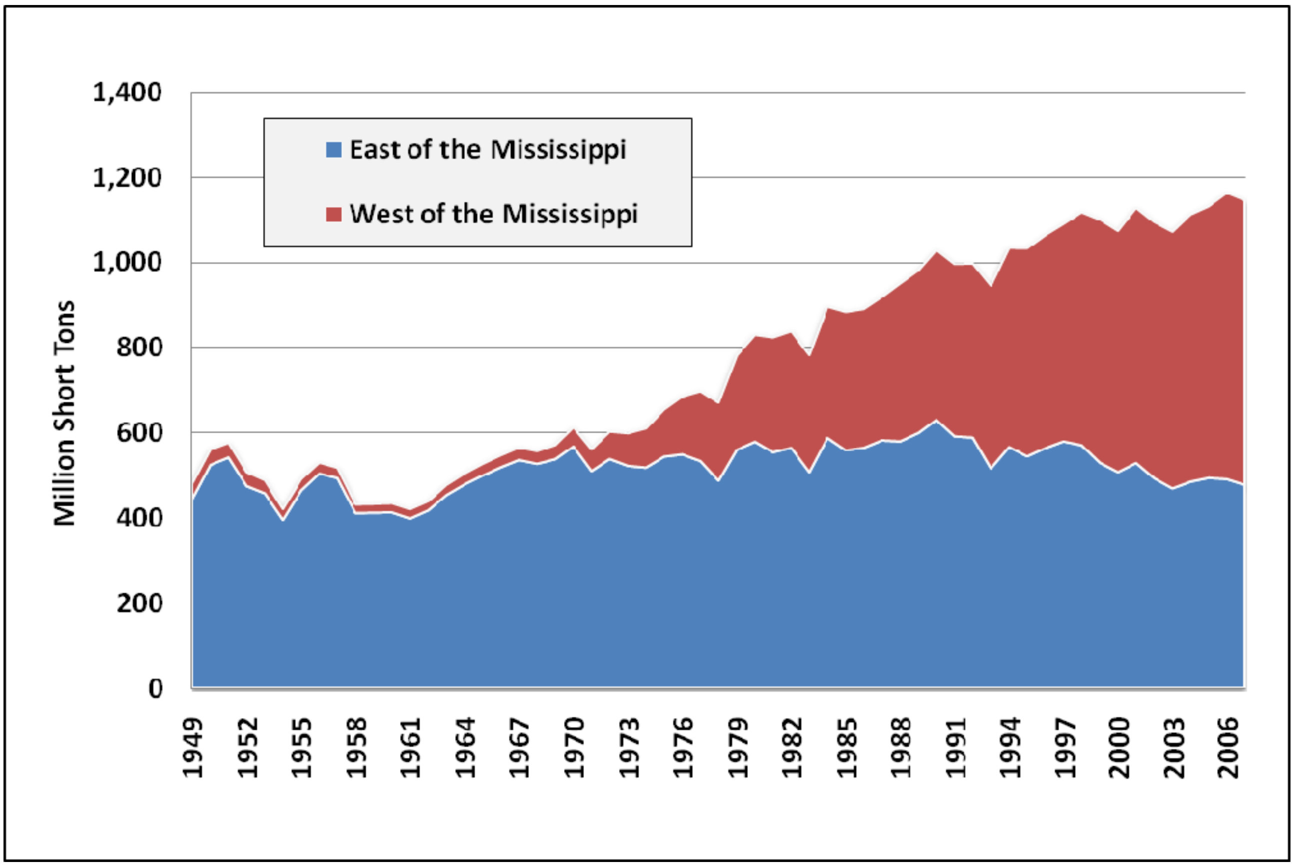
Railroads have made major investments to carry Western coal. In 1979, an entirely new rail line (the longest newly constructed line in the U.S. since World War I) was opened in the Powder River Basin of Wyoming. Originally single track, this line is now mostly triple track, with some sections having a fourth track. Thousands of miles of mainline railroad connecting the Powder River Basin to coal-consuming areas have been rebuilt or upgraded. Other rail shippers have benefitted from these investments as well, since few rail lines carry only coal. However, shippers and the electric power industry are unsure that railroads will be able to continue investing in capacity at the needed pace, as energy demand increases.[71]

The following sections describe where coal is produced, where it is consumed, and the transportation system that ties together the production and consumption areas of the nation, especially to the rural areas.

Production

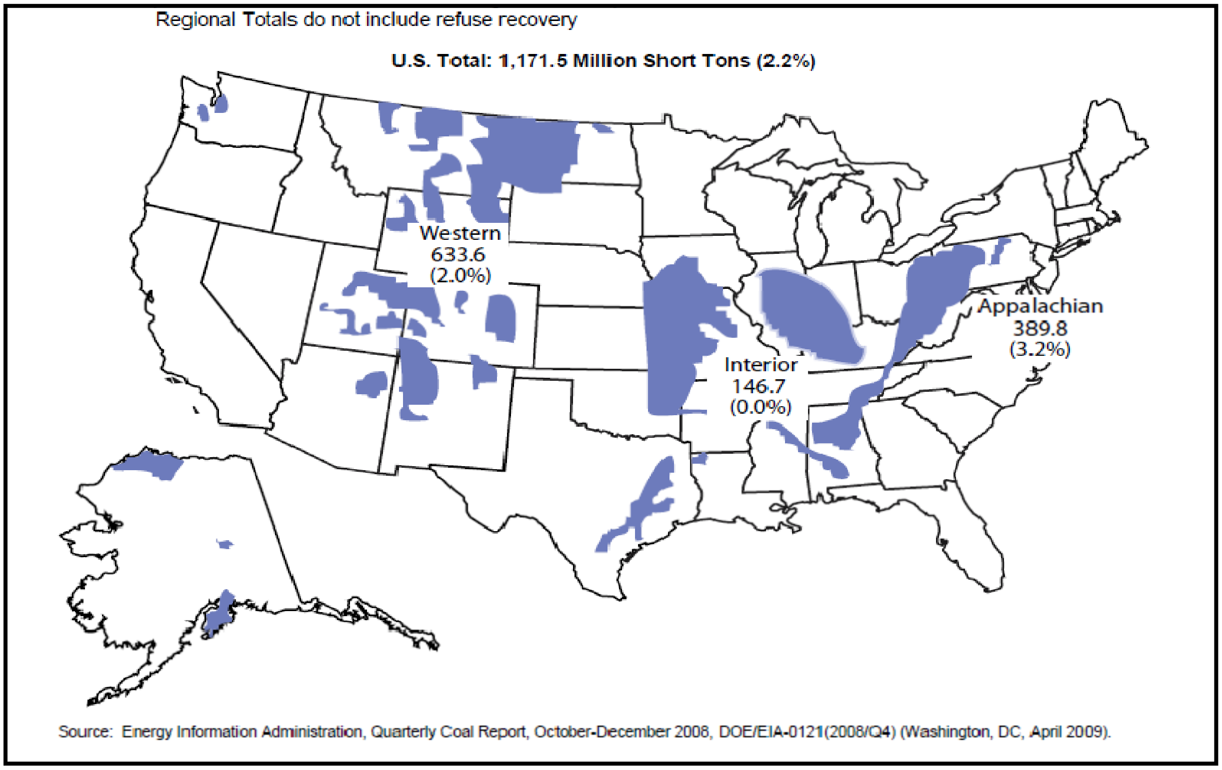
U.S. coal production has been increasing since the early 1970s. Production growth shifted significantly during that period to the Western States (Figure 5-2). The three major coal-producing areas in the U.S. today are the Appalachian area, the Interior area, and the Western area. At present, the Appalachian area produces 33.3 percent of the country's coal, the Interior area 12.5 percent, and the Western area 43.2 percent (Figure 5-3). All the growth in U.S. coal production since the 1970s has been in the West, mostly low-sulfur coal from Wyoming and Montana. This is in part the result of low mining costs (the coal is in very thick seams, close to the surface, and can be strip-mined), and in part because of the increased demand for cleaner coal resulting from provisions in the Clean Air Act that limit sulfur dioxide emissions.

Figure 5-2: U.S. coal production by region, 1949-2007



Source: EIA, *Annual Energy Review 2007*; Report No. DOE/EIA-0384 (2007). June 2008

Figure 5-3: Coal production by region, 2008, million tons and percent change from 2007



Source: EIA, *U.S. Coal Supply and Demand: 2008 Review* <http://www.eia.doe.gov/cneaf/coal/page/special/feature08.pdf>

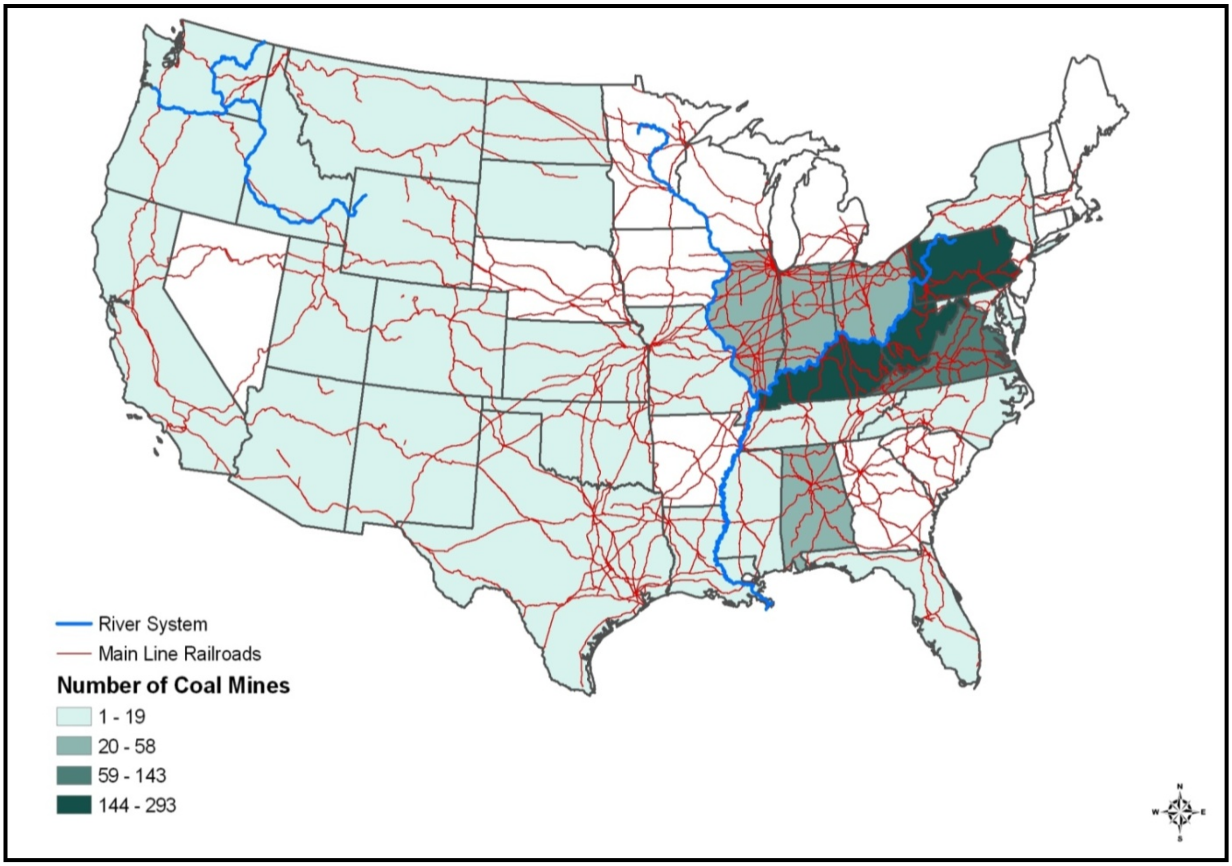
Significant coal mining occurs in 20 States in these three regions, with three States being responsible for most of the production. In 2001, Wyoming, West Virginia, and Kentucky accounted for 70 percent of the coal shipped by rail. By 2006, Wyoming was the largest coal-producing state, at 446.7 million tons—about 40 percent of U.S. coal production. Over half of U.S. coal is now produced west of the Mississippi River (Figure 5-2). Campbell County in Wyoming produces the most coal of any of the Powder River Basin (PRB) counties. It is located far away from the demand centers for PRB coal.

Census data from 2002 provides a snapshot of the distribution of coal mines (in terms of numbers and value of coal shipments) by State and the relative positioning of these States and mines to the transportation system (inland waterway system and main line railroads). The established Appalachian coal-producing States have many mines and are positioned close to the river system and main rail lines (see Figure 5-5). The growing production areas in Montana and Wyoming are characterized by fewer mines, and by their great distances from a river system to transport the coal and their limited access to main line railroads. Only BNSF and Union Pacific (UP) have access to the PRB. Canadian Pacific Railway (CP) (through its purchase of Dakota, Minnesota and Eastern Railroad) has the option of building a line into the PRB, and has received approval from the Surface Transportation Board to do so. However, the uncertain future demand for coal and the current recession have caused CP to defer any construction plans indefinitely.

Figure 5-4: Coal trains passing in Wyoming.

Source: Union Pacific Railway

Figure 5-5: Number of coal mines per state



Source: U.S. Census Bureau, Econ 02 Report Series. 2002.

The transportation issues associated with the western movement of the coal industry are even more evident in Figure 5-6, which maps the value of coal shipments by State. Many shipments originate in parts of the West that have limited transportation. An illustration of the efficiency problems that result from limited transportation access occurred in 2004 and 2005, when disruptions in the railroad and water systems, and hence to coal delivery, led to coal stock drawdowns.

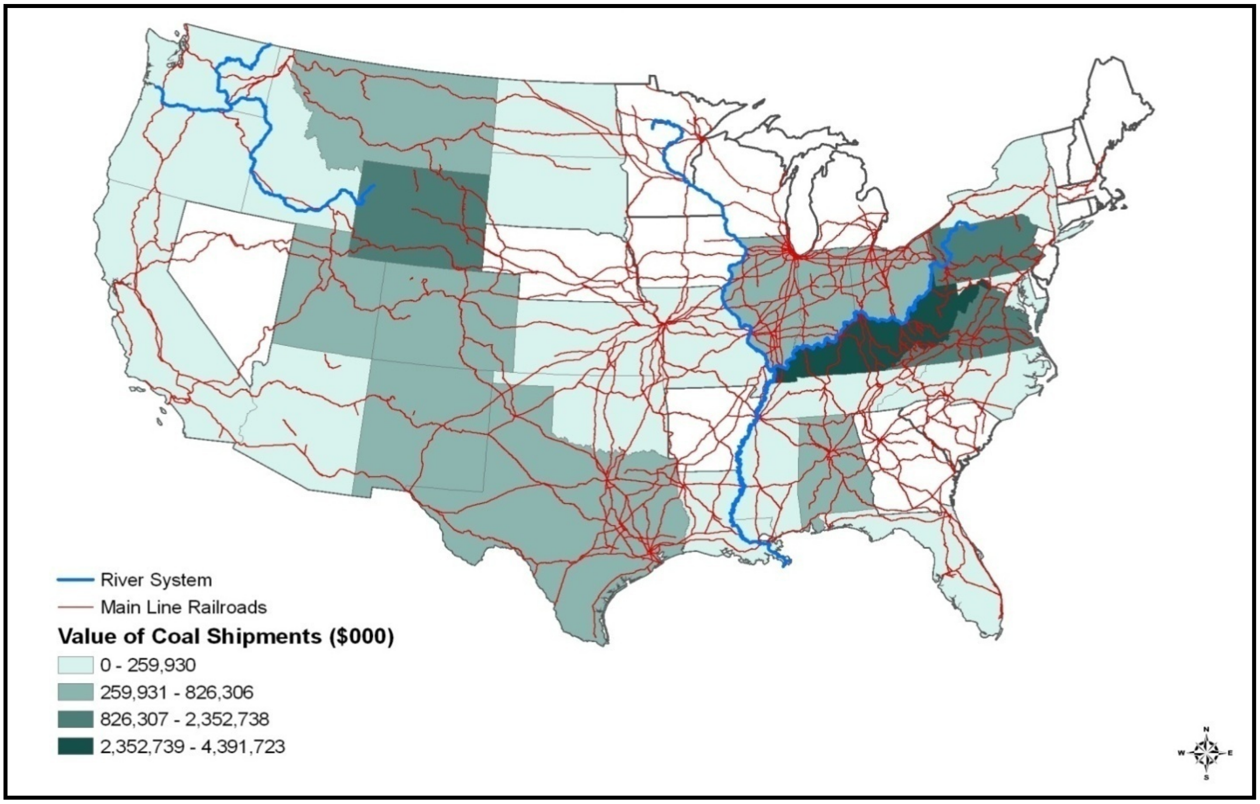
A Case Study of Rail Disruption: The Joint Line*

The Joint Line Railroad, jointly owned and operated by BSNF and UP, is a 103 mile stretch of railway in the PRB dedicated to coal, serving 8 of the 14 active coal mines in the region. It is the most heavily used section of rail line in the world. Although it runs three tracks for most of its length, and four tracks on steep hills, it is the only rail line serving these mines.

In May 2005 a combination of heavy rain and coal dust accumulation in the roadbed destabilized tracks, causing two trains to derail within days of each other and disrupting traffic for almost two years while the roadbed was repaired. The stoppage caused the railroads to default on contracts to transport coal to several power companies, causing the power companies to draw down their stockpiles of coal to unprecedented levels, buy more expensive coal from other sources, and buy electricity from other generators to meet demand.

* U.S. Department of Energy, *Deliveries of Coal from the Powder River Basin: Events and Trends 2005-2007* <www.oe.netl.doe.gov/docs/Final-Coal-Study_101507.pdf>

Figure 5-6: Value of coal shipments per state

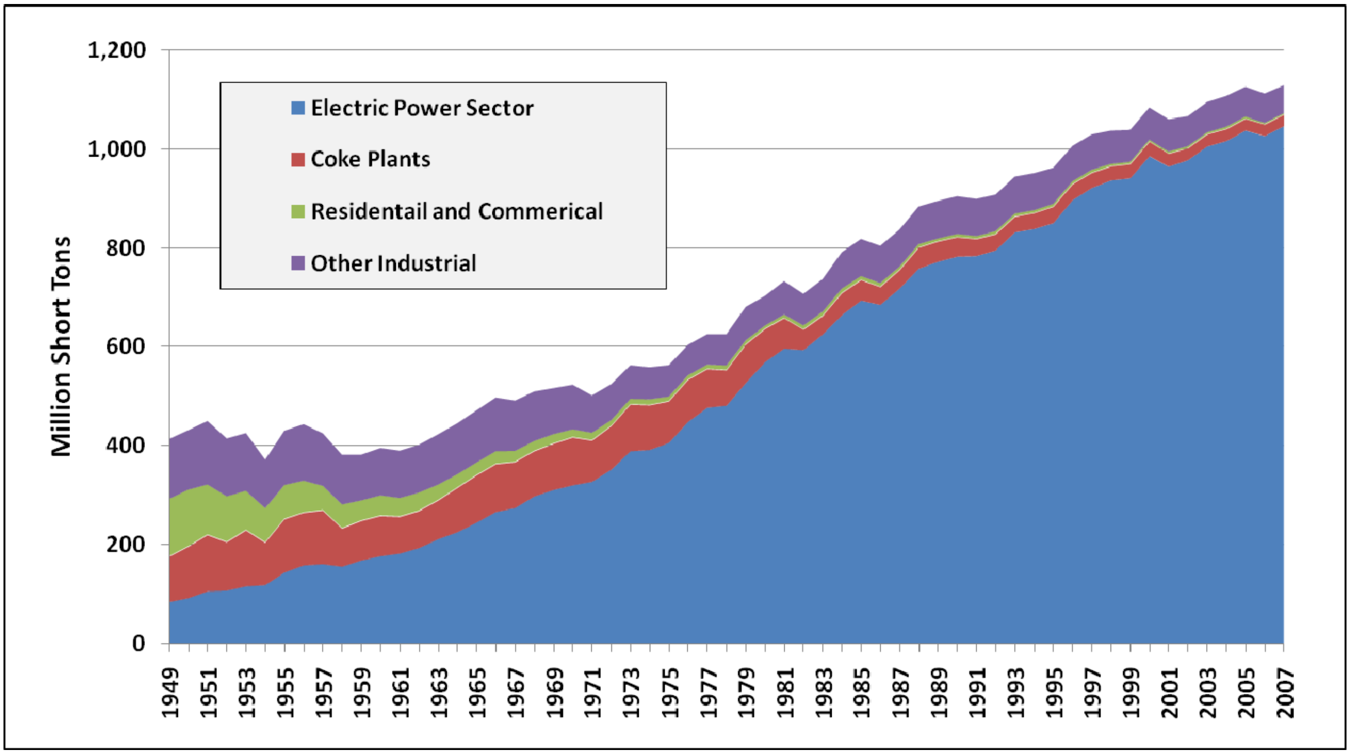


Source: U.S. Census Bureau, Econ 02 Report Series. 2002

Demand and Utilization

The demand for coal derives from its use in generating electricity. The total U.S. consumption of coal in 2006 was 1,163 million tons, with the electric power sector consuming 1,027 million tons or 88 percent of the total.[72] The remainder is utilized by coke plants and other industrial users. Figure 5-7 shows the total consumption over the period 1987–2006. In a typical year, very little coal is imported (approximately 3 percent of total U.S. consumption) and exports usually are about 4–5 percent of total U.S. consumption. Transportation demand for coal is influenced by factors such as weather (within and between years) and the economy. In 2008, imports jumped to over 7 percent of domestic consumption because of increased international demand, demonstrating that the international market should not be ignored.

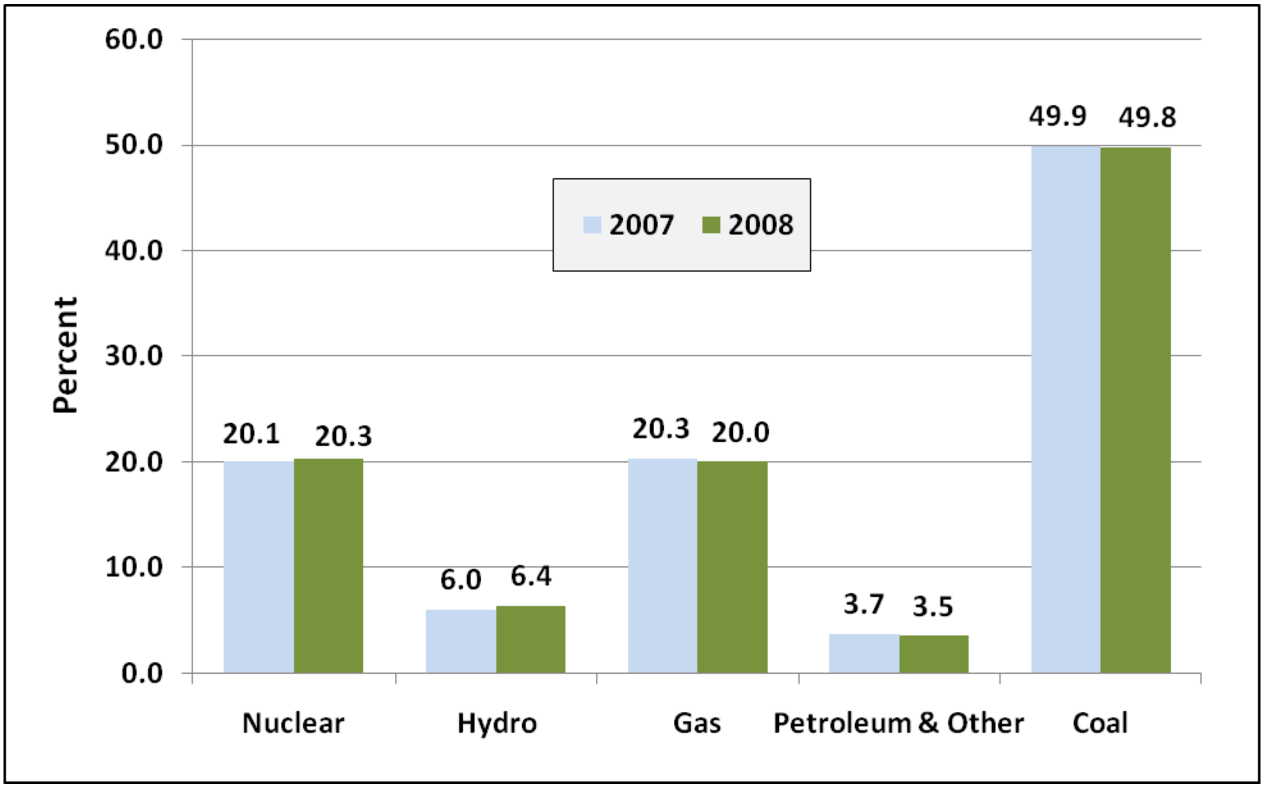
Figure 5-7: U.S. coal consumption by sector, 1987-2006



Source: EIA, *Annual Energy Review 2007*; Report No. DOE/EIA-0384 (2007) <http://www.eia.doe.gov/emeu/aer/coal.html>

In 2008, 49.8 percent of the electric power in the U.S. was generated from coal (Figure 5-8). The next largest contributors to the electricity supply were nuclear, with 20.3 percent of the total, and natural gas, with 20 percent. Minor contributors to the total—but important sources in some areas of the country—include hydro-electric, with 6.4 percent, and petroleum and other, with 3.5 percent. Note that these percentages are relatively unchanged from 2007 but have been changing somewhat over the past decade.

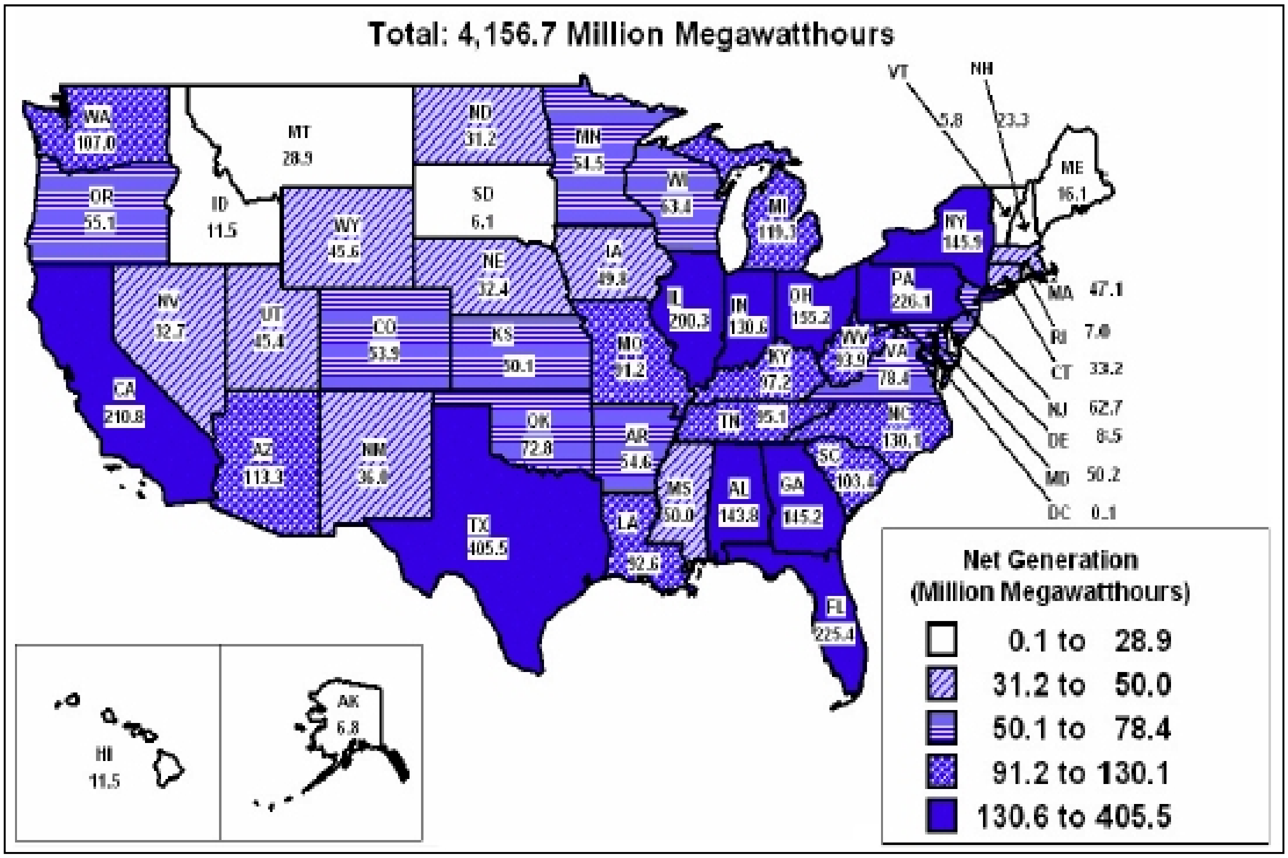
Figure 5-8: Share of electric power sector net generation by energy source, 2007 and 2008



Source: EIA, Form EIA-906, *Power Plant Report* and Form EIA-923, *Power Plant Operations Report*

Most coal production is concentrated in a few States, but the coal must be transported to electric power plants throughout the country. Total U.S. electricity net generation in 2007 was 4,156.7 million megawatt hours, and has been increasing for the past five decades.[73] States vary significantly in their contribution to the total, as can be seen in Figure 5-9. Texas, Pennsylvania, Florida, California, and Illinois generate the most electricity, and Texas, California, and Florida consume the most. In 2005, total U.S. energy consumption was 100,369 trillion Btu; over 10 percent was consumed by Texas alone, and almost a quarter by Texas, California, and Florida.[74]

Figure 5-9: U.S. electric industry net generation by State, 2007

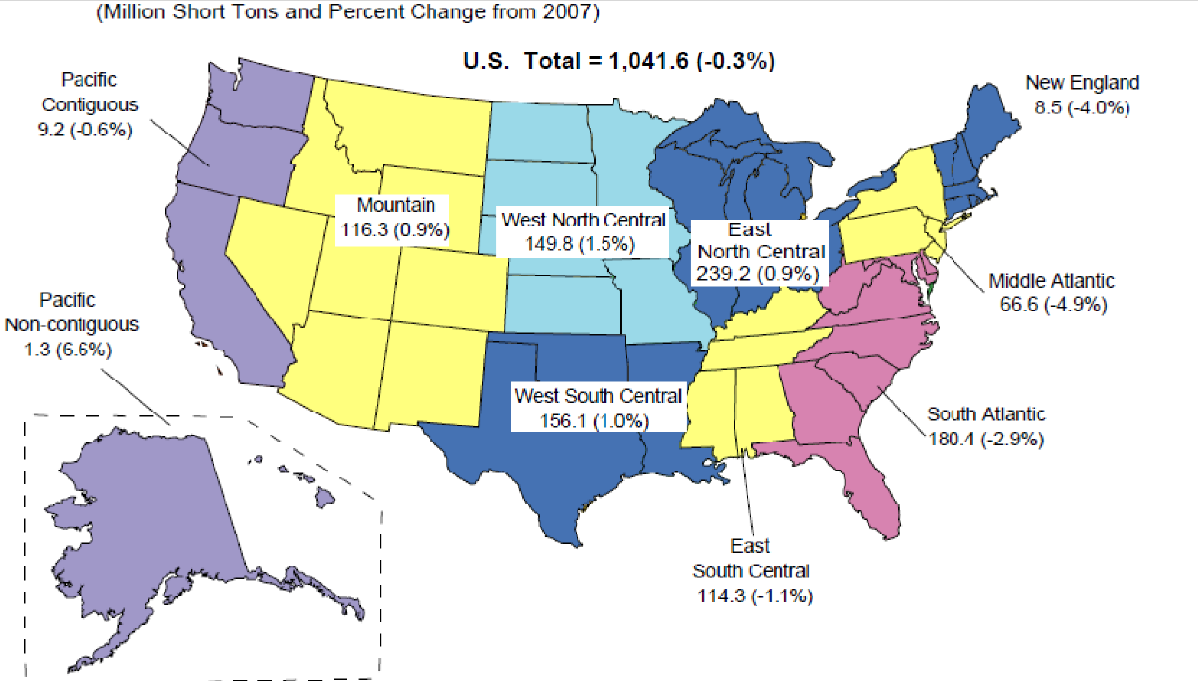


Note: Data is displayed as 5 groups of 10 States and the District of Columbia.
Sources: EIA, *Power Plant Operations Report*, Form EIA-923

Regions differ in their consumption of coal for electric power just as States do. Figure 5-10 shows consumption levels in 2008 by census region and the percent change from 2007. For example, the East North Central Region used 239.2 million tons of coal to produce electric power in 2008, up 0.9 percent from the previous year. The low coal demands in the Pacific Contiguous and the New England Regions are worthy of note.

The Pacific Region relies more on hydroelectric generation and natural gas for electric power than other regions. Despite the fact that the Pacific Region includes California—one of the heaviest-consuming states—the electric power sector only consumed 9.2 million tons of coal in 2008. Although California is the fourth largest generator of electricity, coal accounts for only 1 percent of its generation.

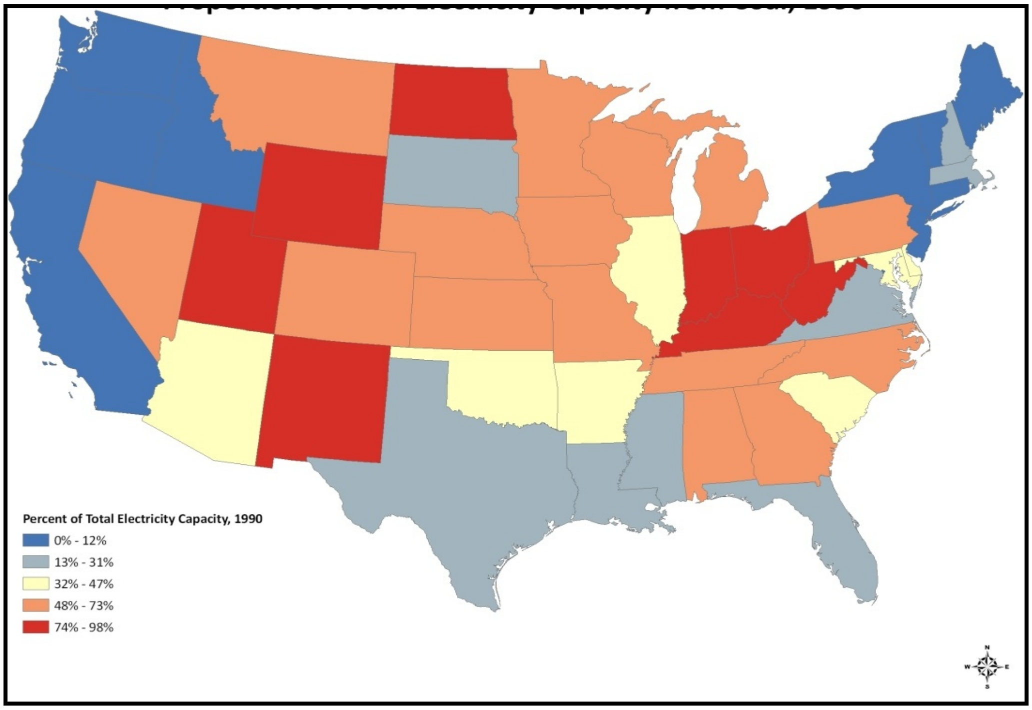
Figure 5-10: Electric power sector coal consumption by census region, 2008



Source: Energy Information Administration, Form EIA-923, "Power Plant Operations Report."

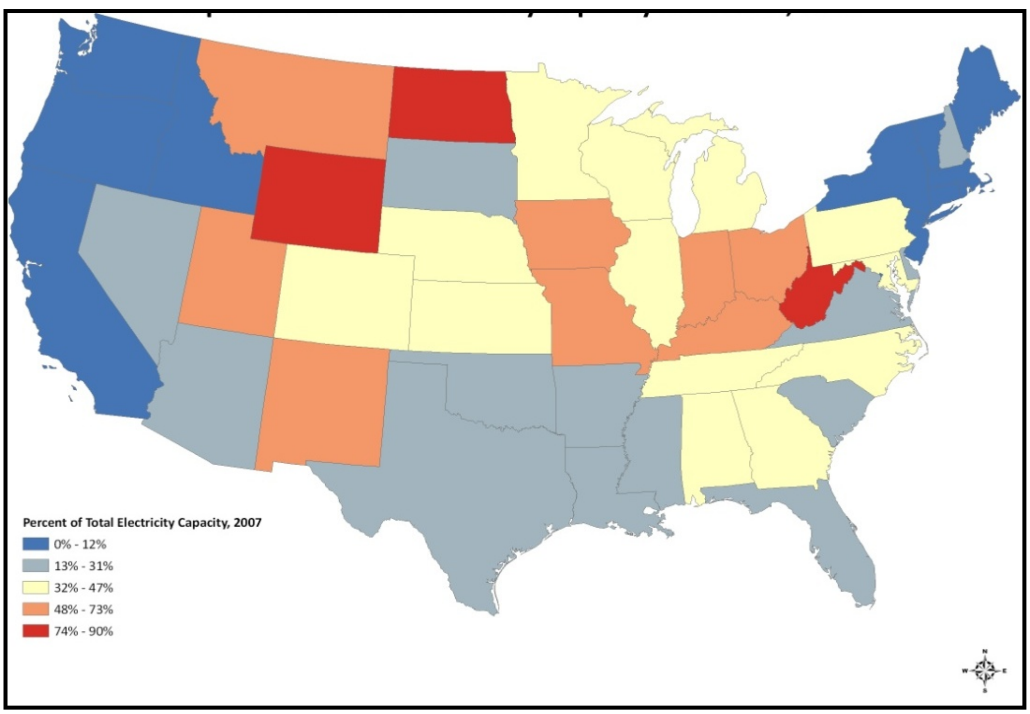
The demand for coal for electricity is increasing or remaining steady, more of the increase in demand for electricity is being satisfied by other sources of energy, especially natural gas.[75] From 1990 to 2007, several States have reduced the proportion of electricity they make from coal and have relied more on other sources for electricity. As illustrated in Figure 5-11, in 1990 eight States generated over three-fourths of their total electricity capacity from coal. By 2007, only three States relied this heavily on coal (Figure 5-12). This figure also shows that more States fell into the two lowest proportion categories (0–12 percent and 12–31 percent) in 2007 than in 1990.

Figure 5-11: Proportion of electricity capacity from coal, 1990



Source: EIA, Net Generation by State, Type of Producer and by Energy Source (EIA-906)

Figure 5-12: Proportion of total electricity capacity from coal, 2007



Source: EIA, Net Generation by State, Type of Producer and by Energy Source (EIA-906)

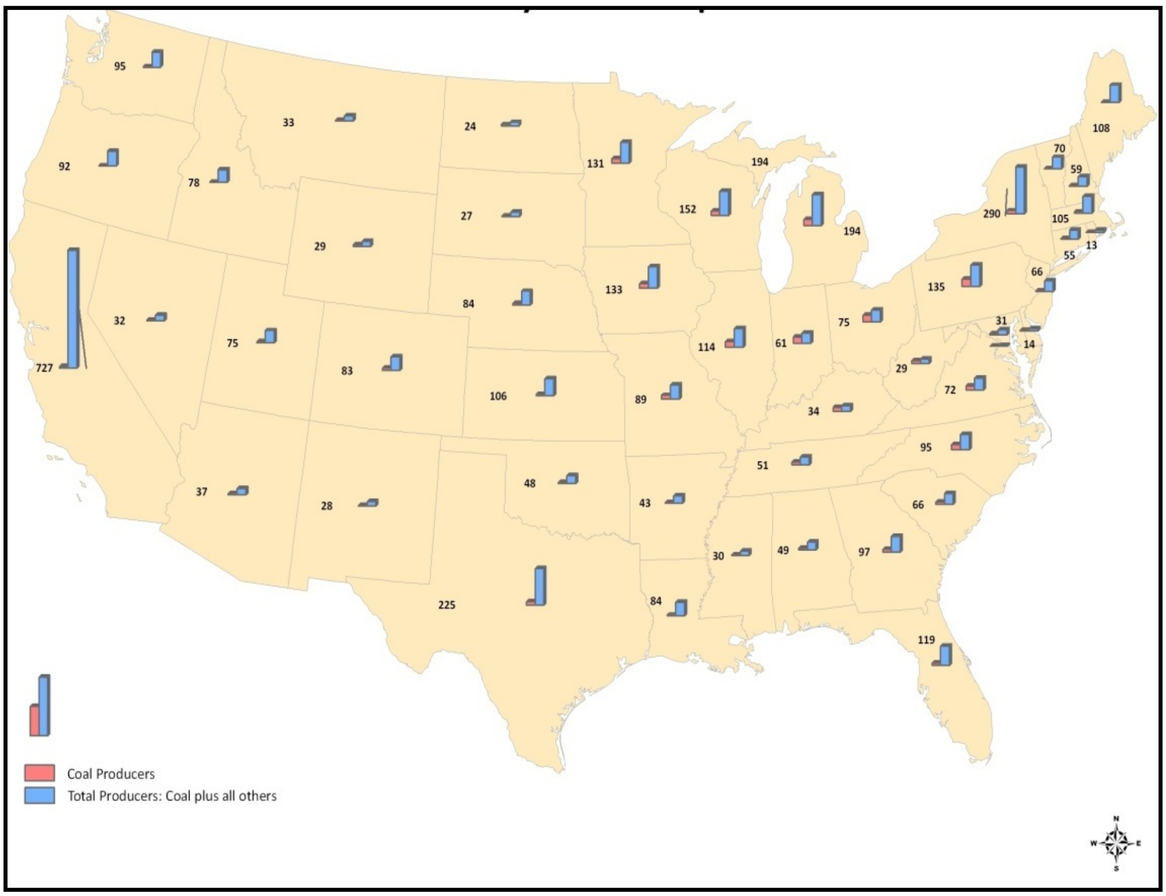
Electric power providers can be characterized in various ways. This discussion highlights the importance of an efficient and reliable transportation system to U.S. customers, particularly in rural communities, for affordable and reliable electricity.

Producers of electric power are classified into two sectors:

- The electric power sector, which includes electric utilities and independent power producers
- The combined heat and power sector, which includes electric power, commercial, and industrial providers.

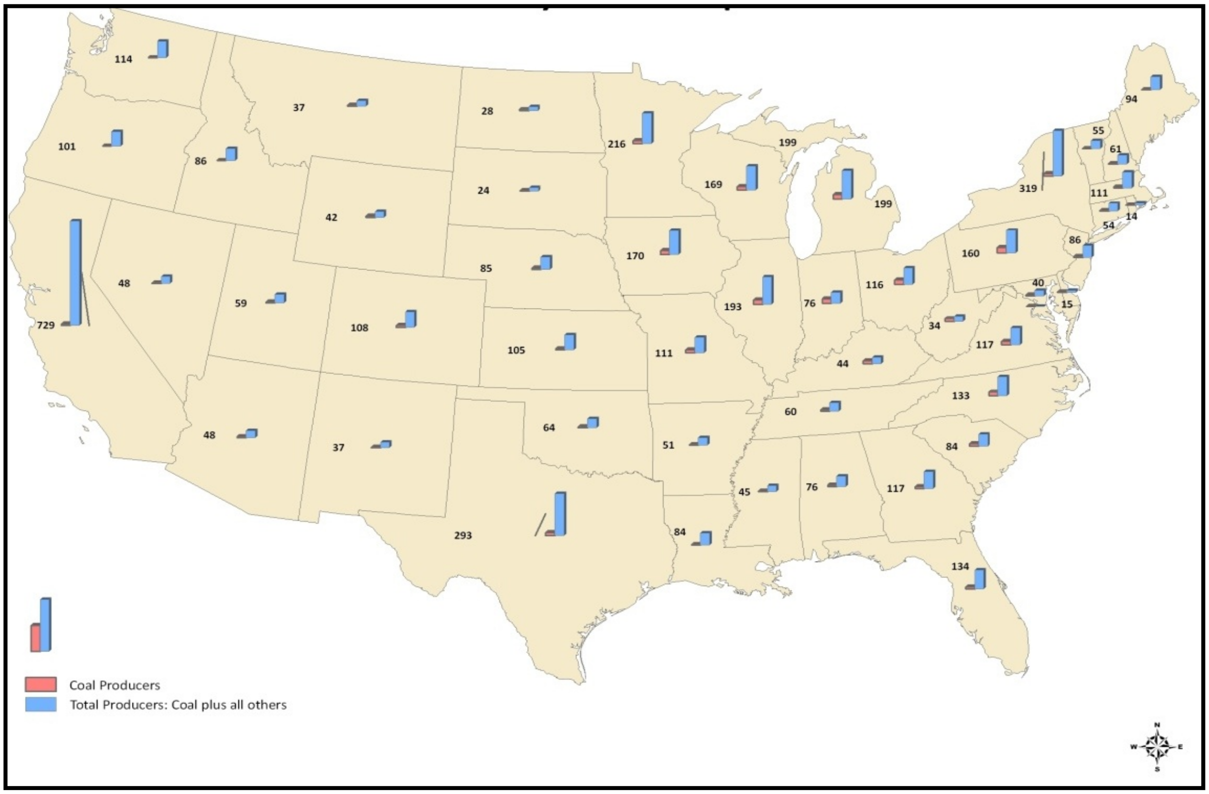
Electricity providers are located far from where coal is mined, requiring a vigorous transportation system to link coal producers to electricity generators. In 2008, approximately 3,150 electric utility providers were dispersed across the United States. Figures 5-12 and 5-13 show the numbers of electricity producers and coal producers by State in 2007 and 1990.

Figure 5-13: Number of electricity producers per State, 1990



Source: EIA, Net Generation by State, Type of Producer and by Energy Source (EIA-906)

Figure 5-14: Number of electricity producers per State, 2007



Source: EIA, Net Generation by State, Type of Producer and by Energy Source (EIA-906)

Table 5-1 shows the 3,150 Electricity Utility providers in 2008 were owned in three different ways**:**

- Investor-Owned Utilities (IOUs)
- Publicly Owned
- Cooperatively Owned (Coops)

Table 5-1: Electric utility providers by type of ownership

	Investor-Owned	Publicly Owned	Cooperatives	Total
Number of Organizations	220	2,000	930	3,150
Number of Total Customers	102 m	20 m	17 m	140 m
Size (median number of customers)	400,000	2,000	12,500	
Customers, % of total	73%	15%	12%	
Revenues, % of total	76%	14%	10%	
kWh sales, % of total	74%	16%	10%	

Source: EIA, RUS Data, CFC. 2005

About 73 percent of the total customers, 76 percent of the total revenue, and 74 percent of the kilowatt hours (kwh) sales are attributed to the IOUs. Only 7 percent of providers are IOUs, but they tend to be larger and serve many more customers—with the median number of customers served by an investor-owned utility being about 200 times as many as served by publicly-owned utilities.

The customer base also varies by type of provider; IOUs and Publicly Owned Utilities play a large role in commercial and industrial electricity provision, and Cooperatives' main customers are the residential market (Table 5-2).

Table 5-2: Sales by customer type and by type of ownership

Sales (billion kilowatt hours)	Investor-Owned	Publicly Owned	Cooperatives	Total
Residential	937	202	213	1,360
Commercial	1,017	207	75	1,285
Industrial	725	153	83	954
Other	4	3	0	7
Total	2,683	564	372	3,619

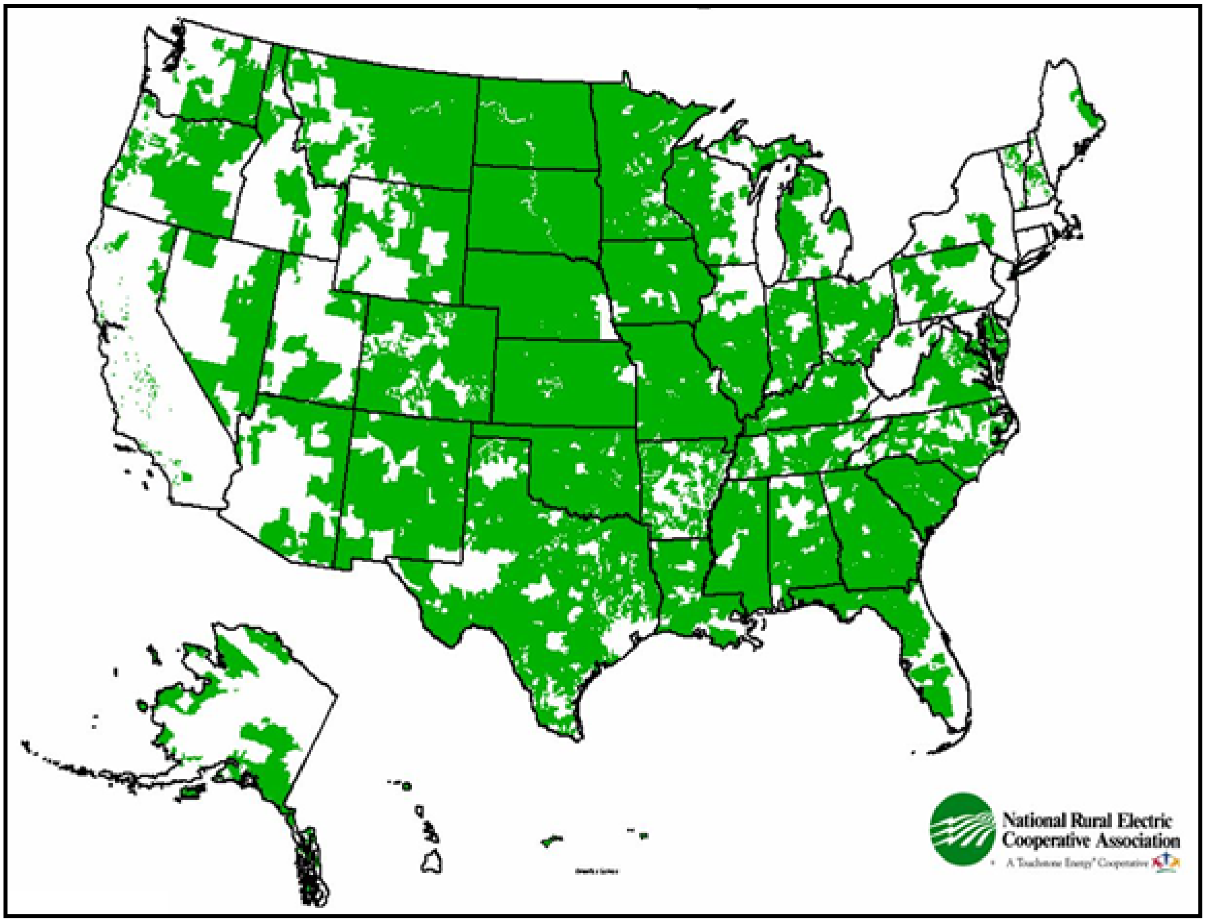
Source: EIA, RUS Data, CFC. 2005; NRECA Strategic Analysis. February 2008

Cooperatives play an important role in providing electricity to farms and families in rural areas. They serve the most rural areas, have the fewest customers and the lowest revenue per mile of transmission line. In February 2008, the 864 distribution and 66 generation and transmission cooperatives served:[76]

- 40 million people in 47 States.
- 17.5 million businesses, homes, schools, churches, farms, irrigation systems, and other establishments.
- Some 2,500 of 3,141 counties in the US (80 percent of the nation's counties).
- About 12 percent of the U.S. population.
- These cooperatives:
- Own assets worth $100 billion.
- Own and maintain 2.5 million miles, or 42 percent, of the nation's electric distribution lines, covering three-quarters of the nation's landmass.
- Deliver 10 percent of the total kilowatt hours sold in the United States each year.
- Generate nearly 5 percent of the total electricity produced in the United States each year.
- Employ 67,000 people.
- Retire more than $500 million in capital credits annually.
- Pay more than $1.2 billion in State and local taxes.[77]

Figure 5-15 shows the distribution of the Electric Cooperative Network across the U.S.

Figure 5-15: America's electric cooperative network



Source: EIA, RUS Data, CFC, *NRECA Strategic Analysis.* 2005. <http://www.nreca.org/AboutUs/Co-op101/CooperativeFacts.htm>

Despite the increased importance of alternative sources of energy, forecasts by the Energy Information Administration indicate that coal will continue to be the primary fuel for energy generation in the United States though 2030. They project that the Rocky Mountain, Central West, and East North Central regions will show the largest increases in coal demand, by about 100 million tons each, from 2005 through 2030.

Transportation Flows

Railroads move most of the coal from where it is produced to where it is converted to electric power. In 2006, 71 percent of the total tonnage of coal was hauled by railroads, 11 percent by trucks, 9 percent by river barges, and the remainder by other or mixed modes of transportation.[78]

Rail's share of total coal transportation has increased about 5 percent from 2001 to 2006, with most of this increase coming at the expense of river barges and other modes. From a cost perspective, water transportation is least expensive way to transport coal, but it is not available at most mines or destination points, particularly in the growing coal-producing mining regions of the West. For example, Campbell County, Wyoming, is the largest PRB County, but is not close to either water or its destinations. Rail is the only feasible transportation mode for coal shipped out of this county.[79] In 2004, 98 percent of all coal shipped from Wyoming to other areas was via rail.

Access to water transportation for coal shipments, either upriver or downriver, is limited to a few western areas in Washington, Oregon, and California; along the East Coast; down from the Midwestern and Southern States to the Gulf of Mexico; and areas around the Northern States through the Great Lakes. The coal waterborne transportation flows throughout the country in 2007 are shown in Figures 5-15 (up-bound) and 5-16 (down-bound).

Figure 5-16: Total annual up-bound waterborne coal shipments, 2007

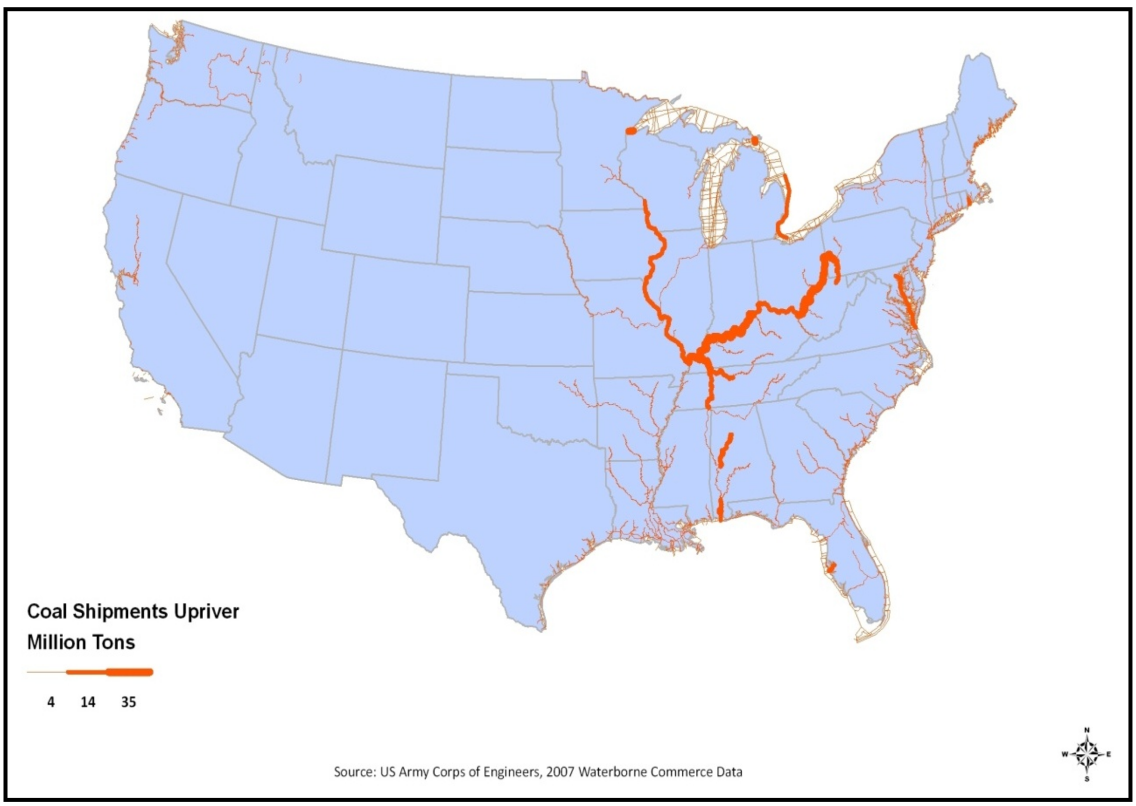
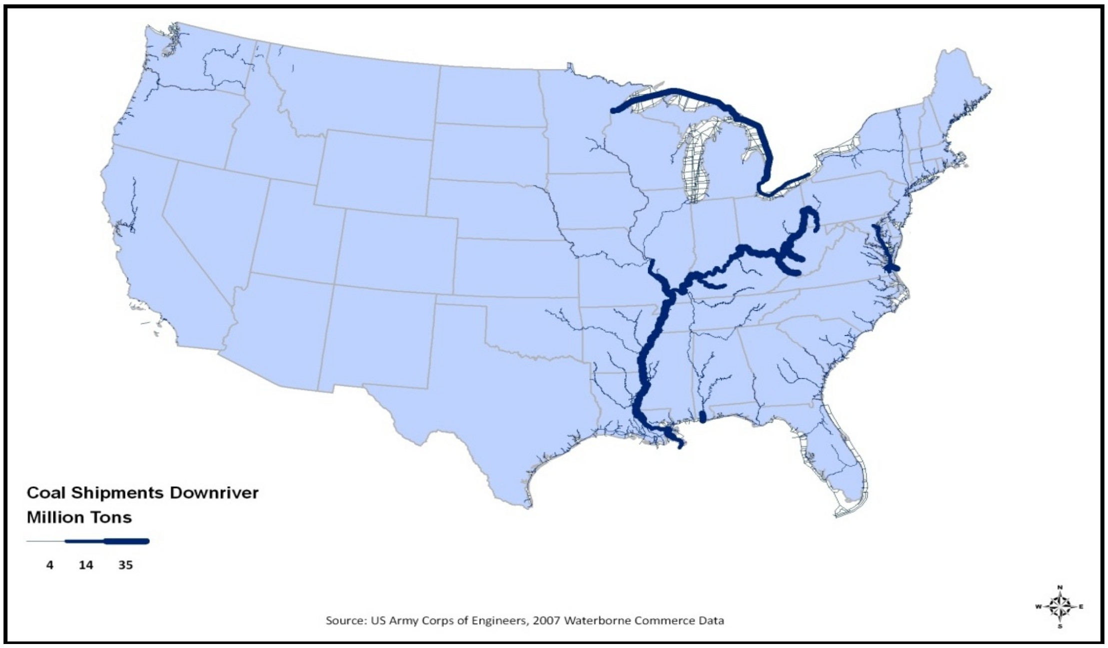
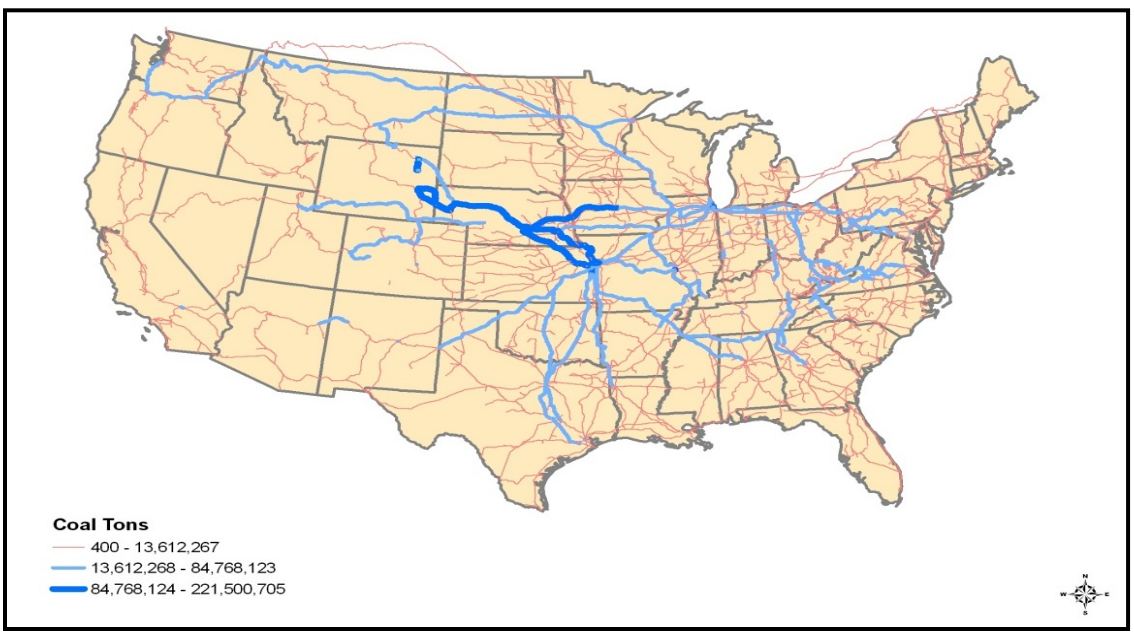


Figure 5-17: Total annual down-bound waterborne coal shipments, 2007



Access to rail for coal transportation is more dispersed, as shown in Figure 5-18. The largest volumes of coal shipped by rail from the PRB area in Wyoming are shown by the more solid lines in the map. The finer lines in the map show the transport of smaller volumes of coal around the country, particularly moving towards the demand areas in the Midwest and Eastern States.

Figure 5-18: Density of coal shipments by rail

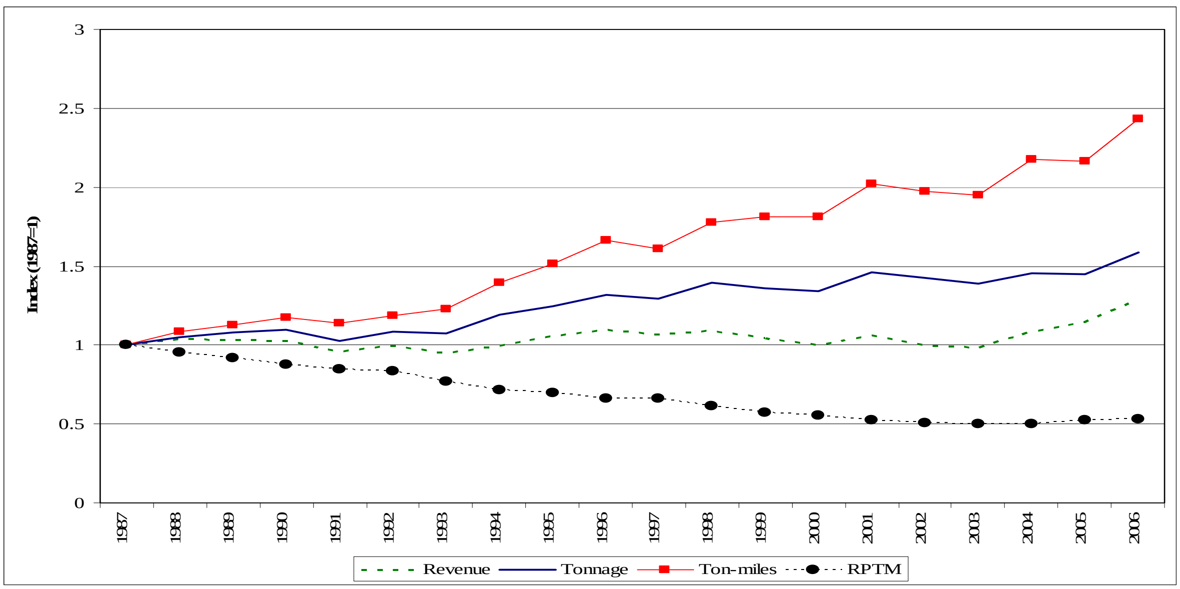


Source: Federal Railroad Administration analysis of STB Rail Waybill Sample

In the Carload Waybill Sample (CWS) Christensen analyzed for 1987-2006, more coal was transported by rail than any other commodity. Figure 5-19 shows the trends in real revenue, tonnage, ton-miles, and real revenue per ton-mile (RPTM) for this 20-year period.[80]

By comparing coal production (Figure 5-2) to tonnage (Figure 5-19) it can be seen that coal tonnage increased almost twice as fast as production, reflecting a modal shift towards rail. Also, coal ton miles increased faster than tonnage as the overall length of haul increased (reflecting the western movement of coal production). As noted by Christensen, in 2006 the median coal waybill originating in an Appalachian State was 409 miles, while the median coal waybill originating in Campbell County was 1,113 miles.

Figure 5-19: Annual rail shipments of coal in 1987-2006 by real revenue, tonnage, ton-miles, and real revenue per ton-mile



Source: CWS data for 1987-2006. Graphic from Laurits Christensen Associates

There have been major changes in the composition of coal shipments over the past two decades, partially reflecting the increased use of large unit trains for long distance coal shipments.[81] The average distance hauled (weighted by tonnage) increased over 50 percent; tons per carload have increased moderately; ton-miles in shipments greater than 100 carloads increased from 60 to 89 percent of the total movements; and the share of shipments in privately owned cars increased from the mid-1990s to the early 2000s and spiked in 2006. This latter change is due to PRB shipments being primarily in privately owned cars and Appalachian shipments in railroad-owned cars. However, in 2004-2005, privately owned car shipments from Appalachian States also increased. Average shipment sizes increased dramatically over this period:

- 583 tons and 6 carloads per waybill in 1987
- 5,080 tons and 46 carloads per waybill in 2005
- 9,634 tons and 86 carloads per waybill in 2006

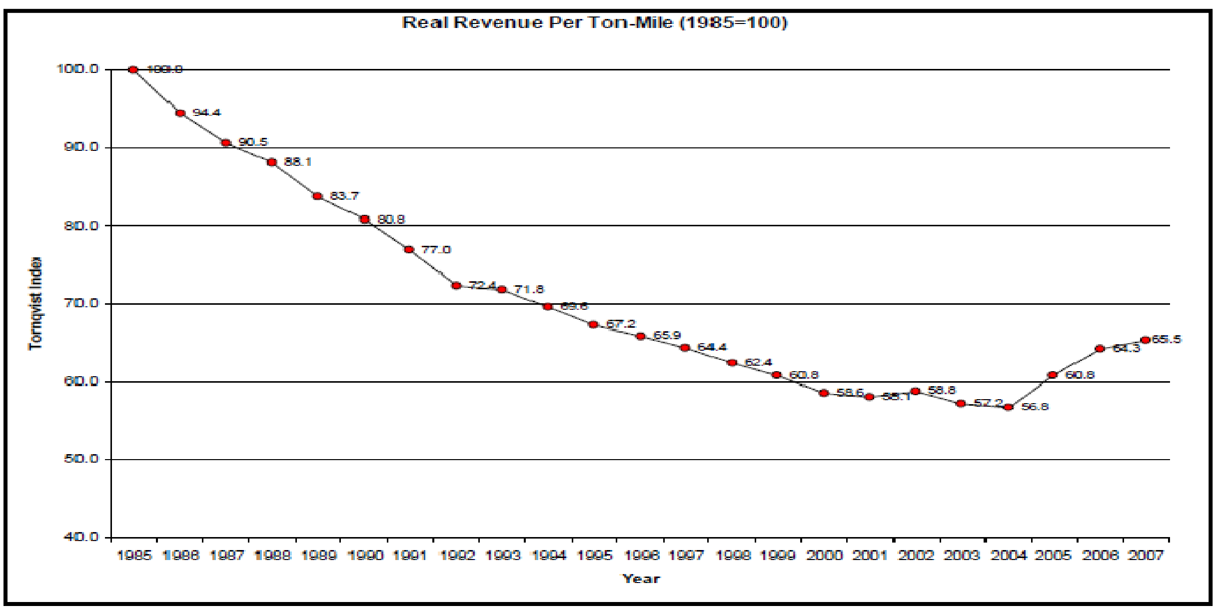
The large change in 2006 from the levels in the previous year is probably an aberration rather than a significant change in the trend. Recall that there were significant rail and water transportation disruptions in 2004–2005. Hence the figures reported above for railroad shipments represent lower than usual shipments in 2005 and higher than usual shipments in 2006 as the utility providers used up their stockpiles in 2005 and built them back up in 2006.

Rail Rates

Coal purchases by utility companies are usually controlled by long-term contracts with mines, but corresponding long-term transportation contracts are not common.[82] In the past, coal transportation contracts were often for 10 years, but now they are usually 1–5 years long. Because of the importance of the railroad system in transporting coal from production to power generation areas, rail rates and their vacillations are of deep concern to the electric generation industry.

The most recent study of railroad rates by the STB from 1985–2007 found that inflation-adjusted rail rates increased in the last 3 years of their study, but had declined in every year but one between 1985 and 2004.[83] Their results suggest that in 2007 alone shippers spent $7.8 billion more than they would have with the 2004 rates. Citing the Christensen study, they conclude that most of the recent rate increases reflect input price increases (mainly fuel) and declining productivity, rather than enhanced market power. Figure 5-20 shows the decline in the STB Rail Rate Index from 1985 to 2000, the flattening out of the index until 2004, and then the increase in the index since 2004.

Figure 5-20: STB rail rate index, 1985 to 2007

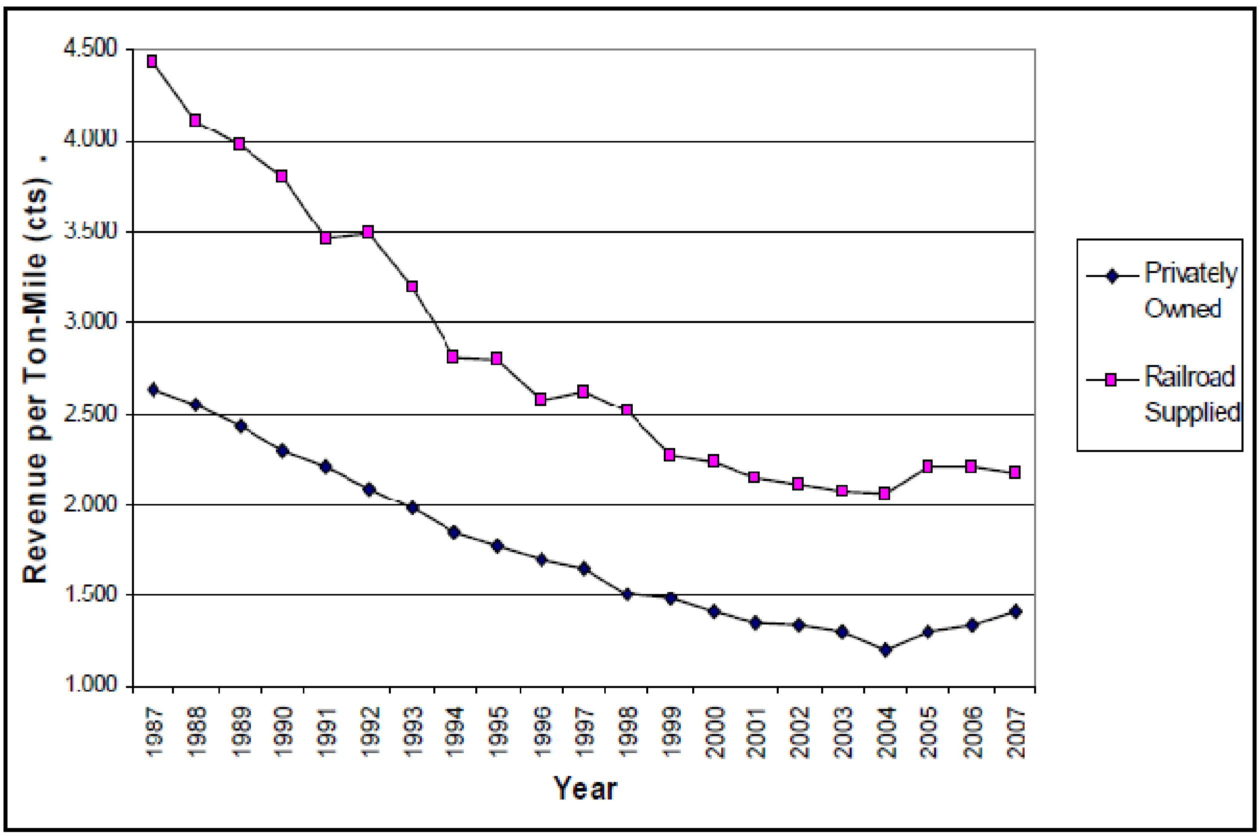


Source: STB, Office of Economics, Environmental Analysis & Administration, Section of Economics, Study of Railroad Rates: 1985–2007. 2009.

The STB conducted additional analyses of grain and coal rates because these shippers are concerned about service and rates as they relate to rail car ownership and length of haul. Coal rail rates over the 1987 to 2007 period, by car ownership, are presented in Figure 5-21. Rates are presented as real rates per ton-mile. This figure shows a consistent decline in rates for both railroad-supplied and privately owned cars until 2004, when both increased. It should be noted, however, that these are only the point-to-point rates, and do not show underlying changes. For example, shippers have been carrying more of other costs, such as the costs for their own railcars, storage costs, and siding and track costs. This cost-shifting effectively increased the rates from 1987 to 2004, partially nullifying the effect of the rate decline that otherwise would have resulted from increased efficiency.

Part of the discount for privately owned equipment might reflect differences in the mix of shipment sizes and distance hauled. Privately owned equipment is used almost exclusively in shuttle train service between a single mine and a single destination, trips that pay the lowest rates. Railroad-owned equipment, however, is more likely to be used for smaller shipments, and often for shorter hauls, which incur higher rates. The discount for privately owned equipment hovered between 34 and 40 percent for the period.[84]

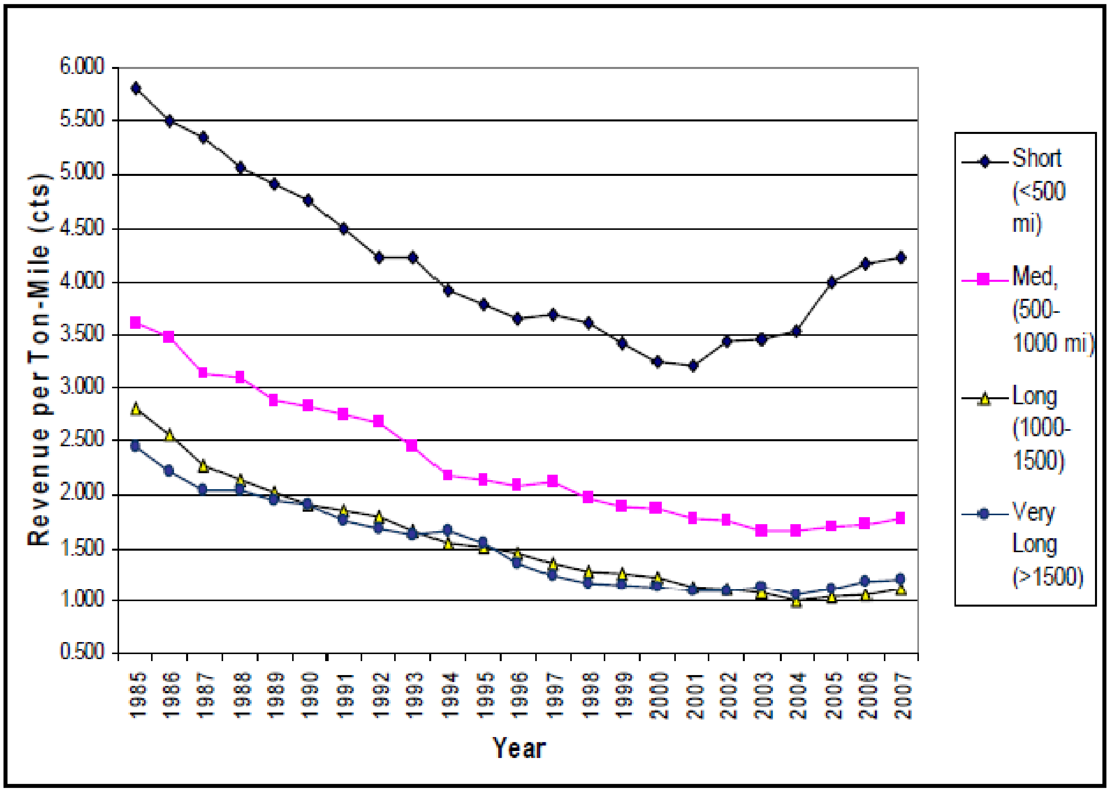
Figure 5-21: Coal rates and car ownership



Source: STB, Office of Economics, Environmental Analysis & Administration, Section of Economics, Study of Railroad Rates: 1985–2007. 2009.

Rates for all shipment distances declined from 1988 to 2001. After 2001, rates in the short-distance category increased dramatically—32 percent between 2001 and 2007—but the increases in other categories were not so extreme. The trends in coal rates per ton-mile, by shipment distance, are shown in Figure 5-22. Four distance categories are analyzed: short (<500 miles), medium (500–1,000 miles), long (1,000–1,500), and very long (>1,500 miles).

Figure 5-22: Coal rates and shipment distance



Source: STB, Office of Economics, Environmental Analysis & Administration, Section of Economics, Study of Railroad Rates: 1985–2007. 2009.

In Christensen Associates' 2008 study, a pricing model was developed to analyze the impact of cost characteristics and market structure (railroads and their modal competition) indicators on railroad rates for various commodity groups (measured as revenue per ton-mile (RPTM)). Christensen found that length of haul was associated with a large negative effect on RPTM and shipment size was associated with a small positive effect. However, the combined effect of increasing shipment size (by both tons and tonnage per car) might be associated with a decreased rate per ton-mile, depending upon the relative change considered. Their model allowed them to estimate the implicit payment (in the form of rate reduction) for privately owned (shipper-supplied) cars. The implicit payment was found to be $223 per carload from 2001 to 2003 and $214 from 2004 to 2006—about a 15 percent discount from the average carload rate for 2007.[*]

[*] An average carload of coal in 2007 carried 113.5 tons at an average rate per ton of $13.50, so an average rate per carload of coal was $1,532.

The market structure indicators they considered were**:**

- Distance from origin to nearest port or waterway facility
- Distance from destination to nearest port or waterway facility
- Railroad competitors at origin
- Railroad competitors at destination.

Based on the model, Christensen calculated the effects on railroad rates of increasing the distance to the water. Their results indicate that a distance of 100 miles from water at points of origin cost 8 percent, and a distance of 500 miles from water at points of origin was worth 11 percent higher rates. Interestingly, when the period from 2004 to 2006 was examined, the distance impact on rail rates was essentially zero.

A similar analysis done in the same Christensen study for distance of points of termination from water, found that 100 miles was worth 7–9 percent higher rates, and that most of this effect occurred at 50 miles. They found that the RPTM is lower in counties with railroad competitors present than in counties served by a single railroad. Their results also suggest that the marginal effect of an increased number of railroad competitors at the termination county is larger than the effect of increased numbers of competitors at the origination county.

In summary, Christensen's pricing model results for coal suggest that coal rail rates are impacted by shipment cost and market structure characteristics. Increased competition at the origin modestly reduces rates while increased competition at the destination results in sizable rate reductions. Also, rail rates are impacted by water transportation competition, with a greater impact at the destination end than at the origin end.

Christensen Associates also calculated adjusted marginal costs (adjusted MC) and Lerner Markup Indexes (LMI) for non-interchanged shipments, using the results from the various commodity pricing models. They found very low adjusted MCs for commodities hauled in large-scale bulk shipments such as coal (and grain), which was consistent with expectations because these are generally less time-sensitive from a quality deterioration perspective. The railroad-specific markup calculations show below-average markups for coal shipments carried by BNSF and UP, suggesting effective competition at the point of origin via joint lines serving the South PRB area. Christensen points out that while industry MCs increased in 2004–2006, some commodities like coal avoided generic cost increases by cost-saving changes, such as increased average car loadings and the length of haul. Hence the overall MCs remained fairly constant for coal, but the shippers may have incurred higher costs due to the adjustments that were made. The shippers note that their adjustments and incurred costs stemmed from the expiration of many long-term, lower-priced contracts during this period and their inability to renegotiate favorable contracts.

Service

This section examines rail service components and markers, such as train speed, reliability, capacity and stockpiles, on-time delivery statistics, and consumer complaints.

Train Speed

Average train speeds are frequently used as a proxy for service quality. Variability in speeds can also be a marker for service quality; large variations in speed indicate problems (unpredictable performance). Christensen used Association of American Railroads Railroad Performance Measures (RPM) data to calculate average train speed for different train types across a railroad's network, and compared changes in average speed across train types to assess reliability. Their data led them to the following observations:

- Between 1999 and 2005, average train speed for large Western railroads decreased while the speed for their Eastern counterparts increased.
- In 2003 and 2004, declines in average train speed and increases in dwell time occurred for most railroads.
- The intermodal trains are the fastest (followed by multilevel trains).
- Coal unit trains tend to be the slowest (manifest and grain units are sometimes slower).

Stakeholder interviews by Christensen revealed the concern that intermodal trains are given preferential treatment (with respect to speed) but the aggregate-level data in the study did not support this claim.

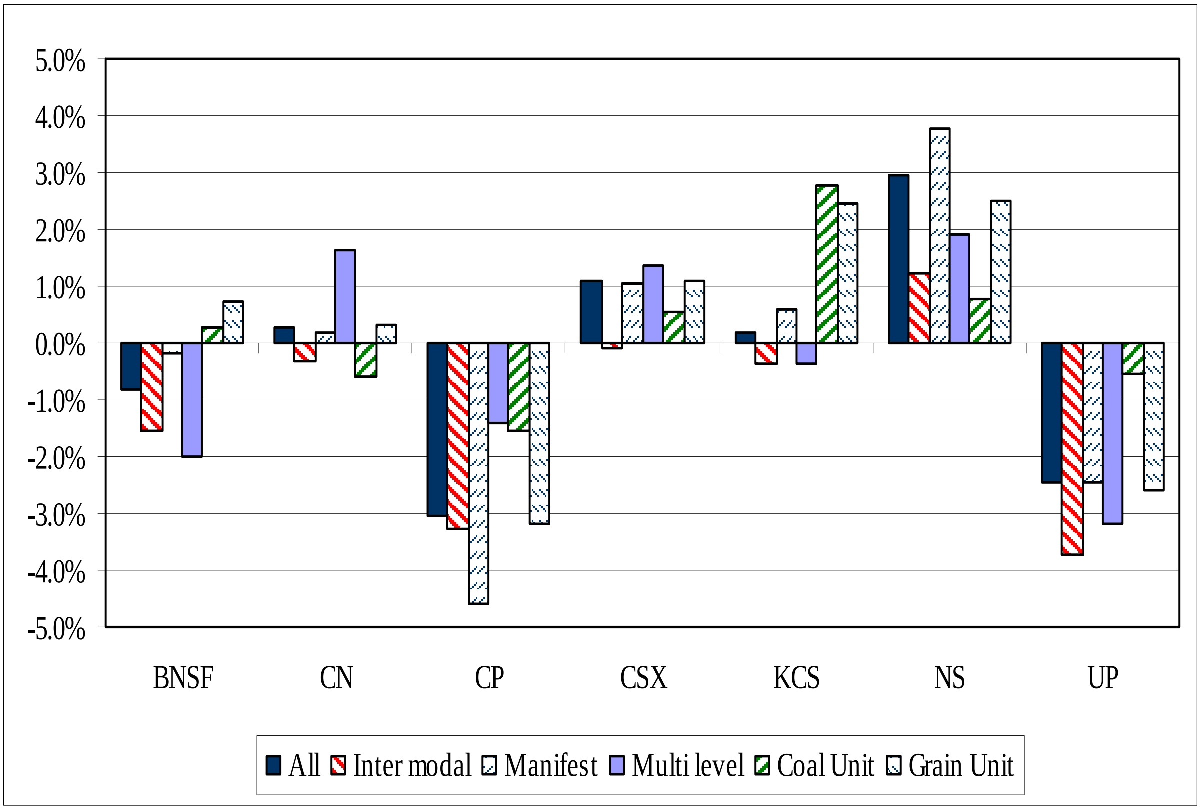
Table 5-3 and Figure 5-23 show the changes in average train speed by railroad and train type for the period from 1999-2005. These data also do not support any large bias towards intermodal trains, as this train type generally experienced speed declines over the period.

Table 5-3: Changes in average speed by railroad and train type, 1999-2005

	All	Inter modal	Manifest	Multi level	Coal Unit	Grain Unit
BNSF	-0.8%	-1.6%	-0.2%	-2.0%	0.3%	0.7%
CN	0.3%	-0.3%	0.2%	1.7%	-0.6%	0.3%
CP	-3.0%	-3.3%	-4.6%	-1.4%	-1.5%	-3.2%
CSX	1.1%	-0.1%	1.1%	1.3%	0.5%	1.1%
KCS	0.2%	-0.4%	0.6%	-0.4%	2.8%	2.5%
NS	2.9%	1.2%	3.8%	1.9%	0.8%	2.5%
UP	-2.5%	-3.7%	-2.4%	-3.2%	-0.6%	-2.6%

Source: Laurits Christensen Associates

Figure 5-23: Changes in average speed by railroad and train type, 1999-2005



Source: Laurits Christensen Associates

A coefficient of variation (CV) is often used as a measure of the variability in average train speed. It is the ratio of the standard deviation to the average train speed, and is useful when comparing train types that have different average speeds. Table 5-4 presents CVs by railroad and train type. These data show that grain and coal units have the greatest variation and intermodal has the lowest CV. From this Christensen concluded that even though the average speed for all train types declined over this period, coal and grain units received the least reliable service and intermodal received the most reliable service.

Table 5-4: Variability in average train speed by railroad and train type, measured by coefficients of variation

	Inter modal	Manifest	Multi level	Coal Unit	Grain Unit
1999-2005					
BNSF	3.6%	3.6%	4.2%	4.9%	4.6%
CN	3.9%	5.1%	6.1%	8.0%	9.4%
CP	5.1%	5.6%	6.8%	5.9%	7.3%
CSX	3.5%	5.1%	6.3%	4.4%	6.3%
KCS	5.5%	7.0%	5.6%	8.2%	8.9%
NS	3.2%	4.4%	5.4%	4.5%	7.1%
UP	3.6%	3.5%	3.9%	4.9%	5.1%
2006-2007					
BNSF	3.8%	4.3%	3.9%	4.4%	4.4%
CN	3.5%	3.5%	5.3%	5.9%	4.5%
CP	4.0%	3.6%	5.9%	8.9%	5.2%
CSX	3.4%	3.8%	4.5%	3.4%	4.3%
KCS	6.0%	4.6%	6.0%	6.5%	5.2%
NS	3.6%	4.1%	5.1%	3.6%	5.7%
UP	3.6%	3.1%	3.2%	4.2%	3.7%

Source: Laurits Christensen Associates

Reliability

A Congressional Research Service (CRS) report for Congress on September 26, 2007, addressed reliability issues in rail transportation of coal to power plants.[85] The study identified 11 episodes since 1990 that caused disruptions in coal supply to power plants due to rail transportation problems. They were caused by weather, surges in demand, difficulties with rail system integration subsequent to railroad mergers, and major unplanned maintenance.

2005-2007

Train derailments in May 2005 triggered a large-scale maintenance project on the PRB Joint Line, causing delays and coal delivery shortfalls through most of the year on the UP and BNSF systems. Delivery shortfalls for some shippers linger into 2006. UP imposes an embargo on accepting new customers for PRB coal shipments that continues until March 27, 2007.

2004

Rail system capacity is stressed by sharp increases in intermodal and grain traffic. UP experiences shortfalls in Colorado and Utah coal shipments and some problems in the PRB due to being short-staffed and needing more locomotives. NS and CSX have shortfalls in shipments of eastern coal to domestic generators due to a surge in coal export demand and capacity limitations exacerbated by hurricane damage.

2003

Delays in the UP shipments of coal from Colorado and Utah due to shortage of staff and locomotives.

1999-2000

Severe congestion and delivery shortfalls in the East due to problems with the integration of the Conrail system into NS and CSX.

1997-1998

Severe delivery shortfalls throughout the UP system because of problems with the integration of SP after the merger.

Mid-year 1998 shortfalls in eastern coal shipments on the NS system, reportedly due to insufficient locomotives.

Early 1996

Eastern coal shipments are disrupted by harsh winter weather and difficulty meeting a surge in power plant demand for coal.

1994-1995

Surge in demand for PRB's low-sulfur coal stemming from passage of the Clean Air Act of 1990 leads to congestion and delivery shortfalls on the UP and BNSF systems.

In the first part of 1994, delivery shortfalls of eastern coal are experienced on the Conrail systems due to harsh winter weather and difficulties implementing a maintenance program.

1993

Coal shipment shortfalls, primarily in the Midwest, due to widespread summer flooding.

1991

PRB coal delivery shortfalls due to congestion on the UP system.

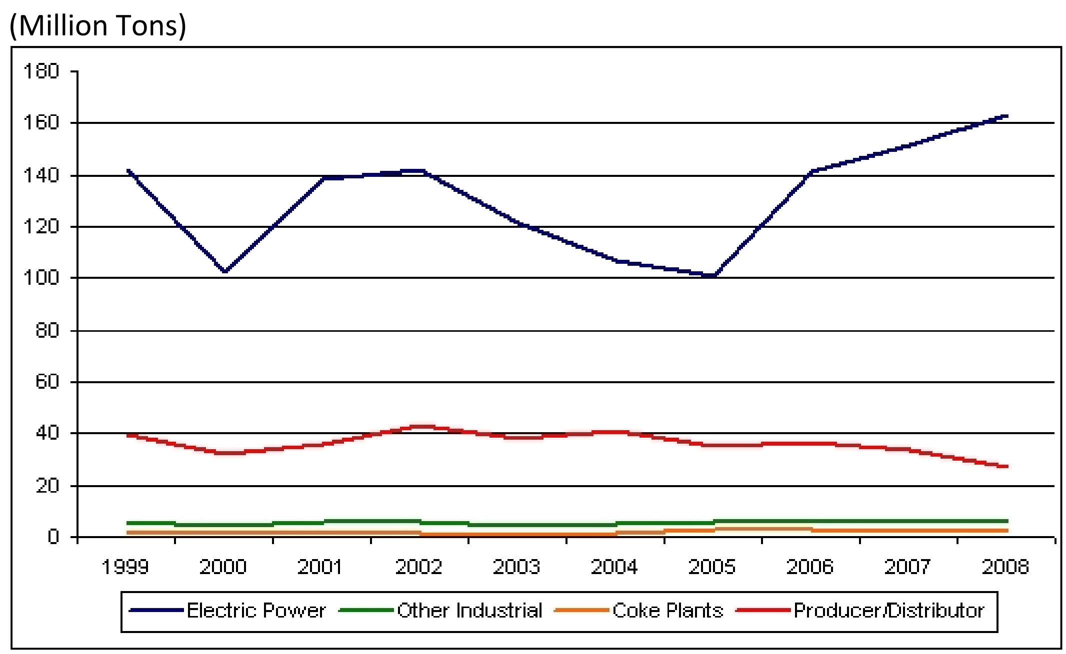
This CRS Report also identifies other, more persistent, indicators of service issues in transporting coal by railroads. The decline in rail speed discussed above is a leading issue. Capacity limits on the rail system contribute to service problems. After experiencing uneconomic excess capacity for years, the railroads have brought capacity and demand for services into better alignment. But unexpected events, such as weather and sudden demand increases, still result in periodic congestion.   Also, the electric power industry and other industrial shippers claim that railroads are increasingly unwilling to offer strong service quality guarantees.

Capacity & Coal Stockpiles

Capacity also has a bearing on service. The historic uneconomic excess capacity in the railroad industry has been brought more into alignment with demand, but at the cost of limited buffer capacity. When rail system capacity is constrained it can be a factor in allowing railroads to raise rates.

Coal stockpiles also serve as a buffer to shortages of rail capacity and disruptions to service (Figure 5-24). The stockpiles declined from 2002 to 2005, probably due to efforts by power companies to cut costs and to improve their financial profiles. These stockpile declines have occurred over a time in which more coal is being shipped longer distances from Western mines, making the power industry (and their ability to provide power to their customers) more vulnerable. However, since the end of 2005, coal stocks have increased, which may possibly reflect the difficulty that the power industry (and other industries) have had in obtaining strong service guarantees from the railroads and their recognition of the risk of being caught with short supplies.

Figure 5-24: Year-end coal stocks, 1999-2008

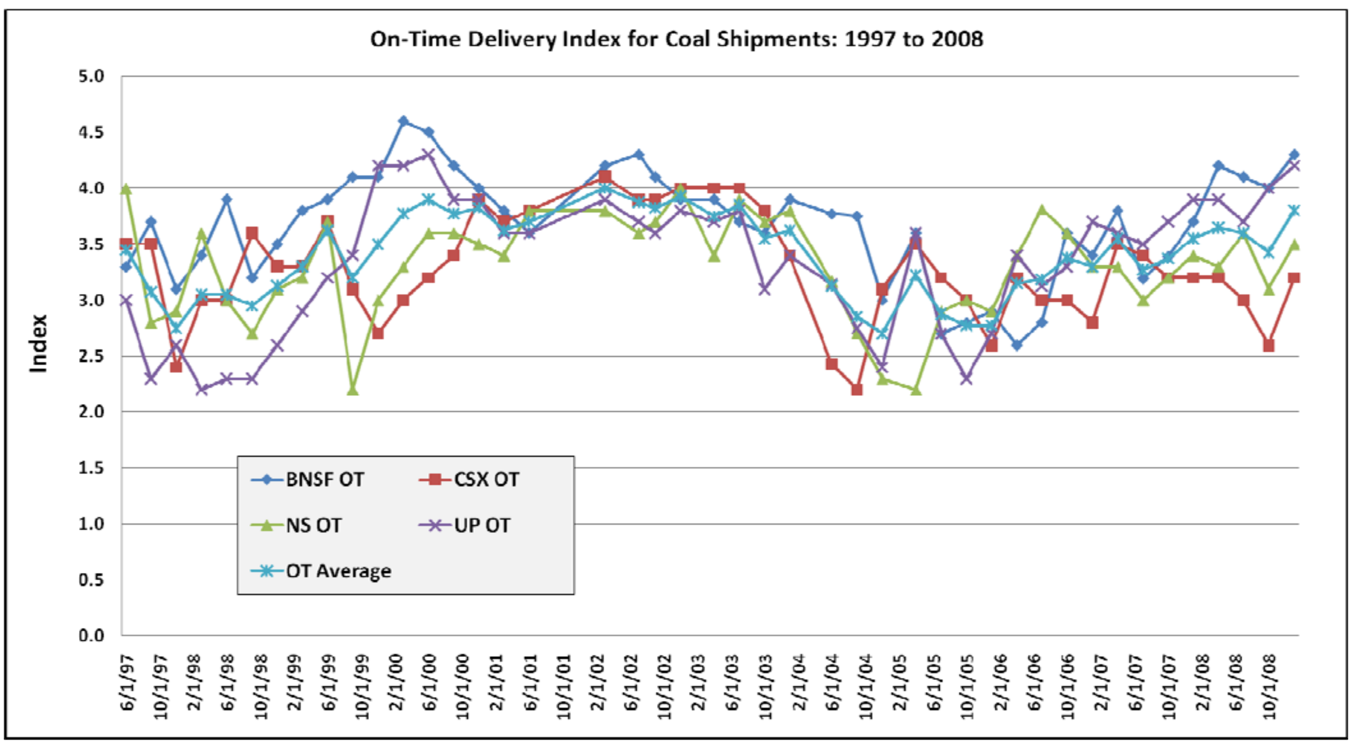


Sources: EIA, *Quarterly Coal Report*, October-December 2008, DOE/EIA-0121(2008/Q4) (Washington, DC, April 2009); and *Coal Industry Annual*, DOE/EIA-0584, various issues."

On-time Delivery

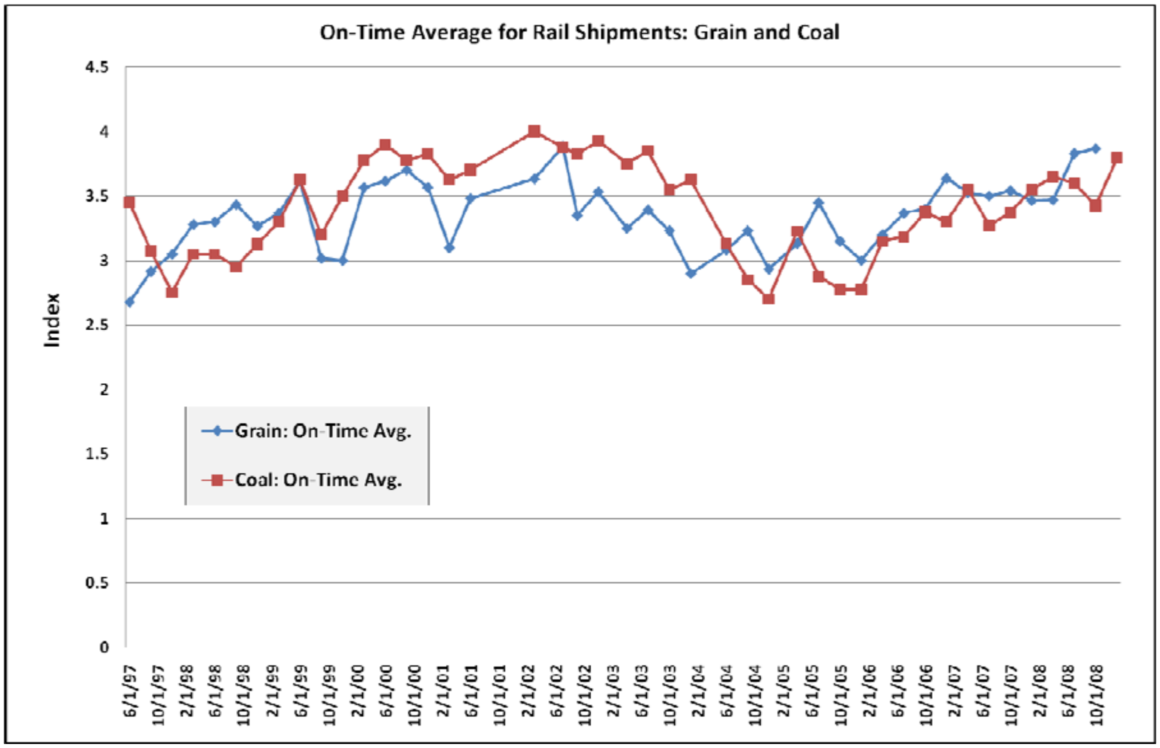
The Argus on-time delivery indexes provide a measure of the reliability of railroads in delivering a product to the final destination.[86] The on-time indexes for coal and grain were calculated for each quarter from June 1997 through September 2008. Figure 5-25 shows the index for four major railroads and the average for the railroads for coal shipments. Burlington Northern and Union Pacific are generally better, with average index values of 3.68 and 3.34, respectively. CSX is generally slightly less consistent with on-time delivery performance, with an index value of 3.28. Variations in on-time delivery can be evaluated using the Coefficient of Variation (CV), a statistic which measures the variation in on-time deliveries for a railroad relative to the average on-time delivery for that railroad. The CV expresses the variability of on-time deliveries for a railroad in percent terms, where the variability is that which occurred over the 1997 – 2008 time period. On the basis of the reliability of on-time deliveries, BNSF was the most reliable over the time period 1997-2008, with a CV of 13 percent while UP was less reliable with a CV of 18 percent. Figure 5-26 shows the on-time delivery index (across four Class I railroads) for coal and grain, for the same time period. In the earlier years in this data series, coal deliveries were more reliable than grain. Since around 2002, coal on-time delivery experienced a fairly steady decrease, until coal deliveries were less reliable than grain deliveries in about ten of the years. Both grain and coal deliveries have increased in on-time delivery and reliability since about 2006.

Figure 5-25: On-time delivery index for coal shipments, 1997-2008



Source: Argus Media Group, Coal, On-Time-Delivery Index

Figure 5-26: On-time average for rail shipments: grain and coal



Source: Argus Media Group, Coal, On-Time-Delivery Index

Consumer Complaints

Consumer complaint statistics kept by the STB are another indicator of service by the railroads. Table 5-5 below summarizes the number of complaints to the STB by commodity group, from 2005–2008. Fewer complaints have been lodged against coal shipping than against other commodities, possibly because coal is a major source of revenue for the railroads, and because it has fewer origination and destination pairs, enabling more efficient shipping.

Table 5-5: Summary of STB consumer complaint statistics, 2005-2008

Complaint Per Commodity Group	2008	2007	2006	2005
Forest Products*	8	8	17	17
Agricultural	23	23	13	17
Metals and Minerals	4	11	9	11
Industrial	3	0	NA	NA
Chemicals	21	13	10	5
Intermodal	5	0	5	2
Coal	5	0	1	2
Automobile	2	0	0	0

**Prior to 2007, this category was labeled paper products.*

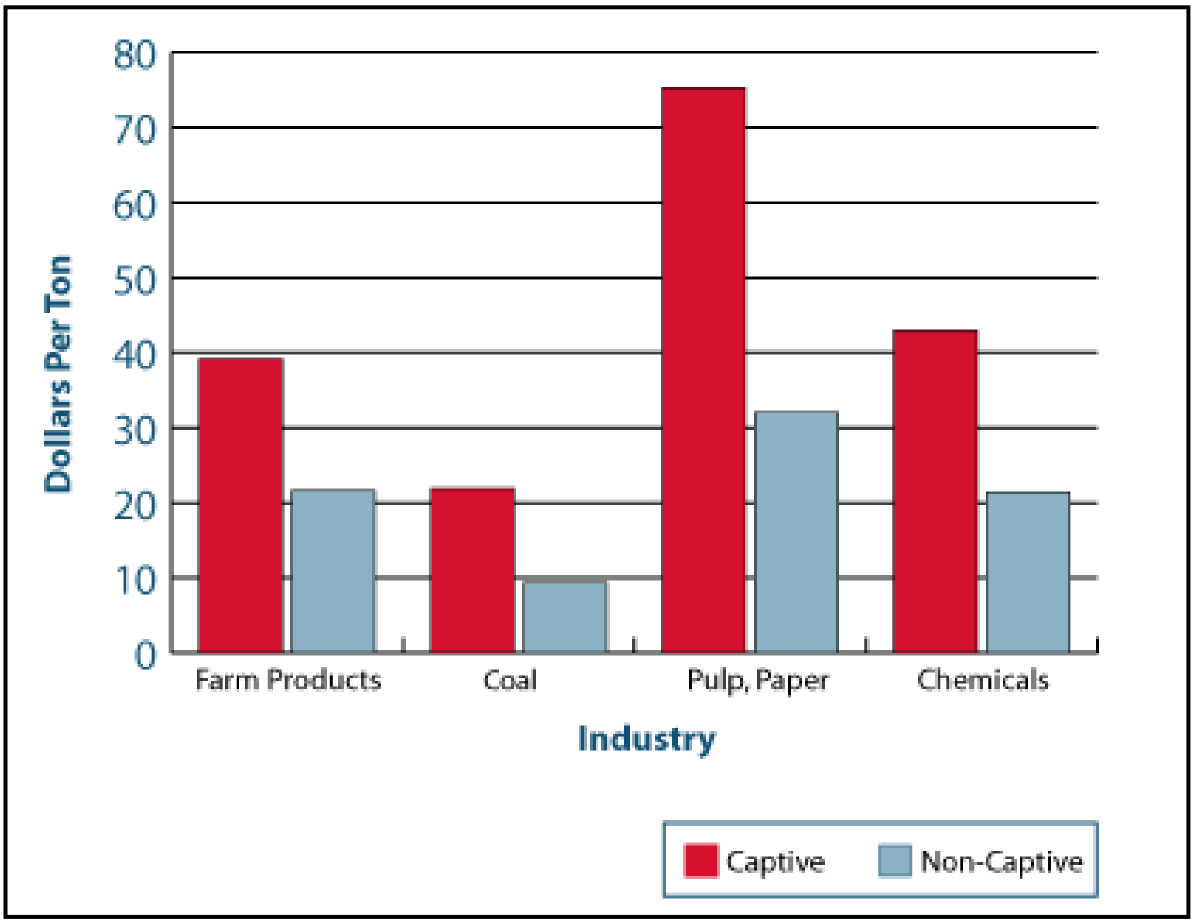
Source: STB, Rail Consumer Complaint Statistics, 2005–08

Paper Barriers

Captive rail customers are shippers, typically moving bulk commodities such as coal or grain that must rely on a single railroad to deliver their products because there is no other cost-effective transportation mode. Historically, 20–30 percent of the Nation's rail movements have been "captive," with many of these movements covering rural America.[87] Shippers continue to express concerns that the system Congress established to ensure competition in the national rail system and to protect rail customers in captive markets is not working as intended. A Government Accounting Office (GAO) report in 2007 also concluded that "concerns about competition and captivity remain as traffic is concentrated in fewer railroads" and that "[the STB's] rate relief processes are largely inaccessible and rarely used."[88]

On a per-ton basis, rates paid by shippers in a captive area are at least twice the rate as those for shippers in non-captive areas. Figure 5-27 illustrates the freight rail rate differences across four commodities, in captive and non-captive markets.

Figure 5-27: Captive vs. competitive freight rail rates



Source: Testimony before Senate Commerce, Science and Transportation Committee, Subcommittee on Surface Transportation and Merchant Marine Infrastructure, Safety, and Security, October 23, 2007, Glenn English, CEO, National Rural Electric Cooperative Association , *Captive vs. Competitive Freight Rail Rates*

Chapter 11 of this study examines STB processes for rail rate grievances and shippers' concerns about those processes. Shippers believe the rate grievance processes take too long, are too costly, and are ineffective in providing practical rate relief to captive shippers. They are concerned about the limited eligibility of rail rates to be challenged, and from the limited use of the process by those eligible.* The STB itself indicated that only 12 percent of rail rates are subject to their review.

In addition to shippers' belief that the rate process does not work as Congress intended, captive shippers are also concerned that rulings of the STB have reduced rail competition, especially two rulings—the paper barriers, or tie-in agreements, and the bottleneck decision, both of which are discussed in this chapter, but also in Chapter 8—on rail service performance.

Paper barriers refer to a restriction in an agreement by Class I railroads to lease or sell lines to a smaller railroad that prohibits the smaller railroad from interchanging traffic with any other connecting railroad. According to the GAO in 2007, about 500 short line railroads have been created since the 1980s by Class I railroads selling a portion of their lines. Paper barriers in these sales are believed to be widespread, but their extent is not actually fully known because they are included in confidential contracts.

Although this type of agreement prevents access to competitive service, the GAO suggests that elimination of paper barriers could reduce the overall capacity of the railroad industry because Class I railroads might abandon lines rather than selling them to smaller railroads. Railroads are required to consider "reasonable" offers of financial assistance when abandoning a line. However, paper barriers are sometimes put in place so that a large railroad can sell or lease a line on attractive terms to a smaller carrier, and still retain the revenue from interchange traffic. If the large railroad were forced to compete for the interchange traffic, it might demand a higher price or lease payment, possibly resulting in abandonment rather than sale of a line.

In general for most industries, restrictions on a purchaser's ability to conduct business with other parties would violate antitrust law. Many shippers believe that were it not for the antitrust exemption on STB-approved transactions, paper barriers put in place by some railroads also would violate antitrust law. Due in part to the anticompetitive nature of paper barriers and the incongruity of deregulating an industry while at the same time allowing antitrust exemptions to remain, Congress is now considering legislation to remove all antitrust exemptions from the railroad industry.

Shippers argue that the regulatory system established by Congress to ensure competition in the railroad industry is not working as intended, and that many vital industries (such as coal, agriculture and farming, and chemical manufacturers and processors) have faced deteriorating service and excessive rates for the rail service available to them. Mr. Glenn English, CEO of the National Rural Electric Cooperative Association and Chairman of Consumers United for Rail

* Movements exempt from STB jurisdiction include any rail movement for which there is a contract and other traffic specifically exempted from regulation, including inter-modal and boxcar movements.

Equity, has testified before many House and Senate Committees. He argues that member-owned, not-for-profit organizations such as his have the obligation of providing an affordable and reliable supply of electricity to consumers. He further argues that there is a national public interest in the operation of the rail system. Of course, if railroads cannot earn an adequate return on their assets, investments will not be made and both capacity and service quality will fall.

Coal delivery problems add costs to consumers. For example, the two railroads delivering PRB coal to Eastern States fell short on their deliveries by 15 percent over the three year period, 2005-2007, forcing the utilities to switch domestic sources, import coal, and use more natural gas; and as a result, raise their electric prices. NRECA estimated that in 2006 alone, the cost of replacing the PRB coal deficit was over $2 billion.

Because many of the short line railroads are interconnected with more than one major railroad, the existence of paper barriers can create an impediment to competition. With less competition, shippers believe railroads are able to charge higher rates and provide less service for transporting coal to electric generation facilities, resulting in higher electricity rates for consumers, particularly rural consumers.

Most coal moved by rail to electric generating stations does not move on short line railroads, so paper barriers are not typically an issue in coal movements. However, where a utility power plant has access to only one railroad, in some cases utilities have constructed costly "build out" rail lines to reach competing railroads and so secure lower rail rates for their coal movements.

Bottleneck Rates

According to the GAO study in 2006, bottlenecks occur when "some shippers have more than one railroad that serves them at their origin and/or destination points, but have at least one portion of a rail movement for which no alternative rail route is available."[89] This portion is referred to as the "bottleneck segment." The rate for the bottleneck segment is referred to as the bottleneck rate.

The STB has ruled that railroads do not have to provide a rate for the bottleneck segment. Since the 1996 bottleneck decision, the discussion has focused on differential pricing, protection for captive shippers, and the financial health of the railroads.[90] The STB's rationale was that the statute and case law preclude it from requiring a railroad to provide service on a portion of its route when the railroad serves both the origin and destination points (and provides a rate from the origin to the destination on their railroad alone).

An example of the issue of bottleneck rates is Powder River Basin coal moving from Wyoming to Rodemacher, LA. As a result of the STB bottleneck decision, Lafayette, LA, homeowners pay an additional $300 per year and Lafayette educational institutions pay an additional $1.5 million per year for their electricity.[91] Coal moves via the UP which has track for the entire trip, including the last crucial and exclusive leg of about 20 miles, from Alexandria, LA, to Rodemacher.

If the shipper could get quotes from competing carriers, the coal could be brought from Wyoming to Kansas City via BNSF. It then could be switched to KCS or to UP, to Alexandria, LA, and finally to UP for the last leg of the movement.

In the bottleneck ruling, a contract with a competing carrier must be in place before the STB will force the railroad to do the interchange, but shippers have found they can not get a contract quote, saying that these duopoly railroads will not compete because of a fear of retaliation on other segments of their own railroad. Hence, shippers believe no remedy or relief is available to them through lower rates brought about by competition.

Further, requiring a rate challenge over the entire length of haul is not felt by shippers to be reasonable or fair, as the rate over the entire length of haul could be determined to be reasonable, even though the rate over the bottleneck segment alone could be quite high. From the shippers' point of view, rates should be challengeable in the bottleneck segment alone.

An example from the grain industry points out the impact of these bottleneck rates. One shipper told USDA that the market has wanted corn to move from eastern Illinois to domestic markets in the East, but it has instead been moving to the Gulf because a premium is paid for export, and because of high rail rates to eastern markets. An affected shipper asked the originating carrier to quote a rate to a junction point that could theoretically allow the grain to move into more lucrative eastern markets, but the rate to the junction was almost precisely the difference in the eastern premium and Gulf rates, thus negating any possible benefit of a competitive market.

The legality of bottleneck practices was confirmed in a seminal court case involving coal rates and MidAmerican Energy Co. in the 8th Circuit Court in 1999.[92] In this case, the ruling was that a railroad did not have to offer a bottleneck rate (for the short-haul portion) when it served the entire route. The 8th Circuit affirmed STB's previous decision in 1996 that separately challengeable bottleneck rates can be required whenever a shipper has a contract over the non-bottleneck segment of a through movement.

The concern shippers have expressed about bottleneck rates is similar to concerns they have about paper barriers—a reduction in competition raises rates and lessens service. The bottleneck ruling allows railroads to engage in a "tying" arrangement that would be prohibited by antitrust law were it not for the antitrust exemption for railroads. A "tying" arrangement is one in which a firm will not sell product/service A without also selling product/service B.[93]

Some shippers also believe bottleneck rates can also cause a loss in efficiency, resulting in longer routes and greater fuel consumption. A recent report prepared by Nelson in 2008 focuses on economic efficiency (including the use of fuel). His research finds "that the bottleneck rule fosters conduct that is supportive of the perceived short-term economic self-interests of individual railroads, but is inconsistent with economic efficiency and the public interest. The conduct is detrimental to captive and competitive shippers as well as to the longer-term interests of railroads." The Nelson study concludes that the impact on economic efficiency is major, conservatively $1.3 billion per year, and that it leads to an extra consumption of over 103 million gallons of diesel fuel per year (and associated carbon emissions and environmental, national energy policy, and security problems). In addition, the study concludes that bottleneck practices cause railroad reliability problems.

The Nelson study was not specific to coal but applies to it. Bottleneck rates are an important issue for coal producers and utility companies. Dairyland Power Cooperative testified before the U.S. Senate Judiciary Subcommittee on October 3, 2007, with regard to railroad competition (and S.772—Railroad Antitrust Enforcement Act).[94] Dairyland burns coal in three plants in western Wisconsin, most of which comes from the PRB in Wyoming. For their coal delivery, they are "captive" to the only two railroads that serve the PRB and argued that the market power of these railroads has resulted in them paying more and receiving less. Paper barriers and bottlenecks are included on their list of concerns. They cite 2005 figures, in which Dairyland experienced a 13 percent shortfall of scheduled shipments and then faced a rate increase averaging 23 percent in the following year. They estimate this to have resulted in a $35 million annual increase in costs.

A policy proposed by GAO would require railroads to offer a rate and service for a bottleneck segment. GAO states, "On the one hand, requiring railroads to establish bottleneck rates would force short-distance routes on railroads when they served an entire route and could result in loss of business and potentially subject the bottleneck segment to a rate complaint. On the other hand, this approach would give shippers access to a second railroad, even if a single railroad was the only railroad that served the shipper at its origin and/or destination point, and could potentially reduce rates."

The AAR maintains that forcing rates on bottleneck segments would cause the total rate for through movements to be below the costs of operation on that movement. This could, according to the AAR, lead to a net revenue loss of several billion dollars a year.

The Nelson study concluded**:** "The original bottleneck decision acknowledged the Congressional intent that in rationalizing interchange practices, carriers should retain efficient routes. Carriers have used the bottleneck decision to insulate themselves from competition through intermediate participation by other carriers, even where such participation would improve efficiency. This has produced private benefits at the expense of economic efficiency and the public interest."

Recent Decision by STB in Favor of Coal Shippers

A recent decision by the STB in the Western Fuels Association, Inc. and Basin Electric Cooperative, Inc. case (February 2009) was made in favor of the utilities and consumers.[95] The utilities had challenged the rates charged by BNSF from mines in the PRB to their electric plant in Moba Junction, WY. The utility plant is captive to BNSF and provides electricity for grids serving consumers in nine States. The STB found that the railroad was charging a rate that was unlawfully high (roughly six times the variable cost). BSNF was ordered to lower its rates by about 60 percent. The order awards $100 million in past overcharges to utilities and an additional $245 million through reduced coal transportation rates through 2024. Electricity consumers in the nine States will benefit directly from this ruling.

This case has been referred to by some shippers as a very important rail rate case that may represent a turning point in the effort to protect captive shippers from monopoly pricing. Shippers have pointed out this is the single largest award to a captive shipper by the STB, and is the first meaningful relief awarded to a captive rail customer through a full, contested rate case since 2001. However, they also indicate this decision came more than 4 years after filing, and the plaintiffs spent approximately $9 million prosecuting their case. Concern still remains by shippers that most captive rail customers will be denied access to meaningful rate relief because of the cost in both time and money; and the complexity of the STB rate challenge process.

Conclusions

Coal is a major source of energy in the United States and is an important commodity for the transportation system. Despite the growth of alternative energy sources, coal will continue to be a major source of power for rural consumers. Because coal plays such an important role in generating electricity, its costs—including its delivery costs—are reflected in the price consumers pay for electricity.

Coal is produced in 20 States around the country. In recent years production has moved westward due to the demand for coal with lower sulfur content. Because coal is primarily used for generating electricity, demand is distributed around the country. With concentrated production areas and dispersed demand, an efficient and effective transportation system is critical for consumers to have an affordable and reliable supply of electricity.

Railroads are the most important mode of transportation for moving coal from areas of production to areas of energy generation. As production moved west, the average distance of shipment, size of shipment, and private-car ownership have all increased. Railroads have concentrated on the more profitable long-haul unit-train movements, abandoning or selling less-used track and facilities. Shippers often find it necessary to own their rail cars and loading facilities to get connecting service to main lines, shifting the costs of siding, track, storage, and loading to them from the railroads.

Rail rates declined from 1985-2004, but have increased steeply since then. Coal shippers are concerned that limited competition at origin and destination points has allowed railroads to charge higher rates than are justified and to pass on more costs to shippers, while reducing the level of service (speed, reliability, capacity). Of particular concern are paper barriers, which constrain shortline railroads from interchanging with competing mainline railroads, and bottleneck rates, which eliminate competition and potential efficiencies among railroads that should be available to shippers.

Railroads have made substantial investments since the 1970s in facilities for handling Western coal, including 103 miles of new railroad line in Wyoming and the upgrade or rebuilding of many thousands of miles of mainline track. These investments have added capacity to the rail network and benefitted all shippers, not just coal shippers.

Analysis using industry average data conceals problems that occur for captive shippers. Despite the recent decision by the STB in the Western Fuels and Basin Electric case (made in favor of the utilities and consumers), captive rail customers fear that the cost and complexity of the STB process still will deny them access to the process set up by Congress to ensure competition.

Railroads are vital to coal transportation, and coal is the largest single commodity handled by railroads. Over the past 35 years, railroads have made substantial investments in track, signals, freight cars, and locomotives to handle this traffic. Railroads are entitled to a return on this investment. On the other hand, shippers are entitled to reliable service at reasonable rates, and this has not always been consistently provided by the railroads. In those instances when service is poor or rates are unreasonably high, rural electricity rates are impacted.