

Record Drop in U.S. Coal-Fired Capacity Likely in 2018

Utilities Are Accelerating Shutdown Dates as Plants Grow Increasingly Uneconomic

Executive Summary

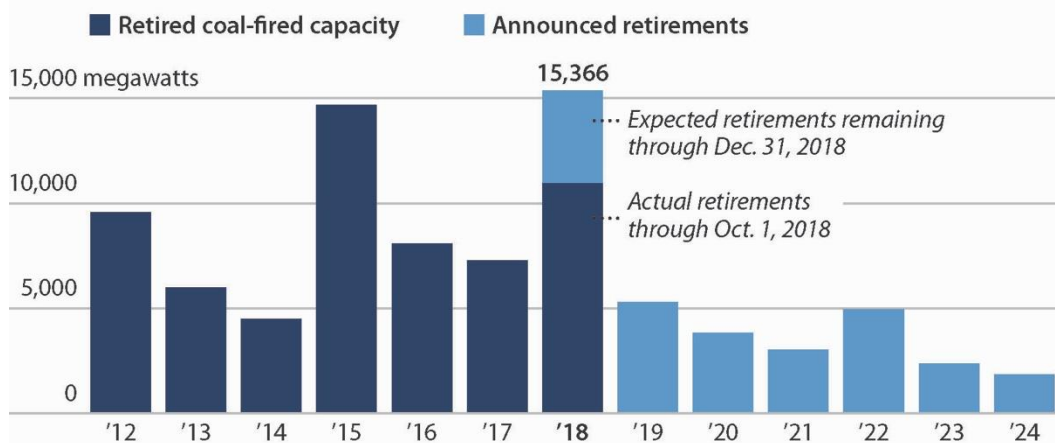
This year will most likely see a record set for coal-fired power capacity retirements in the U.S.

IEEFA expects a total of 15.4 gigawatts (GW) of capacity to close in 2018 through the retirement of 44 units at 22 plants in more than a dozen states.

At least 11GW have already been closed this year, and the retirement trend is on pace to easily exceed the record 14.7GW of coal-fired generation capacity closed in 2015.

Coal-Fired Electric Generation Retirements

2018 is likely to tally a record level of coal-fired capacity retirements, two-thirds of which were only announced in 2017, and new announcements keep adding to the list of closures expected over the next six years.



Sources: EIA; S&P Global; IEEFA research (2017-2024)

At the same time, the pace of announcements of future retirements remains brisk.

As of Oct. 24, according to IEEFA's analysis, an additional 21.4GW of U.S. coal-fired capacity is now set close over the next six years (see the detailed tables at the end of this report).

IEEFA expects this total to rise significantly. Fully two-thirds of 2018's retirements were only announced in 2017, a clear indication that utilities have shortened their

lead time before closures, and the competitive environment for coal-fired power in the generation marketplace is becoming ever more challenging as the price of renewables continues to fall and as natural gas prices are expected to remain low for the foreseeable future.

This research brief concludes further that:

- At least 36.7GW of coal-fired capacity stand to be retired from 2018 through 2024 — 117 units in total. These are closures that have already been announced; more are known to be under review.
- Coal-plant economies in the Ohio River Valley will be among those especially hard-hit by the transition occurring now across the U.S. electricity-generation sector. Companies in the region whose employees stand to be affected include FirstEnergy Solutions, Murray Energy and Westmoreland Coal, although those companies and that region are by no means the only ones confronting fundamental change.
- While the U.S. coal-fired power fleet still had about 246GW of capacity operating in July of this year, retirements already announced will cut that capacity by 15 percent through 2024.
- Cost is the biggest force in the decline of coal, as renewables and gas-fired generation are proving cheaper and more flexible.
- The electric-generating industry is well into a fundamental transition that is gaining momentum and will probably accelerate as technology disruptions occur, most notably around advances in energy storage.
- While the country's coal infrastructure is aging and inflexible, renewable-generated electricity, by comparison, continues to become increasingly cheaper to produce and gas-fired generation is proving more suitable to grid modernization as utilities embrace integrated distributed resources and system modernization.
- The future of coal-fired generation assets in the U.S. is limited, with no new plants being built and a majority of existing plants 40 years old or older.

The utility industry is embracing fundamental transition across the electricity-generation sector.

States with imminent sizeable coal-plant closures include Florida, Indiana, Minnesota, Missouri, Kansas, Kentucky, Maryland, Ohio, Pennsylvania, Tennessee, Texas, Virginia, West Virginia and Wisconsin.

Four Big Ohio River Valley Closures

Among the most recent closures to be announced are four big plants in the eastern Ohio-western Pennsylvania-West Virginia area,— a region that has already had a number of retirements in recent years.

The bankruptcy of FirstEnergy Solutions resulted in two coal-fired closure announcements in late August: Bruce Mansfield Power Plant (2,510MW) in Beaver County, Pennsylvania and W.H. Sammis Power Plant (2,210MW) in Jefferson County, Ohio. A third FirstEnergy plant in the region, Pleasants Power Station (1,300MW) in Pleasants County, West Virginia was also placed on the company's imminent-shutdown list in August but has since been given a reprieve until 2022.

In early October, American Electric Power announced it would begin shutdown of the Conesville Power Plant (1,530MW), in Coshocton County, Ohio, starting early next year.

All of the closures are occurring far sooner than expected.

The first shutdowns are expected to begin in just a few months, and all 15 units across the four plants—7,538 megawatts of capacity—are now slated to be retired within the next four years:

<u>CLOSURE DATE</u>	<u>PLANT</u>	<u>UNIT</u>	<u>CAPACITY, MW</u>	<u>LOCATION</u>	<u>YEAR</u>
May 2019	Conesville	5	375	Coshocton Co., Ohio	1976
	Conesville	6	375		1978
May 2020	Conesville	7	780	Coshocton Co., Ohio	1973
	W.H. Sammis	1	180	Jefferson Co., Ohio	1959
	W.H. Sammis	2	180		1960
	W.H. Sammis	3	180		1961
	W.H. Sammis	4	180		1962
June 2021	Bruce Mansfield	1	830	Beaver Co., Pa.	1976
	Bruce Mansfield	2	830		1977
	Bruce Mansfield	3	850		1980
June 2022	Pleasants	1	644	Pleasants Co., W.V.	1979
	Pleasants	2	644		1980
	W.H. Sammis	1	290	Jefferson Co., Ohio	1967
	W.H. Sammis	2	600		1969
	W.H. Sammis	3	600		1971

These closures will reverberate through the regional economy for years as hundreds of plant workers and miners from many different communities cope with these changes.

Impacts on some of the mining companies in question are already evident. Westmoreland Coal, which sold nearly one million tons of coal to the Conesville plant from January to July of this year from two of its Ohio mines declared bankruptcy on Oct. 9. Westmoreland executives say the bankruptcy filing will not translate into layoffs or production cuts, but the long-term consequences of a constantly shrinking customer base is likely to affect the company's restructuring.

Murray Energy, which has a 6.5-million-ton annual delivery contract with FirstEnergy Solutions, is also likely to face increasing challenges. The company was the primary supplier of coal to both the Bruce Mansfield and W.H. Sammis plants in 2018, according to S&P Global. At one time, Murray warned it could go into bankruptcy if the two plants were shut down and made prominent appeals to the federal government to prevent that from happening; now the company says it will weather the challenges by refinancing debt and finding new customers.

U.S. Coal-Fired Capacity Remains Relatively Large, But Looks Increasingly Vulnerable

The U.S. coal-fired power fleet remains relatively large: about 246GW of capacity was still operating in July 2018, according to the Energy Information Administration (EIA).¹ The expected retirements from 2018 through 2024, a total of 36.7GW, amount to about 15 percent of the current total.

Yet the use of coal for power generation looks increasingly vulnerable.

The EIA now expects natural gas to be the fuel for 35 percent of electricity generation in 2018 and 2019, up from 28 percent five years ago.² The contribution from non-hydro renewables, mostly wind and solar, is also expected to rise, to 10 percent in 2018 and nearly 11 percent in 2019. Coal's share of the electricity-generation market, on the other hand, is expected to fall to 27 percent in 2019—from 39 percent as recently as 2014.

Coal's share of power generation will fall to 27 percent next year, down from 39 percent in 2014.

These trends appear set to continue. The construction pipeline for renewables remains strong, and costs continue to decline; high domestic production of gas from fracking is expected to keep gas prices low and steady for the foreseeable future.

Plant age is also becoming a significant factor for the U.S. coal industry. Most of the country's coal-generation capacity was built in the 1960s, 70s, and 80s, and many of those units are approaching the end of their normal operating life. Data from S&P Global shows that in 2017, fully two-thirds of coal deliveries went to power plants

¹ Energy Information Administration, Electric Power Monthly, September 2018, Table 6.1.

² EIA, Short-Term Energy Outlook, Oct. 10, 2018.

that were at least 38 years old; close to 15 percent went to plants that were at least 55 years old.³

In contrast, much of the natural-gas generating capacity in the U.S. has been built since 2000, and most wind and solar facilities are less than a decade old.⁴ Significant amounts of new gas, wind and solar capacity become operational every year, whereas little new coal-fired capacity has come online in the past five years, and little—or none—is likely to be built going forward.

Coal has serious competitive disadvantages to renewables and natural gas, and in areas of the country where both are abundant, even younger coal-fired plants are being closed. Sandow Power Plant No. 5, a 600-MW unit in Texas that started operating in 2010, was retired this past January just months after its closure was announced.

Cost is the biggest force in the decline of coal. Texas has one of the most openly competitive power markets in the country and has the most installed wind generation capacity of any state, 22GW and climbing. That wind power, with zero operational fuel costs, gets priority on the Electric Reliability Council of Texas (ERCOT) grid system because of its low cost, and during peak wind season this year in March and April the state's turbines generated more than a quarter of ERCOT's power.⁵ Higher-cost generation resources—like coal—were pushed out of the market.

Wind generation, with no fuel cost, and natural-gas-fired plants, which can respond quickly to demand, are pushing coal aside.

Natural gas generation has its own distinct advantage over coal: gas plants can usually respond quickly to changes in demand, ramping up or down across the day, making them a good fit with wind and solar in meeting the daily demand cycle while still being competitive on cost.

Coal plants, in contrast, fare best when run continuously. Operating and maintenance costs rise when they are cycled, that is, run at varying generation levels throughout the day, or run seasonally, sometimes being shut down for extended periods of time. Yet coal-plant cycling happens frequently now across the nation's midsection, where new wind capacity is being installed at the same time that new shale gas reserves are being tapped, pushing coal-fired plant operators to cycle to participate in the market.⁶

³ S&P Global, Coal's 'Aging-Out' Problem, Jan. 30, 2018 (coal deliveries from Nov. 1, 2016 to Oct. 31, 2017).

⁴ EIA, "Most coal plants in the United States were built before 1990," Today In Energy, April 17, 2017.

⁵ Electric Reliability Council of Texas, September 2018 Demand and Energy report, Oct. 8, 2018

⁶ EIA, "Like natural gas, coal in the Southwest Power Pool is cycled to accommodate wind power," Today in Energy, Sept. 26, 2018.

Together, these trends indicate the electric-generating industry is well into a fundamental transition. Coal infrastructure is aging and inflexible; renewables continue to get cheaper to produce; utilities are embracing the integration of distributed resources as they modernize their systems; and natural gas provides response flexibility and significantly lower emissions than coal.

All of these trends are gaining momentum even as newer technology disruptions like energy storage are only beginning to emerge.

In short, the future of coal-fired generation assets is limited, a conclusion borne out by the closure of 117 coal-fired units with 36.7GW of capacity through 2024 that have already been announced. These units are detailed in the tables that follow.

IEEFA expects this list to grow as the energy transition accelerates.

Coal-Fired Retirements, 2018-2024

The following tables include coal-fired units in the U.S. with announced closure dates through 2024.

This data is drawn from retirements and cold closures reported by the Energy Information Administration; corporate announcements and company integrated resource plans; grid operator documents; and news reports. Planned closures have occasionally been delayed or reversed by companies or grid operators for a variety of reasons; changes in state or federal policy could also influence how closures play out.

Not included: “Zombie plants,” or units that remain in operational status even if they have been run infrequently or not at all in recent years (“Zombie plants”); and units that are known to be currently under corporate review for retirement but for which no announcement has been made.

Table 1: 2018 Coal units already closed (10.9 gigawatts capacity)

CLOSURE DATE, 2018	OWNER(S)	PLANT	UNIT	SUMMER CAPACITY MW	COUNTY	STATE	OPERATING YEAR
January	JEA; Next Era Energy	St Johns River	1	626	Duval	Florida	1987
		St Johns River	2	626	Duval	Florida	1988
	Vistra Energy	Monticello	1	535	Titus	Texas	1974
		Monticello	2	535	Titus	Texas	1975
		Monticello	3	795	Titus	Texas	1978
Vistra Energy	Sandow	4	600	Milam	Texas	1981	
	Sandow (Unit 5)	5	600	Milam	Texas	2010	
February	Vistra Energy	Big Brown	1	606	Freestone	Texas	1971
		Big Brown	2	602	Freestone	Texas	1972
March	Tennessee Valley Authority	Thomas H Allen	1	247	Shelby	Tennessee	1959
		Thomas H Allen	2	247	Shelby	Tennessee	1959
		Thomas H Allen	3	247	Shelby	Tennessee	1959
April	WEC Energy	Pleasant Prairie	1	594	Kenosha	Wisconsin	1980
		Pleasant Prairie	2	594	Kenosha	Wisconsin	1985
May	Vistra Energy; AES; AEP	J.M. Stuart	2	577	Adams	Ohio	1970
		J.M. Stuart	3	577	Adams	Ohio	1972
		J.M. Stuart	4	577	Adams	Ohio	1974
	AES; Vistra Energy	Killen Station	2	600	Adams	Ohio	1982
June	Avenue Capital Group	C.P. Crane	1	190	Baltimore	Maryland	1961
		C.P. Crane	2	195	Baltimore	Maryland	1963
	NiSource	Bailly	7	160	Porter	Indiana	1962
		Bailly	8	320	Porter	Indiana	1968
September	Alliant Energy	Edgewater	4	294	Sheboygan	Wisconsin	1969
Units: 23 10,944 megawatts							

Sources: Energy Information Administration; S&P Global; PJM; news reports; IEEFA analysis

Table 2: 2018 Coal units remaining to be closed (4.4 gigawatts capacity)

ANTICIPATED CLOSURE DATE, 2018	OWNER(S)	PLANT	UNIT	SUMMER CAPACITY MW	COUNTY	STATE	OPERATING YEAR
October	WEC Energy	Pulliam	7	76	Brown	Wisconsin	1958
		Pulliam	8	134	Brown	Wisconsin	1964
November	Vistra Energy	Northeastern Power Cogen Facility	1	52	Schuylkill	Pennsylvania	1989
December	ALLETE*	Clay Boswell	1	67	Itasca	Minnesota	1958
		Clay Boswell	2	67	Itasca	Minnesota	1960
	CPS Energy	J.T. Deely	1	420	Bexar	Texas	1977
		J.T. Deely	2	420	Bexar	Texas	1978
	Duke Energy	Crystal River	1	324	Citrus	Florida	1966
		Crystal River	2	442	Citrus	Florida	1969
	Evergny	Sibley	1	42	Jackson	Missouri	1960
		Sibley	2	42	Jackson	Missouri	1962
		Sibley	3	364	Jackson	Missouri	1969
	Evergny	Montrose	2	164	Henry	Missouri	1960
		Montrose	3	170	Henry	Missouri	1964
	Dominion Energy	Chesterfield	3	98	Chesterfield	Virginia	1952
		Chesterfield	4	163	Chesterfield	Virginia	1960
	Dominion Energy	Yorktown**	1	159	York	Virginia	1957
Yorktown**		2	164	York	Virginia	1958	
OGE Energy	Muskogee***	4	487	Muskogee	Oklahoma	1977	
	Muskogee***	5	50	Muskogee	Oklahoma	1978	
Evergny	Tecumseh	7	65	Shawnee	Kansas	1957	
				Units: 21	4,422 megawatts		

* An earlier version of this table included owners of any part of the plants listed; it now reflects only unit ownership, and WPPI Energy, which only owns a portion of Clay Boswell unit 4, has been removed.

** In 2017, grid operator PJM ordered these units to remain on standby for limited use until transmission upgrade work was finished. The deactivation date has now been extended to Dec. 8, 2018, and may be extended again.

*** Units being converted from coal to natural gas

Sources: Energy Information Administration; S&P Global; PJM; news reports; IEEFA analysis

Table 3: 2019 Coal units scheduled to be closed (5.3 gigawatts capacity)

ANTICIPATED CLOSURE DATE, 2019	OWNER(S)	PLANT	UNIT	SUMMER CAPACITY MW	COUNTY	STATE	OPERATING YEAR
January	Texas Municipal Power Agency	Gibbons Creek	1	470	Grimes	Texas	1983
	Ares Owners Holdings	Spruance	1	53	Richmond	Virginia	1992
		Spruance	2	53	Richmond	Virginia	1992
		Spruance	3	43	Richmond	Virginia	1992
		Spruance	4	43	Richmond	Virginia	1992
February	Kentucky Utilities	E.W. Brown	1	106	Mercer	Kentucky	1957
		E.W. Brown	2	166	Mercer	Kentucky	1963
March	Honeywell International	James River	1	46	Hopewell	Virginia	1988
		James River	2	46	Hopewell	Virginia	1988
April	JEMB Family; WE Power; Ares Owners Holdings; Rockland Capital Energy	B.L. England	2	150	Cape May	New Jersey	1964
May	AEP	Conesville	5	375	Coshocton	Ohio	1976
		Conesville	6	375	Coshocton	Ohio	1978
June	WEC Energy	Presque Isle	5	55	Marquette	Michigan	1974
		Presque Isle	6	55	Marquette	Michigan	1975
		Presque Isle	7	83	Marquette	Michigan	1978
		Presque Isle	8	83	Marquette	Michigan	1978
		Presque Isle	9	83	Marquette	Michigan	1979
	City of Owensboro	Elmer Smith	1	137	Daviess	Kentucky	1964
November	Duke Energy	Asheville	1	189	Buncombe	North Carolina	1964
		Asheville	2	189	Buncombe	North Carolina	1971
December	Salt River Project; U.S. Govt.; Pinnacle West Capital; Berkshire Hathaway; others	Navajo	1	750	Coconino	Arizona	1974
		Navajo	2	750	Coconino	Arizona	1975
		Navajo	3	750	Coconino	Arizona	1976
	IDACORP; Berkshire Hathaway	North Valmy	1	254	Humboldt	Nevada	1985
				24	5,303 megawatts		

Sources: Energy Information Administration; S&P Global; PJM; news reports; IEEFA analysis

Table 4: 2020 Coal units scheduled to be closed (3.8 gigawatts capacity)

ANTICIPATED CLOSURE DATE, 2020	OWNER(S)	PLANT	UNIT	SUMMER CAPACITY MW	COUNTY	STATE	OPERATING YEAR
May	AEP	Conesville	4	780	Coshocton	Ohio	1973
	FirstEnergy Solutions	W.H. Sammis	1	180	Jefferson	Ohio	1959
		W.H. Sammis	2	180	Jefferson	Ohio	1960
		W.H. Sammis	3	180	Jefferson	Ohio	1961
		W.H. Sammis	4	180	Jefferson	Ohio	1962
June	Riverstone Holdings	Herbert A Wagner	2	118	Anne Arundel	Maryland	1959
September	AEP; Brownsville Public Utilities; Oklahoma Municipal Power	Oklunion	1	650	Wilbarger	Texas	1986
October	Ares Owners Holdings	Edgecombe	1	58	Edgecombe	North Carolina	1990
		Edgecombe	2	58	Edgecombe	North Carolina	1990
December	City of Lansing	Eckert Station	4	64	Ingham	Michigan	1964
		Eckert Station	5	63	Ingham	Michigan	1968
		Eckert Station	6	63	Ingham	Michigan	1970
	TransAlta	Centralia	1	670	Lewis	Washington	1971
	Portland General Electric; IDACORP	Boardman	1	585	Morrow	Oregon	1980
				Units: 14	3,829 megawatts		

Sources: Energy Information Administration; S&P Global; PJM; news reports; IEEFA analysis

Table 5: 2021 Coal units scheduled to be closed (3.0 gigawatts capacity)

ANTICIPATED CLOSURE DATE, 2021	OWNER(S)	PLANT	UNIT	SUMMER CAPACITY MW	COUNTY	STATE	OPERATING YEAR
June	FirstEnergy Solutions	Bruce Mansfield	1	830	Beaver	Pennsylvania	1976
		Bruce Mansfield	2	830	Beaver	Pennsylvania	1977
		Bruce Mansfield	3	850	Beaver	Pennsylvania	1980
	Otter Tail	Hoot Lake	2	58	Otter Tail	Minnesota	1959
		Hoot Lake	3	80	Otter Tail	Minnesota	1964
	Public Service Enterprise Group	Bridgeport Harbor 3	3	383	Fairfield		1968
				Units: 6	3,031 megawatts		

Sources: Energy Information Administration; S&P Global; PJM; news reports; IEEFA analysis

Table 6: 2022 Coal units scheduled to be closed (5.0 gigawatts capacity)

ANTICIPATED CLOSURE DATE, 2022	OWNER(S)	PLANT	UNIT	SUMMER CAPACITY MW	COUNTY	STATE	OPERATING YEAR	
June	FirstEnergy Solutions	Pleasants	1	644	Pleasants	West Virginia	1979	
		Pleasants	2	644	Pleasants	West Virginia	1980	
	FirstEnergy Solutions	W.H. Sammis	5	290	Jefferson	Ohio	1967	
		W.H. Sammis	6	600	Jefferson	Ohio	1969	
		W.H. Sammis	7	600	Jefferson	Ohio	1971	
	July	Puget Holdings; Talen Energy*	Colstrip	1	307	Rosebud	Montana	1975
			Colstrip	2	307	Rosebud	Montana	1976
September	AES	AES Hawaii	1	180	Honolulu	Hawaii	1992	
December	Duke Energy	R. Gallagher	2	140	Floyd	Indiana	1958	
		R. Gallagher	4	140	Floyd	Indiana	1961	
	Xcel Energy**	Sherburne County	2	682	Sherburne	Minnesota	1977	
	Xcel Energy***	Comanche	1	325	Pueblo	Colorado	1973	
	Tri-State Generation & Transmission Association	Nucla	1	12	Montrose	Colorado	1959	
		Nucla	2	12	Montrose	Colorado	1959	
Nucla		3	12	Montrose	Colorado	1959		
Nucla		4	64	Montrose	Colorado	1991		
Units: 16				4,959 megawatts				

An earlier version of this table included owners of any part of the plants listed; it now reflects only unit ownership, and the following have been removed:

* Portland General Electric, Avista, and Berkshire Hathaway, which only own portions of Colstrip units 3 and 4; and NorthWestern, which only owns a portion of unit 4.

** Southern Minnesota Municipal Power Agency, which only owns a stake in Sherburne County unit 3.

*** Intermountain Rural Electric Association and Holy Cross Electric Association, which only own portions of Comanche unit 3.

Sources: Energy Information Administration; S&P Global; PJM; news reports; IEEFA analysis

Table 7: 2023 Coal units scheduled to be closed (2.4 gigawatts capacity)

ANTICIPATED CLOSURE DATE, 2023	OWNER(S)	PLANT	UNIT	SUMMER CAPACITY MW	COUNTY	STATE	OPERATING YEAR
December	NiSource	R.M. Schahfer	14	431	Jasper	Indiana	1976
		R.M. Schahfer	15	472	Jasper	Indiana	1979
		R.M. Schahfer	17	361	Jasper	Indiana	1983
		R.M. Schahfer	18	361	Jasper	Indiana	1986
	Vectren	A.B. Brown	1	245	Posey	Indiana	1979
		A.B. Brown	2	245	Posey	Indiana	1986
	City of Owensboro	Elmer Smith	2	263	Daviess	Kentucky	1974
	Units: 7				2,378 megawatts		

Sources: Energy Information Administration; S&P Global; PJM; news reports; IEEFA analysis

Table 8: 2024 Coal units scheduled to be closed (1.9 gigawatts capacity)

ANTICIPATED CLOSURE DATE, 2024	OWNER(S)	PLANT	UNIT	SUMMER CAPACITY MW	COUNTY	STATE	OPERATING YEAR	
December	NRG Energy	Will County	4	510	Will	Illinois	1963	
	Xcel Energy*	Sherburne County	1	680	Sherburne	Minnesota	1976	
	Vectren	F.B. Culley	2	90	Warrick	Indiana	1966	
	Duke Energy	G.G. Allen		1	162	Gaston	North Carolina	1957
		G.G. Allen		2	162	Gaston	North Carolina	1957
		G.G. Allen		3	258	Gaston	North Carolina	1959
Units: 6				1,862 megawatts				

* An earlier version of this table included owners of any part of the plants listed; it now reflects only unit ownership, and Southern Minnesota Municipal Power Agency, which only owns a stake in Sherburne County unit 3, has been removed.

Sources: Energy Information Administration; S&P Global; PJM; news reports; IEEFA analysis

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