Fall 2025

ENERGY INDUSTRY UPDATE

POWER BRIEF

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The Power Brief offers focused perspectives on current topics and emerging trends across the global energy value chain—concise yet substantive insights that inform decision-making in real-time. Released between editions of the Energy Industry Update, the Power Brief extends our commitment to thought leadership, offering relevant and actionable insights when you need them most.

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Executive Summary

Less than a year after a new Presidential administration has taken the reins, it has initiated many policy changes, several reversing the actions of the prior administration. In this Power Brief, we discuss three such changes.

- First, we look at the EPA's reversal on carbon emissions policy and more generally emissions standards from fossil-fired power plants, seeking to go back to pre-Biden administration standards.
- Second, we summarize how renewables development is being impacted by new tariffs and tax credit changes.
- Third, in October, the Secretary of Energy directed the Federal Energy Regulatory Commission to promulgate rules that standardize and facilitate interconnection of large electrical load, including the often-discussed data centers. While the commission is interested, jurisdictional issues and an aggressive timeline could be hurdles to rulemaking.

This Power Brief also examines developments in power markets, including growing capacity costs in some regions, in the face of growing demand and ongoing bottlenecks in power plant construction. We also review gas market developments, as these markets increase in importance with the acceleration of natural gas-fired generation development and anticipated liquefied natural gas exports.

Finally, we take a quick look at April's power blackout on the Iberian Peninsula—still being investigated—and what (if anything) it may portend for the North American power system.

There is a quote of debated origin that says, "There are weeks when decades happen." For the energy industry, the pace of activity in 2025 has felt like that, and many expect that to continue into the coming year.

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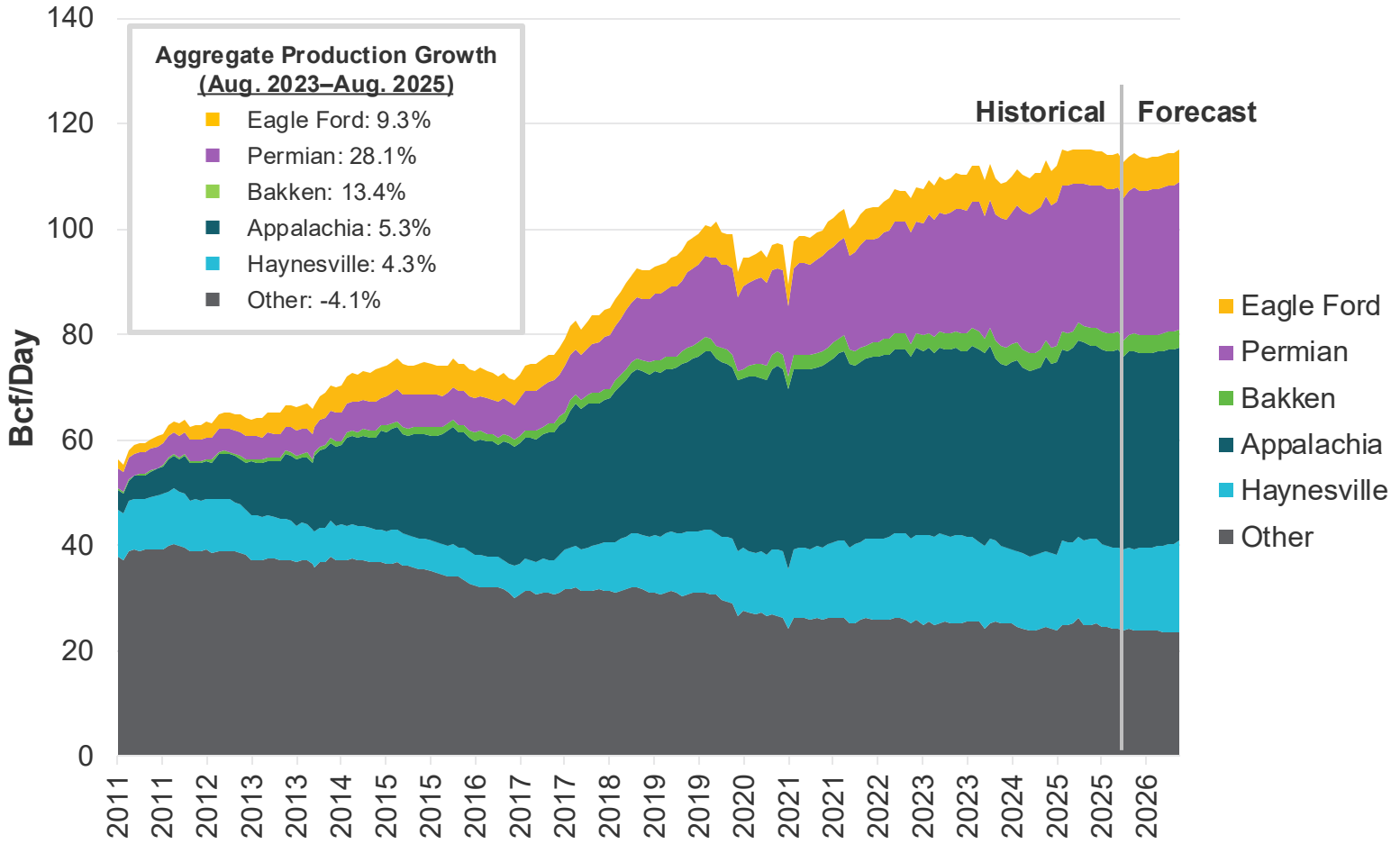
Gas Production Grinds Higher

Growing Production

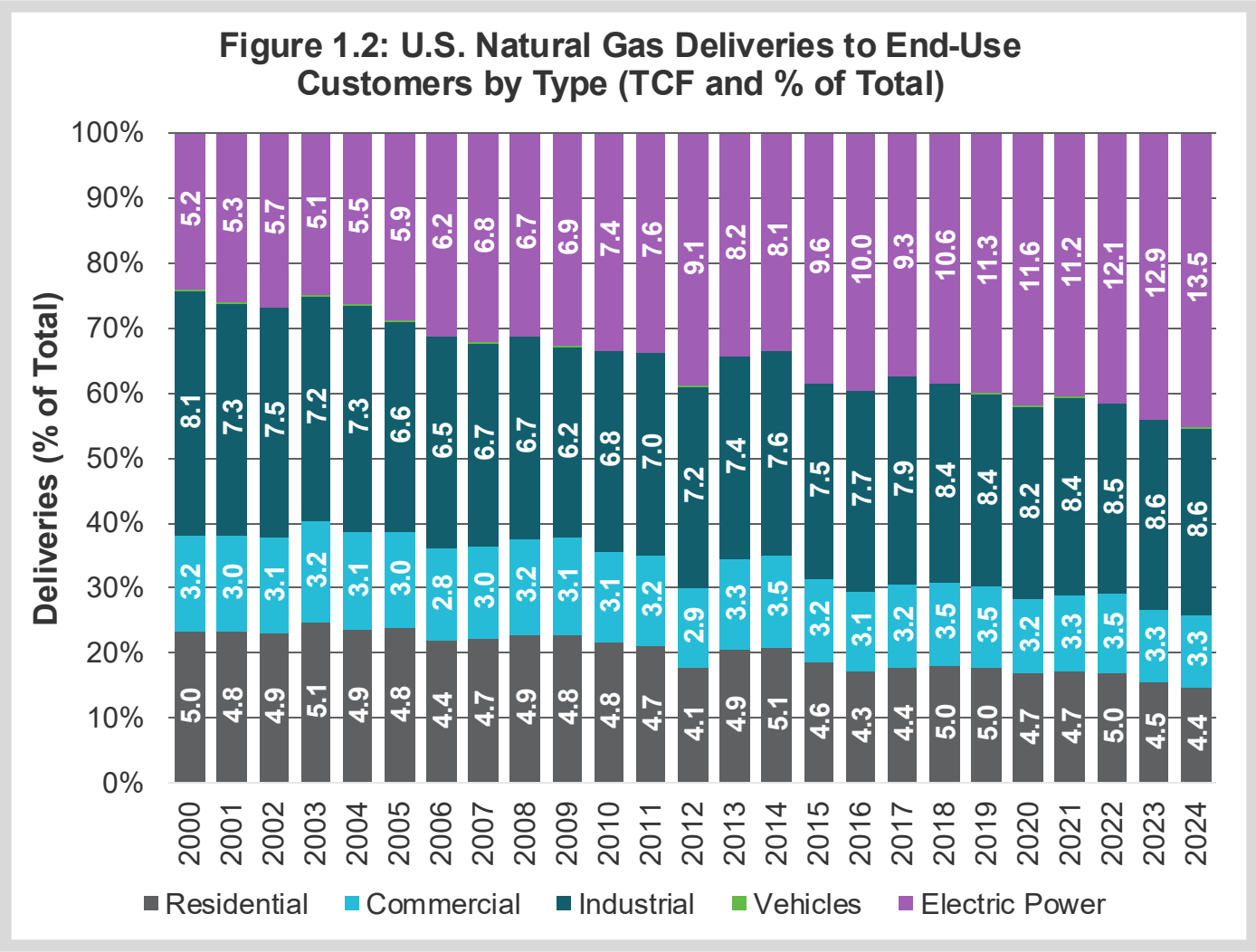
- Natural gas production has been steadily growing over the past several years. The 2025 annual monthly average (through August) is up 3.8% over the monthly average production in 2023.
- Both production and demand in the Lower 48 United States are at record highs in 2025. Production remains focused onshore, with a small fraction of Gulf production contributing to the total. The Permian basin remains a source of significant production growth although Marcellus continues to surpass it in volumes.
- Associated gas production from oil-linked production increased from winter 2023–24 to winter 2024–25. However, persistently low oil prices may lead to reduced oil—and associated gas—production. Oil rigs have been declining while the number of gas rigs has increased 18% year-over-year.
- Gas prices may affect future production activity. Henry Hub prices were $2.50 and $2.20 in 2023 and 2024, respectively. EIA projects that HH price will average $3.50 in 2025 and $3.90 in 2026.

Figure 1.1: Historical and Forecast Monthly U.S. Lower 48 Natural Gas Production by Region (Jan. 2011–Dec. 2026) (Bcf/Day)



Sources: EIA, Short-Term Energy Outlook (Oct. 7, 2025); *Natural Gas Week*

Power Demand for Gas Grows



Source: EIA

Power Demand for Natural Gas Remains High

- Natural gas constituted 42% of electricity generation by fuel type in 2023 and 2024—the largest share. It is on pace to comprise 40% in 2025 and 2026. The lower share may decline because of fuel switching (to coal, solar, and wind), efficiency gains, and economic conditions.
- Data center demand is growing as a key driver of gas demand. EQT, a large, vertically integrated gas company, estimates that data center growth and coal plant retirements could drive 10 Bcf/day to potentially 18 Bcf/day of incremental gas demand by 2030 (compare nearly 115 Bcf/day of U.S. production expected in 2025).
- It is expected that gas-fired power—including self-supply—will remain a key driver of gas demand growth. One estimate notes data center demand growth of 11.7 GW by 2027 over 2024 levels.

Deliverability

- A persistent issue for the gas industry has been the availability of infrastructure. Gas producers have said that storage and pipeline additions will be needed to move gas in this new demand environment.
- As of July 2025, approximately 9.6 Bcf/day of new U.S. interstate pipeline capacity was approved, partially completed, or under construction for the years 2025–2027 (compare 156 Bcf/day of U.S. interstate capacity as of 2024).

Note: Pipeline figures exclude capacity originating or terminating in Canada or Mexico.

Sources: American Gas Association; EIA, Short-Term Energy Outlook (Oct. 7, 2025); *Natural Gas Week*; EIA, "EIA Expects Record U.S. Natural Gas Consumption in 2025" (Aug. 25, 2025); EQT Corporation, Second Quarter 2025 Results Investor Presentation (July 22, 2025)

LNG Exports May Put Pressure on Markets

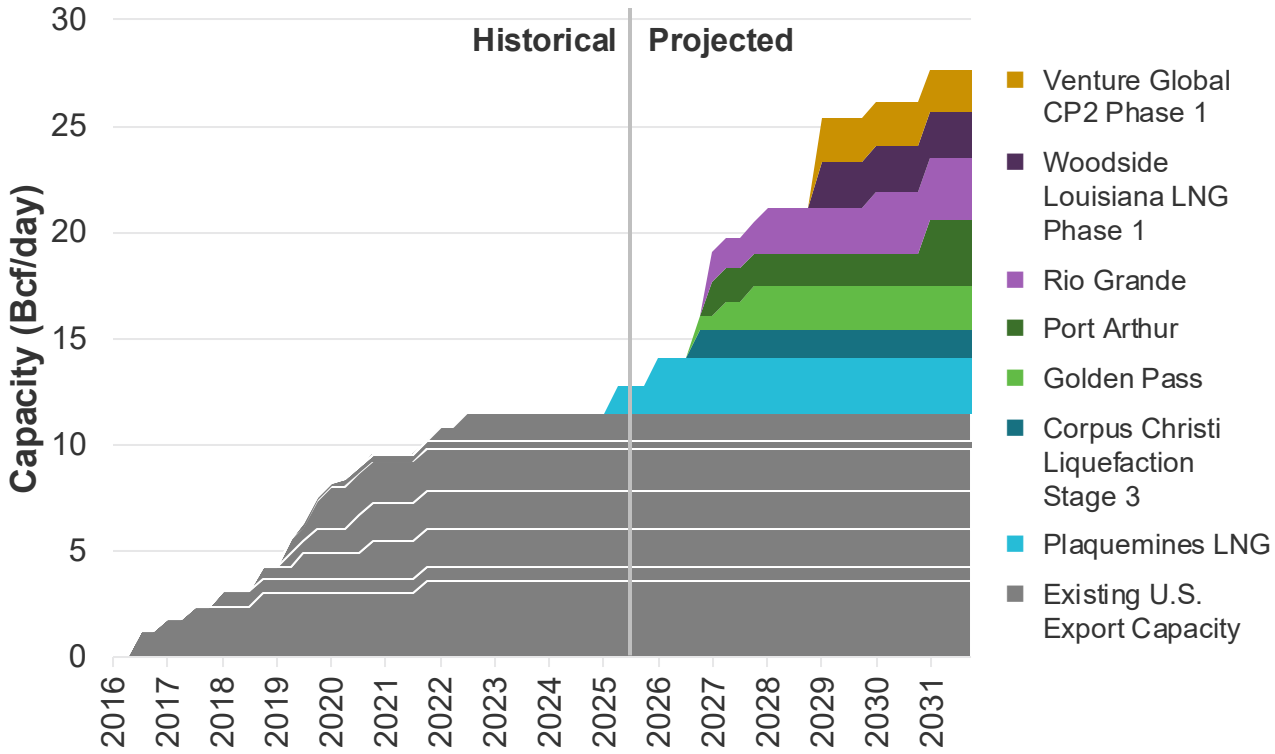
LNG Paused and Unpaused

- Over the past decade, there have been several studies of potential impacts of LNG exports on the U.S. domestic gas markets. Concerns have traditionally focused on effects on U.S. natural gas prices.
- In January 2024, the Biden administration "paused" LNG export approvals pending evaluation of the "public interest" for approval—specifically, impacts on energy security, natural gas prices, renewable energy displacement, and environmental impacts.
- The Trump administration ended the pause in January 2025 pursuant to its "energy dominance" strategy, continuing reviews of LNG export facilities under the rebuttable presumption favoring exports.

Projects Lining Up

- Approximately 5 Bcf/day of U.S. export capacity is forecast to be added between August 2025 and year-end 2026 (see Fig.1.3).
- With reviews "unpaused," additional projects are moving forward, but companies are cautious about final investment decisions.
- Additional export capacity could afford prolific Permian and Haynesville gas production a potential outlet.
- Potential domestic gas price impacts of LNG exports are unclear. Increased U.S. exports, combined with Qatar and Australian volumes and anticipated Canadian exports, could cause a global supply glut, depending upon global economic and geopolitical conditions.

Figure 1.3: U.S. LNG Export Facilities – Baseload Nameplate Capacity of Existing or Under Construction Liquefaction Facilities by In-Service Date (2016–2031 Forecast)



Source: EIA

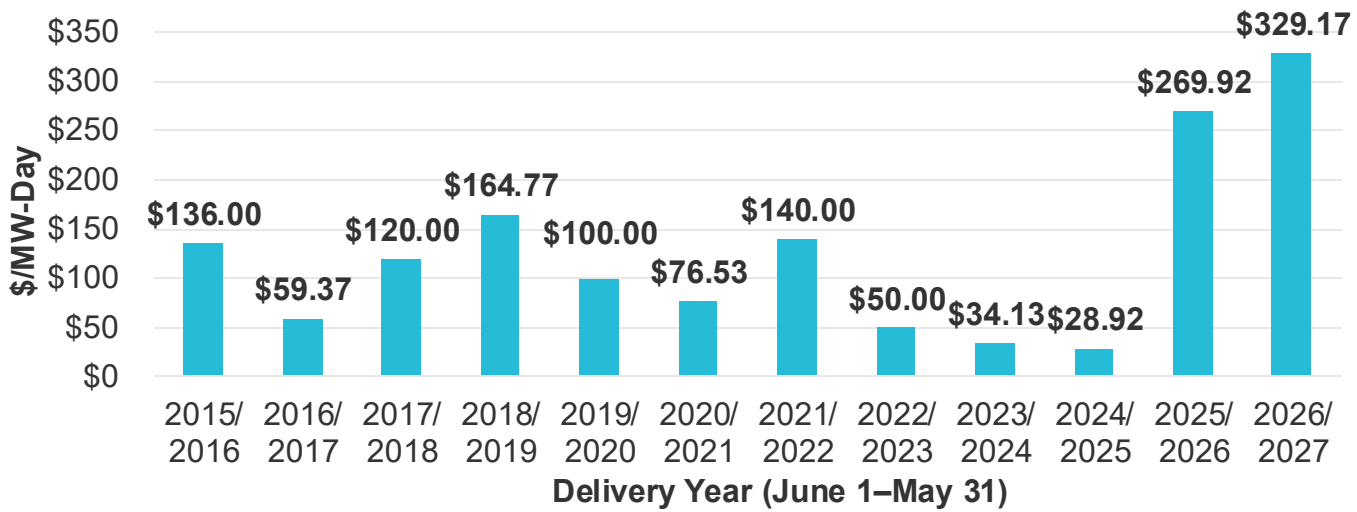
Sources: U.S. Dept. of Energy; *Natural Gas Week*; Akin, "Liquefied Natural Gas Export Authorizations Closer After DOE Releases Final Response to Comments on 2024 LNG Export Study" (May 22,2025)

Capacity Needs and Market Signals

PJM Capacity Market Sends Signals

- The expected growth in power demand in PJM has been well documented. Rising large loads, expected electrification of heat and transportation, and industrial growth have led to increased load growth estimates.
- At the same time, capacity prices have climbed significantly in past two auctions (see Fig. 2.1). Several factors have contributed: plant retirements, higher demand, and importantly implementation of a new capacity accreditation approach.
- The new approach, known as marginal effective load-carrying capability, discounts capacity, sometimes significantly, based on probable unavailability at high demand periods. This especially affects intermittent resources (solar and wind) and gas (potentially unavailable fuel during cold spells).
- Some PJM-area state governors are concerned about rising customer prices. Recent headlines regarding capacity prices have led some to seek more input and address perceived shortcomings or even consider exiting the RTO.
- However, the capacity prices have only recently taken effect; the delivery year begins in June. Also, capacity costs have historically been low—in PJM, they comprised 6.6% of the total cost per MWh in 2024.
- An upcoming December 2025 auction for Delivery Year 2027/2028 will provide some indication of whether this trend will continue as the region continues to work through its interconnection backlog.

Figure 2.1: PJM Area-Wide Capacity Clearing Price by Delivery Year



Sources: CRS; PJM

Key Observations About the 2026/2027 Capacity Auction

- **Resource mix cleared:** 45% natural gas, 21% nuclear, 22% coal, 4% hydro, 3% wind, and 1% solar
- **Price cap and floor:** A new price cap ($329.17/MW-day) and floor ($177.24/MW-day)
- **Efficiency:** Energy efficiency was no longer a product category
- **New capacity:** New capacity and uprates totaled 2,669 MW
- **Withdrawn deactivations:** Since last auction, 17 generating units totaling 1,100 MW withdrew planned deactivations
- **Demand growth:** Forecasted peak load for the 2026/2027 Delivery Year increased year to year by more than 5,400 MW

Sources: Congressional Research Service; Monitoring Analytics, 2024 Annual State of the Market Report for PJM (Mar. 13, 2025); PJM Inside Lines (July 22, 2025); industry news

New England Studies the Economics of Ambitious Climate Goals

Figure 2.2: Study Tags Long-Duration Storage, SMRs as Lowering Capacity Needs

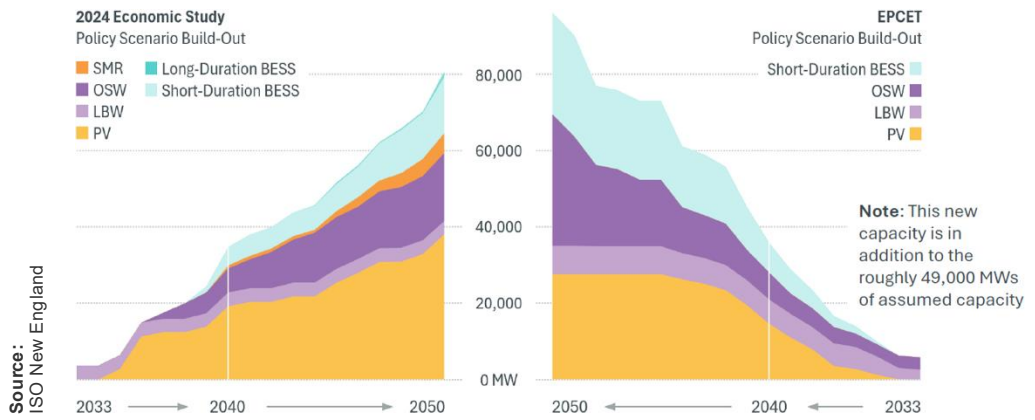
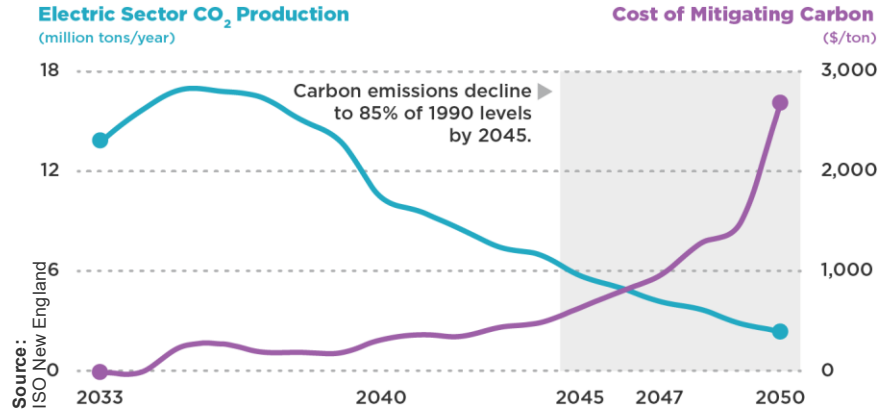


Figure 2.3: The Last Increments of Decarbonization Require Significantly Higher Costs



Penciling out Resource Needs

- In September 2025, ISO New England released a 2024 economic study that looked at how the New England grid and resources might meet a 100% net-zero goal by 2050.
- Updating prior ISO-NE analysis* (see Fig. 2.2), this study included SMRs and long-duration storage (100-hour iron-air batteries) as potential resources, which it characterized as key dispatchable technologies.
- Key observations included the following:
  - 80/20 (or 85/15) rule applies: 85% of emissions reduction can be achieved with marginal costs of $500/ton with earlier action, while the costs of the last 15% range from $1,000 to $2,500/ton by 2050 (see Fig. 2.3).
  - Shifting to daytime EV charging and appliance usage can reduce compliance costs (coincident with solar).
  - Land-based wind is economical but constrained by land availability.

The Challenges

- Key technologies are still pre-commercial, but the study assumes a buildout of long-duration batteries and SMRs by the mid-2030s. Moreover, SMRs are assumed to operate at a potentially impractical 21% capacity factor by 2050, increasing their effective energy cost.
- It is unclear whether the incremental heating and charging infrastructure costs (e.g., workplace charging) and behavioral changes (e.g., mid-day appliance usage) are factored into the ISO-NE analysis.
- Winter remains a challenge. Storage availability remains scarce in cold weather months (November–March) as solar availability is limited.

Note: *ISO New England, Economic Planning for the Clean Energy Transition (Oct. 24, 2024) (EPCET); OSW means offshore wind; LBW means land-based wind; BESS means battery energy storage systems; SMR means small modular reactors; PV means solar photovoltaic.

Source: ISO New England, New England's Evolving Grid (Sept. 15, 2025)

Policy Headwinds

U.S. Federal Policy Changes and Hurdles to Renewables Development

- In January 2025, all new or renewed wind energy leases were paused, and existing leases were ordered reviewed.
- Tariffs on steel, aluminum, solar panels, mounting racks, inverters, steel blades, and batteries from southeast Asia, China, and the European Union have imposed additional costs for renewable projects.
- The Department of the Interior has mandated a sign-off from the Interior Secretary for all wind and solar projects on public land and requiring projects to match the energy output per acre of fossil fuel plants.
- The One Big Beautiful Bill Act (OBBBA), signed into law July 4, 2025, altered the timing and qualifications for the investment tax credit (ITC) and the production tax credit (PTC) for wind and solar generation originally promulgated under the 2022 Inflation Reduction Act.
- A description of key changes in the tax provisions is shown at right at Fig. 3.1 and illustrative changes in timing of various tax provisions are shown on the next page at Fig. 3.2.

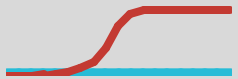
Figure 3.1: Key Energy Tax Credit Provisions of the OBBBA

- Under the OBBBA, to be eligible for Section 48E ITCs and Section 45Y PTCs, wind and solar projects are required to be placed in service by Dec. 31, 2027. There is an exception to this deadline for projects that "begin construction" within one year of the OBBBA's enactment (i.e., by July 4, 2026).
- Subsequent IRS guidance (Notice 2025-42) noted that wind and solar projects beginning construction in 2025 would have a placed-in-service deadline of Dec. 31, 2029, and those beginning construction in 2026 on or before July 4 would have a placed-in-service deadline of Dec. 31, 2030. The guidance also eliminates the 5% safe harbor provision for most projects (solar projects < 1.5 MW are exempted). As a result, most projects will need to demonstrate physical work of a significant nature to establish start construction.
- The phase-out of the 48E and 45Y credits for all other qualified facilities—including energy storage facilities—begins in 2034. Facilities that begin construction in 2034 will be eligible for 75% of the full credit amount, dropping to 50% for construction beginning in 2035, and phasing out entirely for projects beginning in 2036 or later.
- Under "foreign entity of concern" restrictions, companies organized or located in specific non-U.S. countries (e.g., China, Russia) (including the supply chain) are prohibited from obtaining certain credits directly or indirectly, investing in projects resulting in these credits.

Sources: S&P Capital IQ; Columbia Business School; White & Case; Semafor; Argus Media; Kirkland & Ellis; Jones Day; Latham & Watkins; McGuire Woods; *National Law Review*; ScottMadden research

Policy Headwinds (Cont.)

Figure 3.2: IRA Incentives (2022–2025) vs OBBB Policy Changes (2025–Onward)
(Illustrative Timing Changes of Selected Energy-Related Incentives)

Solar and Wind		■ 48E and 45Y credits available until 2033 ■ Phased out after 2027; sourcing rules tightened (“foreign entity of concern”)
Electric Vehicles		■ Multiple credits for EVs and charging infrastructure ■ Phased out by 2026 (EVs by Oct. 2025)
Energy Storage		■ 48E credit available until 2033 ■ Preserved in full
Geothermal		■ 48E and 45Y credits available until 2033 ■ Preserved in full
Nuclear		■ ITC/PTC for new; credit for existing plants until 2033 ■ Preserved in full; fuel sourcing rules apply after 2028
Oil and Gas		■ No support ■ Gains tax breaks and other regulatory benefits

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Sources: Columbia Business School Climate Knowledge Initiative

Policy Headwinds (Cont.)

Different Outcomes for Renewables Under OBBBA

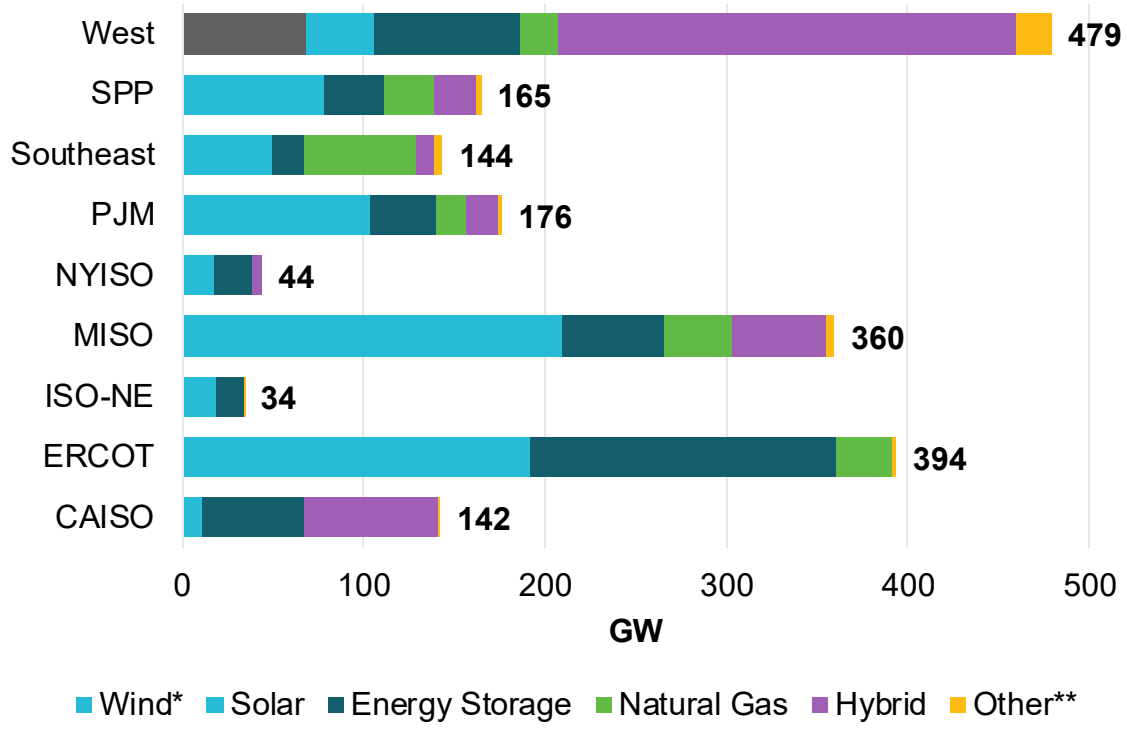
- Standard and Poor's analyzed the impact of OBBBA's incentive changes on capacity and generation by solar, wind, storage, coal, hydro, and natural gas in 2030 and 2035. The analysis (see Fig. 3.3) found that:
  - Solar capacity and generation was poised to grow by an additional 35.6 GW and 68.1 TWh by 2030 compared to the pre-OBBBA forecast, as projects rush to completion to qualify for tax credits. However, solar growth will be 42.1 GW and 129.0 TWh lower by the end of the forecast period due to changes from the law.
  - Wind capacity and generation would expand more slowly under OBBBA than solar. By 2030, wind capacity and generation are forecast to be 3.7 GW and 21.5 TWh lower, respectively. Forecast declines expand further by 2035 to 51.7 GW and 178.4 TWh.
  - Storage capacity and generation were little changed by 2030, while by 2035, capacity growth is expected to be ~20 GW lower, and generation is expected to increase by ~40 TWh.

Figure 3.3: Forecasted Change in Capacity (GW) and Generation (TWh) Based on Changes to IRA Incentives in the OBBBA (as of Aug. 15, 2025)

Source: S&P Capital IQ

Market Factors Driving Renewables Activity

Figure 3.4: Capacity in the Interconnection Queue by ISO/RTO and Non-ISO Region by Type (as of Oct. 2025) (GW)



Source: Interconnection.fyi

* Includes 213 GW of onshore wind and ~40 GW of offshore wind

** Includes, biomass, biofuel, coal, compressed air storage, diesel, geothermal, hydro, hydrogen, nuclear, oil, other storage, pumped storage, waste heat, wave, and other technologies

Continued Growth Driven by Tech-Driven Demand

- The nation's interconnection queues show that renewable projects still dominate new generation requests (see Fig. 3.4). Out of the nearly 2,000 GW of generation in U.S. queues, renewables represent ~1,700 GW of proposed generation.
- Solar, wind, and battery storage make up a substantial majority of interconnection requests in 8 out of 9 regions (see Fig. 3.4). The exception is the Southeast, where renewables and gas each are roughly 50% of the queue.
- According to S&P, corporate offtakers contracted ~11.5 GW of renewables in the five-month period between February 2025 and July 2025.
  - Amazon, Meta, and Microsoft accounted for more than 76% of this activity, indicating demand for renewables to power growing data center demand.
  - Overall, the technology and web services sector accounted for more than 84% of the tracked projects, with 9.7 GW of contracted capacity, including 7 GW of solar, 1.4 GW of wind, and 1.3 GW of nuclear.

Some Offshore Wind Issues Predated Lease Revocations

- For offshore wind, cost spikes and cancellations started before 2025's federal policy shift, hitting a sector that was already repricing. For example, Orsted canceled Ocean Wind 1 and 2 in New Jersey in 2023 due to inflation, rising rates, and supply chain issues, and Equinor/Empire Wind 2 terminated its NYSERDA offtake in early 2024.
- Despite policy headwinds, some projects are progressing. On their most recent earnings call, Dominion Energy's management described the Coastal Virginia Offshore Wind project as "the fastest and most economical way to deliver nearly 3 GW to Virginia's grid" at levelized cost of energy of ~$84/MWh (2027$) with renewable energy credits and a projected net reduction of 0.63¢ on monthly residential customer bills.

Sources: S&P Capital IQ, Lawrence Berkley National Laboratory, Dominion Energy; Investing.com; www.interconnection.fyi

Reasons for Optimism: Speed and Price

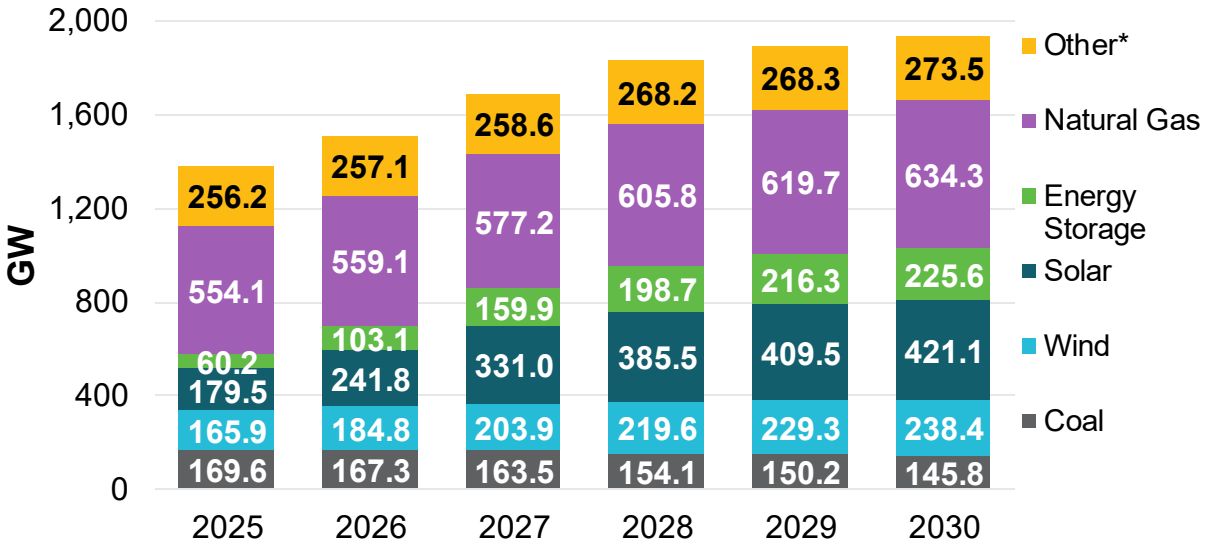
Levelized Cost Is Attractive

- While OBBBA trimmed credits for solar and wind, the technologies remain somewhat attractive as they are relatively cheap and quick to build.
- Even without the tax credits, the levelized cost of energy for utility-scale solar and onshore wind can compare favorably to nuclear, coal, and both combined-cycle and peaking natural gas units, according to Lazard. There are, however, regional differences in the "firming cost" (capacity cost) that can affect the comparison of technologies.
- Importantly, the OBBBA preserves the value and timeline of credits for utility-scale battery energy storage systems. Analysis from S&P found that 143 GW of storage capacity additions could receive at least a 40% tax credit.

Storage in Focus

- According to an investor presentation from NextEra, battery storage projects can come online within 12 months, compared to approximately four years for a new gas peaking plant, and between 1% and 38% cheaper across different regions.
- Further, analysis from S&P shows renewable capacity additions with announced commercial operation dates of 476 GW (energy storage 164 GW, solar 240 GW, and wind 72 GW) over the next five years.

Figure 3.5: U.S. Operational and Planned Generation (2025–2030) (GW) (as of Oct. 29, 2025)**



Source: S&P Capital IQ

* Includes hydro, geothermal, nuclear, biomass, oil, petroleum, and other fuels
** Excludes projects with no estimated commercial operation dates

Figure 3.6: Planned, Announced, and Early Development* Utility-Scale Storage Capacity and Potential Eligibility for Section 48E Tax Credit by Region

Gigawatts	ERCOT	WEST	CAISO	MISO	Southeast	ISO-NE	PJM	NYISO	SPP	Other	Total
Storage capacity	80.9	57.7	42.9	10.4	8.2	7.0	6.7	6.6	4.0	1.2	225.6
Capacity eligible for 40% tax credit	61.3	36.7	29.3	6.0	2.8	0.8	2.4	0.8	2.2	0.5	143.0

*Includes projects with no estimated commercial operation dates

Sources: S&P Capital IQ, Energy Information Agency, PV Magazine, NextEra; Lazard

The Trump Administration Launches Multiple Deregulatory Actions

Executive Priorities Drive EPA Actions

- The Trump administration took office in January 2025 with stated priorities that included energy dominance ("reliable, abundant, and affordable") and cutting "costly and burdensome regulations."
- In March, EPA Administrator Zeldin launched a deregulatory initiative involving 31 different EPA actions broken down into three areas: (1) unleashing American energy, (2) lowering the cost of living for American families, and (3) advancing cooperative federalism.

Reversing Course…Again

- EPA's deregulatory actions will address myriad regulations impacting water, air, and climate rules for power plants, oil and gas companies, vehicle emissions, and manufacturing and industrial facilities.
- Power sector actions include reversing new, stricter greenhouse gas (GHG) emissions rules for fossil-fired power plants promulgated in May 2024 under Section 111 of the Clean Air Act. Those rules included the repeal of the 2019 Affordable Clean Energy rule (which, in turn, had reversed the Obama-era Clean Power Plan) as well as tighter mercury and air toxics (MATS) rules. Those rules had already been subject to litigation and compliance was targeted for 2027.
- It is unclear whether rules will be revised or entirely eliminated. A timeline of key EPA and executive actions is shown at right in Figure 4.1.

Figure 4.1: Significant EPA-Related Activity Since January 2005

Q1 2025	Q2 2025	Q3 2025
Jan. 20: EO 14154 directs suspension/rescission of burdensome regulations on domestic energy resources, enabling deregulatory actions for power plants and oil & gas sectors.	**Apr. 8:** White House issues proclamation exempting 68 coal-fired power plants from MATS for two years (from July 2027 compliance date to July 2029).	**July 31:** White House grants two-year exemptions from power plant rules and methane rules for oil & gas facilities.
Jan. 31: EO 14192 requires agencies to repeal 10+ existing regulations for every new one issued.	**Apr. 8:** EO 14260 orders the Attorney General to report on state laws and causes of action regarding GHGs or climate change and to take action to stop those that are "illegal" (incl. preemption).	**Aug. 1:** EPA proposes rescission of 2009 Endangerment Finding.
Feb. 5: EPA moves to hold in abeyance ongoing court cases involving Biden-era GHG rules pending agency reconsideration.	**June 11:** EPA proposes repeal of 2024 GHG emissions standards and MATS for fossil-fired generation.	**Sept. 16:** EPA to remove GHG program obligations for most source categories, including the distribution segment of the petroleum and natural gas systems.
Mar. 12: EPA announces agency review and rollback of 31 Biden-era rules.	**June 30:** EPA announced plan to initiate a rulemaking to extend compliance deadlines for steam power plant wastewater discharges.	**Sept. 22:** Endangerment Finding rescission comment period ends.
	July 17: White House issues another proclamation for MATS exemption for six more coal-fired units.	

Sources: The White House; Federal Register; Regulations.gov; Holland & Knight; Kirkland & Ellis; Harvard Environmental & Energy Law Program Regulatory Tracker; Harvard Law School Electricity Policy Initiative's State Power Project

Significant Actions Affecting Power Plants

Rule	Proposed Action	Arguments For	Arguments Against	Outlook
Repealing Power Plant Carbon Emissions Standards	**Alternatives:** ■ Reject power plant emissions as not "significant" for health and thus eliminate all Clean Air Act §111 GHG regulation. ■ OR targeted repeal all GHG standards for existing sources of the most stringent requirements for new sources—specifically, those based on CCS and natural gas co-firing.	■ Forced expensive retrofits or closures could increase energy costs and jeopardize reliability. ■ CCS and hydrogen (compliance standards) are not yet cost-effective or adequately demonstrated at scale.	■ Fossil power plants are the largest stationary source of GHGs. ■ Claiming emissions are not "significant" is inconsistent with prior EPA findings and likely to be reversed in court. ■ Action would permanently remove EPA's ability to regulate GHGs.	■ Proposed repeal was published on Oct. 2, 2025. ■ Comments are expected through late 2025. ■ The speed of repeal is an issue with a possible regulatory gap. ■ Finalization is expected in 2026, with litigation a certainty.
Revising Mercury and Air Toxics Standards	■ Repeal 2024 MATS amendments which tightened mercury emissions limits from lignite plants and tripled stringency of particulate matter emissions from all coal plants.	■ Pre-existing 2012 rule, which reduced 85% to 90% of emissions, addresses major risks. ■ Costs of compliance and monitoring with 2024 standards are $1 billion. ■ Similar risks for cost, reliability as for 2024 GHG regulation.	■ No level of mercury is truly "safe." ■ Point to EPA's prior cost-benefit analysis which justified 2024 rule. ■ Concerns about localized impacts to some communities.	■ Proposed rules were published on June 17. ■ Finalization of repeal expected by December 2025 and will also certainly be litigated. ■ The 2012 rules remain in place, but President's extension of 2024 rule compliance is being litigated.

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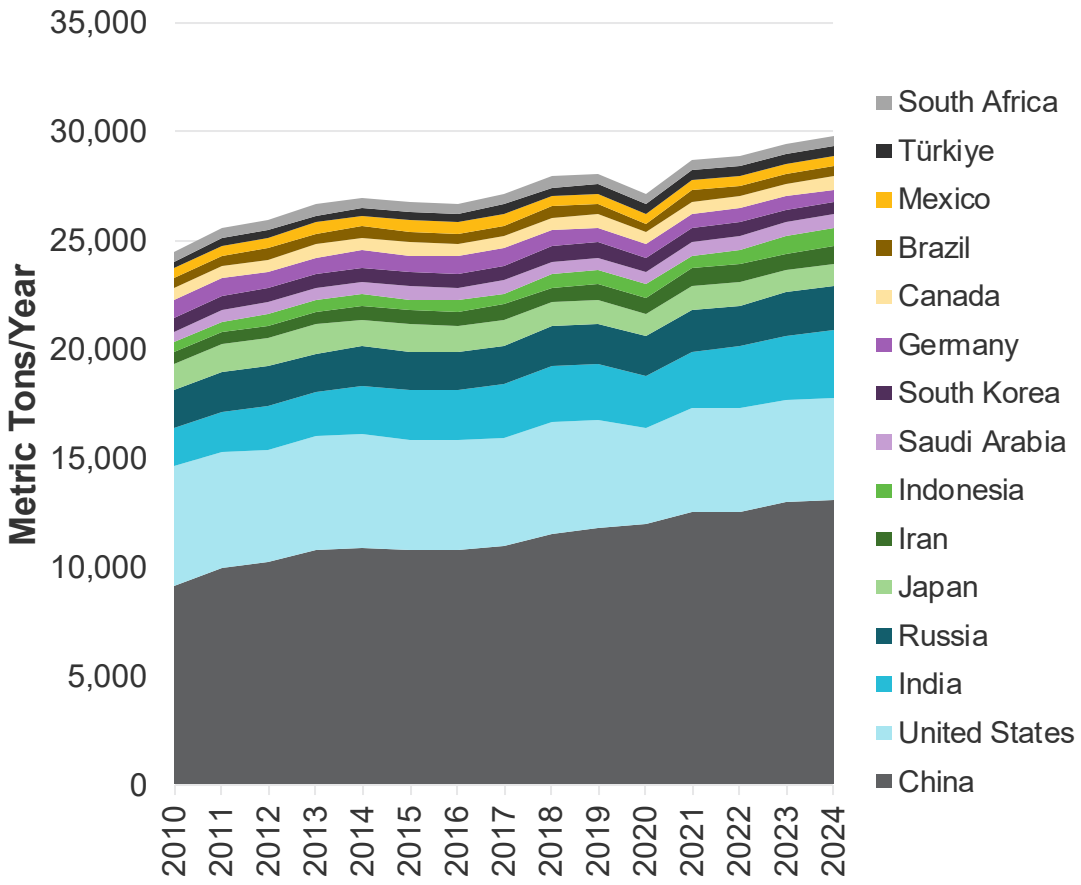
Sources: Federal Register; U.S. Environmental Protection Agency; Harvard Environmental & Energy Law Program; *Power* magazine; Vinson & Elkins

Targeting Key Underpinnings of Greenhouse Gas Regulation

Figure 4.2: Fossil CO_2 Emissions* of Top 15 Emitting Countries (2010–2024) (Metric Tons CO_2/Year)



Source: JRC/IEA

2009 Endangerment Finding in Danger

- In Executive Order 14154 issued in January 2025, President Trump directed EPA to determine "legality and continuing applicability of EPA's prior finding that GHGs endangered "public health and welfare." While the Supreme Court has ruled that GHGs can be regulated under the Clean Air Act, EPA made the endangerment finding.
- On August 1, 2025, proposed to rescind the 2009 Endangerment Finding, which provides the regulatory predicate for the agency to issue regulations directly for vehicle emissions but also power plant, oil & gas, and industrial emissions, among others.
- According to one law firm, in an accelerated scenario, if EPA undoes the Endangerment Finding in early 2026, followed by expedited D.C. Circuit briefing and a late 2026 decision by that court, the Supreme Court could potentially hear and decide an appeal by mid-2027.

Social Cost of Carbon – A Moving Target

- In January 2025, the President also disbanded the working group on the social cost of GHGs, which includes the social cost of carbon (SCC), a metric regulators use to estimate the economic benefits of avoiding climate change in cost-benefit analyses of climate regulation. As directed under that EO, the EPA in March began proceedings to issue successor guidance, including potential elimination of the SCC.
- A higher SCC favors more regulation; a lower SCC favors less. The Biden administration set SCC at about $190/ton. This metric has been subject to change based upon administration preferences.
- Key criticisms have been the attribution of global benefits (vs. U.S.-only benefits) and discount rates, which can affect present value of benefits from impacts decades in the future.

Note: *Emissions from combustion and processes, not limited to power sector.

Sources: U.S. Environmental Protection Agency; R Street Institute; Holland & Knight; Kirkland & Ellis; K&L Gates; Akin; Crippa M., et al., GHG Emissions of All World Countries – JRC/IEA 2025 Report (2025) (using EDGAR database); The White House

Industry Reactions to Proposed EPA Power Plant Rule Repeal

2024 Power Plant Rules Proposed for Repeal

- Required all coal-fired plants intending to operate past 2039 and all new baseload gas-fired plants to employ emissions reduction to control 90% of their carbon emissions based on carbon capture and sequestration (CCS) standard, characterized as the best system of emissions reduction.
- Electric generating units that planned to cease operations before 2039 could comply through using 40% natural gas cofiring by 2030.
- Required additional reduction in toxic metals by two-thirds, from 0.030 to 0.010 lbs./MMBtu.

Figure 4.3: Selected Comments on the GHG Rule Repeal

EEI	"Finalize the Alternative Proposal as quickly as practicable…removing unachievable CCS-based requirements will provide EEI members with the needed regulatory certainty."
APPA	"Public power utilities need immediate relief from the 2024 GHG Standards to ensure that they will be able to continue providing reliable and affordable electricity to their customers."
NRECA	"EPA has yet to find a durable, cost-effective approach under Section 111. The regulatory uncertainty from EPA's oscillating attempts…creates substantial challenges for electric utilities."
NRDC	"There can be no reasonable basis for concluding that greenhouse gases from power plants do not significantly contribute to air pollution that endangers public health and welfare."

The Proposed Rule

- EPA's proposal, issued in June 2025, presents two alternative approaches to repeal of GHG emissions standards for all fossil-fired power plants.
  - Approach 1: Repeal all GHG limits for coal- and gas-fired power plants based on the premise that these sources do not "contribute significantly" to the endangerment of public health (claiming that they comprise only 3% of global emissions and no cost-effective control measures are reasonably available.
  - Approach 2: Repeal the 2024 rules' (1) 90% reduction through CCS as not adequately demonstrated, (2) 40% natural gas co-firing as inefficient use of natural gas, and (3) requirements for existing oil and gas-fired plants as "inefficient use of state resources" since those emissions are low.
- EPA also proposes repeal of the 2024 MATS rule, instead going back to 2012 MATS standards. EPA also proposes options other than particulate matter continuous emissions monitoring for cost-effectiveness.

Muted Response by Industry Organizations

- Many industry organizations have not issued statements relating to the EPA deregulatory initiative in part because of a diversity of member interests within those organizations.
- Further, comments from organizations such as the American Petroleum Institute noted the continued commitment to environmental protection and growing production while criteria air pollutants and GHG emissions have fallen.
- Many of the themes of comments (see Fig. 4.3) include agreement with repeal of perceived unworkable terms of the 2024 GHG and MATS rules as well as the need for expeditious action and regulatory certainty and a preference for EPA's alternative approach.

Sources: Regulations.gov (comments on Sec. 111 GHG power plant rule repeal); K&L Gates; Holland & Knight

Iberian Peninsula Grid Collapses in April 2025

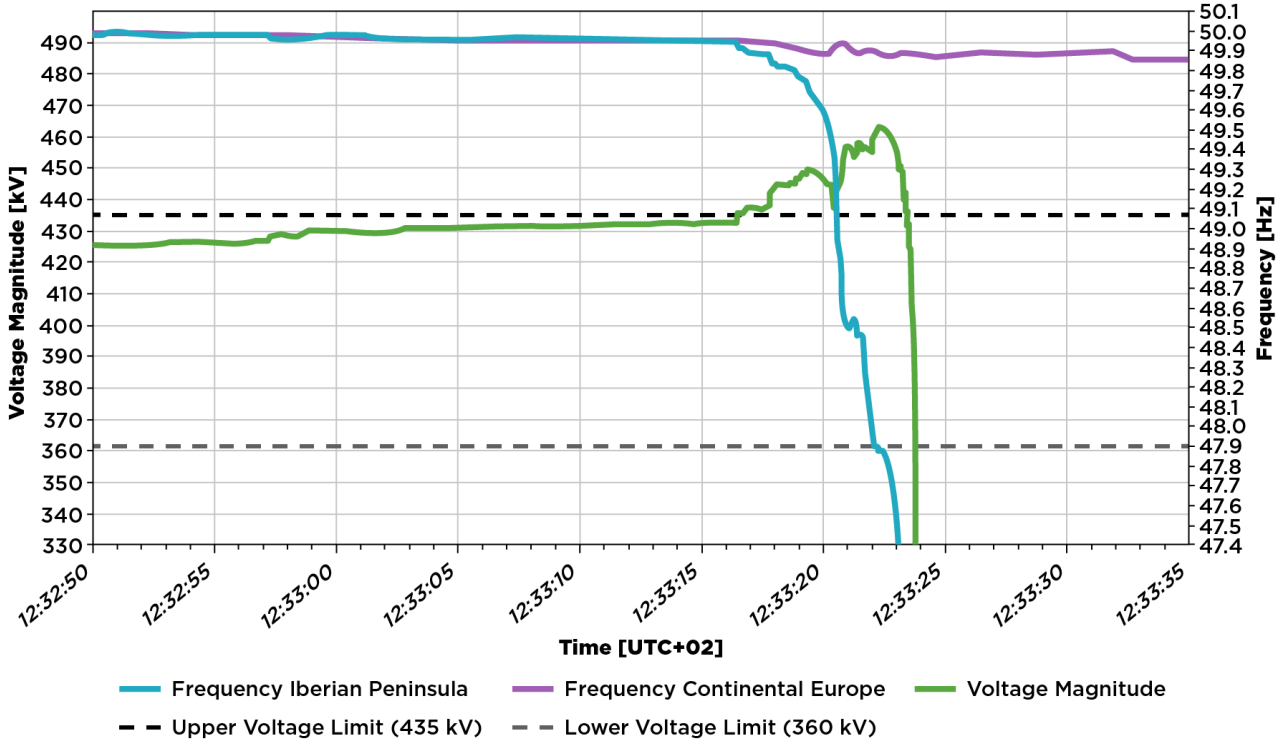
The Event and Its Consequences

- On April 28, 2025, at 12:33 PM (local time CEST), the Spanish and Portuguese grid experienced a total blackout that lasted more than 12 hours in some areas. A small area in France near the Spanish border also experienced disruptions for a limited duration. One estimate puts economic losses and damages from the blackout cost Spain approximately $1.82 billion.
- The blackout left more than 55 million people without power for hours. The remainder of the Continental Europe Synchronous Area (CESA) did not experience any significant disturbance. To date, reports have indicated that a series of generation disconnections and voltage increases is the most probable trigger for the blackout.

Status of the Grid Before the Event

- Installed capacity in Spain totaled 123 GW as of January 2025. 66% of its resources are renewables, with about 50% of all resources being inverter-based renewables.
- Total installed storage was 3.3 GW (mostly pumped hydro; < 50 MW battery storage). There is a significant amount of rooftop PV for self-consumption: ~ 8.5 GW.
- On the day of the event, the Iberian Peninsula was experiencing weak grid conditions, with higher voltage sensitivity to network changes. Total load pre-event was 27 GW with exports of 1 GW to France, 2.8GW to Portugal, and 800 MW to Morocco.
- Generation was comprised of more than 81% renewables (26.4 GW) of which 17.5 GW were solar PV and wind resources.

Figure 5.1: Evolution of Frequency and Voltage in the Substation of Carmona (Spain) and Frequency in the Rest of Continental Europe (April 28, 2025, 12:32:55 to 12:33:35 CEST)

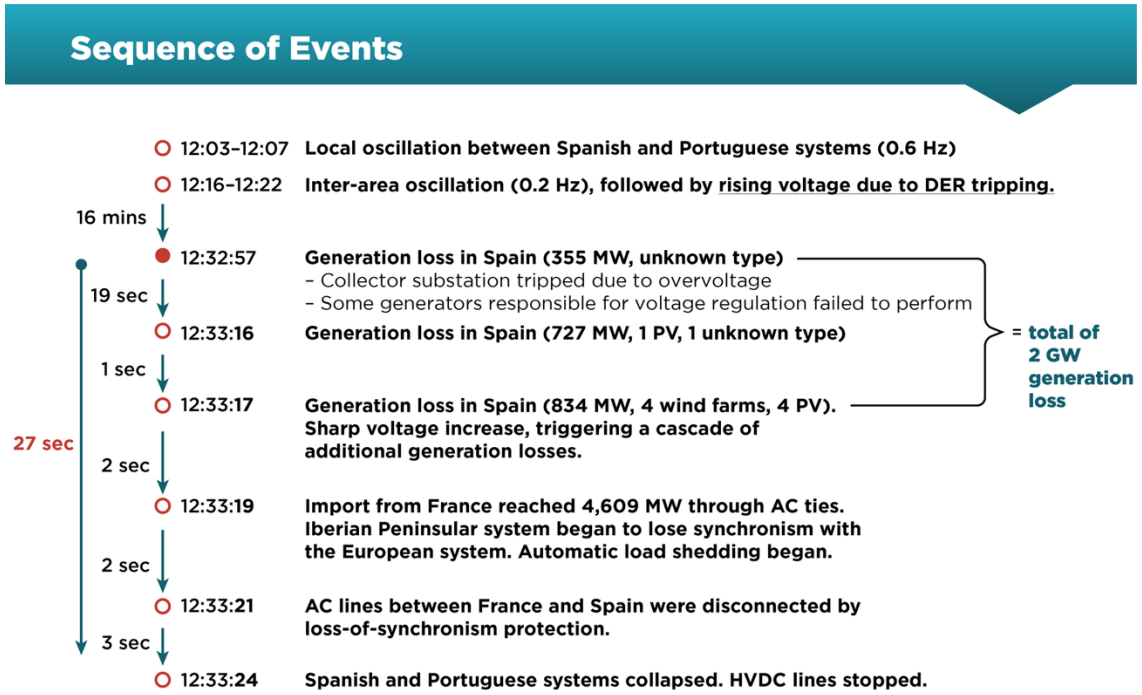


Source: ENTSO-E

Sources: NERC, Iberian Peninsula Blackout, presented at FERC Open Meeting (June 26, 2025); The Breakthrough Institute; ENTSO-E ICS Investigation Expert Panel Factual Report, Fig. 1-4 (Oct. 3, 2025)

A Series of Oscillations, Then Rapid Disconnection of Resources

Figure 5.2: Sequence of Key Events Leading to Iberian Blackout on April 28, 2025



Source: NERC

Excursions from Normal Voltage and Frequency

- The morning of the event was a windy day with plenty of sunshine. Thermal generators were generally running smoothly, and there was plenty of capacity. It followed similar conditions from the prior day. Plentiful solar and wind resources led to reduced output of thermal, grid-forming resources.
- At 12:03 PM, voltage and frequency oscillation originated from a solar PV plant. A second oscillation occurred around 12:19 PM, leading to the loss of 208 MW identified as distributed wind and solar generators in northern and southern Spain. There was also an increase in net load of 317 MW, likely in part as rooftop PV disconnected.
- Exports to France were reduced, but voltage increased. Around 12:33 PM, a generation transformer representing 355 MW tripped, with several other trips within a minute or so of about 930 MW of PV, thermal solar, and wind resources.
- The Iberian grid was disconnected from Morocco due to underfrequency, and it was separated from France as it lost synchronism.

Restoration Takes Time

- Complete restoration of services across the entire Iberian grid took about 14 hours from the start of the blackout. Black-start procedures were required to initiate restart of the Iberian grid.
- During the restoration, not all black-start attempts were successful, and some electrical islands had to be built up again after tripping. However, by 3:30 PM, eight black-start islands could be built up successfully in Spain, and first areas were already connected to the rest of Continental Europe via interconnectors between Spain and France.

Sources: ENTSO-E ICS Investigation Expert Panel Factual Report (Oct. 3, 2025); The Breakthrough Institute; NERC

The Aftermath and Key Questions that Remain

Quick Takes and Longer Takes

- Both Red Eléctrica, the transmission system operator (TSO), and Spanish government authorities reviewed the events and prepared preliminary factfinding and recommendations.
- The reviews agreed upon the key drivers: insufficient voltage control capacity and premature disconnections and cascading failure. The government report also cites instability as early as April 22. However, they disagreed on allocation of responsibility.
- The role of inertia is still being investigated, but the TSO and Spanish government reports highlighted the inability of the system to absorb reactive power (voltage control), which would have been the role of operating, synchronous thermal units. Moreover, both reports recommended a review of overvoltage tripping settings on resources.

Other Investigations

- NERC reviewed the events and identified four key factors:
  - Poor voltage ride-through performance
  - Insufficient dynamic voltage regulation
  - Unreliable voltage regulation of conventional generators
  - Potential gaps in operations planning
- ENTSO-E, the European TSO association providing technical coordination under EU law, released an extensive, technical factfinding of the event. A report with root cause analysis and recommendations, however, is not expected until Q1 2026.

Could It Happen Here?

- NERC points to its current bulk power system standards as mitigating events such as those in the April Iberian blackout (see Fig. 5.3).
- In addition, a NERC work plan priority is to develop a comprehensive framework to identify risks resulting from the transforming grid (e.g., inverter-based resources, large loads, and essential reliability services). Those relevant essential reliability services include inertia, rate of change of frequency (RoCoF), frequency response measurement, reactive capability, voltage performance, and system strength (sensitivity to voltage magnitude and phase).

Figure 5.3: NERC's Comparison of Red Eléctrica (REE) Recommendations to NERC Current Practice

REE Recommendation	Current NERC Practice/Standard
Mandate all generation units, including IBRs,* be capable of voltage regulation perform such control	NERC VAR-002-4 and FERC Order No. 827
Review overvoltage protection settings	NERC Level 2 and Level 3 Alerts on IBR Performance Issues and Modeling Deficiencies
Enhance of voltage control resources	Synchronous condensers and static VAR compensators are already leveraged in North American bulk system
Define minimum monitoring requirements for incident analysis	New PRC-028: Disturbance Monitoring

Note: *IBR means inverter-based resources.

Sources: Red Eléctrica, Incident in the Spanish Peninsular Electrical System on April 28, 2025 (June 18, 2025); Government of Spain, Non-confidential Version of the Report of the Committee for the Analysis of the Circumstances That Led to the Electricity Crisis of April 28, 2025 (June 15, 2025); ENTSO-E ICS Investigation Expert Panel Factual Report (Oct. 3, 2025); Strategic Energy Europe; NERC; Grid Strategies

DOE Employs Seldom-Used Authority to Address Large Loads

DOE Orders FERC to Initiate Large Load Rulemaking

- On October 23, 2025, the Secretary of Energy directed the Federal Energy Regulatory Commission (FERC) to initiate rulemaking procedures to ensure the "timely and orderly interconnection of large loads to the transmission system."
- The Secretary outlined a proposed advanced notice of proposed rulemaking (ANOPR) for FERC consideration. The ANOPR proposed a general set of principles for a proposed rulemaking (see Fig. 6.1).
- DOE emphasized that these loads are growing rapidly and require urgent regulatory attention to maintain affordability, reliability, and fairness in transmission system access.
- Key provisions of DOE's proposed ANOPR include:
  - Establishing standardized interconnection processes for large loads comparable to generator interconnection rules (Orders 2003, 845, 2023)
  - Initially, application only to loads greater than 20 MW
  - Application only to transmission-level interconnections
  - A deadline for FERC to act by April 30, 2026
- Under the DOE regulatory authority, FERC may decline to act. However, it is a topic of keen interest to the Commission, and it has initiated a docket (RM26-4-000).

Figure 6.1: DOE's Principles for Reform of Large Load Interconnection Process

1. Jurisdictional Limitation	Applies only to transmission-level interconnections.
2. Applicability Thresholds	Covers new and hybrid loads greater than 20 MW, mirroring generator standards.
3. Integrated Study Approach	To reduce network upgrade redundancies, load, hybrid, and generation interconnection requests should be studied together.
4. Standardized Deposits and Readiness Requirements	Applicants should meet consistent financial and procedural requirements, including study deposits, withdrawal penalties, and readiness milestones.
5. Hybrid Facility Treatment	Hybrid projects should be studied based on their requested injection and withdrawal rights to incentivize co-location and ensure efficient transmission buildout.
6. System Protection Requirements	Hybrid interconnections must include adequate protection systems to prevent unauthorized injections or withdrawals.
7. Expedited Process for Curtailable Loads	Loads or hybrids agreeing to be curtailable or dispatchable should receive accelerated study timelines (potentially within 60 days).
8. Cost Responsibility	Large loads and hybrid facilities should bear 100% of assigned network upgrade costs.
9. Option to Build	Non-utility interconnection customers should retain the same "option to build" rights as generator customers.
10. Partial Suspension for Existing Generators	If generation seeks to partially suspend operations to serve an adjacent load, DOE proposes an SSR/RMR-type* study before approval.
11. Transmission Service Responsibility	Utilities serving large or hybrid loads must procure transmission service consistent with their withdrawal rights, reflecting actual network usage.
12. Ancillary Services	Load-serving utilities should pay for ancillary services based on peak demand.
13. Implementation Plan	A defined transition plan to implement reforms, including management of ongoing large-load interconnection requests, is already under study.
14. Reliability and NERC Standards	All affected entities must comply with applicable NERC reliability standards and Open Access Transmission Tariff (OATT) provisions.

Notes: *SSR means system support resource. RMR means reliability must-run.

Sources: Secretary of Energy Letter to FERC Regarding the Interconnection of Large Loads (Oct. 23, 2025)

Questions and Issues and What's Next

Figure 6.2: Recent FERC/NERC Actions on Large Loads

Initiated	Docket	Description
October 24, 2025	SPP High-Impact Large Load Filing (ER26-247-000)	SPP proposes tariff revisions to expedite interconnection of high-impact large loads.
September 23, 2025	PECO–Amazon Transmission Security Agreement (ER25-3492-000)	PECO seeks FERC approval for Amazon data-center transmission security arrangement.
September 9, 2025	NERC Large Loads Task Force	NERC issues an Industry Recommendation to address risks observed from analyzed large load behavior.
May 14, 2025	Annual Reliability Technical Conference—Large Loads Focus (AD25-8-000)	FERC explores reliability challenges, planning, and coordination from rapid large-load growth.
February 20, 2025	Consolidated Show Cause Order, 190 FERC ¶61,115 (2025)	FERC show cause order challenging PJM tariff concerning co-location.
November 22, 2024	PJM Co-location Complaint (EL25-20-000)	Constellation contests PJM's tariff treatment for co-located generation and load resources.
August 16, 2024	Co-location Technical Conference (AD24-11-000)	FERC hosts conference examining co-located large loads, market impacts, and interconnection.

Threshold Jurisdictional Question

- FERC has exerted jurisdiction over interconnection of generation but not interconnection of large loads, which is typically overseen by the states.
- FERC makes several justifications for jurisdiction, which will likely be challenged, including:
  - Large load interconnections are a "critical component" of transmission service, requiring minimum terms to ensure non-discriminatory service.
  - Those interconnections "directly affect…wholesale electricity rates."
  - FERC jurisdiction does not encroach on state authority over distribution, generator siting, or retail sales.
  - FERC has exclusive jurisdiction over power transmission in interstate commerce.

Key Issues to Watch

- DOE's request to have a rule or report in place by late April 2026 may not be achievable because of detailed drafting, notice, and comment periods. Some observers note that a NOPR with a framework of foundational steps may be what is ultimately issued in April, given the regulatory activity on this topic for more than two years (see Fig. 6.2).
- Some areas of expected debate or opposition among the "14 Principles" include:
  - Large load responsibility for 100% of network upgrades
  - Expedited interconnection study process (60 days)
  - Emphasis on hybrid facilities (co-location), with transmission charges based upon net of load MW and generation MW behind the meter
  - Impact of potential rule on current queue, both load and generation, and complexity of system studies
  - Threshold (20 MW) application may invite alternatives and distribution carve-outs, as well as "work-around" behaviors

Sources: Vinson & Elkins; Gibson Dunn; McGuireWoods; White & Case; Perkins Coie; Akin; Troutman Pepper Locke

Glossary

48E – Clean Electricity Investment Tax Credit under Section 48E of the Internal Revenue Code

48Y – Clean Electricity Production Tax Credit under Section 45Y of the Internal Revenue Code

AC – alternating current

ANOPR – advanced notice of proposed rulemaking

APPA – American Public Power Association

Bcf – billion cubic feet

CEST – Central European Summer Time

CO_2 – carbon dioxide

DOE – U.S. Department of Energy

EEI – Edison Electric Institute

EIA – U.S. Energy Information Agency

ENTSO-E – European Network of Transmission System Operators for Electricity

EO – executive order

EPA – U.S. Environmental Protection Agency

ERCOT – Electric Reliability Council of Texas

FERC – Federal Energy Regulatory Commission

GHG – greenhouse gas

GW – gigawatt

HH – Henry Hub

HVDC – high voltage direct current

Hz – hertz, a unit of frequency

IRA – Inflation Reduction Act

ISO – independent system operator

ISO-NE – ISO New England

ITC – investment tax credit

LNG – liquified natural gas

MATS – mercury and air toxics

MISO – Midcontinent Independent System Operator

MW – megawatt

MWh – megawatt-hour

NERC – North American Electric Reliability Corporation

NRDC – Natural Resources Defense Council

NRECA – National Rural Electric Cooperative Association

NYISO – New York Independent System Operator

NYSERDA – New York State Energy Research & Development Authority

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Glossary (Cont.)

OBBBA – One Big Beautiful Bill Act, P.L. 119-21

PECO – PECO Energy Company, a subsidiary of Exelon Corporation

PJM – PJM Interconnection LLC

PTC – production tax credit

PV – photovoltaic

RTO – regional transmission organization

SMR – small modular reactor

SPP – Southwest Power Pool

TCF – trillion cubic feet

TWh – terawatt-hour

VAR – volt-ampere reactive, a unit of reactive power in an alternating current circuit

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