A Clear-Eyed Look At U.S. Coal

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May 7, 2025

Institute for Energy Economics and Financial Analysis

Photo credit: Ecoflight

Notes on Terminology

Plants and Units

- A power plant may have several, independently operable units for generating power.
- Each unit typically uses a primary fuel, such as coal, but different units at the same plant may use different fuels — some coal, some gas.
- For this reason, IEEFA looks at units; “coal-fired units” are defined as those that burn at least some coal.

Notes on Terminology

Retirements and Closures, Conversions, and the end of coal use

- "Retired" or "closed" describes when a unit has stopped generating power and has been either officially deactivated from its grid connection or has long-term unavailability to the grid.

- Rarely, this may include units in "mothballed" or "cold shutdown" status that have not been officially "retired" by the owner. These units typically have not used coal for extended periods of time and would be unable to restart without considerable lead time. This does not include "operating" units with short-term outages.

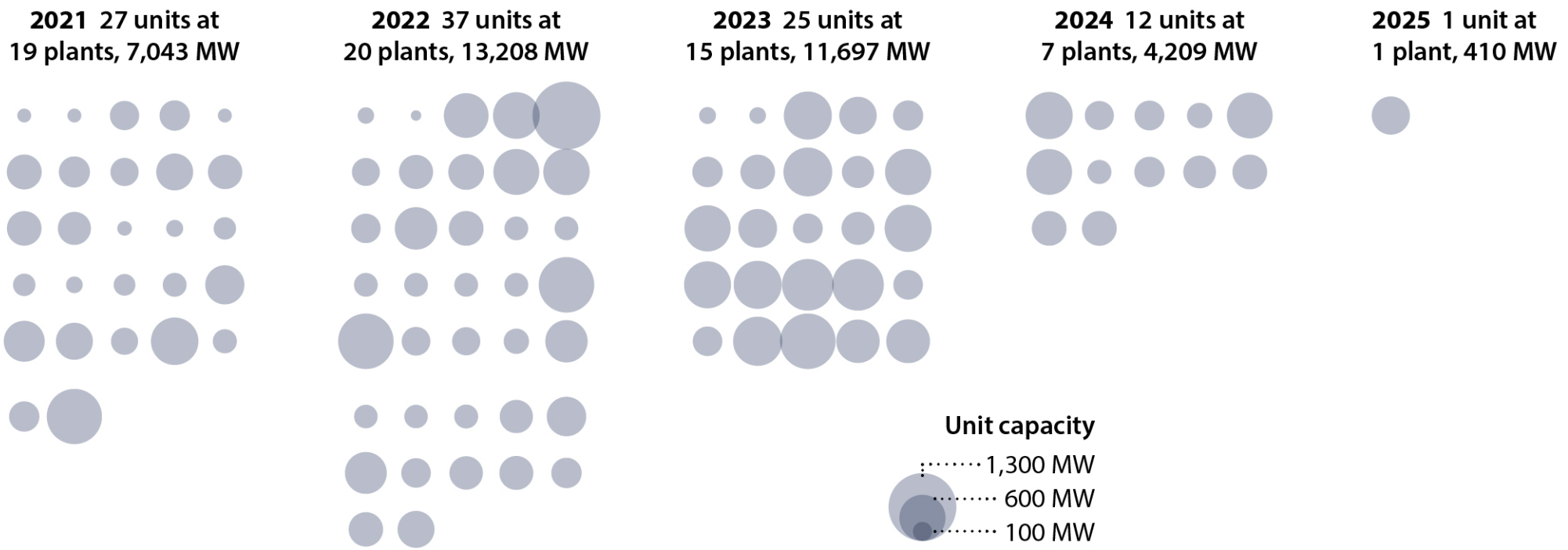
- IEEFA considers units being converted to 100% gas as having permanently ended coal use (but not units that can continue to co-fire some coal with gas).

The Past: Closed Coal Plants Will Stay Closed

Coal Plants Past—The Impossible Restarts

- IEEFA examined the 102 coal-fired units (50MW or more) closed or converted between the beginning of 2021 and early 2025
- Total capacity: 36,566 MW
- Potentially the most viable for restart, since these are the most recently closed

Coal Plants Past—The Impossible Restarts



Sources: EIA; PJM; S&P Global; company reports; IEEFA research

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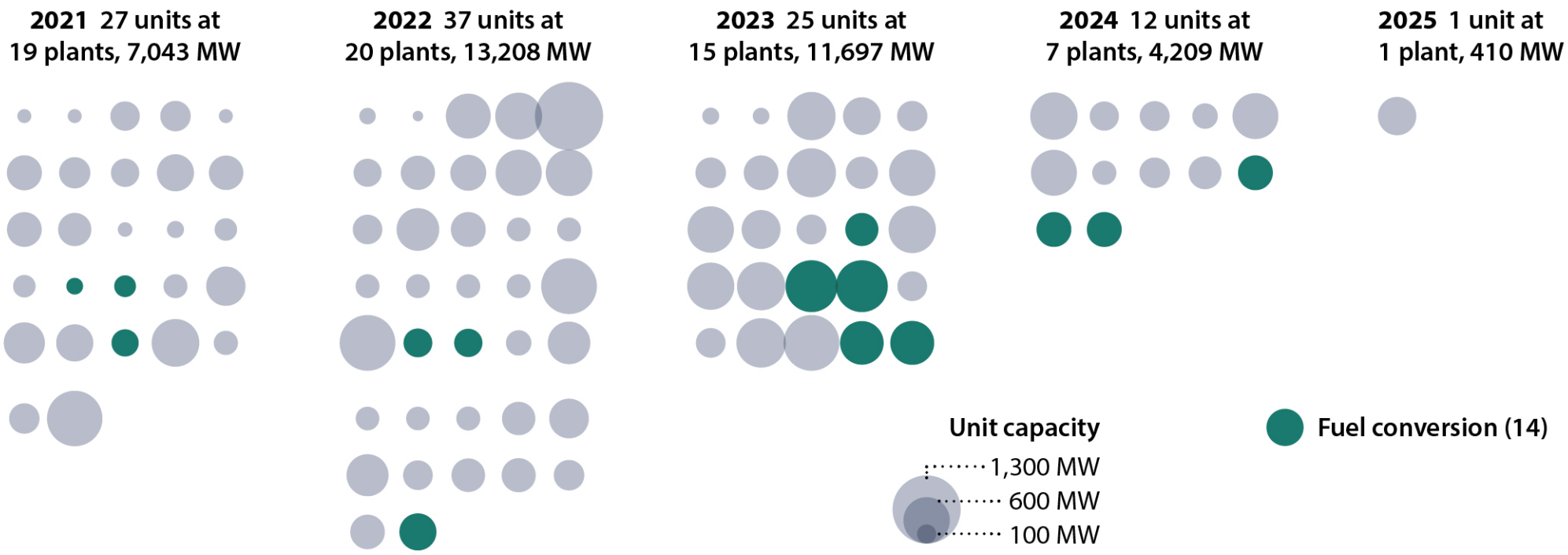

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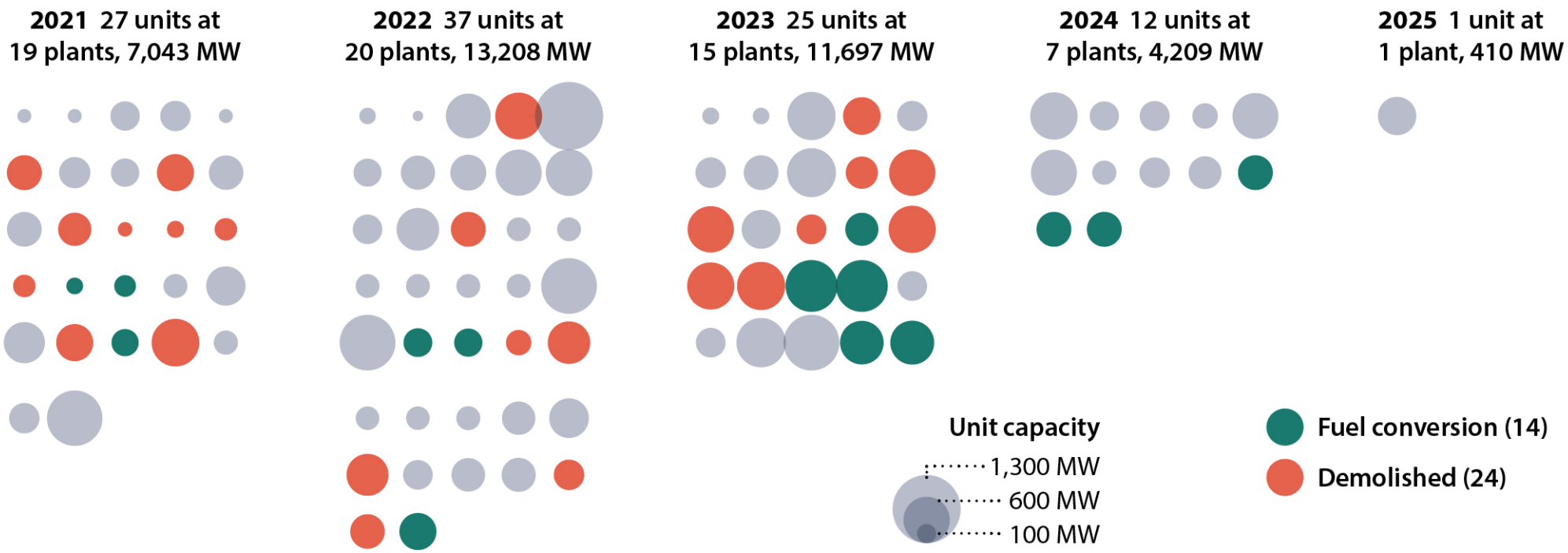

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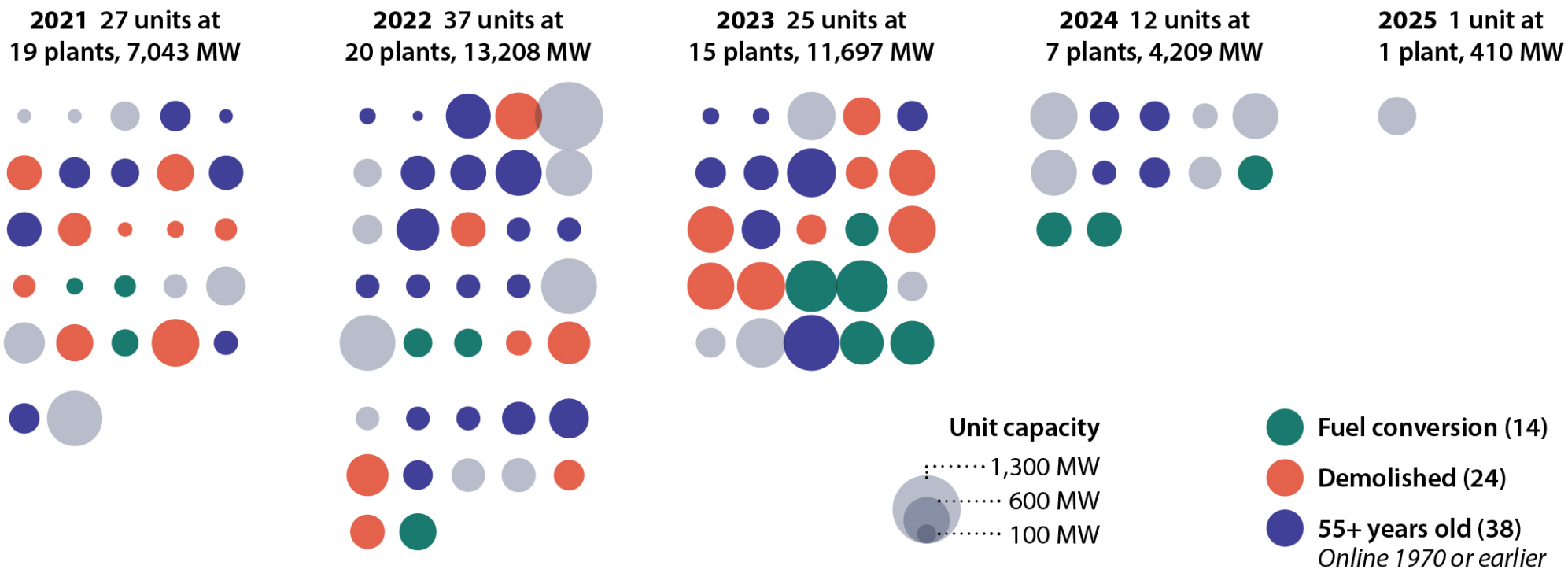

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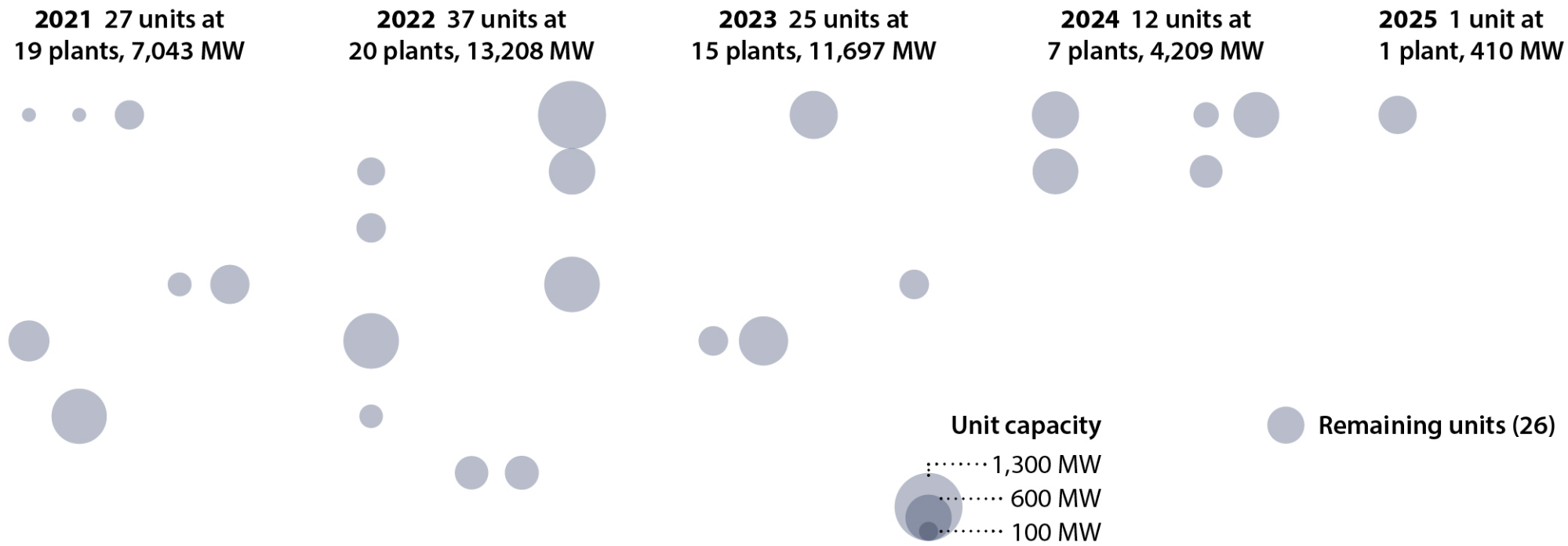

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Coal Plants Past—The Impossible Restarts (Retired for a Reason)

- Closures part of long-term plans, usually extensively negotiated with state regulators, that included replacement resources — not likely to be changed
- Xcel a prime example; coal units closed in Minnesota and Colorado since 2021 will not be restarted
- Closures were almost always uneconomic — frequently the poorest performing among generation assets, roughly one-quarter had a capacity factor < 30% in 2024
- Valuable site infrastructure, land, and transmission rights already committed
- Maintenance deferrals would add significant costs to any restart efforts; idled equipment, including turbines, may no longer be viable for restart
- Median age of the 102 units was 56 at closure – well past prime performance

Coal Plants Past—The Impossible Restarts (Who Will Pay?)

- If plants are to be kept open past their planned closure date, someone has to pay: ratepayers, investors, or through some kind of government subsidy
- Utilities would entitled to recover those costs from ratepayers
- Costs would impact investors in independent power producers
- Costs unlikely to be fully recovered from selling power, and losses from uneconomic generation could be significant

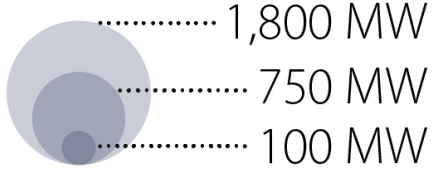
The Present: Planned Retirements and Conversions Continuing

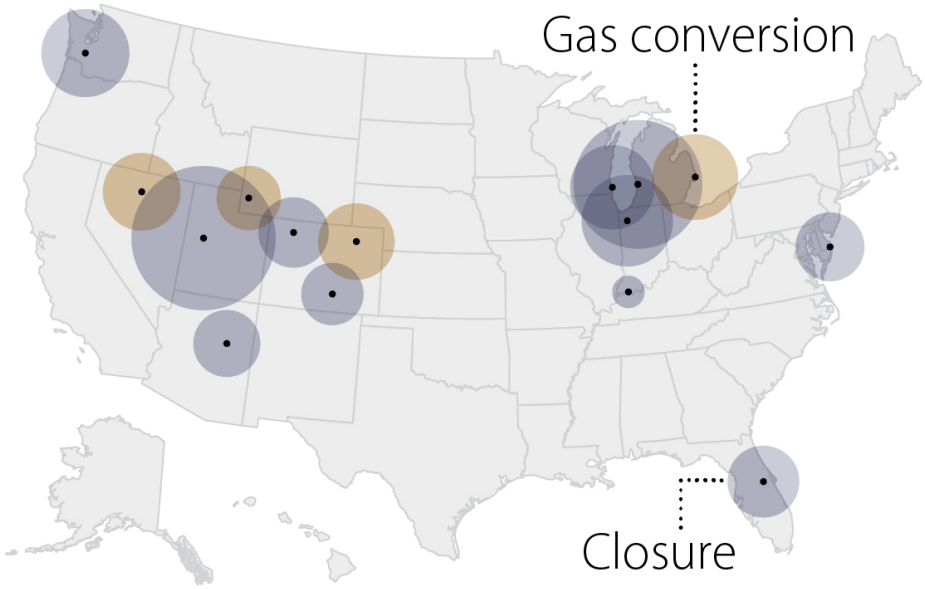
2025 Retirements and Conversions

23 Units at 15 Plants Scheduled to End Coal Use in 2025

Includes 17 retiring coal units and 6 units being converted to 100% gas announced by owners as happening in 2025

Total Capacity: 9,356 MW





Source: company financial reports and announcements

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Most Currently Planned Retirements Likely to Happen

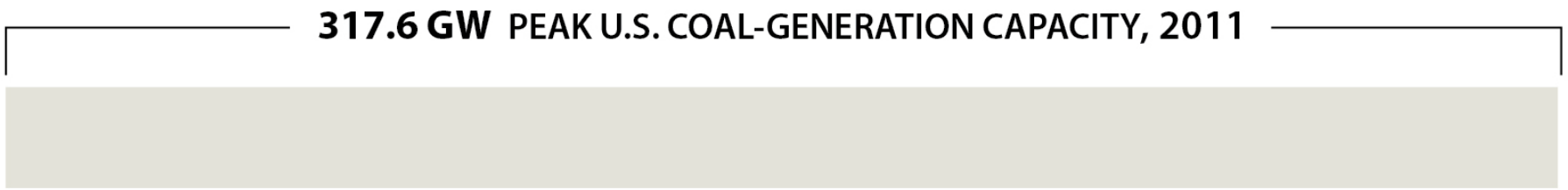
- Closures are part of long-term plans, usually extensively negotiated with state regulators
- Large, long-term investments in replacement resources — not likely to be changed
- Planned closures are frequently the poorest performing among generation assets
- Who will pay? Keeping plants open and in operable condition costs money
- Utility and state coal phaseout plans not likely to be affected by current federal policy

As part of these resource planning processes, I've been asked to comment on the impacts of recent executive orders on coal plants. Our generation retirement strategy is the product of long-term planning process with state commissions and other stakeholders that seeks to balance energy demand with long-term assets that we need for our customers. With access to some of the country's best wind and solar resources as well as incremental natural gas generation, we've demonstrated that we can retire these inefficient and aging coal plants while ensuring reliability and keeping customer bills low."

--CEO Robert Frenzel on Xcel's coal plant retirement plans

Overview of Coal-Fired Power Capacity

Status of U.S. Coal Generation Capacity Since Its 2011 Peak



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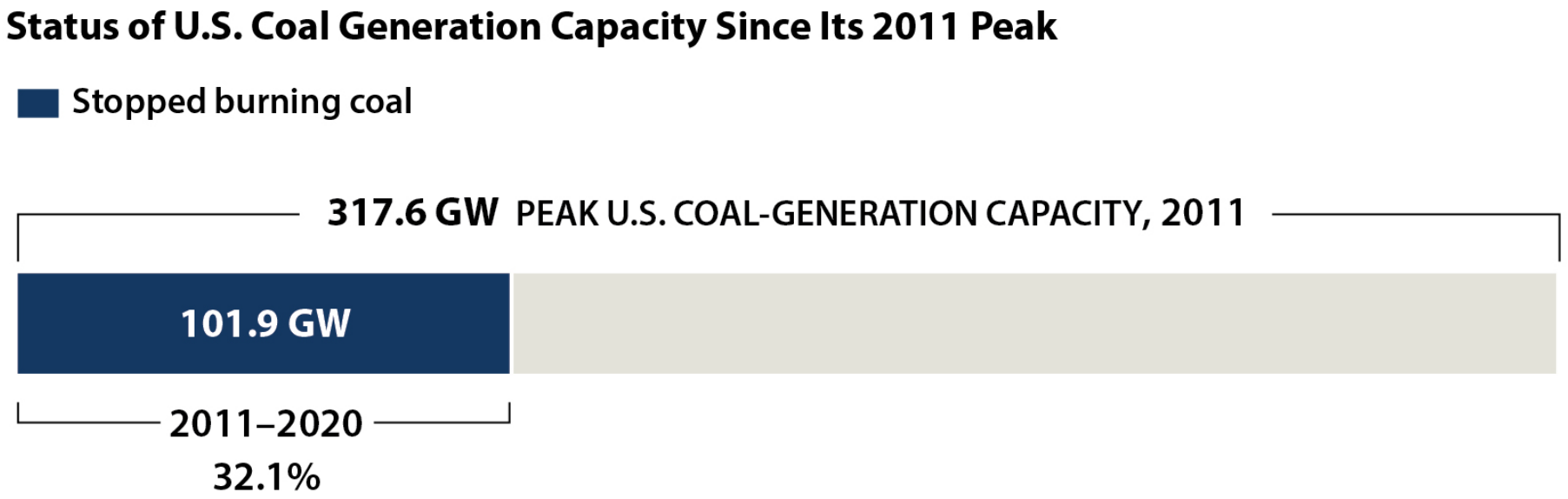
As of May 5, 2025

Overview of Coal-Fired Power Capacity



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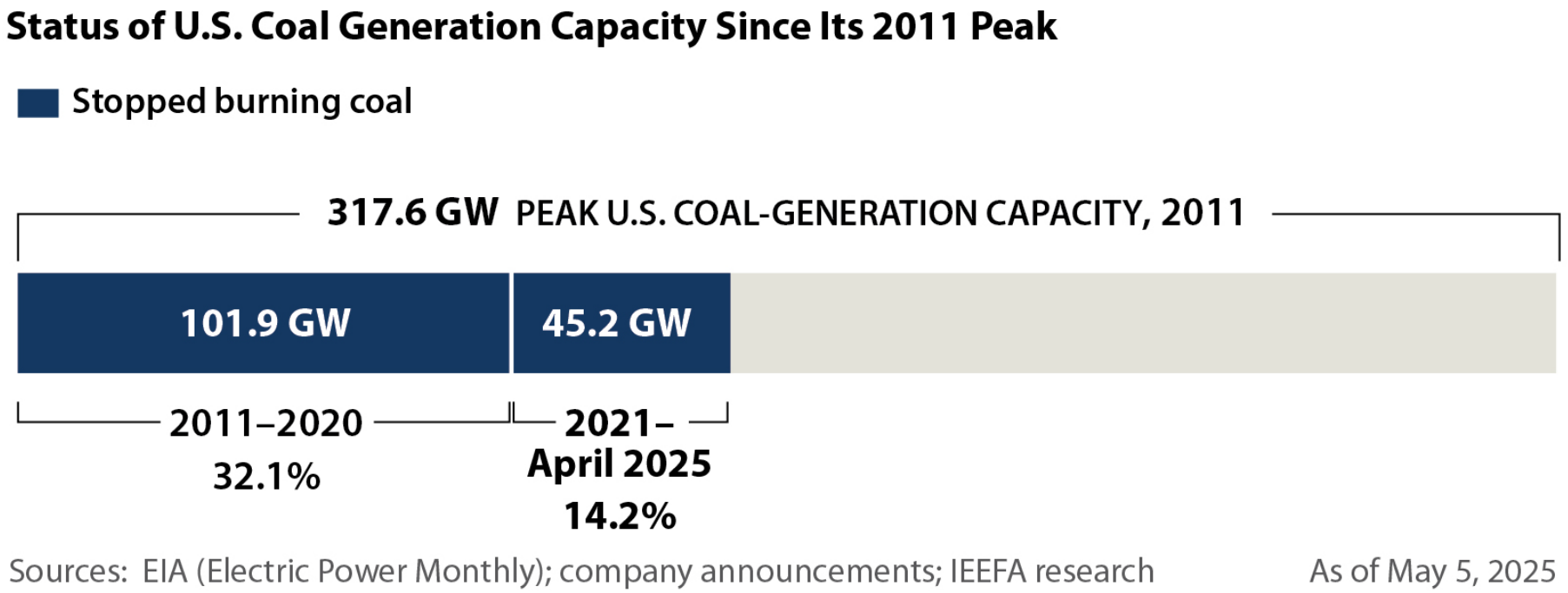

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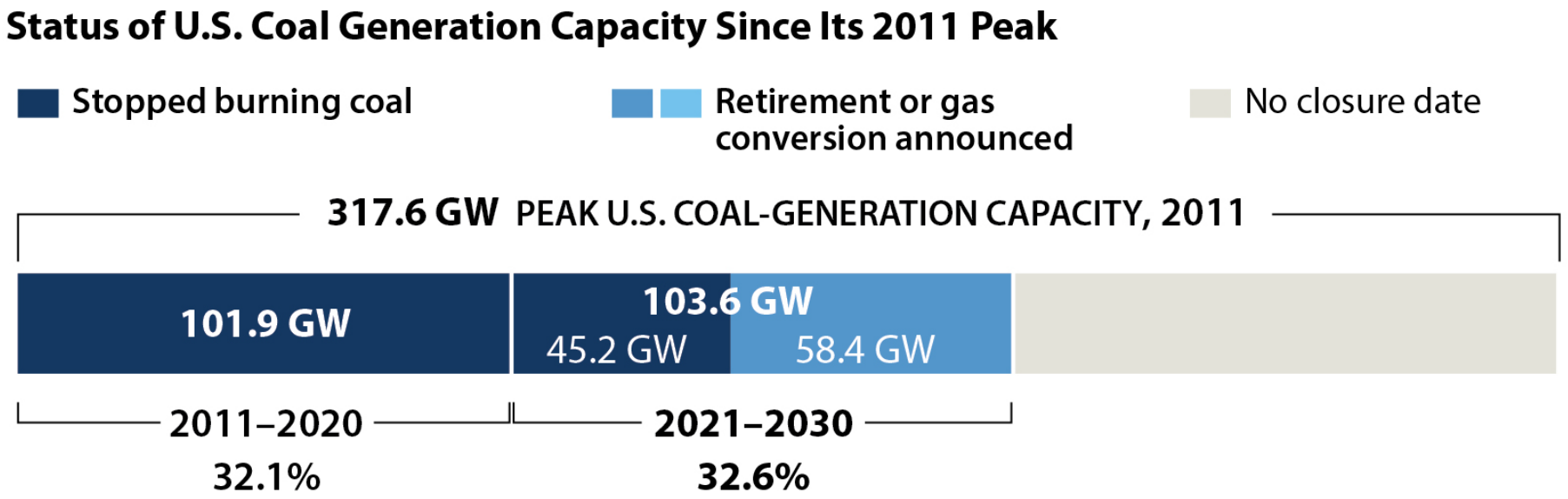

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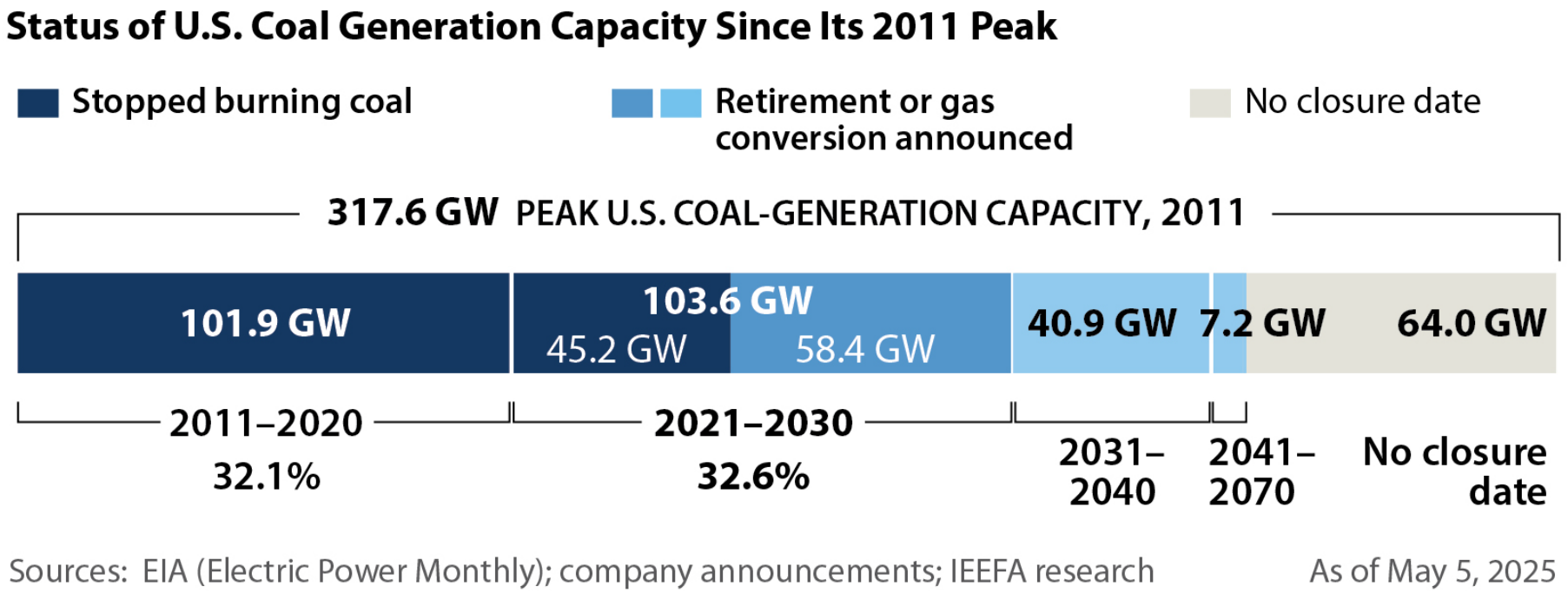


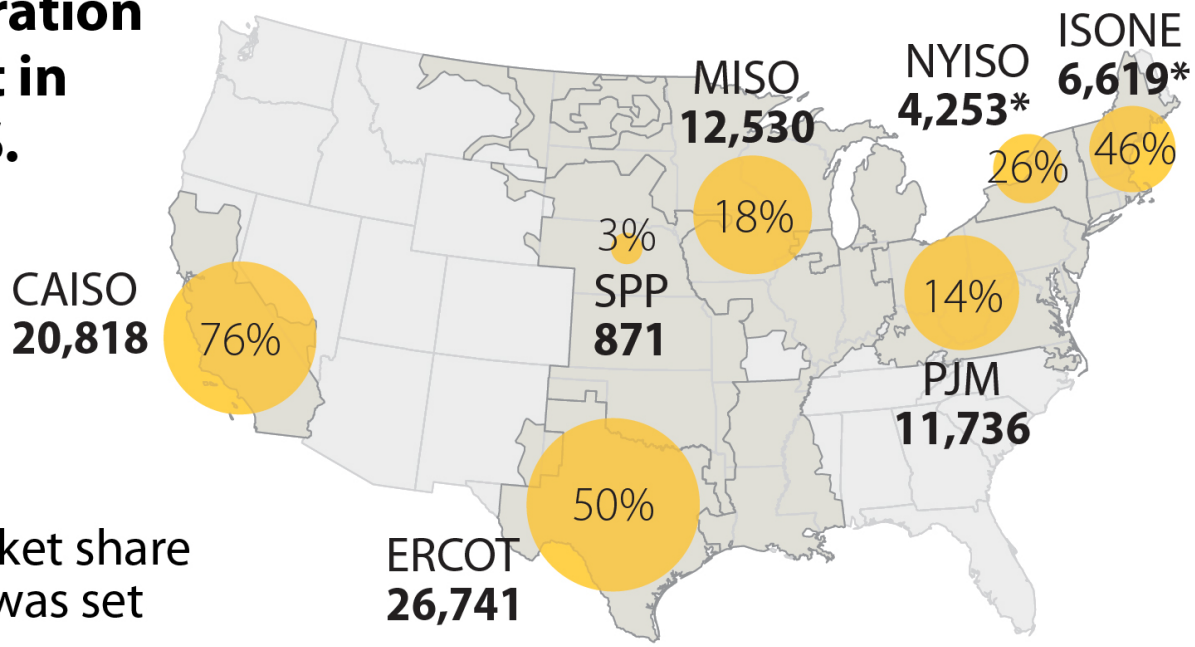
The Future: Market Challenges, Age Pose Mounting Threats for Coal

For Operating Coal Plants, More Trouble Ahead

- Growth of solar, dispatchable battery storage, and continued buildout of wind and new gas poses major threat to existing coal
- This competition will continue to push coal plants into retirement
- Milestone 50% reduction in coal-fired capacity, from 2011 peak, likely to be reached in 2026

Coal's Market Problems: Rapid Solar Growth

Solar Generation Records Set in April By U.S. Grids



Generation in megawatts and solar market share when record was set

Sources: ERCOT; gridstatus.io

*Rooftop solar only

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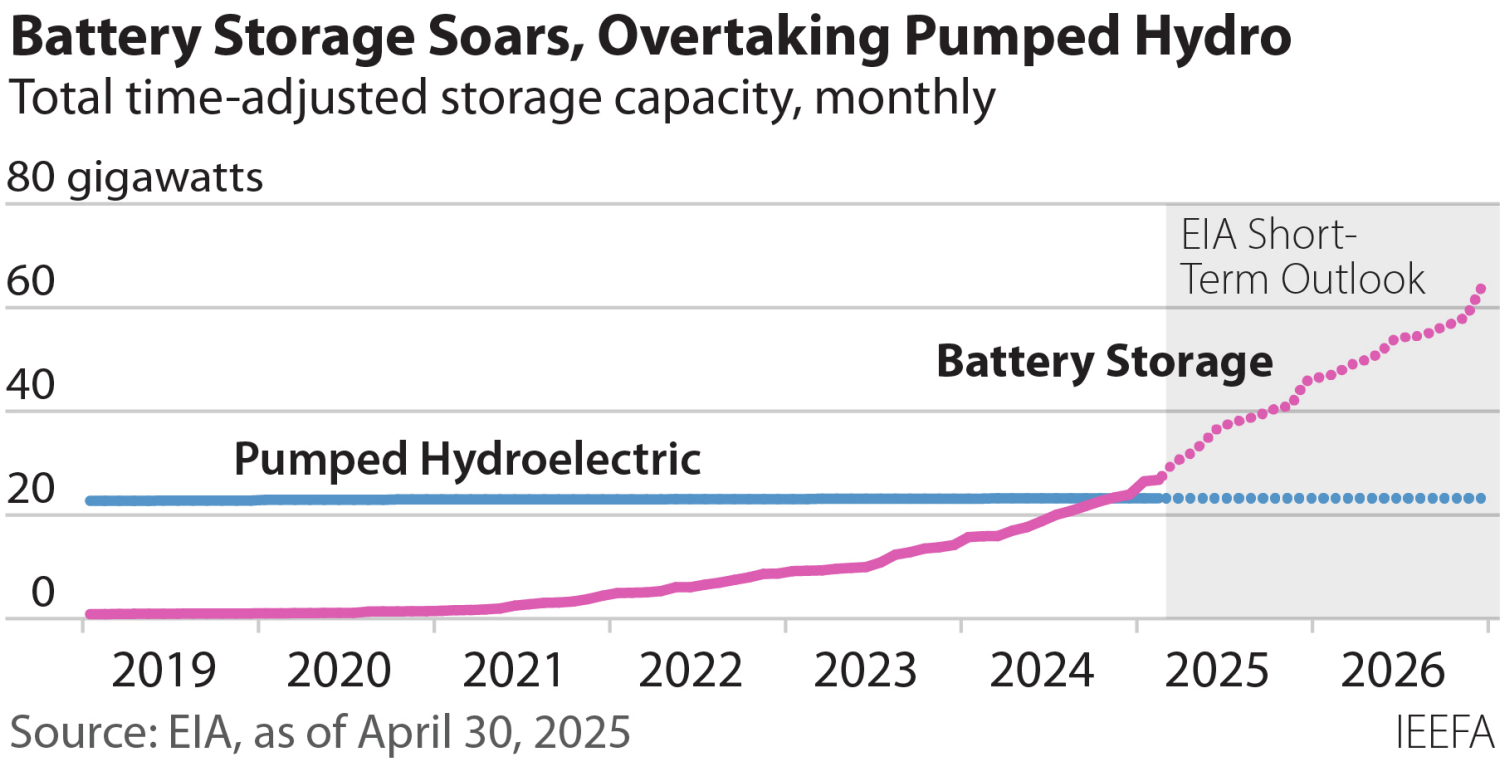
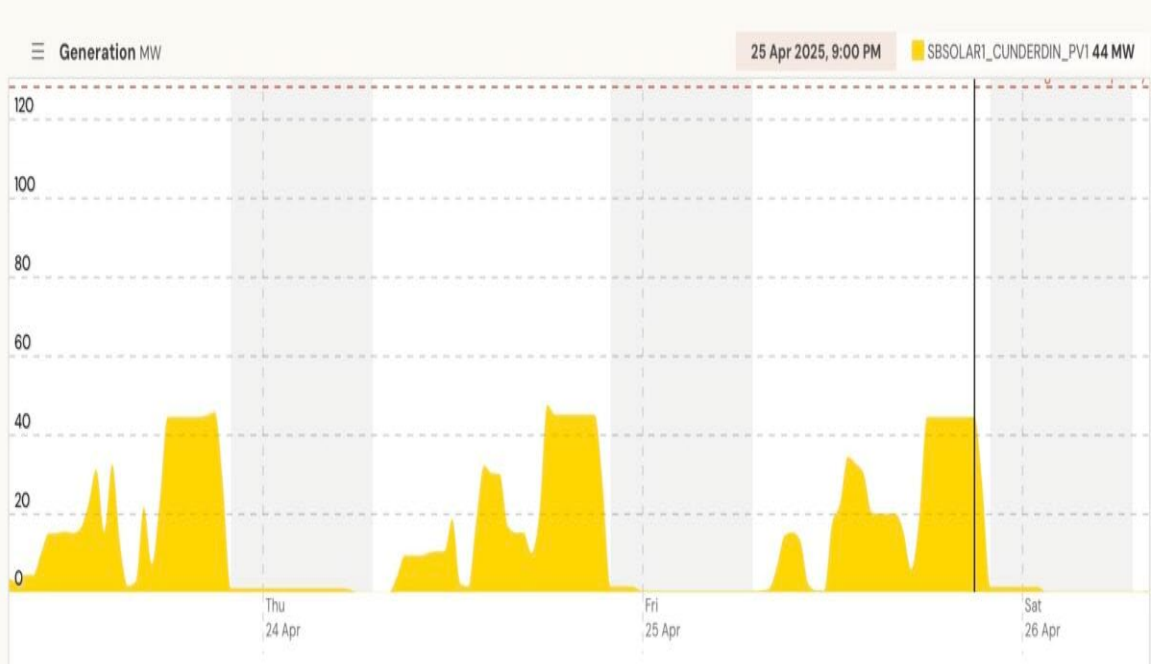
Coal's Market Problems: Dispatchable Batteries



The Transformative Role of Battery Storage

- Batteries = Dispatchable solar and wind > changes everything, for coal and the grid
- EIA data shows 26,000 MW of battery storage capacity was installed as of yearend 2024, with another 19,600 MW under development for 2025
- This dispatchable battery capacity firms renewable generation, reduces ramping needs from fossil fuels, and provides grid stability services, among other benefits
  - April 22 example in California, batteries pumped >5GW of power into the grid for ~2.5 hours in the evening providing more than 20% of system demand
  - Batteries are providing similar service in Texas, significantly reducing ramping needs for gas and coal

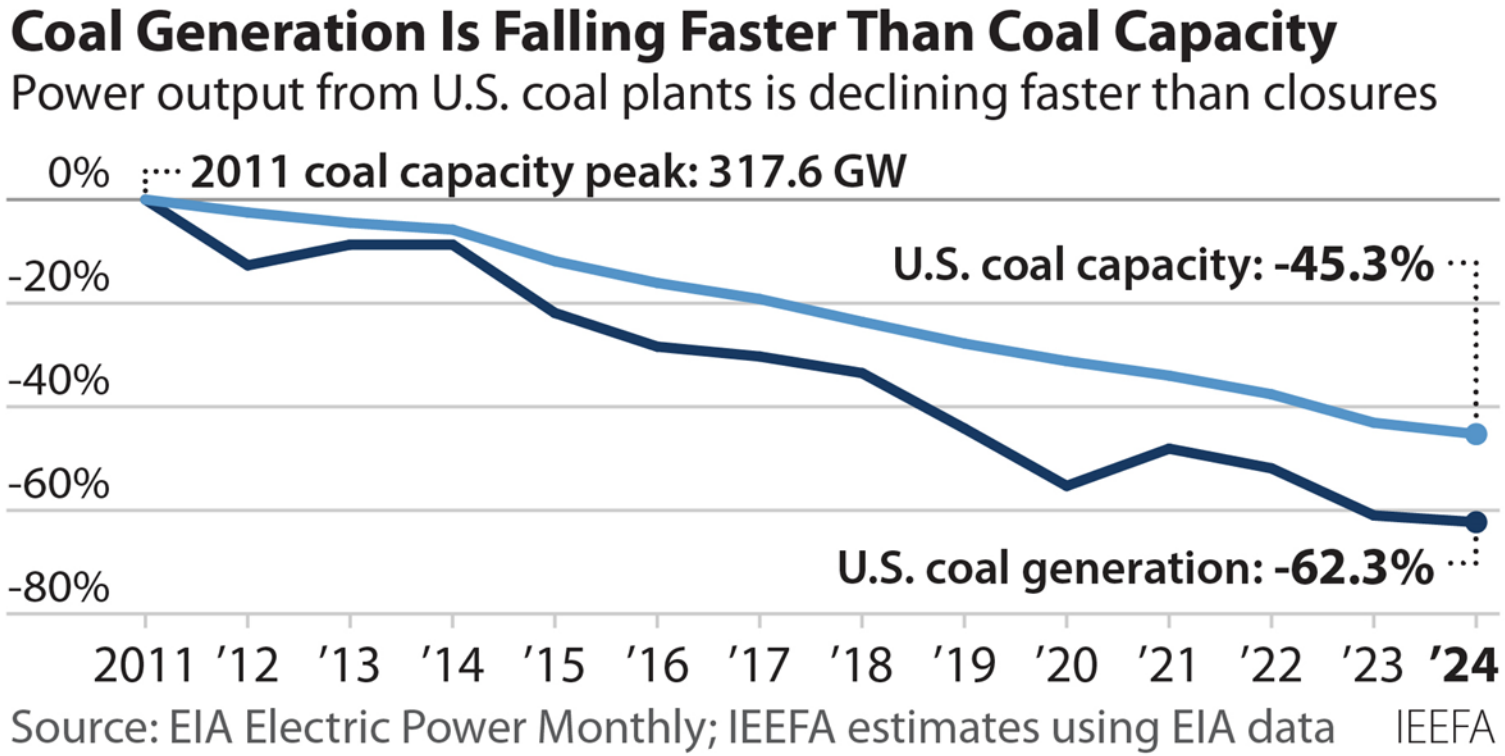
The Transformative Role of Battery Storage



Batteries = Solar after Dark

- Australian example of the firming capability of battery storage
- Cunderdin solar + storage project now providing 44 MW of firm capacity to the Australian grid – from 5:30 PM to 9:30 PM
  - Solar at night, a concept touted by APS for a number of its Arizona projects as well

Restarting Old Plants Makes No Sense When Operating Coal Plants Have Low Usage Rates



Restarting Old Plants Makes No Sense When Operating Coal Plants Have Low Usage Rates

- Low capacity factors — a measure of usage — indicate that they continue to be uneconomic most of the year
- Even many of the largest U.S. coal plants are having trouble competing against renewables, gas, and dispatchable battery storage
- Bowen (3,200MW), Gibson (3,132MW), Amos (2,900MW), Scherer (2,580MW), Roxboro (2,439MW) and Jeffrey (2,011MW) had 2024 capacity factors below 40 percent

The Spain Blackout

- Analysis of the Spain blackout is going to take time
- Unfortunately, there has been plenty of early finger-pointing, largely trying to blame renewables for the outage
- Key point is that renewable-dominated systems have different operating characteristics than those primarily running on fossil fuels
  - That, in and of itself, is not a problem, simply a planning requirement
  - Renewable-heavy grids have less inherent inertia, BUT THAT CAN BE PLANNED FOR
    - Grid-forming inverters and batteries are two crucial tools, both available now

Thank You

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