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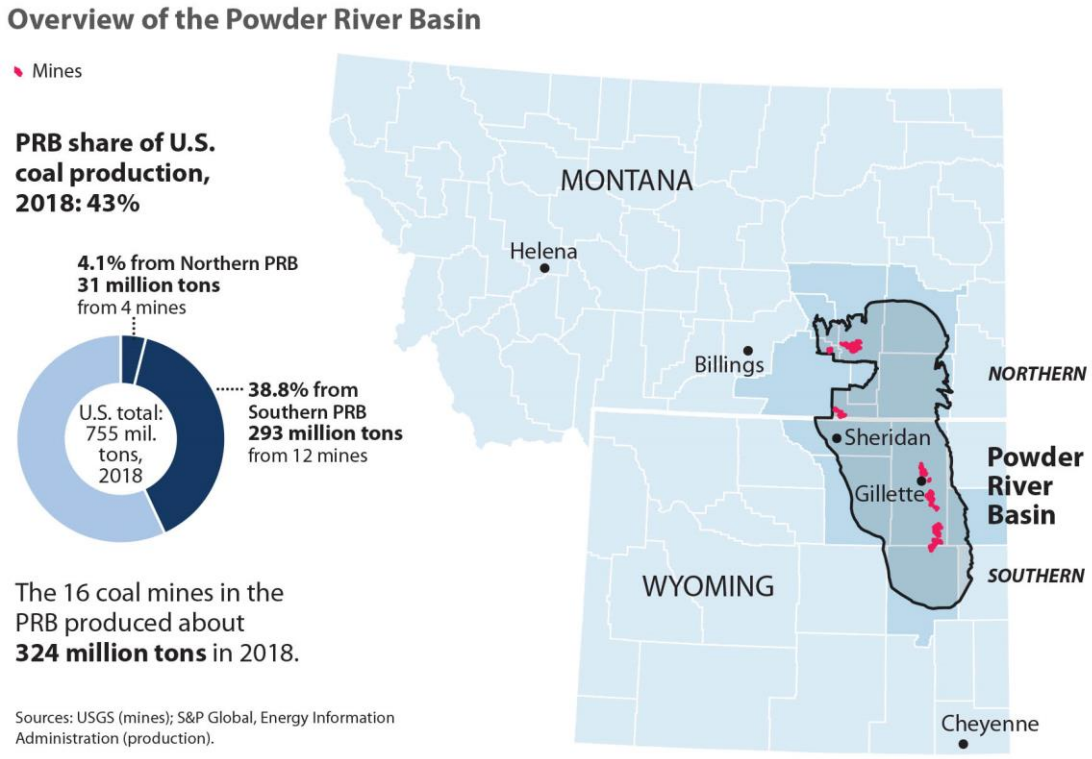
Powder River Basin Coal Industry Is in Long-Term Decline

Fast-Changing Markets Indicate Deeper Downturns to Come in Montana and Wyoming

Executive Summary

In the broad and fast-moving transition occurring across U.S. electricity-generation smarkets, no region stands at greater economic risk than the coal-rich Powder River Basin of Montana and Wyoming.

The PRB, as the basin is known for short, for years has produced roughly 40% of the coal used in power generation nationally, and the vast majority of the region's coal has gone into that sector. Demand for PRB coal has been driven historically by federal coal-lease policy, expanding energy markets, and the fact that it can be inexpensively strip-mined—as opposed to extracted from underground seams—and is relatively low in sulfur and ash content.



Yet today the region is losing its customer base as utilities across the U.S. embrace a wave of technology disruptions that have brought lower-cost generation from natural gas and renewables, especially wind and solar, creating competition that

is driving coal-fired power plants out of business. The U.S. market for thermal coal—that is, coal used for electricity generation—is in long-term structural decline, a trend that spells erosion in demand for PRB coal.

This shift raises major issues for local economies. PRB coal production directly employed 5,723 people in Montana and Wyoming in the fourth quarter of 2018, and coal mining contributes a major part of the tax base in at least three Montana counties and five Wyoming counties.

This report presents a breakdown of how PRB mines have been affected by the electricity sector's transition nationally and—perhaps more important—it suggests how those mines will likely be affected going forward.

Three categories emerge:

- The most vulnerable PRB mines, including Absaloka and Rosebud (both owned by Westmoreland Coal), are dependent on single-customer operations or plants that are already scheduled to retire.

- Mines with lower-quality coal that have slightly broader customer bases, some of which have better-diversified and financed owners but are at substantial risk nonetheless, including Rawhide (Peabody Energy), Coal Creek (Arch Coal), Eagle Butte (Blackjewel), Belle Ayr (Blackjewel), Buckskin (Kiewit), and Cordero Rojo, (Cloud Peak Energy).

- Mines that are in a better position to survive for the longer term based on their comparatively robust customer profiles and (in some cases) large-company ownership, including North Antelope Rochelle–School Creek (Peabody), Black Thunder (Arch Coal), and Antelope Coal (Cloud Peak).

This report also includes an overview of trends in U.S. electricity production and explains how those trends continue to diminish demand for coal. It touches as well on major technology advances that are driving change, notably in the rise of wind-power generation and the nascent but rapid emergence of solar.

And it notes, importantly, how two initiatives to save the PRB coal industry are unlikely to succeed. The first, a push for greater West Coast exports, is hobbled by foreign competition and local opposition to port expansions. The second turns on efforts to develop "clean coal," applications that remain economically uncompetitive or technically unfeasible.

Utility companies, as a result of the changing markets described here, are dealing from a newly powerful position in which they operate with less dependence on coal—and from a position that regards coal-fired power as increasingly untenable.

As the U.S. coal fleet ages and deteriorates in efficiency and value, it grows increasingly vulnerable to changes in utility company behavior, which includes considerable ambivalence toward the declining state of the coal sector. Without the robust customer base it had for generations, the U.S. coal industry—the PRB segment of that industry included—cannot continue along a business-as-usual path.

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U.S. Electricity Generation Overview

The share of total power generation from coal-fired power plants tumbled to 28% last year, compared with 45% in 2010, according to the Energy Information Administration (EIA), the federal repository for energy data. Coal's market share is expected to decline to 24% by 2020. U.S. coal consumption declined by an estimated 4% in 2018 and is now at levels similar to the late 1970s.[1]

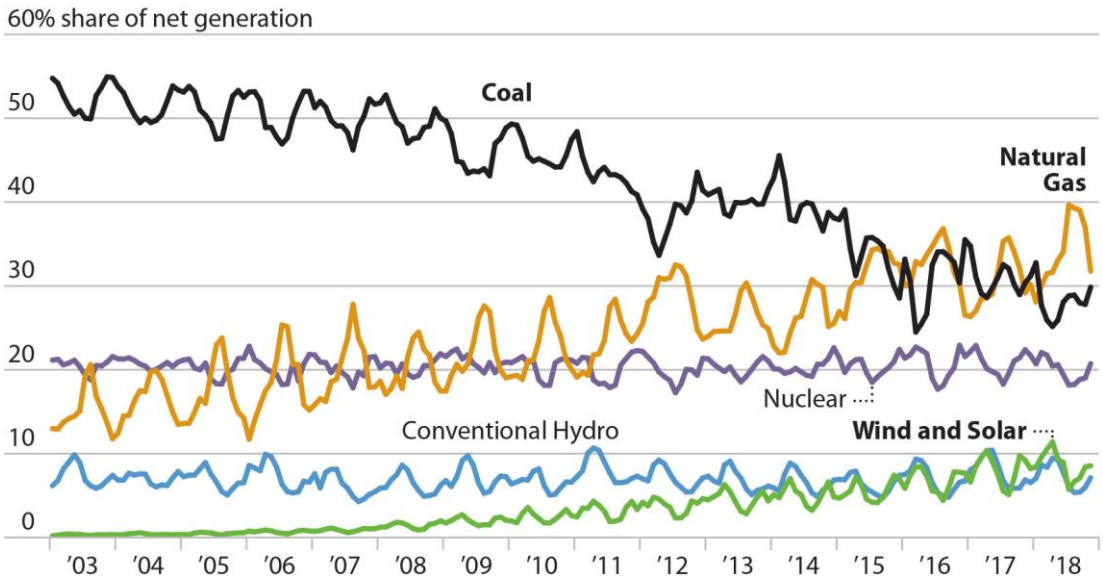
A Utility-Driven Shift

Powder River Basin producers of thermal coal are almost totally dependent on the domestic power industry, which is becoming an increasingly less reliable consumer.

Technology disruptions have brought cost-competitive generation from renewable energy and natural gas. The chart below illustrates gains in other forms of generation—most notably in natural gas-fired generation. But significant market share has been won by wind and solar—which now generate more power than conventional hydro— in a trend that is gaining momentum and that will take an increasingly bigger bite of the market in the future.[2,3,4,5,6]

Share of U.S. Electricity Generation, Electric Power Sector, by Fuel

Coal's share as a fuel for electricity generation has fallen sharply over the last 15 years as natural gas, wind, and solar have gained market share. Hydro and nuclear have remained relatively unchanged over the same period.



Source: Energy Information Administration

[1] While EIA's long-term coal forecasts have been consistently incorrect, the agency's historical data is widely regarded as accurate and the short-term forecasts have been much more reliable.
[2] IEEFA Report, "Power Industry Transition, Here and Now," February 2018.
[3] IEEFA Report, "Cheap Renewables Are Transforming Global Electricity Markets," February 2018.
[4] IEEFA Report, "Westmoreland Coal Is in Trouble," February 2018.
[5] IEEFA Report, "Economic Picture Worsens for Navajo Generating Station," April 2018.
[6] IEEFA Report, "The Seven Disruptions Driving the Global Energy Transition," October 2018.

And there is no end in sight to this transition, which is unlikely to be linear but will proceed nonetheless. No new coal plants are being built in the U.S., coal plant retirements are expected to continue, some coal-fired plants are being converted to use natural gas, and capacity factors—the measure of how much of a plant's potential is actually being used—are declining.

In large part, utilities are driving the shift from coal. Power-generation companies now see renewables as a lower-cost energy resource and are executing long-term resource development plans around the fact that renewables can be integrated reliably into the grid.[7]

Strong customer and corporate pressure for clean energy is also pushing the transition.[8,9,10]

Together, these forces have resulted in a reassessment of coal-fired generation. Now, utilities see coal as an economically challenged proposition hobbled by aging assets whose value is deteriorating and is further undermined by the high cost of pollution control and site cleanup.[11,12,13]

Because coal is an increasingly shrinking part of their generation portfolio, utility companies are less reliant on the coal industry than they have been and are largely free to make decisions irrespective of the impact on coal producers. This phenomenon can be seen in how utilities are changing their coal-purchasing behavior by opting, for instance, for short-term supply contracts and more spot purchases, a trend that compounds uncertainty for coal producers.

Even broader risks lurk at the macroeconomic level. A national recession, for instance, would likely drive utilities to accelerate plans for coal-unit retirements, especially if power demand declines, as it did during the 2007-2009 recession and financial crisis, and during the previous recession in 2001.[14]

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[7] IEEFA report: "Power-Industry Transition: Here and Now," February 2018.
[8] Wood Mackenzie: "Technology giants top list in bumper year for corporate procurement," January 2019.
[9] Bloomberg New Energy Finance: "Corporate Clean Energy Buying Surged to New Record in 2018," January 2019.
[10] Pew Research Center, "Two-thirds of Americans give priority to developing alternative energy over fossil fuels," January 2017.
[11] Washington Post: "TVA defies Trump, votes to shut down two aging coal-fired power plants," Feb. 14, 2019.
[12] IEEFA report: "Record Drop in U.S. Coal-Fired Capacity Likely in 2018," October 2018.
[13] IEEFA report: "Struggling U.S. Coal Companies Face Debt Hurdles, Complications From Reclamation and Pension Obligations, Pressure From Hedge Funds," June 2015.
[14] EIA, "Electricity Net Generation (All Sectors), Table 8.2a, Annual Energy Review, September 2012, and "Net generation, United States, all sectors," EIA Electricity Data Browser, eia.gov

Seven Technology Disruptions

Seven technology disruptions are driving these broad changes in the U.S. electricity-generation sector:[15]

- *Gains in efficiency,* which represent a quiet disruption pushed by increasingly efficient appliances, machines, and lighting, helps explain the decoupling between national economic growth and electricity demand.
- *The rise of wind-power generation,* which now accounts for almost 10 percent of electricity production nationally.
- *The rise of utility-scale solar-power generation,* which is about a decade behind wind but is advancing rapidly.
- *The fracking-driven natural gas boom,* which has pushed down the price of electricity generation and made coal-fired generation uncompetitive.
- *Major advances in grid management* that have allowed the seamless integration of thousands of utility-scale wind and solar plants; enabled a far higher share of renewables than was forecast even a few years ago and facilitated greater flexibility in fuel switching by utilities.
- *Trends in grid independence* that allow residential consumers and businesses to generate power themselves or adjust their individual demand.
- *Rapid advances in battery-storage technology* that suggest broad potential for homeowners and utilities alike.

These forces, taken together, have created a technology-driven shift in power-generation markets that is likely to continue to gain momentum.

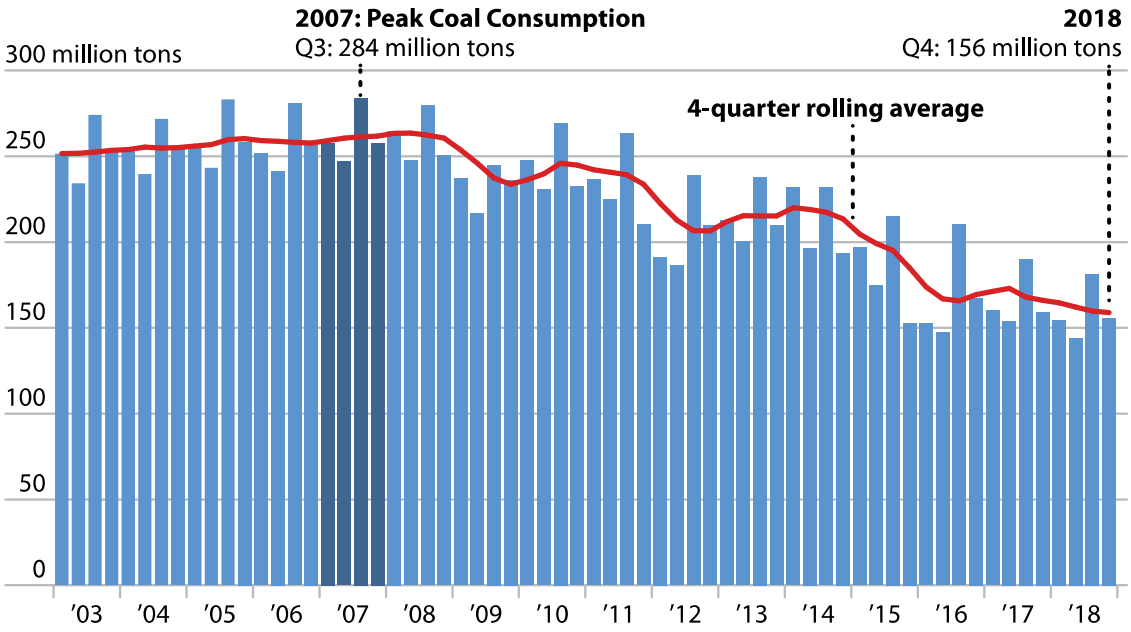
[15] IEEFA report: "The Seven Technology Disruptions Driving the Global Energy Transition: A Primer," October 2018.

Market Trends, Nationally and Regionally

Coal consumption for electricity generation has been on a downward trajectory across the U.S. for a decade, intensifying competition among producers that collectively are chasing a shrinking market. Most of the decline shown in the charts that follow reflects the effect of the technology disruptions described above.

U.S. Coal Consumption for Electricity Generation, Quarterly, 2003-2018

Coal consumption has fallen sharply in the past decade as disruptive energy technology trends have taken hold.

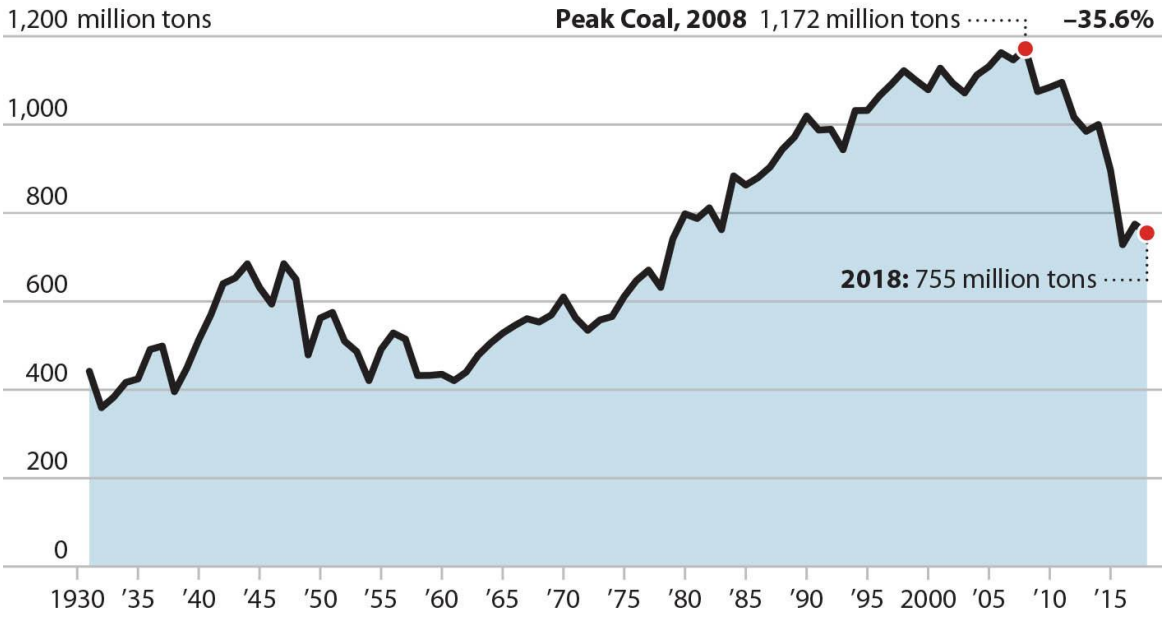


Source: Energy Information Administration

As consumption has dropped, so has production—nationally, regionally, and locally. Regionally speaking, Appalachian coal production has fallen the most, partly due to the high cost of underground mining, partly because many of the best resources have already been mined, leaving deeper seams that are more expensive to reach—all disadvantages in a highly competitive domestic market.

U.S. Coal Production, 1931-2018

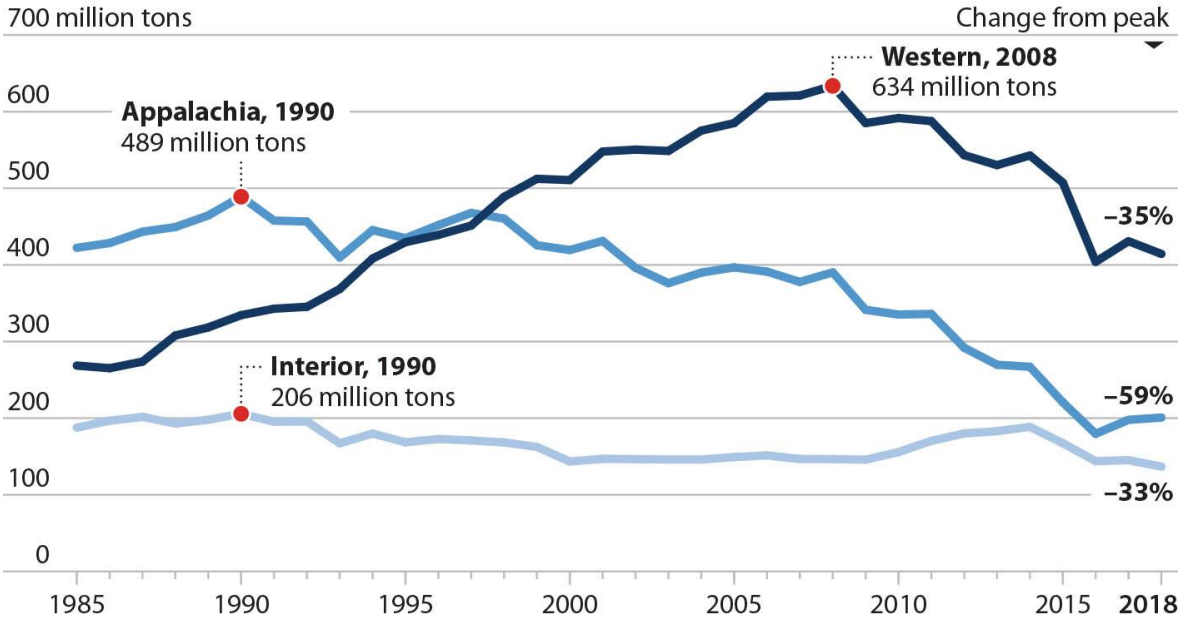
Overall coal production fell by about 20 million tons in 2018 compared to 2017, resuming its precipitious slide from 'peak coal' in 2008, and despite an increase in exports of about 19 million tons.



Source: Energy Information Administration

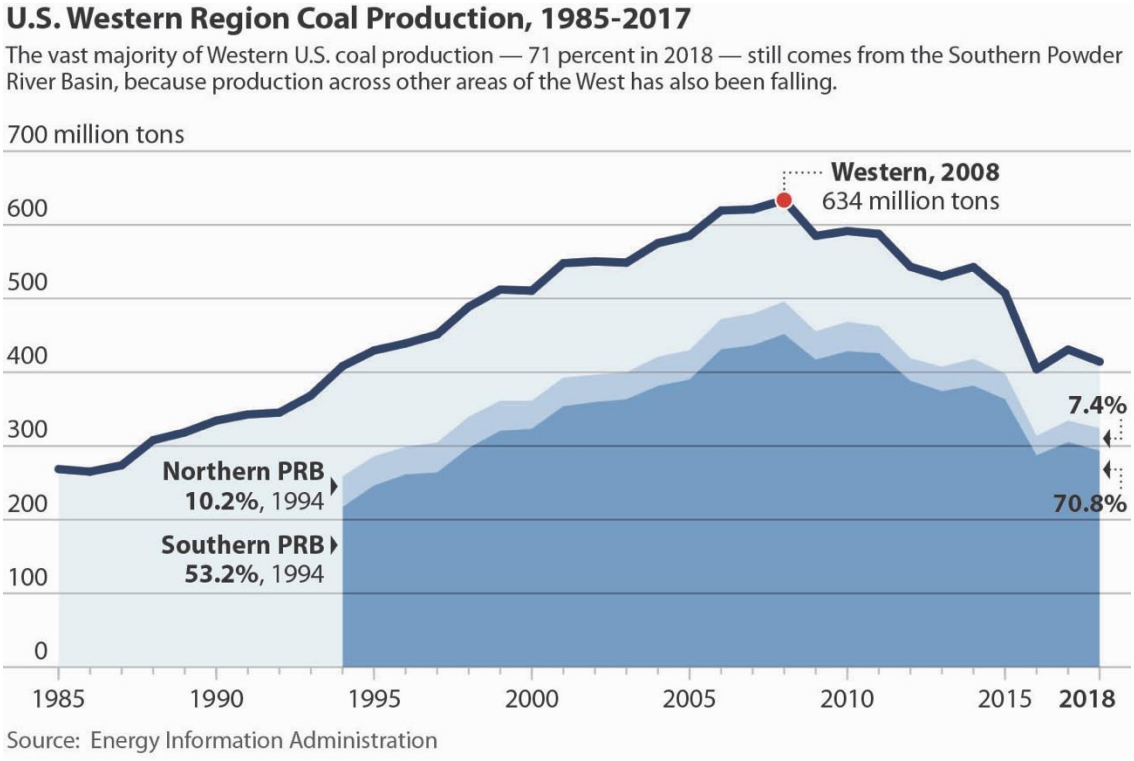
U.S. Regional Coal Production, 1985-2018

Coal production has fallen significantly in all three major coal mining regions. Since their peak production years, output is down by more than a 33 percent in the West and the Interior, and down 59 percent in Appalachia.



Source: Energy Information Administration

But the production declines in Appalachia and the Interior have been going on for 30 years, driven in no small measure by the inexpensive coal coming out of the Powder River Basin.[16] In contrast, the sharp declines that began after 2008 in the PRB have been driven by competition from outside of the coal industry, as cheap natural gas from the boom in fracking entered the market and as enormous wind farms across the Great Plains were built.



These developments led to more and more utility-company decisions to retire coal-fired electric generation as they faced the rising costs of those plants, but executives also began to see the opportunities the cheaper alternatives offered. The consequence has been a series of waves of coal-fired plant closures, cresting in 2012, 2015, and again in 2018.

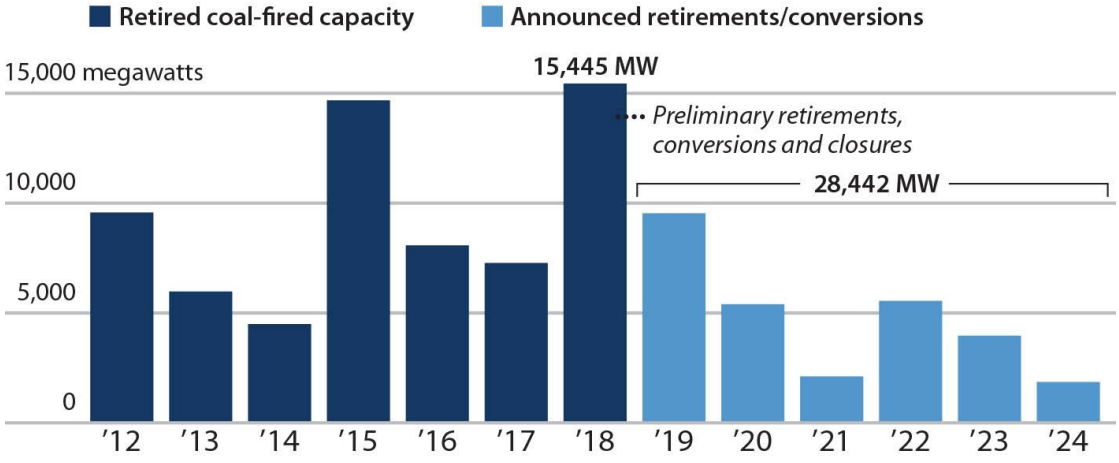
Coal-fired capacity in the United States peaked quite recently: in 2011, there were nearly 318 gigawatts (GW) available compared to 415GW of natural gas, 46GW of wind and a mere 1GW of utility-scale solar photovoltaic. By the end of 2017, coal-fired capacity had fallen by nearly 20 percent, or 61GW, to 257GW. In contrast, natural gas, wind, and solar capacity all rose. Wind capacity had nearly doubled, to 88GW and solar PV soared to 25GW.[17]

[16] IEEFA Brief: "The Federal Government Owns the Nation's Largest Coal Deposits—and Must Act Accordingly," August 2015.
[17] EIA: Electric Power Annual 2017, Table 1.2, "Summary Statistics for the United States, 2007-2017, Net Summer Generating Capacity," December 20, 2018.

Last year, an additional 15GW of coal capacity was closed, and even more is already planned over the next six years, as seen in the chart below. The projections depicted are conservative: They include only those plants whose owners have announced impending closures.

Coal-Fired Electric Generation Retirements and Conversions

Preliminary figures show that in 2018, nearly 15.4 gigawatts of coal-fired capacity retired or was converting to natural gas. New announcements continue to add to the list of closures expected over the next six years.



Sources: EIA; PJM; S&P Global; IEEFA research (2017-2024) As of March 13, 2019

These retirements add up to a rapidly growing crisis for coal producers: Roughly 90% of their output is earmarked for a market—coal-fired electric generation—that is in long-term decline. The situation is magnified in the PRB by customer-base risk, since many of the region's coal mines rely on just a small pool of large customers.

This customer-loss risk has been particularly evident in Texas, where the 2018 closures of Monticello, Big Brown, and J.T. Deely power plants were significant hits to PRB producers.

But more ominous, in many ways, is the tale that coal-plant capacity factors are telling. An IEEFA analysis of capacity factors at the largest coal-fired power plants over the past decade shows that most of the still-operating generators have been running less and less,[18] and many of these do not even have retirement dates set. Examples include plants like those run by the Southern Co. subsidiary Georgia Power[19] and at some Duke Energy power plants, where the myth of the baseload primacy of coal has been burst.[20]

Emblematic of the difficulties that continue to hamper coal-fired power generation, the board of directors for the Tennessee Valley Authority voted in February to close

[18] Based on IEEFA analysis of capacity factors at the 102 largest coal-fired power plants from 2007 through 2017, using EIA data from S&P Global Market Intelligence.
[19] IEEFA Georgia: "The diminishing importance of coal-fired power generation," Dec. 14, 2018.
[20] IEEFA U.S.: "Two of Duke Energy's plants in North Carolina reflect national trend in baseload slippage for coal," Oct. 29, 2018.

the sole remaining unit at the Paradise Fossil Plant in Muhlenberg County, Ky.

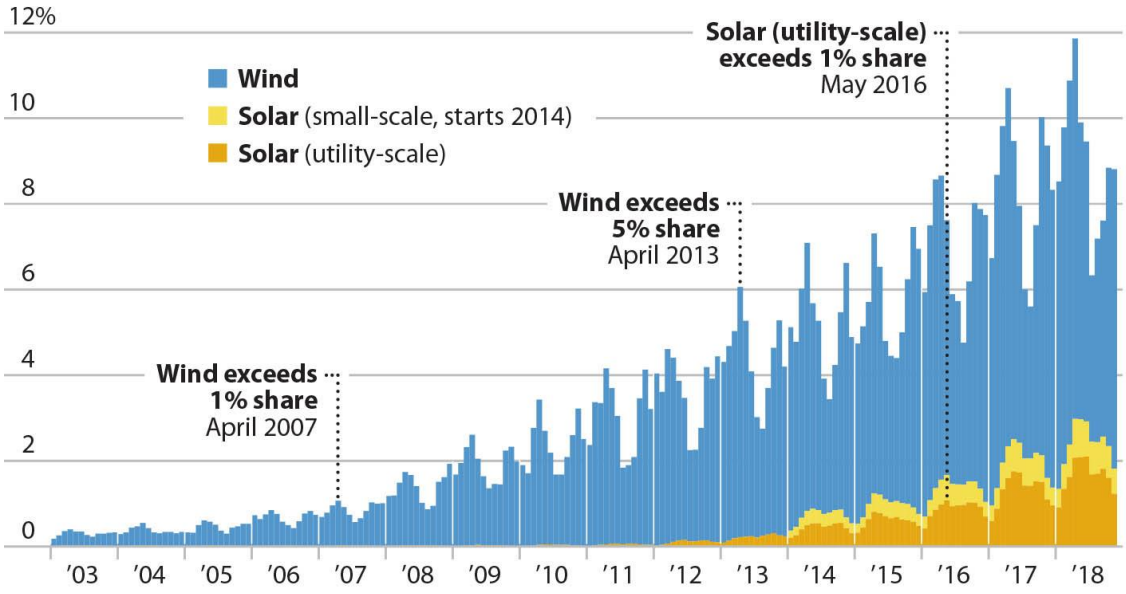
“This decision is about economics," the CEO of the TVA said in announcing the closure.[21] "It's about keeping rates as low as feasible."

Meanwhile, the ascension of wind- and solar-power generation continues. Driven by cost advantages and technological gains, wind and solar together generate more than 10 percent of electricity nationally, up from just 2 percent a decade ago.

In a 2019 outlook published in January, the EIA has 24 GW of new generation capacity coming online this year, 46% from wind and 18% from solar—none from coal.[22]

Wind and Solar Share of U.S. Electricity Generation

Wind and solar have been growing relentlessly as costs for these renwables have fallen sharply, grid operators have mastered integrating them, and utilities have increasingly embraced them.



Source: Energy Information Administration

Note: Share of generation for all sectors

Companies like Florida Power & Light (FPL) exemplify these trends. In 2015 and 2016, FPL bought two coal plants—to shut them down, saying they could save ratepayers $200 million by getting out of expensive power contracts. By early 2018, FPL had built 600 megawatts of new solar facilities at eight locations around the state.[23] Then, in January,[24] the company announced plans to dramatically increase its utility-scale solar footprint by a factor of five. Like FPL, utility companies across

[21] AP: “Coal-fired power plant set to close, despite Trump support,” Feb. 14, 2019.
[22] EIA: “New electric generating capacity in 2019 will come from renewables and natural gas,” Jan. 10, 2019.
[23] Florida Power & Light, ”10-Year Power Plant Site Plant, 2018-2027,” April 2018.
[24] “IEEFA U.S.: The gathering solar wave,” Jan. 24, 2019.

the U.S. are now regularly writing renewable energy expansions into resource development plans.

States, too, are encouraging this trend. California, as part of a push to go all renewable, had increased the solar portion of its electricity generation to 16% by 2017 from next to nothing five years earlier. Hawaii, historically addicted to expensive oil imports, in just three years tapped solar for 11% of its energy in a renewables program similar to California's.

Other states that have shown rapid uptake of solar run the gamut geographically and politically from Arizona (6%) to Massachusetts (7%). Some growth also stems from public-private initiatives, such as 413MW partnership between Google and the Tennessee Valley Authority on projects in Alabama and Tennessee. The EIA has identified North Carolina—along with California and Texas—as having one of the largest solar-growth markets in the U.S.[25] Solar initiatives are building also on tribal lands in the Southwest.[26]

The economics, relative to coal, is the driving force behind the spread of solar and wind alike. That advantage, shared by natural gas and the developing utility-scale battery-storage industry,[27] spells more trouble to come for coal producers.

Long-Shot Coal Industry Initiatives

The coal industry has promoted two long-shot survival strategies that include development of bigger export markets and development of carbon-capture projects that it contends will make coal a more viable source of electricity generation—neither is likely to save the industry.

Most PRB coal is not high-quality enough to compete as exports on price in a way that would offset its significant shipping costs. The U.S. has always been a swing producer of seaborne thermal coal, which is to say demand has been marginal at best and anything but stable or substantial enough to sustain the U.S. coal industry.

The export-oriented Spring Creek PRB mine, owned by Cloud Peak Energy (a company tottering on the verge of bankruptcy), reported a production increase of 1 million tons last year—but this was not nearly enough to offset a 9.1-million-ton drop in production from Cloud Peak's two domestic-oriented PRB mines, Cordero Rojo and Antelope Coal.[28]

Second, carbon capture and storage (CCS) remains a pipe dream. While billions of dollars have been spent on carbon capture research and development in North America, and while rosy predictions for CCS have been ritually repeated year in and

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[25] Ibid.
[26] IEEFA report: "Growing Interest in Developing Navajo Utility-Scale Solar Industry," October 2018.
[27] IEEFA U.S.: "5 ways utilities are driving the rapid expansion of solar-plus-storage," Feb. 14, 2019.
[28] S&P Global Market Intelligence: "Powder River Basin coal production down in Q4'18, flat to year-ago period," Feb. 1, 2019.

year out, those efforts have come up far short of being economically viable, and plenty of technical hurdles also remain.

As IEEFA noted in a report published last year,[29] "Today, 15 years after CCS development work began in earnest, there remains only one operational coal-fired carbon capture project in the U.S." And that project is small, costly and mainly experimental.

Implications for the Powder River Basin

In short, the Powder River Basin's coal industry is in a permanent, structural decline that began a decade ago and is set to continue.

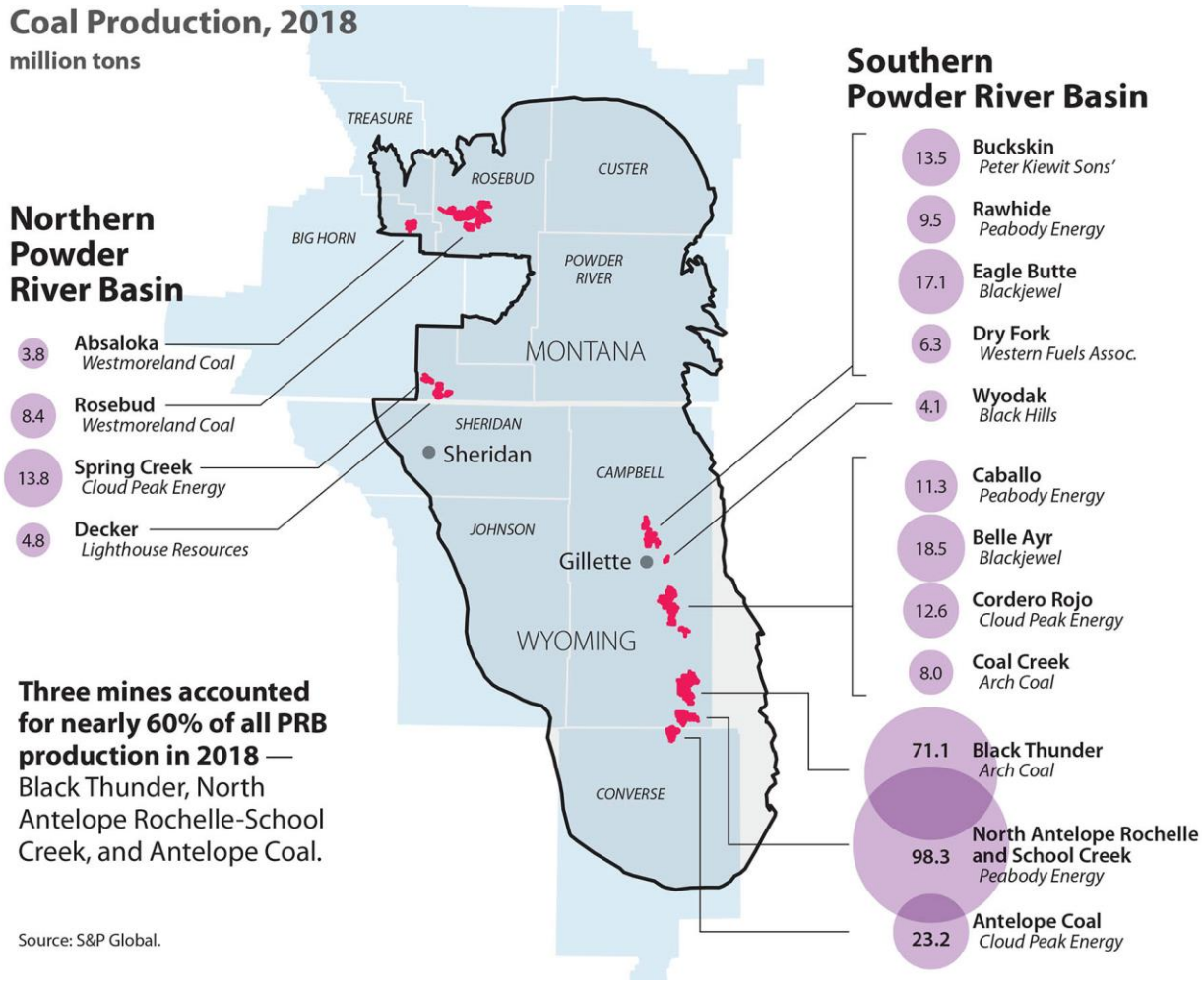
Almost completely dependent on a small number of domestic customers—only about 132 plants in the U.S. bought PRB coal in 2018 (down from slightly more than 200 a decade ago)—the PRB mining industry is facing a daunting series of risk factors identified by IEEFA.

Recently, Peabody Energy announced it is reducing the target volume for 2019 coal production from its North Antelope-Rochelle mine by 10 million tons.[30] The mine is the largest in the U.S. and produces thermal coal for the shrinking domestic coal-fired electricity generation market. North Antelope Rochelle produced 98.3 million tons of coal in 2018 and accounted for about 13.1% of all U.S. coal production in 2017, according to federal data and IEEFA research.

The lead coal analyst for Moody's Investors Service put this news in perspective with this statement. "While strong export markets and fewer retirements of coal-fired power plants should help Peabody generate meaningful free cash flow again in 2019, *we expect the company will continue to divert much of it to shareholders, rather than expand capacity amid long-term sector decline in the demand for thermal coal in the U.S. and competitive issues in the Powder River Basin.* [emphasis added]"[31]

In 2008, the PRB produced 496 million tons of coal. By 2018, that number had fallen to 324 million. The bulk of that production occurred mainly from three mines in the southern PRB (see map below).

[29] IEEFA report: "Holy Grail of Carbon Capture Continues to Elude Coal Industry," November 2018.
[30] S&P Global Market Analysis, "Peabody emphasis on 'value over volume' leads to cuts at US thermal coal mines," Feb. 6, 2019.
[31] Ibid.



Customer-Base Risk

The electricity-generation customer base for the 16 Powder River Basin coal mines covered in this analysis is becoming increasingly fragile.

Three categories emerge:

- The most vulnerable PRB mines, including Absaloka and Rosebud (both owned by Westmoreland Coal), are dependent on single-customer operations or plants that are already scheduled to retire.

- Mines with lower-quality coal that have slightly broader customer bases, some of which have better-diversified and financed owners but are at substantial risk nonetheless, including Rawhide (Peabody Energy), Coal Creek (Arch Coal), Eagle Butte (Blackjewel), Belle Ayr (Blackjewel), Buckskin (Kiewit), and Cordero Rojo, (Cloud Peak Energy).

- Mines that are in a better position to survive for the longer term based on their comparatively robust customer profiles and (in some cases) large-company ownership, including North Antelope Rochelle–School Creek (Peabody), Black Thunder (Arch Coal), and Antelope Coal (Cloud Peak).

Some mines, as can be seen, serve only a single plant (Absaloka and Rosebud, both owned by Westmoreland) that have already set dates for closure. Others, while selling to more plants, still send big portions of their production to just a few. Cloud Peak's Cordero Rojo mine, for example, sold coal to 19 plants in 2018—but nearly 27 percent of its production, some 3 million tons, went to only one, the J.T. Deely plant in Texas, which ceased coal-fired operations in December. (Charts showing the concentration of coal deliveries by plant for all 16 mines, as well as maps showing the plants each mine served in 2018, are at the end of this report.)

More hidden risks arise from large plants sourcing their coal from multiple mines, which is a common practice (see chart below) The largest plant in the country, Scherer, in Georgia, with a capacity rating of nearly 3,400 megawatts, purchased more than 8 million tons of PRB coal, sourced from five different mines and four different mine owners last year. Should a large plant like this close, or even significantly reduce its generation, the effect would ripple across the entire region. When Pleasant Prairie, a 1,188MW plant in Kenosha County, Wisc., was retired in April 2018, for example, it stopped buying coal from five PRB mines. In 2017, its last full year of operations, the plant purchased nearly 3.1 million tons of coal, according to S&P Global, primarily from Peabody's Caballo mine (1.6 million tons) and Cloud Peak's Cordero Rojo mine (1.3 million tons), with smaller amounts coming from the Antelope Coal mine (Cloud Peak, 140,000 tons), North Antelope Rochelle (Peabody, 84,000 tons), and Black Thunder (Arch Coal, 17,000 tons).

Two-thirds of plants get coal from multiple mines. In 2018, 15 plants sourced coal from five or more mines. This poses serious risks for mining companies should plants consolidate purchases, run less, or shut down.

Core takeaways on PRB customer-base risks:

- The total customer base of PRB mines has fallen to about 130 plants from just over 200 in 2008, a 35 percent drop. This decline is due mainly to coal plant retirements, a trend that is likely to continue.[32] These 130 plants include seven mine-mouth plants located at three of the mines.

- The majority of sales from at least 11 PRB mines are now concentrated at just a few power plants, leaving them highly vulnerable to individual power plant closures or changes in supply contracts.

- Nearly two-thirds of all PRB-supplied coal plants get coal deliveries from multiple PRB mines, suggesting that individual mines are increasingly vulnerable to contract consolidation pressures, and that many mines could be affected simultaneously from a large individual plant closure or cut in generation.

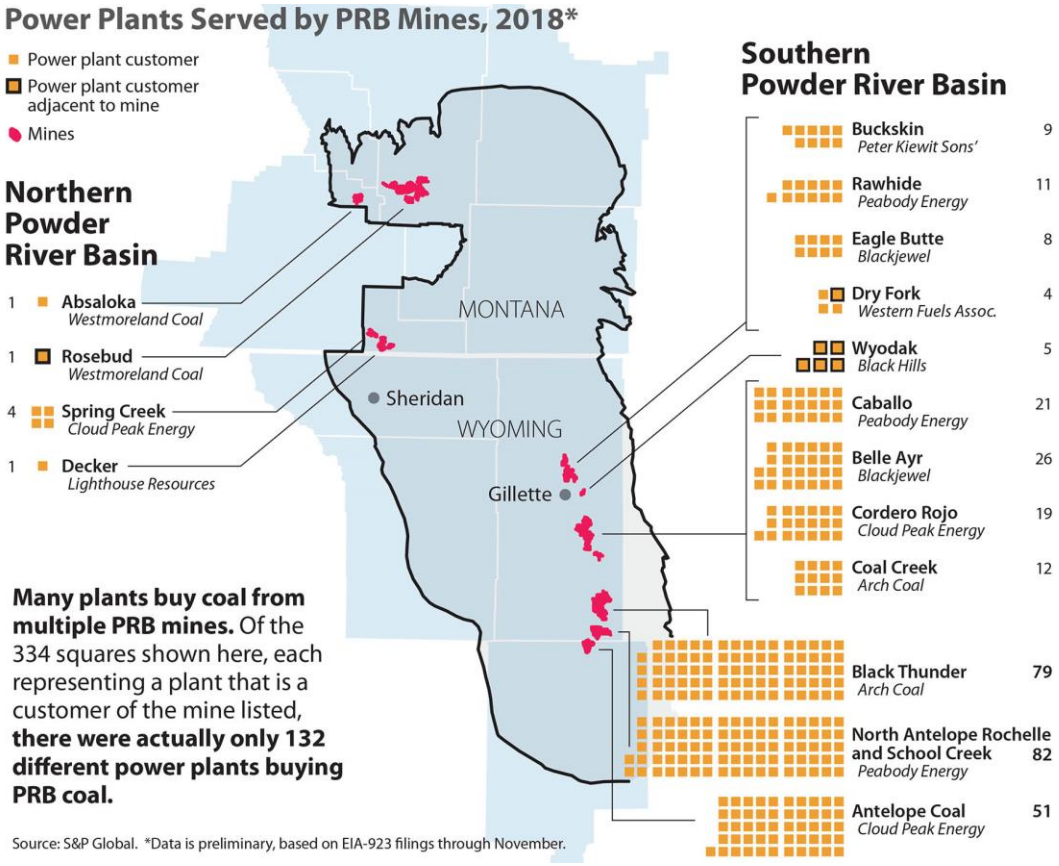
- Many of the coal plants historically served by PRB mines are facing intense price competition from wind generation. Much of the PRB's customer base is coincidentally situated in the country's best wind resource region, an area that covers at least a dozen states from Texas to North Dakota.

- Utility-scale solar is also rapidly increasing across much of the area served by PRB coal[33].

- Recent utility company mergers could drive more coal plant retirements and affect coal-purchasing behavior as it relates to PRB suppliers. One of these mergers, between Vistra Energy and Dynegy, covers a number of important PRB customers in Texas and Illinois (some of which closed in 2018); the other, between Westar Energy and Great Plains Energy, created Evergy, and resulted in the 2018 closure of the Montrose and Sibley plants in Missouri.

- Utilities are changing their coal-purchasing contract behavior, shifting from longer-term contracts to spot purchases, short-term contracts and delaying purchasing commitments. This trend obviously increases the financial uncertainty of coal-mining companies and the predictability of their revenue.

[32] IEEFA report: "Record Drop in U.S. Coal-Fired Capacity Likely in 2018," October 2018.
[33] IEEFA U.S.: "The Gathering Solar Wave," Jan. 24, 2019.



Economic and Policy Risks

- Risk from volatility in the price of natural gas, especially sudden drops in the price of gas, as happened in early 2016. That price drop led to a sharp decline in coal consumption.

- Risk from more fuel switching by utilities. Utilities are increasingly able to switch fuels across their fleets to take advantage of the lowest prices, a trend that adds volatility and competitive pressure to the demand for coal. This risk will only increase as natural gas and renewable generation capacity grows.

- Risks from an economic downturn or recession. Utilities will likely accelerate closures and cut generation at more expensive coal-fired units first with any decline in power demand or need to improve their bottom lines.

- Risks from policy changes that address carbon emissions or environmental pollution in general, or the coal industry specifically. Many states continue to strengthen mandates for renewable energy portfolios or provide economic incentives and subsidies for alternatives to coal; and long-term federal policy remains in flux with a divided Congress and a looming presidential election.

- Risks from utility customers, including both large corporations and individual retail customers, pushing to move away from fossil-fuel generation.
- Risks from grid- and power-equipment modernization efforts. These projects often favor new renewable, battery storage, and other distributed energy options at the expense of traditional baseload coal and nuclear.

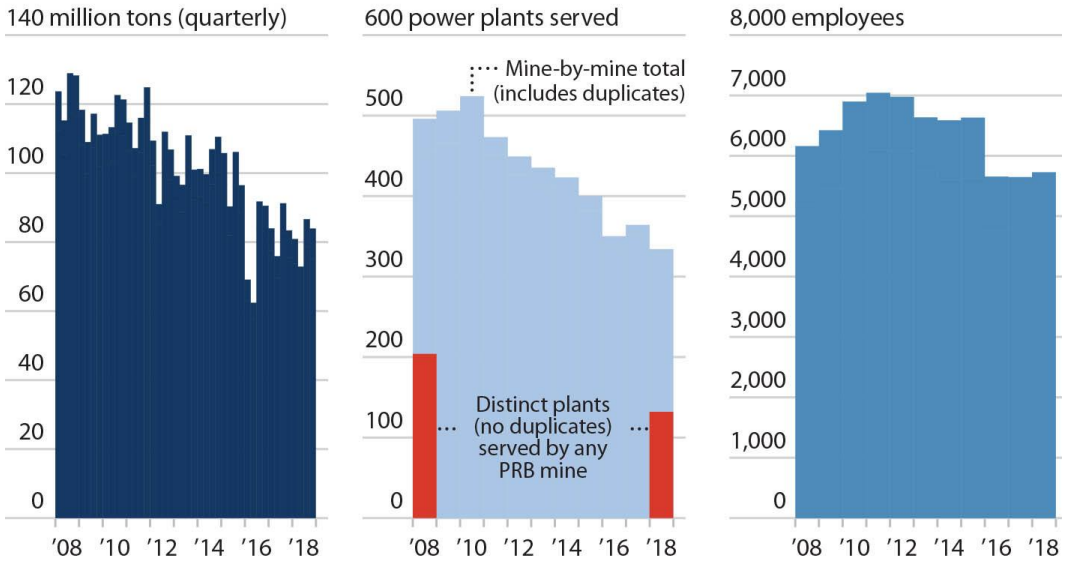
Looming Effects on Payrolls and Local Economies

PRB coal industry employment over the past decade has remained relatively stable compared to the sharp declines in production and number of power plants served, as the chart here shows.

This stability appears unsustainable: As a shrinking customer base takes its toll and drives production lower, company payrolls will inevitably be affected.

Production, Power Plants Served, and Employees of PRB Mines

After many years of growth, coal mining in the Powder River Basin has experienced a sharp reversal in production, declining power plant customers, and, to a lesser extent, lower employment.



Source: S&P Global

At the end of 2018, 1,024 workers were employed at the four Montana mines in the Northern PRB and 4,699 were employed at the 12 Wyoming mines in the Southern PRB mines for a total across the PRB of 5,723, down from more than 7,000 in 2011.

This is not an insignificant number. The entire nine-county region that encompasses the PRB had 133,909 residents in 2017, the most recent tabulation by the Census Bureau. (The population breakdown, by county: In Montana, Big Horn, 12,865; Custer, 11,699; Powder River, 1,743; Rosebud, 9,233; and Treasure, 718. In Wyoming, Campbell, 46,133; Converse, 13,833; and Johnson, 8,569; and Sheridan, 29,116).

While some PRB coal production workers commute from outside that nine-county area, the relative payroll importance of the coal industry on local communities is high. The Census Bureau puts average residents per household in Montana and Wyoming at about 2.5, which means there are probably somewhere on the order of 50,000 households in the counties that encompass the PRB.

That calculation suggests that roughly 1 in 10 households in the region is supported directly by coal production employment.

This is to say nothing of the ripple effects of looming job losses. As payrolls shrink, so too will business activity. Proprietors of grocery stores, restaurants, gas stations and so on will feel the pinch, as will equipment suppliers, mine-service contractors and related business. Those effects are beyond the scope of this report, as are the likely impacts on local tax bases, which are heavily dependent on mining activity and that support schools, infrastructure and public services in general.

Additionally, millions of dollars in medical and retirement benefits flow to the region, providing significant economic support—benefits that can get cut sharply or even eliminated as companies go through bankruptcy, as Westmoreland Coal has recently done.[34,35,36]

Conclusion

The Powder River Basin's coal industry is in structural decline. Flat electricity demand growth coupled with the development of cleaner and cheaper alternatives has led to a sharp decline in coal consumption for power generation—the dominant market for PRB coal.

These trends are expected to continue, pushing more coal plants into retirement and leading to continued contraction in coal demand. In turn, this will put continued pressure on the PRB's mines and lead to rising economic uncertainty in the region.

These macro trends are outside the control of the coal industry. And even the limited initiatives over which the industry has some control, particularly efforts to boost demand by increasing exports and developing carbon capture technologies, are unlikely to stanch the sector's long-term decline.

[34] Casper Star-Tribune: "Troubled Wyoming coal firm speeds up bonuses it says will retain execs," Jan. 29, 2019.
[35] Wall Street Journal: "Westmoreland Paid Millions in Executive Bonuses in Year Before Bankruptcy," Nov. 9, 2018.
[36] S&P Global Market Intelligence, "US court allows Westmoreland Coal to eliminate healthcare obligations," Feb.16, 2019.

Appendix: Powder River Basin Mine by Mine

The following section offers a visual mine-by-mine depiction of the customer base of PRB coal producers. This is shown in two ways:

- A chart showing the approximate share of each mine's 2018 production that went to the plants it served, highlighting those receiving 20% or more of the coal produced as well as plants getting between 10% and 20%.

- A map of the U.S. showing the location and name of plants receiving coal from each mine and indicating the rough size of 2018 deliveries: 1 million or more tons, between 75,000 and 1 million tons, and less than 75,000 tons.

Sixteen mines are presented, roughly from North to South, starting with the four mines of the Northern Powder River Basin in Montana:

Absaloka	*Westmoreland Coal*
Rosebud	*Westmoreland Coal*
Spring Creek	*Cloud Peak Energy*
Decker	*Lighthouse Resources*

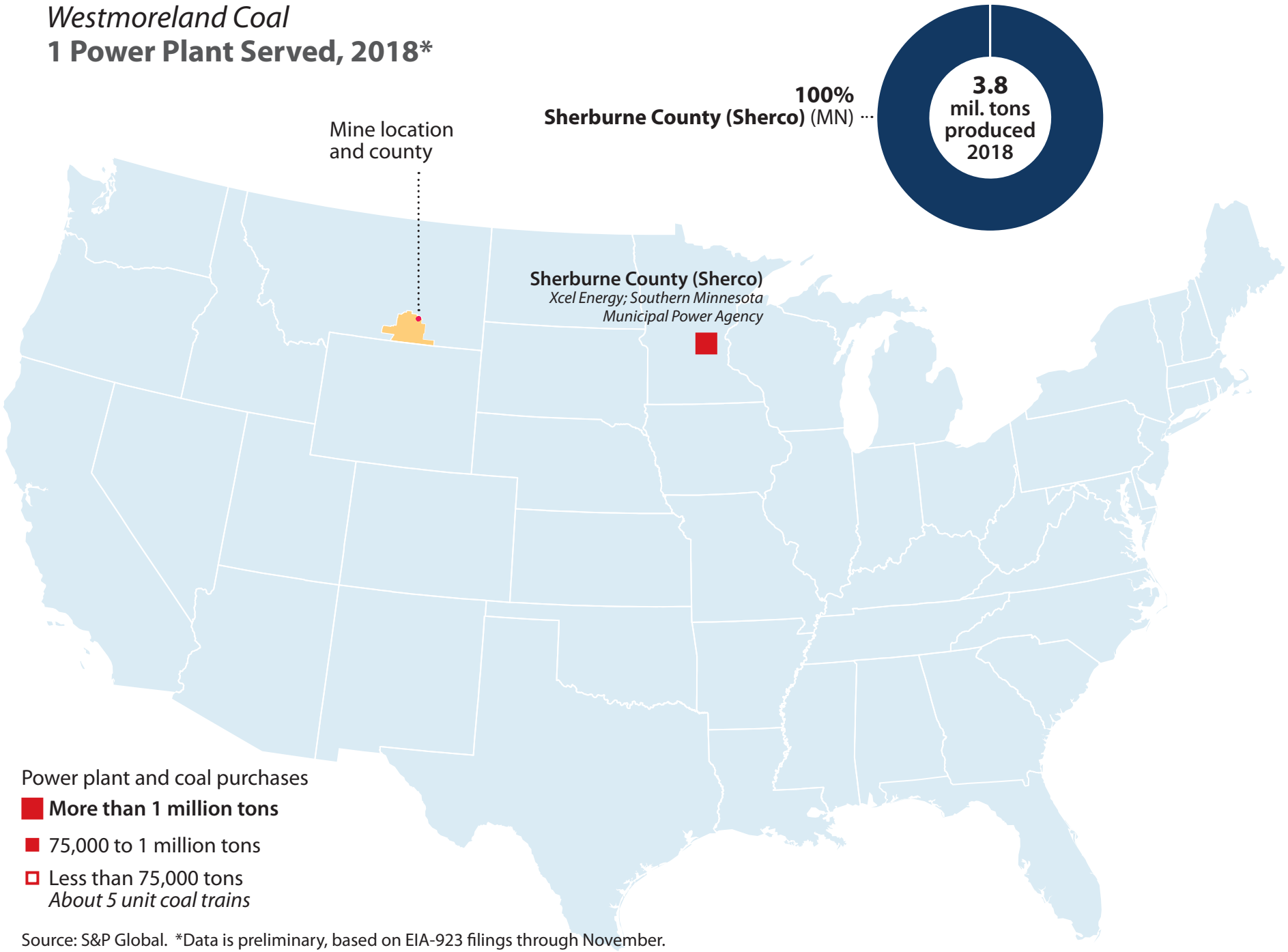
Next are the 12 mines in the Southern Powder River Basin, in Wyoming. The two largest producing mines, Black Thunder and the North Antelope Rochelle-School Creek complex, are each shown across two pages because of the large number of customers. The first page shows the plants getting about 1 million tons or more; the second page shows plants getting smaller deliveries, of less than 1 million tons.

Buckskin	*Peter Kiewit Sons'*
Rawhide	*Peabody Energy*
Eagle Butte	*Blackjewel*
Dry Fork	*Western Fuels Association*
Wyodak	*Black Hills*
Caballo	*Peabody Energy*
Belle Ayr	*Blackjewel*
Cordero Rojo	*Cloud Peak Energy*
Coal Creek	*Arch Coal*
Black Thunder	*Arch Coal*
North Antelope Rochelle-School Creek	*Peabody Energy*
Antelope Coal	*Cloud Peak Energy*

Absaloka

Westmoreland Coal

1 Power Plant Served, 2018*

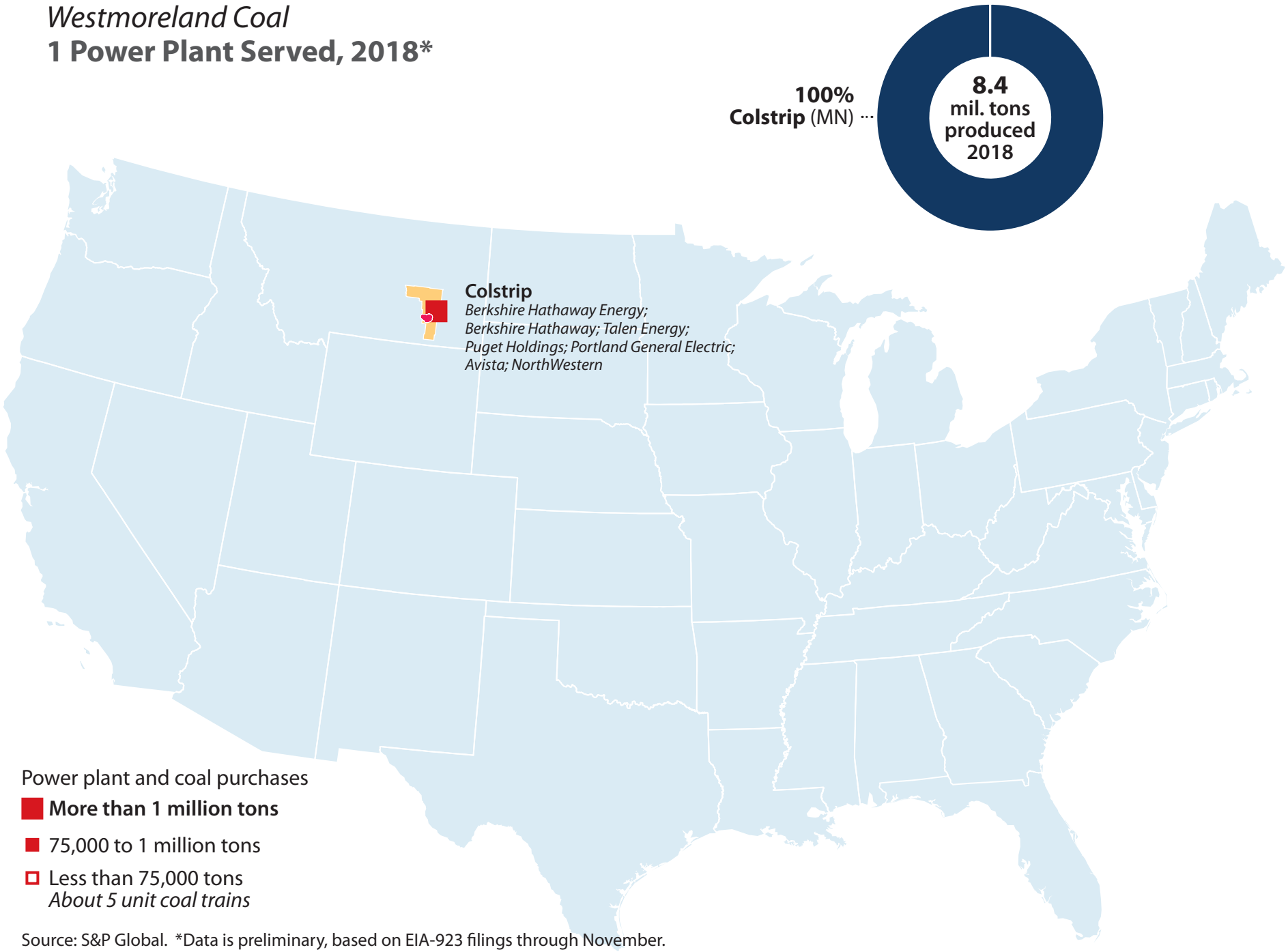


Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Rosebud

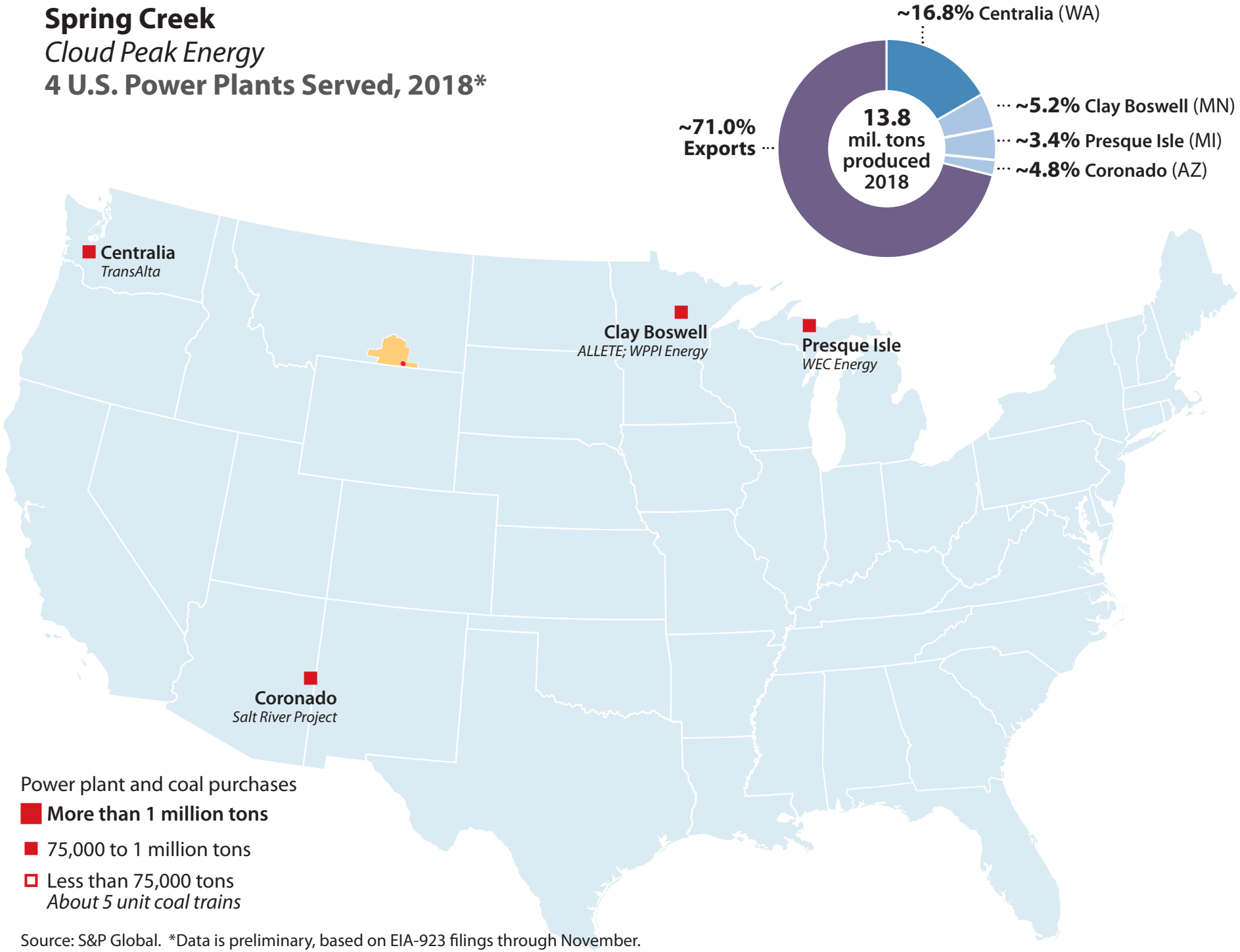
Westmoreland Coal

1 Power Plant Served, 2018*



Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Spring Creek
Cloud Peak Energy
4 U.S. Power Plants Served, 2018*

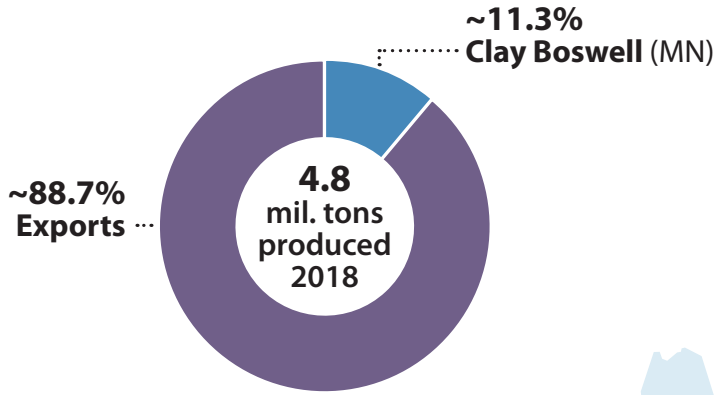


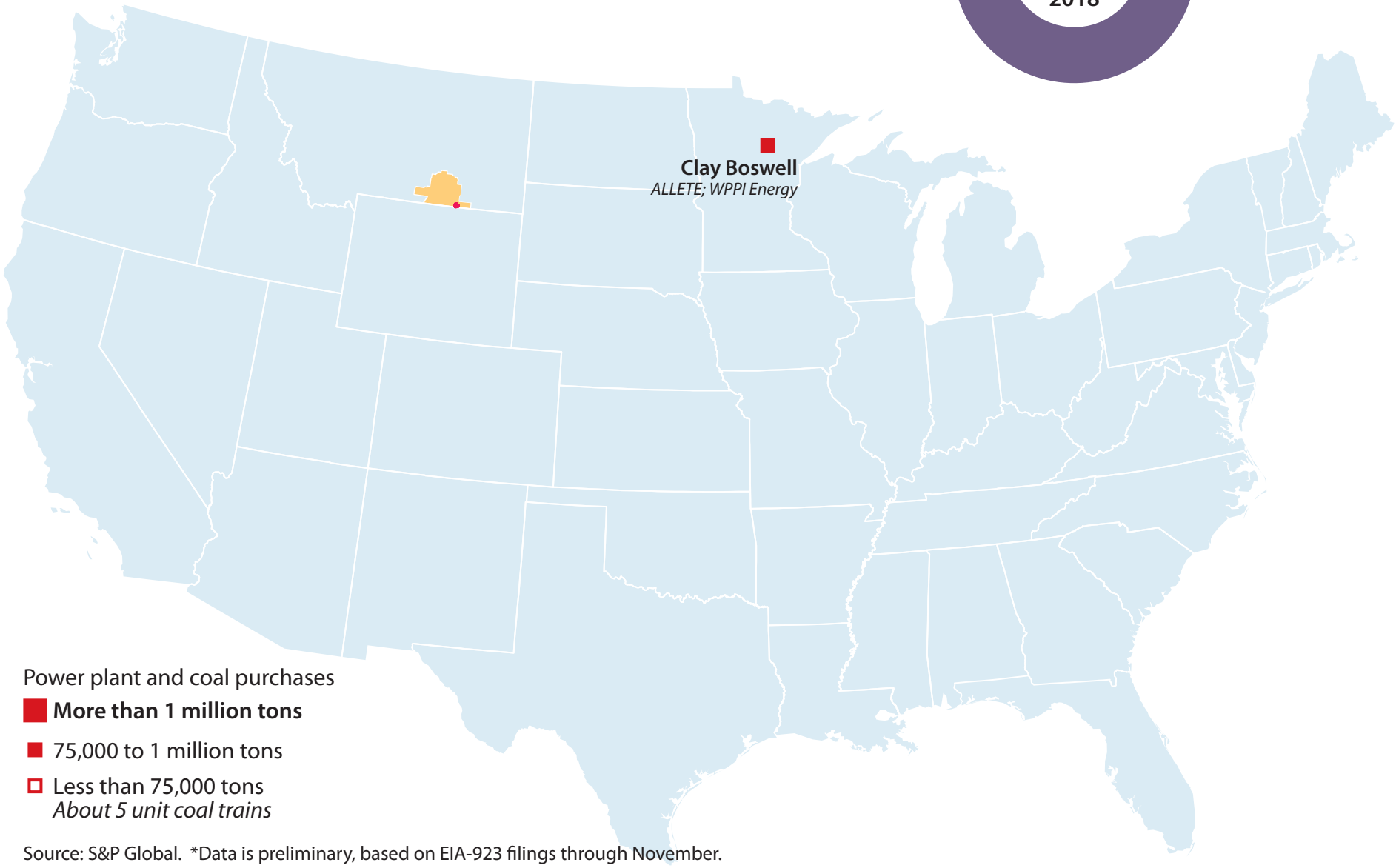
Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Decker

Lighthouse Resources

1 U.S. Power Plant Served, 2018*





Power plant and coal purchases

More than 1 million tons

75,000 to 1 million tons

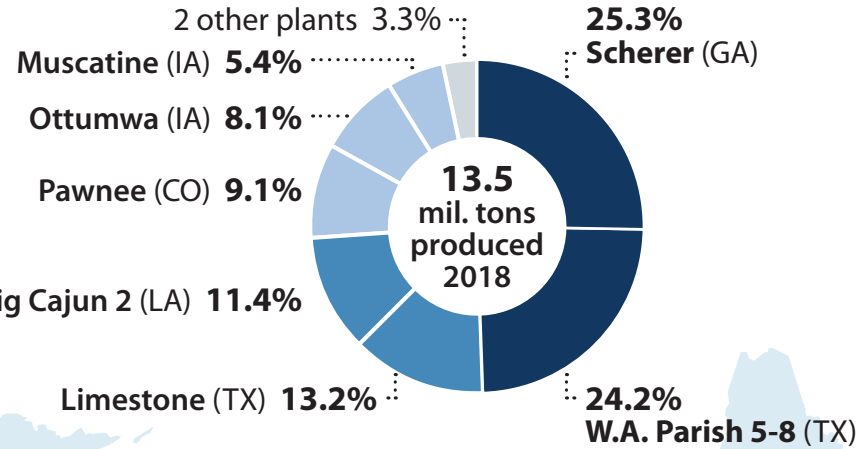
Less than 75,000 tons
About 5 unit coal trains

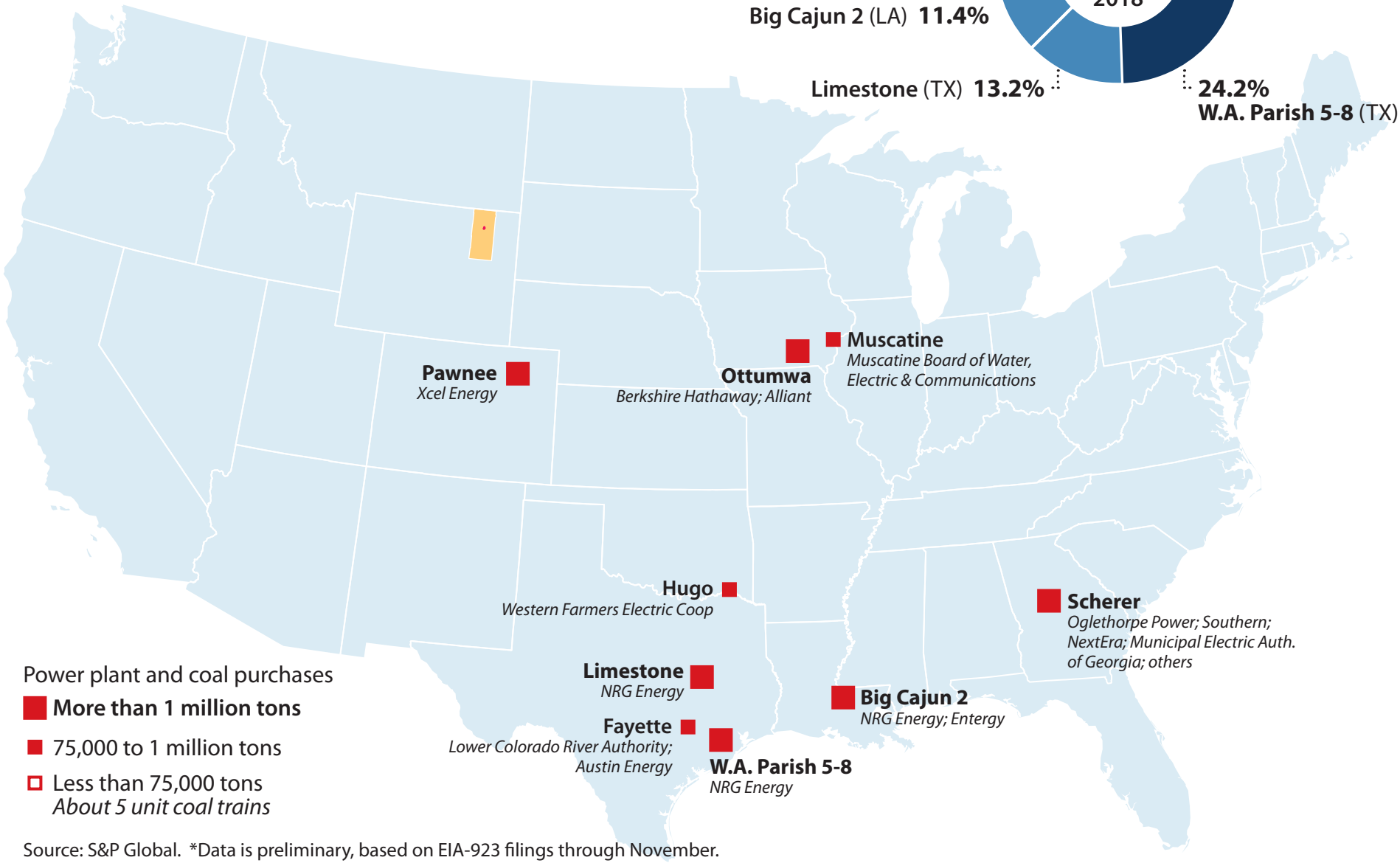
Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Buckskin Mine

Peter Kiewit Sons'

9 Power Plants Served, 2018*





Power plant and coal purchases

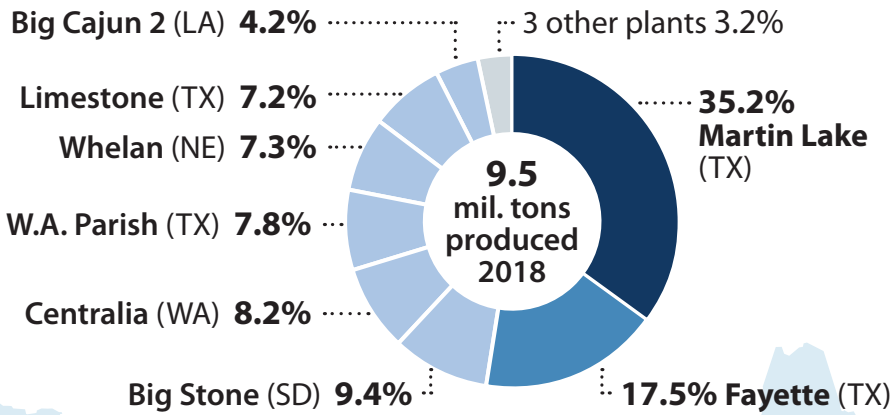
- **More than 1 million tons**
- 75,000 to 1 million tons
- Less than 75,000 tons
  About 5 unit coal trains

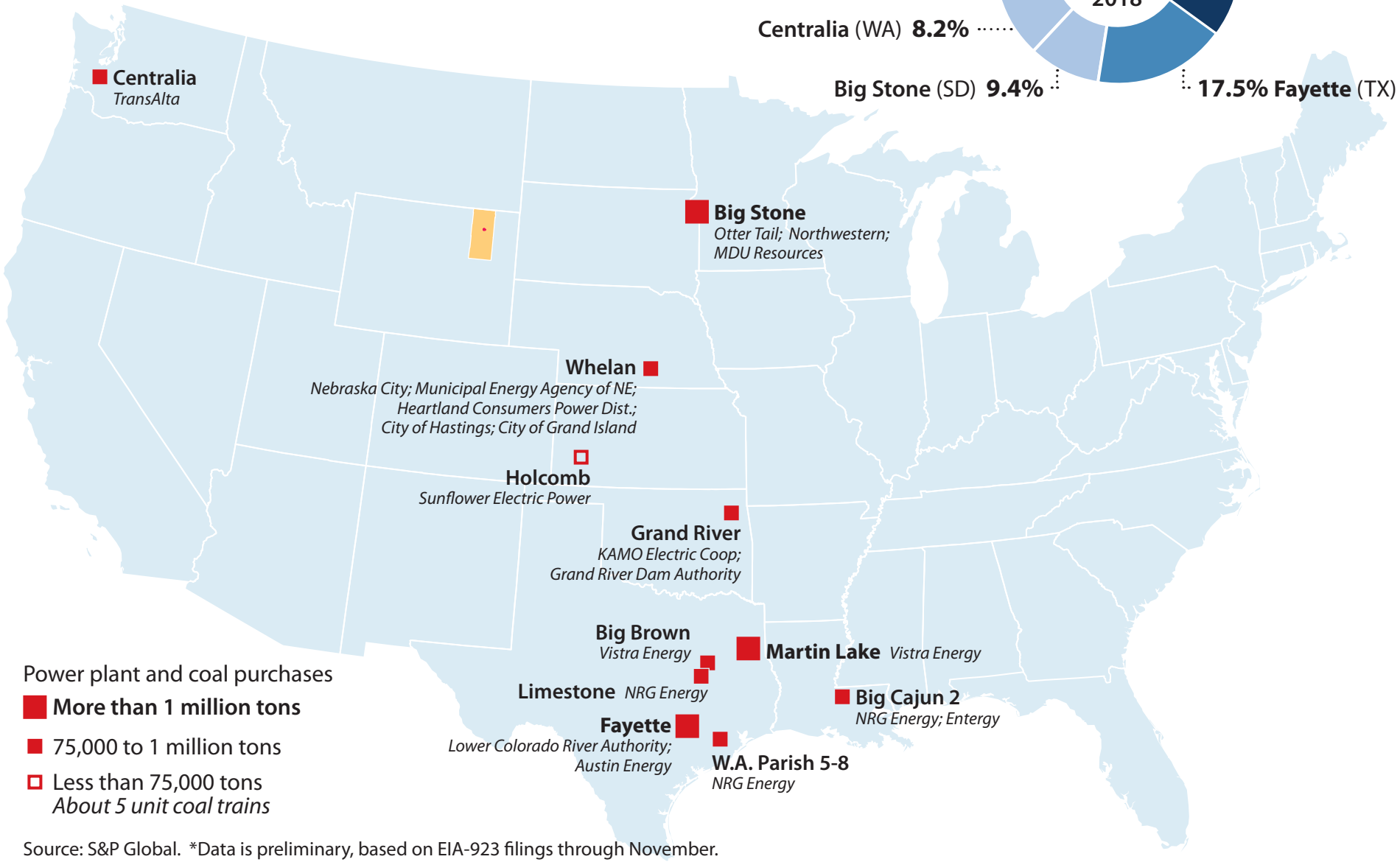
Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Rawhide Mine

Peabody Energy

11 Power Plants Served, 2018*



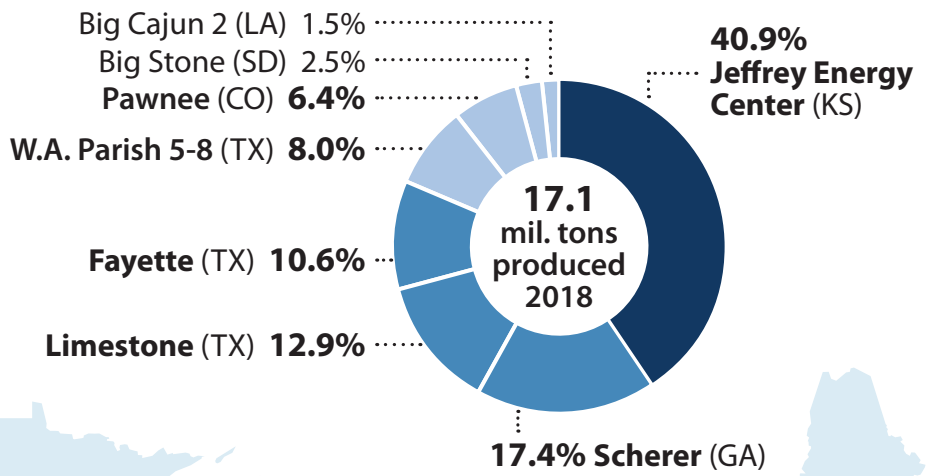


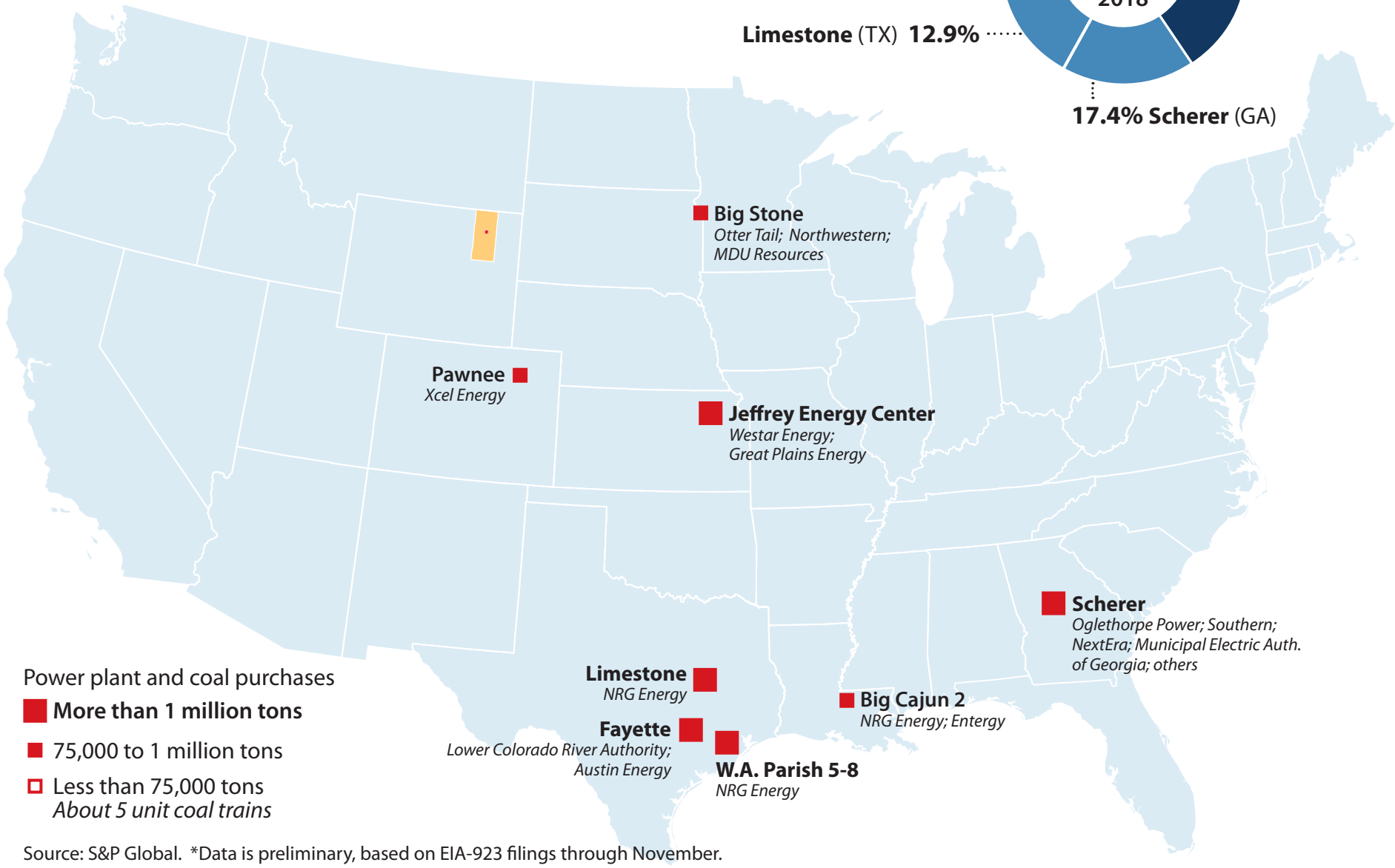
Power plant and coal purchases

- **More than 1 million tons**
- 75,000 to 1 million tons
- Less than 75,000 tons
  About 5 unit coal trains

Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Eagle Butte
Blackjewel
8 Power Plants Served, 2018*





Power plant and coal purchases

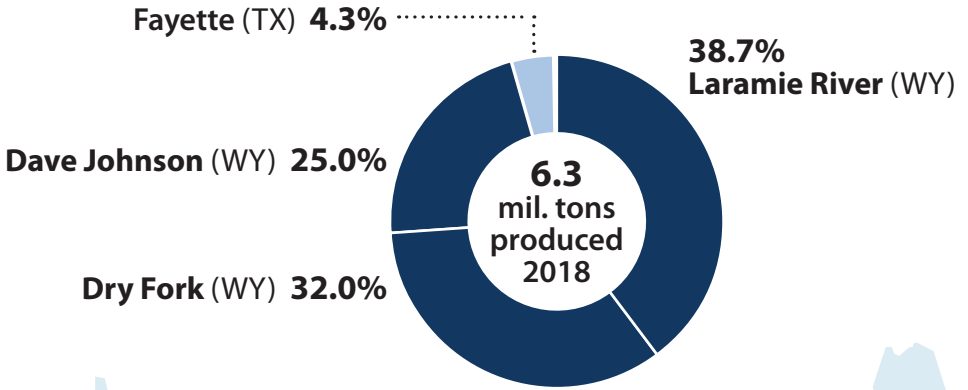
- **More than 1 million tons**
- 75,000 to 1 million tons
- Less than 75,000 tons
  About 5 unit coal trains

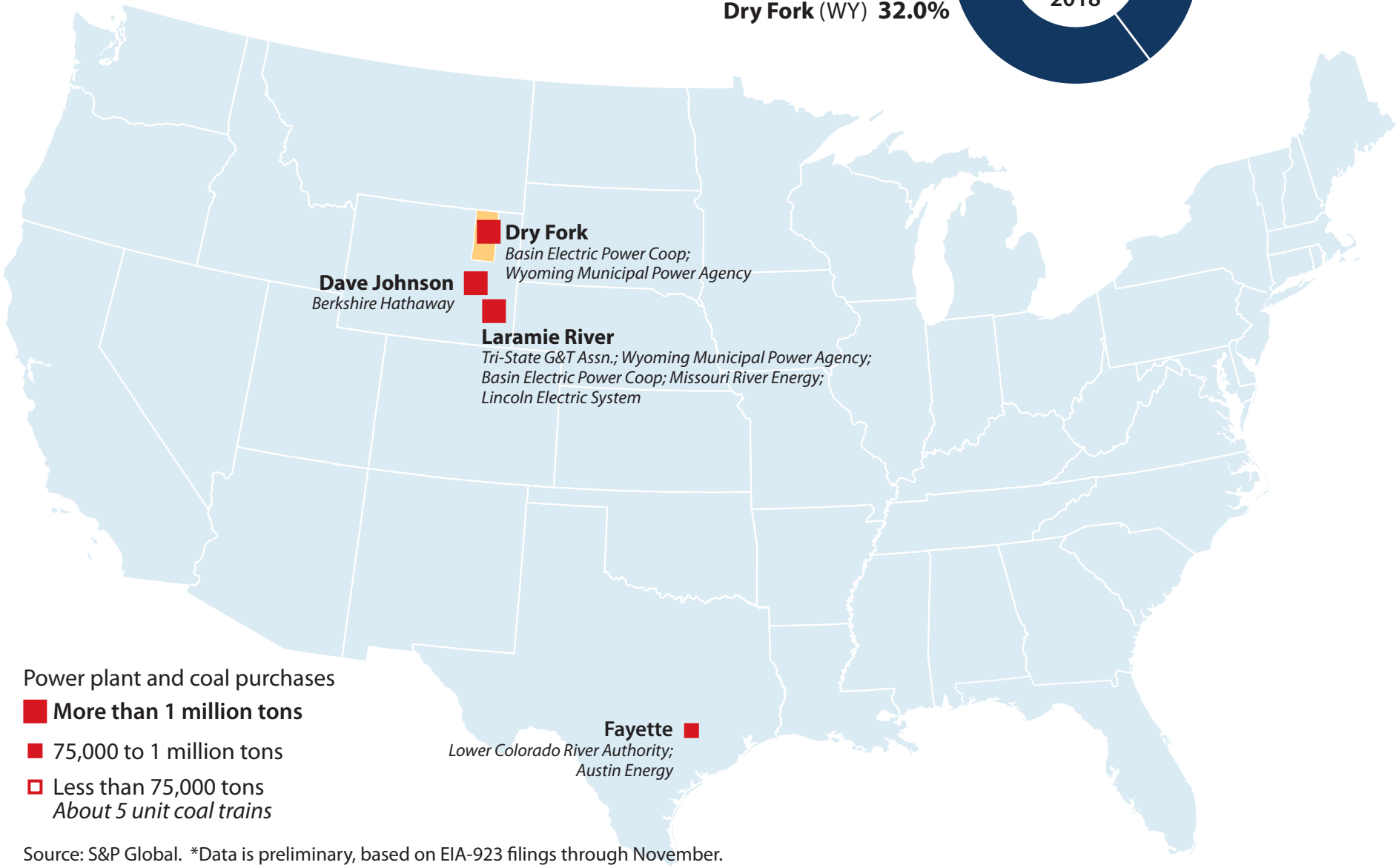
Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Dry Fork

Western Fuels Association

4 Power Plants Served, 2018*



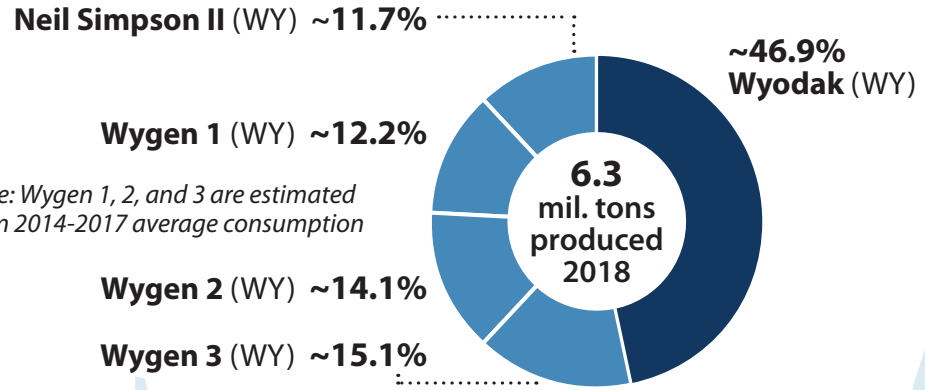


Power plant and coal purchases

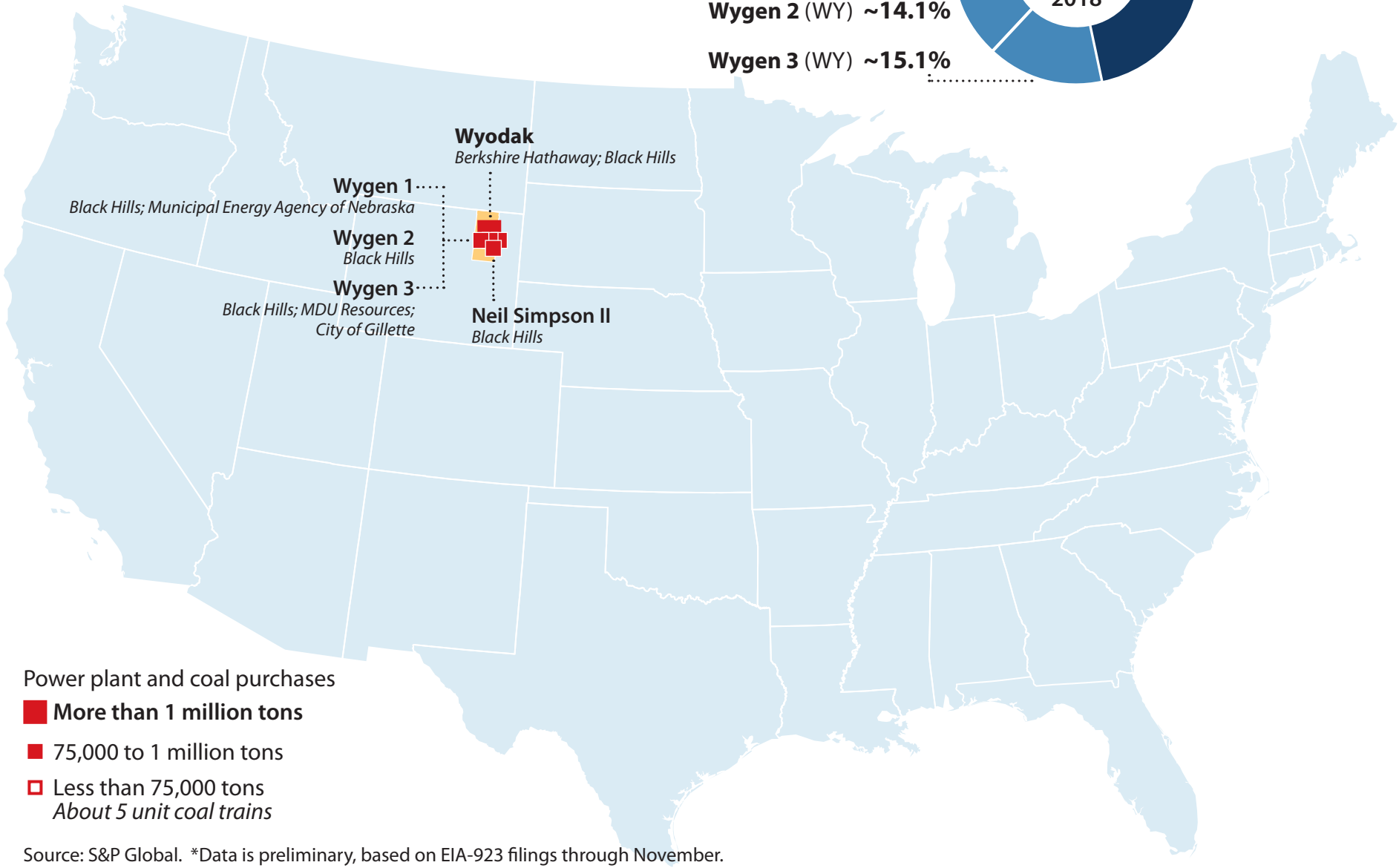
- **More than 1 million tons**
- 75,000 to 1 million tons
- Less than 75,000 tons
  About 5 unit coal trains

Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Wyodak
Black Hills
5 Power Plants Served, 2018*



Note: Wygen 1, 2, and 3 are estimated from 2014-2017 average consumption



Power plant and coal purchases

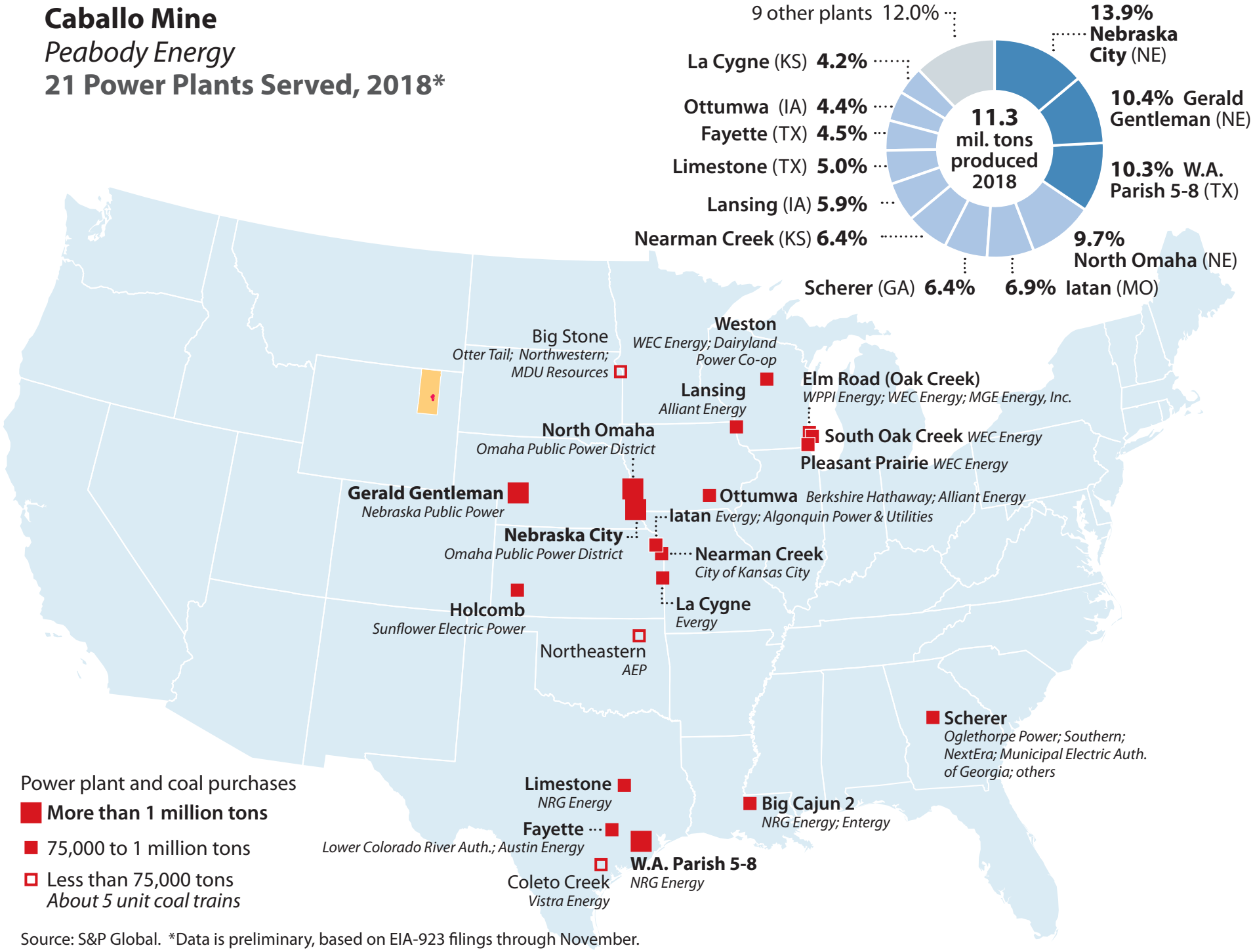
- **More than 1 million tons**
- 75,000 to 1 million tons
- Less than 75,000 tons
  About 5 unit coal trains

Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Caballo Mine

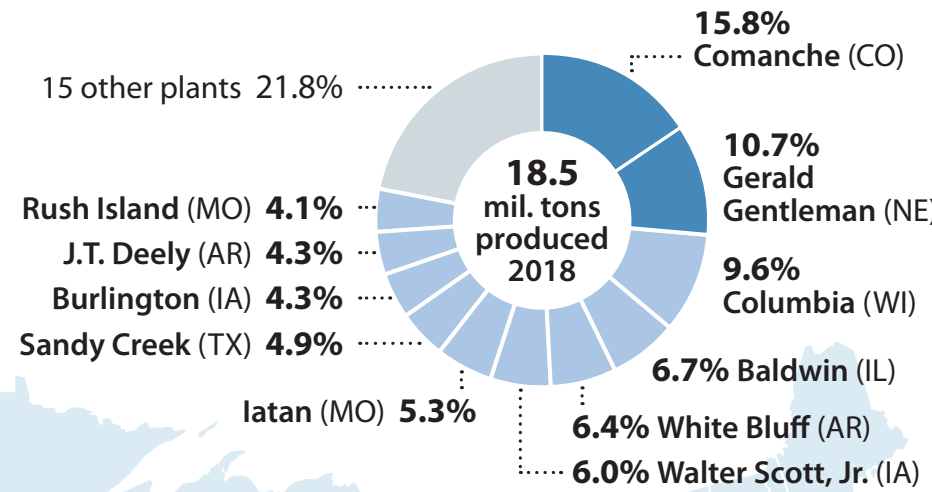
Peabody Energy

21 Power Plants Served, 2018*



Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Belle Ayr
Blackjewel
26 Power Plants Served, 2018*



Boardman
Portland General Electric; IDACORP

George Neal N.
Berkshire Hathaway; Alliant Energy

George Neal S.
Berkshire Hathaway; Alliant Energy; 13 others

Walter Scott, Jr.
Berkshire Hathaway; 14 municipals

Louisa
Berkshire Hathaway; 7 others

Columbia
Alliant Energy; WEC Energy; MGE Energy

Gerald Gentleman
Nebraska Public Power

Sheldon
Nebraska Public Power

Hennepin *Vistra Energy*

Burlington *Alliant Energy*

Havana 6 *Vistra Energy*

C.P. Crane
Avenue Capital

Montrose
Evergy

Newton *Vistra Energy*

Comanche
Xcel Energy; Intermountain Rural Electric

Iatan
Evergy; Algonquin Power & Utilities

La Cygne
Evergy

Baldwin *Vistra Energy*

Joppa Steam
Vistra Energy; PPL

Rush Island
Ameren

White Bluff *Entergy; City of West Memphis; Arkansas Electric Cooperative; City of Jonesboro, Ark.; Conway Corp.*

Sandy Creek
Lower Colorado River Authority; Brazos Electric Power Coop; LS Power

Brame (Rodemacher 2)
Cleco Partners; Louisiana Energy & Power Authority; Lafayette Public Power Authority

J.K. Spruce
CPS Energy

J.T. Deely
CPS Energy

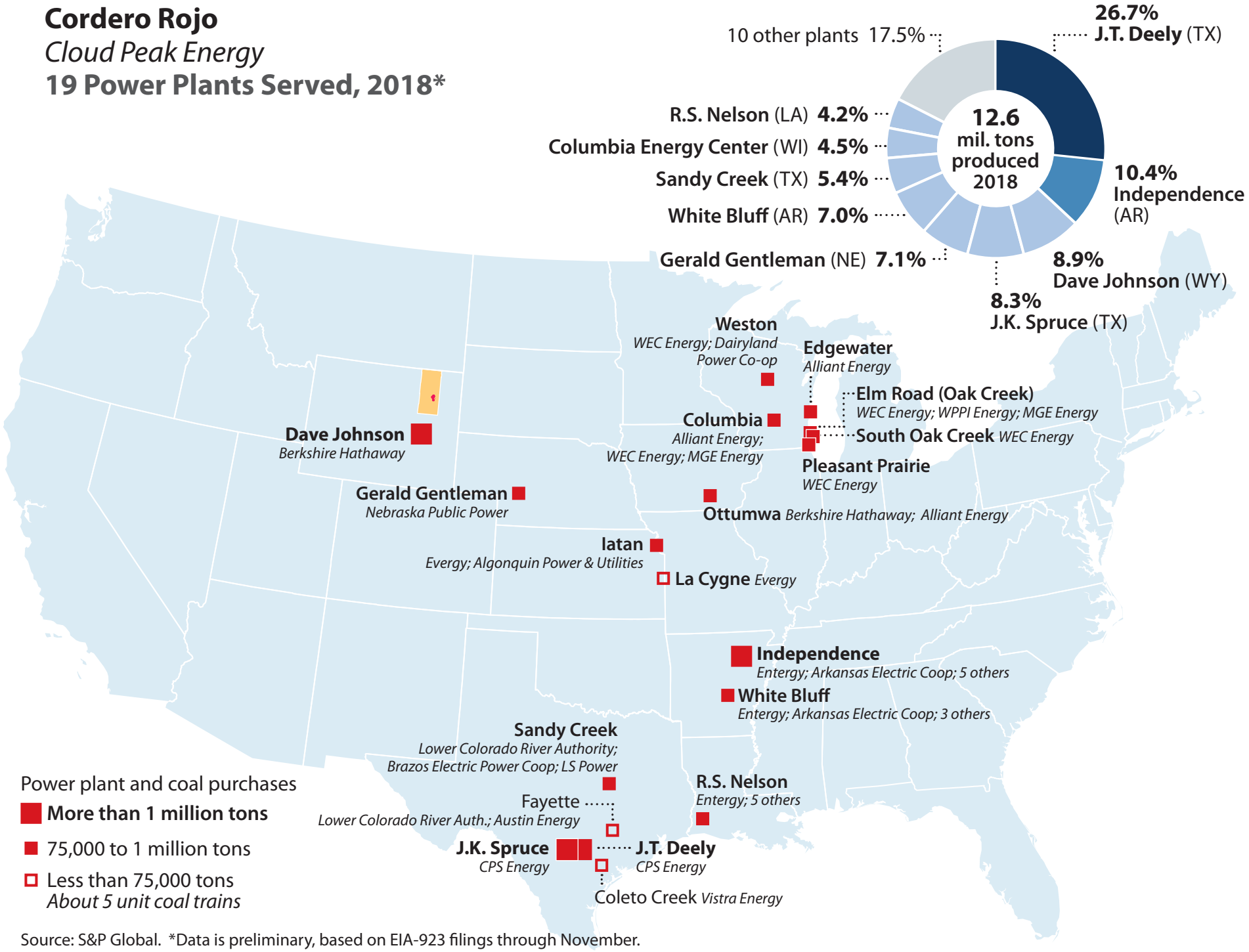
R.S. Nelson
Entergy; 5 others

Power plant and coal purchases

- **More than 1 million tons**
- 75,000 to 1 million tons
- Less than 75,000 tons
  About 5 unit coal trains

Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Cordero Rojo
Cloud Peak Energy
19 Power Plants Served, 2018*

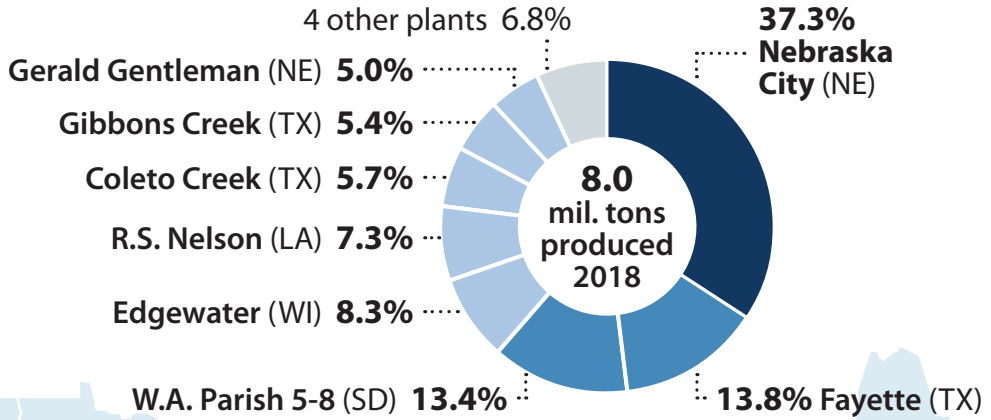


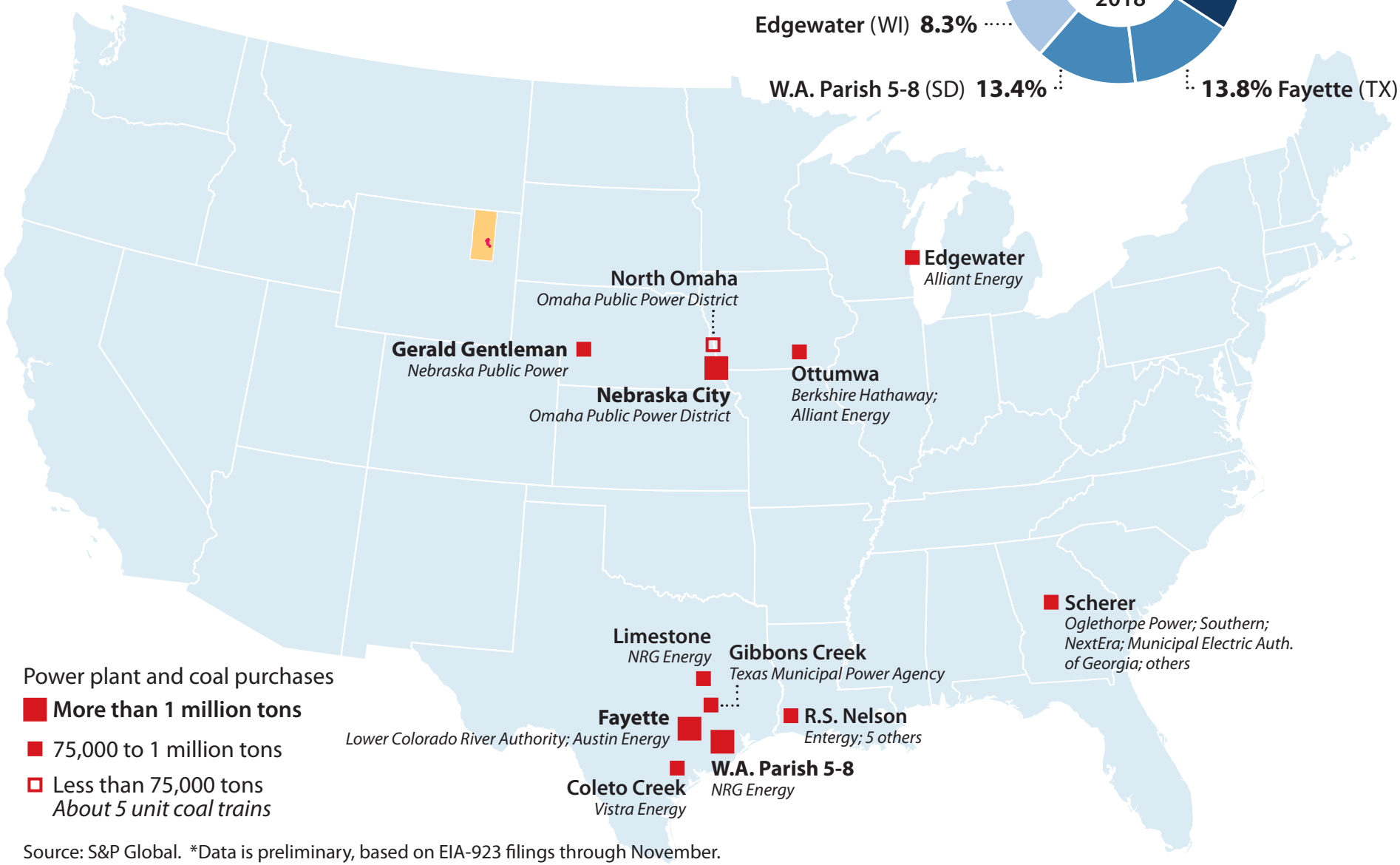
Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Coal Creek

Arch Coal

12 Power Plants Served, 2018*



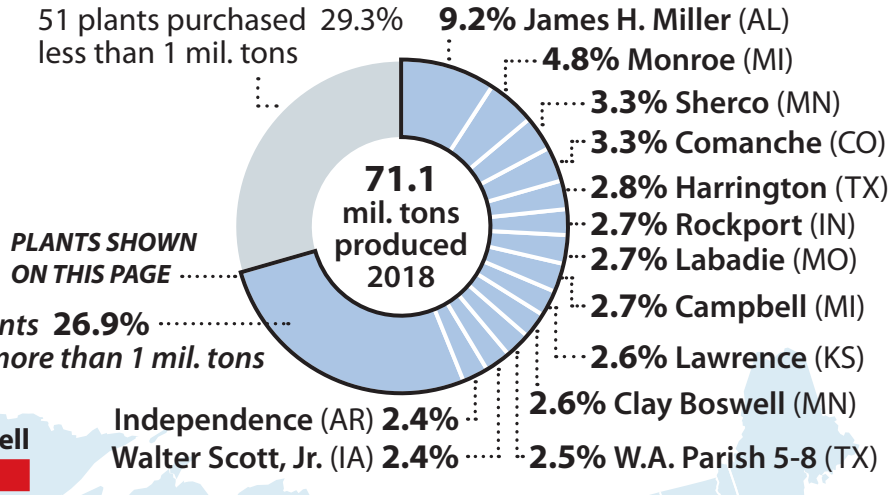


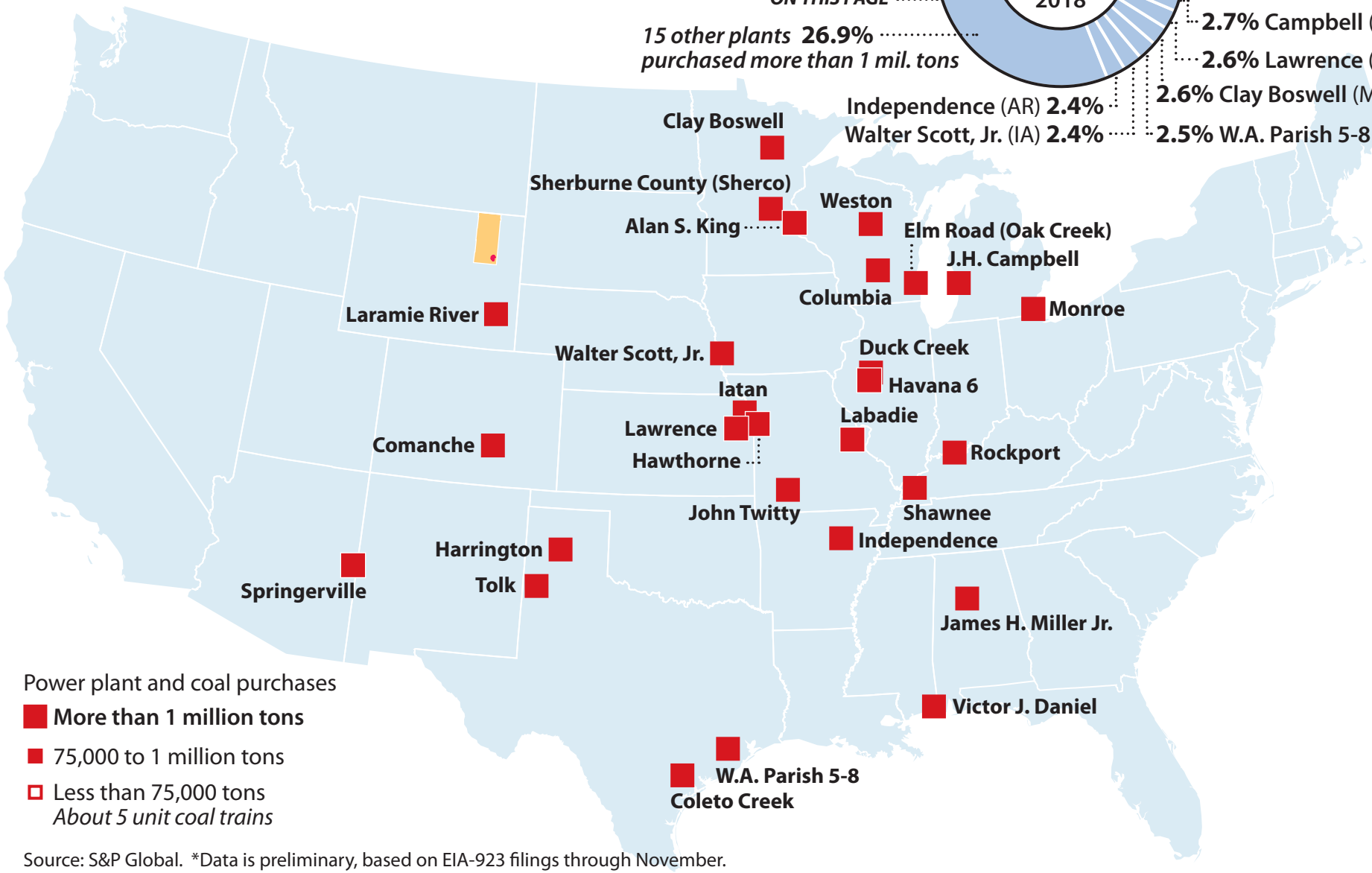
Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Black Thunder

Arch Coal

28 Plants Purchased 1 Million or More Tons*
(79 Power Plants Served Total, 2018*)





Power plant and coal purchases

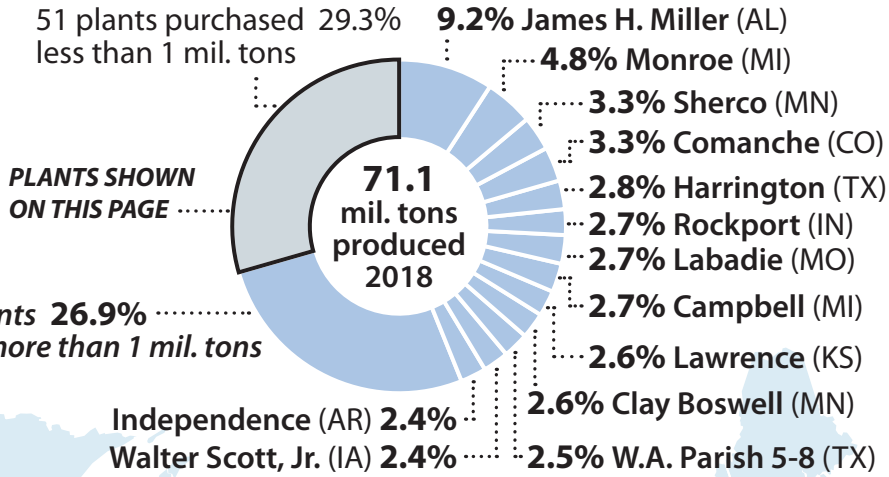
- **More than 1 million tons**
- 75,000 to 1 million tons
- Less than 75,000 tons
  About 5 unit coal trains

Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Black Thunder

Arch Coal

51 Plants Purchased Less than 1 Million Tons*
(79 Power Plants Served Total, 2018*)



Boardman
TS Power
R.D. Nixon
Coronado
Apache Station
Edgewater
Pleasant Prairie
South Oak Creek
J.P. Madgett
Genoa
Dan E. Karn
Eckert
River Rouge
Trenton Channel
George Neal N.
George Neal S.
Hennepin
Louisa
Michigan City
R.M. Schahfer
North Omaha
Nebraska City
Ottumwa
E.D. Edwards
C.P. Crane
Decatur
Lake Road
Sioux
Newton
Sibley
Meramec
Trimble County
La Cygne
Rush I.
Joppa Steam
Asbury
Montrose
Sikeston
Kingston
Northeastern
Shady Point
White Bluff
Limestone
Brame
Barry
Sandy Creek
Big Cajun 2
Fayette
R.S. Nelson
J.K. Spruce
J.T. Deely

Power plant and coal purchases

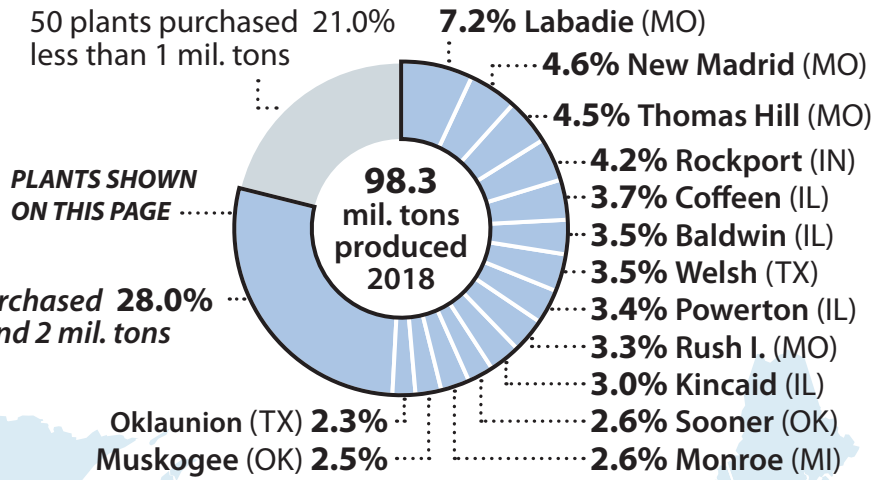
- **More than 1 million tons**
- 75,000 to 1 million tons
- Less than 75,000 tons
  About 5 unit coal trains

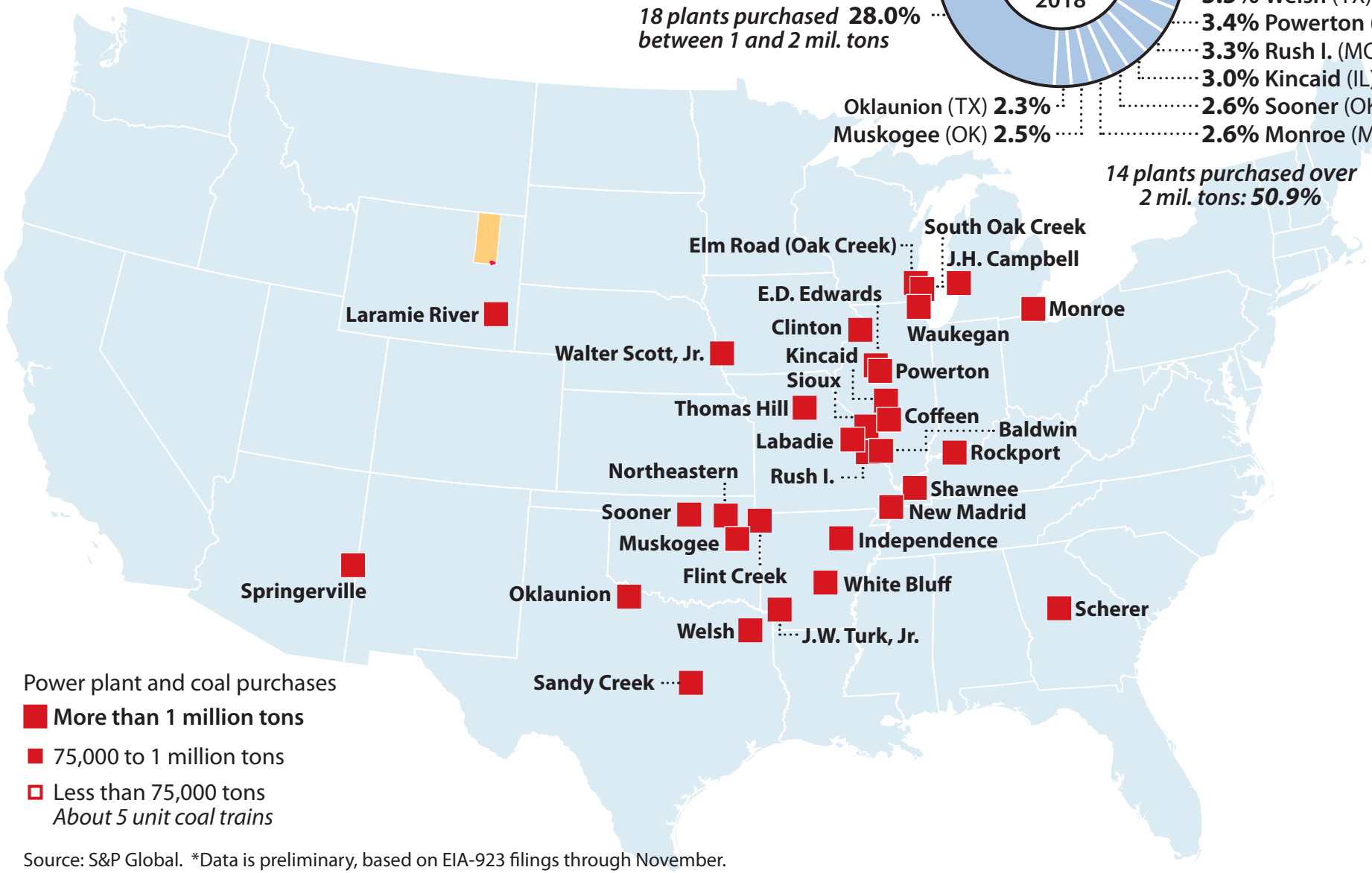
Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

North Antelope Rochelle-School Creek

Peabody Energy

32 Plants Purchased 1 Million or More Tons*
(82 Power Plants Served Total, 2018*)





Power plant and coal purchases

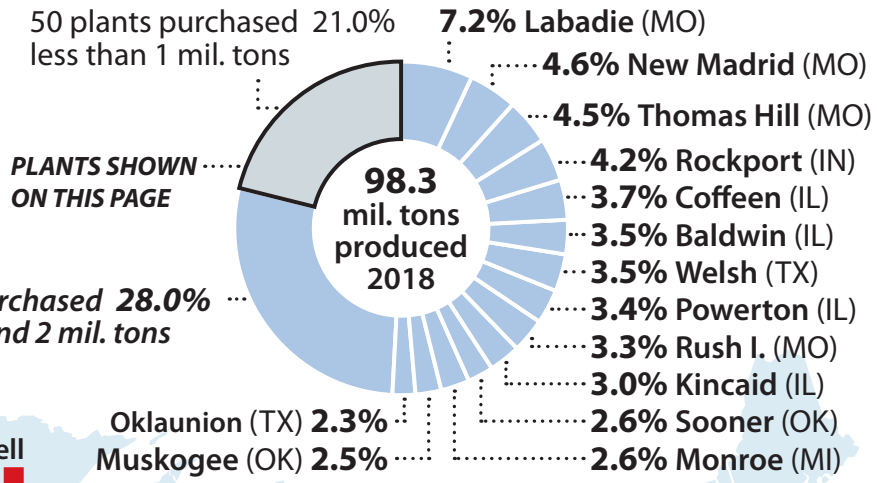
- **More than 1 million tons**
- 75,000 to 1 million tons
- Less than 75,000 tons
  About 5 unit coal trains

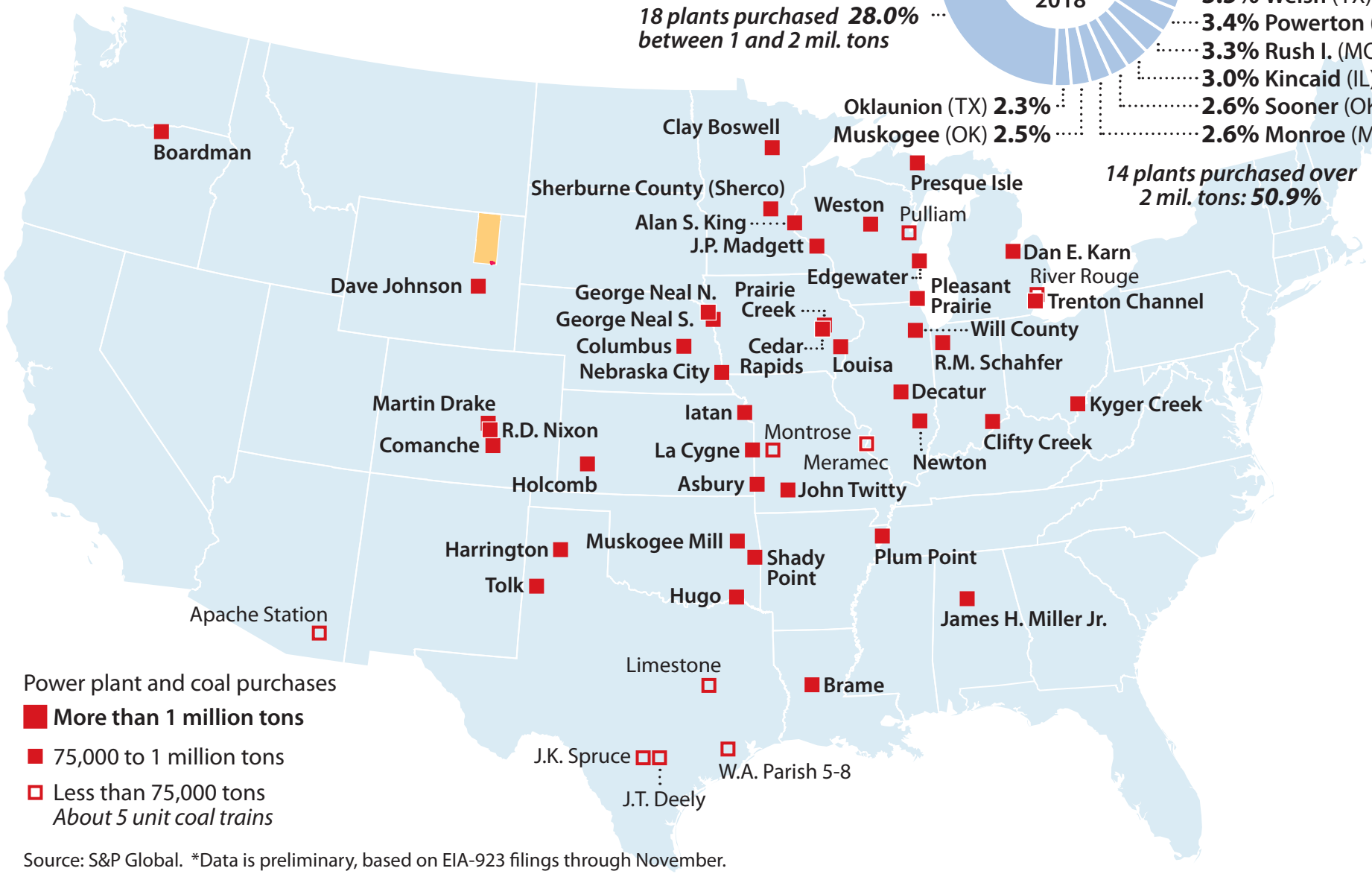
Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

North Antelope Rochelle-School Creek

Peabody Energy

50 Plants Purchased Less Than 1 Million Tons*
(82 Power Plants Served Total, 2018*)





Power plant and coal purchases

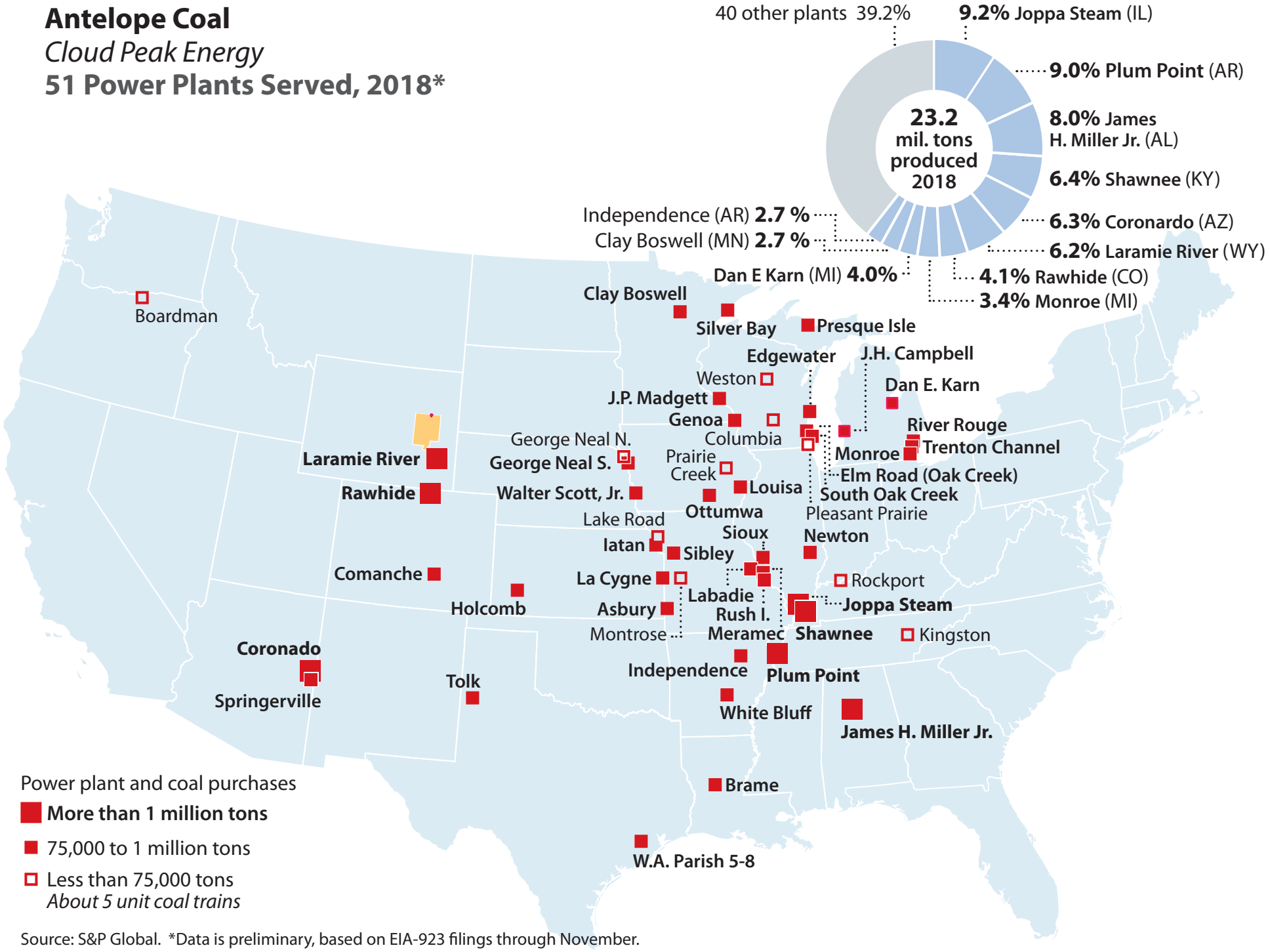
- **More than 1 million tons**
- 75,000 to 1 million tons
- Less than 75,000 tons
  About 5 unit coal trains

Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

Antelope Coal

Cloud Peak Energy

51 Power Plants Served, 2018*



Power plant and coal purchases

- **More than 1 million tons**
- 75,000 to 1 million tons
- Less than 75,000 tons
  About 5 unit coal trains

Source: S&P Global. *Data is preliminary, based on EIA-923 filings through November.

About IEEFA

The Institute for Energy Economics and Financial Analysis conducts research and analyses on financial and economic issues related to energy and the environment. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

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